Table of Contents

Winery Overview

Winemaking is about transforming healthy and clean grapes into young, immature wine, a 3-4 month process. This is the step after growing quality grapes, an annual endeavor. The step after winemaking is cellaring, which is about maturing the young wine in barrels, bottling the wine, and maturing the bottles – that takes 5-8 years.

This section is organized as follows:

- On this page, we explain the general concepts and processes used. We start with a simplistic view, then describe our winemaking facility and then summarise the 15 individual process steps. We conclude with a summary of how we made the wine in each of the past eleven years, 2009 – 2020.
- On the following pages, we describe the process steps in more detail and how they apply in the last harvest (2020), what decisions we made and what we learned.

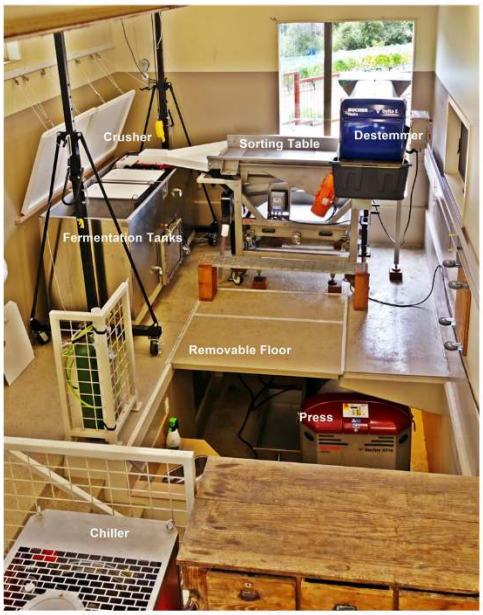
A very simplistic view

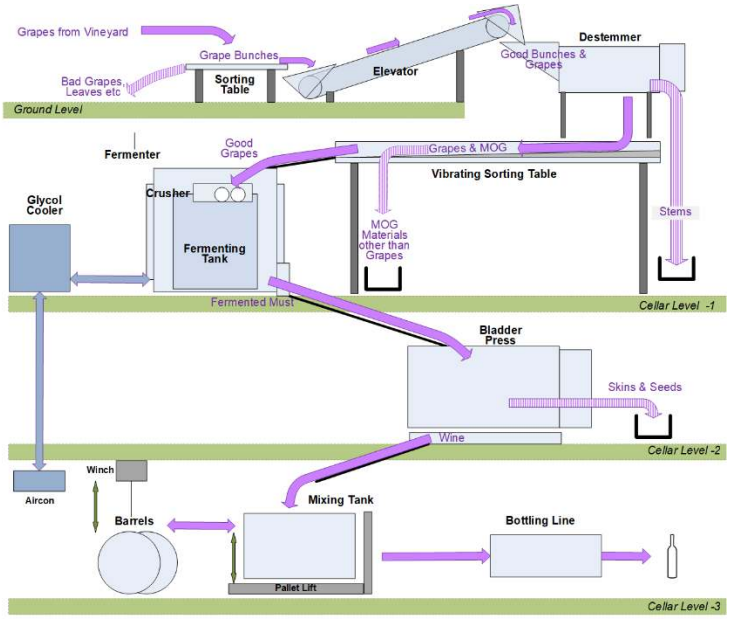
In a very simplistic view, making red wine has three distinct phases:

- Phase 1 - from grapes to sweet must:
  First, we decide when we pick grape bunches in the vineyard. Then we sort out the bad bunches, destem the remaining good ones, sort out debris and dirt and crush the grapes into a sweet must. Must is a slurry of grape juice, grape skins, and seeds. Phase 1 takes 6-8 weeks of monitoring grapes in the field and a few hours of picking and processing the grape bunches.
- Phase 2 - from sweet must to alcoholic must
  We ferment the sugar with the help of yeasts into alcohol. During this process, many valuable organic compounds are extracted from the skins, pulp, and seeds. These compounds give the wine its characteristic odors, taste, and mouthfeel. This phase takes 2-3 weeks and is the most critical and challenging of the three.
- Phase 3 – from alcoholic must to juvenile wine
  We separate the now alcoholic juice from the skins and seeds by pressing the must into settling tanks. This takes a few hours

The facility

To go through these three phases, we need a special-purpose facility: a winery. We built our facility on four levels, so we do not need to use pumps – we rely on gravity to move the product and winches or lifts when required. The rationale is to prevent the rough physical treatment of juice, skins, and seeds inside a pump. This graphic illustrates the sequence:





A brief explanation covering the entire winemaking and cellaring process:

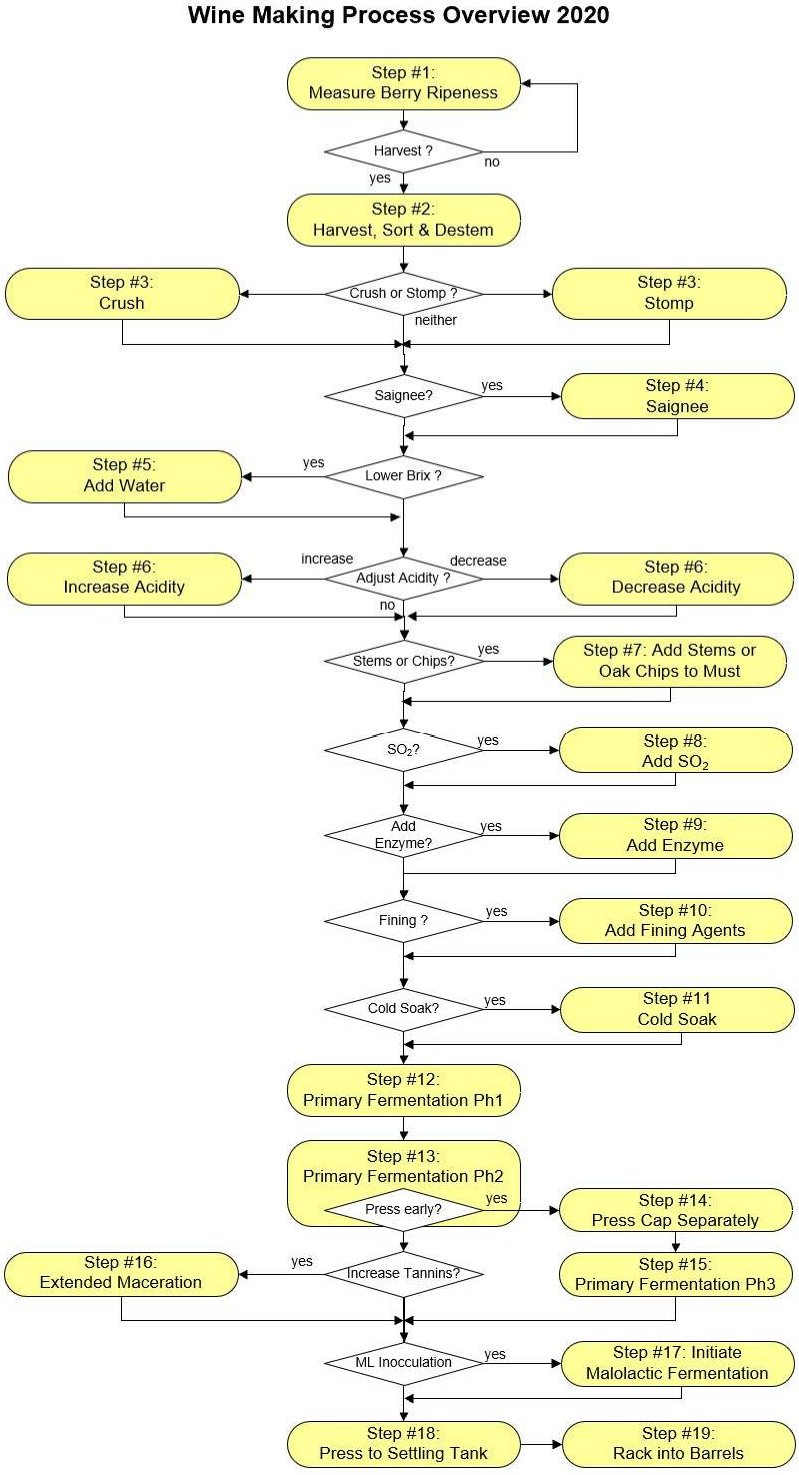
- On the **Bunch Sorting Table**, we sort out the damaged bunches and leaves coming in from the vineyard
- The **Elevator** moves the sorted bunches to the mouth of the destemmer
- The **Destemmer** separates the grapes from the stems
- On the **Berry Sorting Table**, we pick out the “Material Other than Grapes” or MOG, mostly small stem and leaf pieces
- As the berries leave the Sorting Table and fall into the Fermenter; we have the option of inserting a **Crusher** which breaks their skin so valuable compounds can be extracted more efficiently during fermentation
- In the **Fermenter,** we convert Grapes into Fermented Must (i.e., sugar into alcohol). The Fermenter is temperature-controlled by a **Glycol Cooler** pumping cold or warm glycol through the Fermenter walls.
- The **Press** separates the juice (i.e., wine) from the grape skins and grape seeds.

- Finally, we drop the young wine into a **Mixing Tank** in the cellar. During the cellaring process, covered in the next section, the young wine is moved back and forth between Barrels until it is matured and bottled. The mixing tank and barrels can be moved up or down to allow gravity-flow between them. The temperature in the cellar is kept at 55-60 dF by the **Glycol Cooler** pumping cold glycol through an air-conditioner.

To the left of the graphic is a picture of the physical layout. You can see the ground level outside through the window, and you can see cellar levels -1 and -2. Half the floor between level -1 and -2 is removable to connect the fermenting tank with a bridge to the press. This is shown on the page explaining the press. Cellar level -3 is below. We move the wine by a hose through holes in the floor to the mixing tank and barrels below.

Overview of the process

Here is the next level of detail: a closer look at the three phases described above. Note, this process has evolved significantly over the years; what follows is our process for the 2020 vintage and after. Before we start any activity, and at the end, we need to clean all equipment and facilities thoroughly – this is step #0. The flowchart on the right shows 19 process steps that follow and the decisions which link them:



1. **Measure Berry Ripeness**: We measure the progress towards grape maturity in the vineyard and then decide when to harvest.

2. **Harvest, Sort & Destem**: We pick the grape bunches, sort out the dirt, destem them, sort the berries end up with clean grape berries in a fermentation tank.

3. **Crush or Stomp**: We decide whether we want to break the skins of the grapes with rollers (crush) or with our feet (stomp) or not at all (i.e., Full Berry Fermentation)

4. **Saignée?** We decide whether we want to increase the concentration of flavors in the wine artificially. We do this by increasing the “skins & seeds”-to- “liquids” ratio by siphoning off some juice. We can use this excess juice to produce rosé wine.

5. **Adjust Brix**: We decide whether we need to lower the sugar level by adding water.

6. **Adjust Acidity**: We decide whether we need to adjust the pH up (add carbonates) or down (add tartaric acid). This adjustment can be made upfront (i.e., as step 6) or later (i.e., during fermentation or cellaring) in increments.

7. **Add Stems or Oak Chips**: We decide whether we want to add back some of the stems to adjust the flavor profile or add Oak Chips to adjust the phenolic extraction.

8. **SO_2 or native Fermentation**: We decide whether we want to ferment with yeasts and bacteria native in the vineyard and winery or with cultured yeasts purchased from external providers. If we decide to use cultured yeasts, we add SO_2 to kill off all native non-saccharomyces yeasts and bacteria.

9. **Enzymes**: We decide whether we want to add enzymes to break down cell walls. This speeds up the extraction of desirable components from the skin, pulp, and seeds into the must. An alternative, but less effective, is to add blocks of dry ice – freezing on contact shatters the skins.

10. **Add Fining Agents**: We decide whether we want to add antimicrobial agents to bind and precipitate spoilage bacteria.

11. **Cold Soak**: We decide whether we want to extract desirable components of the skin and pulp into the grape juice before fermentation is converting the juice into alcohol. Again the idea is to get more aromas and flavors. We soak at a low temperature of around 50-55 ^oF to limit spoilage.

12. **Fermentation Phase 1**: Now, we raise the temperature of the must to 70 dF and decide whether to start fermenting with native yeasts living in the vineyard and the cellar or industrial yeasts purchased from third parties. We generally prefer native fermentations; we simply wait for the fermentation to start on its own. Alternatively, we mix in a bucket of must, which we had set aside a week or so earlier and successfully started fermenting on its own. If we decide for industrial, we inoculate the must with cultured yeast. In either case, we consider adding nutrients for the yeast, depending on the level of Yeast Available Nitrogen (YAN) in the must.

13. **Fermentation Phase 2**: After the fermentation accelerates and the sugar level has fallen by around a third, we have a few decisions to make. If we started with native yeasts, we might decide to finish with industrial yeasts and inoculate. Also, more yeast nutrients and an injection of oxygen may be required. Because fermentation releases thermal energy, we may also need to cool the tanks so the temperature stays below 90 ºF. At the same time, we need to start watching the amount of phenolics extracted from the skins and pulp. If the tannins extracted exceed the anthocyanins extracted by more than 10-20% before the fermentation is complete, we decide to press the cap separately to limit further tannin extraction while completing the primary fermentation (steps 14 & 15). Alternatively, we proceed to step 16.

14. **Press Cap Separately**: We scoop out the cap (mostly skins floating on top of the must), press it, and then pour the resulting juice back into the fermentation tank.

15. **Primary Fermentation Phase 3**: we complete the primary fermentation, i.e., wait until all the sugars have been converted to alcohol.

16. **Extended Maceration**: If the fermentation has completed before tannins have reached 110% of peak anthocyanins, we decide whether to extend the time the now fermented juice is exposed to the grape skins - and, more importantly, the seeds - to extract even more phenolics (i.e., primarily tannins).

17. **Malolactic Fermentation**: We decide whether we want to innoculate the now young wine with malolactic bacteria to convert the malic acids into lactic acids. To facilitate the malolactic fermentation, we raise the temperature to around 65dF.

18. **Press**: We separate the juice from the skins and seeds by first letting the young wine flow out of the fermentation tank into the settling tank (called “Free Flow”) and then pressing the remaining wet must into the same tank and other containers (called “Press Run”). We dispose of the remaining, now dry, skins & seeds in the field to fertilize the soil.

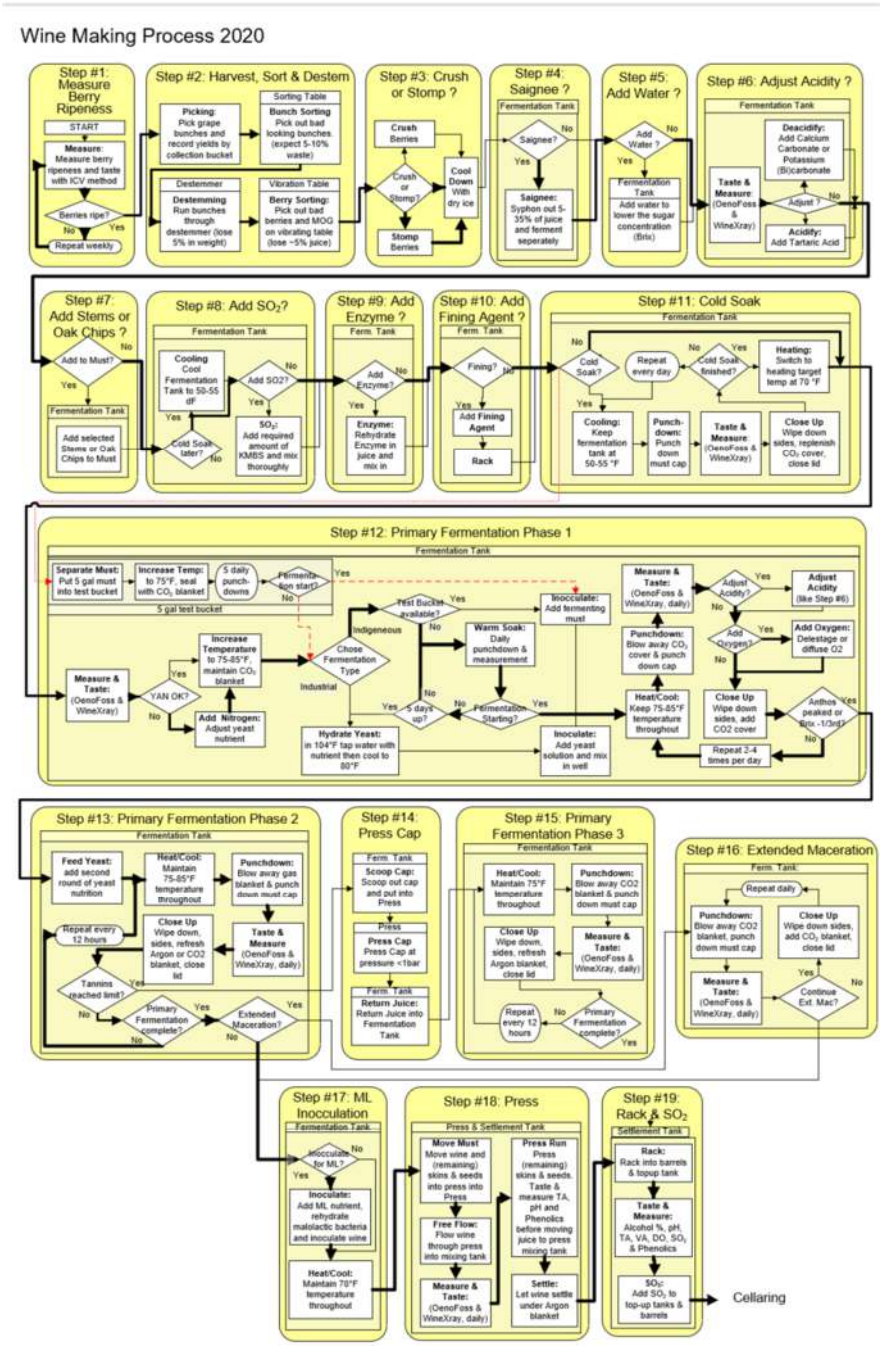
19. **Rack into Barrels**: After letting the wine settle for a few days in the mixing or other settlement tanks, we rack the juice into barrels and topup tanks, leaving the sediment behind.

Steps 1 through 19 take between 10 and 30 days.

Up to 2015, we implemented this process for a single grape variety, Cabernet Sauvignon. In 2016 we started dealing with four different grape varieties (Cabernet Sauvignon, Merlot, Petit

Verdot, and Cabernet Franc), each possibly reaching harvest maturity at a different date. So we have up to four processes running simultaneously, slightly staggered time-wise.

Following is a detailed flowchart of the process and the decisions taken for each of the four harvests in 2020. The only purpose of showing this chart upfront is to illustrate how the steps and decisions described in the following pages fit together. The bold arrows indicate the decisions taken. We describe the individual steps in the pages which follow.



Wine Making 2009 through 2020

The following table summarises how we made wine during the first seven years, 2009 – 2015

During the first three years, I relied heavily on Aran Healy, who helped me decide what equipment to buy and taught me how to use it and make wine. We took relatively few measurements, relying mostly on Aran's experience and tasting skills. The first year was about setting a benchmark: producing the wine with minimal additions and interventions in a 100% natural fashion. In the second and third year, we started experimenting with established winemaking techniques (like using commercial enzymes and yeasts). In the third year, we were particularly challenged by a bad harvest (low volume and quality of grapes)

Wine Making Summary 2009-2015

Step			2009 Duration	2009 Measurements (at end of period)	2009 Comment	2010 Duration	2010 Measurements (at end of period)	2010 Comment	2011 Duration	2011 Measurements (at end of period)	2011 Comment	2012 Duration	2012 Measurements (at end of period)	2012 Comment	2013 Duration	2013 Measurements (at end of period)	2013 Comment	2014 Duration	2014 Measurements (at end of period)	2014 Comment	2015 Duration	2015 Measurements (at end of period)	2015 Comment
	Berry Testing	JCV Score											3.75			3.55			3.58			3.58	
		Brix		23.6	Focus solely on Brix		23.0	Focus solely on Brix		21.00	Focus solely on Brix		24.75	Started ICV		25.00	ICV		24.50	ICV & Phenolics		24.50	ICV & Phenolics by clone
		pH											3.32			3.48			3.53			3.53	
		Total Acidity [mg/L]											8100						6000			6000	
1	Harvest	Date		10-Oct			20-Oct			4-Nov			7-Oct			28-Sep			11-Oct			26-Sep	
		Weight harvested (lbs)		2600			2000			1000	poor late harvest		2000	Clean grapes; 16 people 3.5 hrs		**2150**	Clean grapes, 2 hrs, 15 people		1349	Clean grapes, 2 hrs, 18 people		1080	Shrivelled grapes, 2 hrs, 16 people, by plant
		Brix		23.6			22			21.5			24.75			25.00			24.50			24.50	
		pH											3.46			3.48			3.55			3.70	
		Total Acidity [mg/L]																	5400			5000	
	Bunch Sorting	Weight after bunch sort [lbs]			in field			in field			in field			on tables		2100	extensive		1334	extensive		1027	extensive
	Grape Sorting	Weight after grape sort [lbs]			none			none			Vib table			Vib table		1900	Vib table		1148	Vib table		837	Vib table
4	Crush or Stomp	Brix	same day			same day	23.00		same day	22.50		same day	25.25		same day			same day	24.00	Stomp & 40lbs dry ice	same day	25.50	40lbs dry ice, no crush/stomp
		pH			Stomp		3.50	Stomp		3.34	Stomp		3.47	Stomp		3.53	Stomp		3.65			3.70	
		Total Acidity [mg/L]								6500			7900						5460			5100	
8	SO2 Addition	Amount [g KMBS]			none		?	KMBS		21 g	KMBS		72 g	KMBS		50 g	KMBS		40 g	KMBS		15 g	KMBS
5-6	Adjustments	Water [L]																				5	
		Tartaric Acid (g)																	1050 g	overadjusted acidity		250 g	
		Potassium Percarbonate [g]																					
7	Saignee	Weight after saignee [lbs]						none								1900	on Vib table		1150	on Vib table		1030	on Vib table
		Amount saigneed [gallons]					20 gals									200			180			150	
9	Enzyme Addition	Enzyme [g]					50 g	LaFasse GrandCru		20 g	LaFasse GrandCru		30 g	LaFasse GrandCru		35 g	LaFasse GrandCru		40 g	LaFasse GrandCru		21 g	LaFasse GrandCru
11	Cold Soak	Temp [dF]				9 days	~55	dry Ice	6 days	55	dry ice	5 days	55	cooling jacket	5 days	55	cooling jacket	5 days	55	cooling jacket	5 days	43	cooling jacket
		Punch-down						daily			daily			daily			daily			daily			daily
		YAN														160						135	
		Free Anthocyanins														889			709			365	
12	Primary Fermentation Phase 1	Inoculation [g]		none	native		150 g	EM4x4		90 g	F-15		200 g	VQ51		200 g	F-15		245 g	VQ51		141 g	VQ51
		Nutrition			none			none			none		60 g	Nutriferm Energy		90 g	Nutriferm Energy		175 g	Nutriferm Energy		51 g	Nutriferm Energy
		Macro-oxidation			none			none		1 min @ 20 psi	daily	3 days			6 days	1 cft	daily	5 days	1 cft	daily	6 days	0.2 cft	daily
		Punchdowns			daily			daily			2/day			2/day heating			3/day heating			3/day heating			3/day heating
		Temp [dF]	14 days			14 days			7 days				88			83			75			74	
		Free Anthocyanins														1598			1106			860-1100	
		Brix														15.00			16.00			16-18	
13	Primary Fermentation Phase 2	Nutrient											200 g	Nutriferm Advance 2/day		200 g	Nutriferm Advance 2/day		175 g	Nutriferm Advance 2/day		120g +45g	NAdvance + DAP 2/day
		Punch-downs			daily			daily			daily	6 days	71		10 days	76		9 days	79		3-5 days	76	
		Temp [dF]														**2136**			1489			1050-1540	
		Peak Total Anthocyanins														1690			1253			870-1210	
		Free Anthocyanins														1955			1441			1130-1450	
		Tannins														0.15			2.80			1.8-5.5	
		Brix		0			0			0			0										
16	Extended Maceration	Punch-down				7		daily															
		Temp [dF]					55?	dry ice															
14	Press Cap Seperately	Freeflow volume [L]	same day	350		same day	420		same day	110		same day	350		same day	350		same day	0		same day	0	
		Press volume [L]		280			130	0.2 bar		115	0.6 bar		180	0.2-0.3 bar		180			36			36	
		pH											3.41			3.41			3.30	At 2.6 Brix pressed 80% of cap only and reurned 36L of juice to fermentation tank1.6 bar		3.30	at 3-5 Brix scooped out cap and pressed each batch in manual press and returned juice
		Total Acidity [mg/L]															Pressed all at 0.2 bar into barrels		10.5			10.5	
		Malic Acids [mg/L]																					
		Lactic Acids [mg/L]														1402			1045			880-1210	
		Vol Acidity [mg/L]														212			126			87-125	
		Free Anthocyanins [mg/L]														1869			1357			1200-1500	
		Bound Anthocyanins [mg/L]														3205			2517			2380-2880	
		Tannins [mg/L]																					
		Total IRPs [mg/L]																					
15	Complete Primary Fermentation in Ferm Tank or Barrel	Temp [dF]														79			69			75	
		Alcohol [%]														14.60%			14.00%			0.00%	
		Residual Sugar (mg/L)														450			500			500	
		pH														3.42			3.31			3.52	
		Total Acidity [mg/L]														11044			10950			11000	
		Malic Acids [mg/L]													14 days		in 2 barrels & variable top steel tank	9 days		in Fermentation Tank	2-5 days		in Fermentation Tank
		Lactic Acids [mg/L]																					
		Vol Acidity [mg/L]														1285			1085			875-1210	
		Free Anthocyanins [mg/L]														243			109			100-147	
		Bound Anthocyanins [mg/L]														1836			1564			1130-1450	
		Tannins [mg/L]														3230			2770			2300-2800	
		Total IRPs [mg/L]																					
17	Final Press	Freeflow volume [L]																	300			300	
		Press volume [L]																	100			100	
		pH																	3.27			3.52	
		Total Acidity [mg/L]																	8240			8300	
		Malic Acids [mg/L]																	1600			1900	
		Lactic Acids [mg/L]																	900			1100	
		Vol Acidity [mg/L]																	**680**	Pressed at 0.5 bar into Mixing Tank, then filled one barrel with 100% 2014 and second barrel with 75% 2014 plus 25% 2012 CSVtopup	same day	610	Hand pressed remairing caps in manual press and combined through sieve into barrel, add 7gal 2012CSV
		Free Anthocyanins [mg/L]																					
		Bound Anthocyanins [mg/L]																				813	
		Tannins [mg/L]																				138	
		Total IRPs [mg/L]																	*962*			1447	
																			125				
																			1530				
																			2748			2814	
18-20	Malolactic Fermentation	Inoculation		0	native		3 bags	Viniflora Oenos		2.5 g	ML Silver			ML Silver		2 bags	Viniflora Oenos		20 g	Enartis MLOne		5g + 5g	MLSilver + Osmobaci
		Nutrition		0	none		0	none		0	none			Nutriferm ML		30 g	Microessential Oenos		135g & 9g	Nutrifer ML & Nutriferm Osmobacti		55g	Nutriferm ML
		Alcohol [%]					13.1			12.10%			13.50%			14.00%			13.60%			13.08%	
		Residual Sugar [mg/L]								400			450			400			**700**			**700**	
		pH	55 days	3.3		148 days	3.41		190 days	3.48		81 day	3.35		300 days	3.32		300 days	3.4		360 days	3.52	
		TA [mg/L]					6720			6860			6600			7600			7650			8300	
		Malic Acids [mg/L]					100			380			110?			150?	stuck ML; racked & reinoculated with Viniflora CH16		**760**			**970**	
		Lactic Acids [mg/L]																	1250			1600	
		Vol Acidity [mg/L]					671			658			600			600			**845**	incomplete malo!		**990**	incomplete malo! High VA
		Free Anthocyanins [mg/L]											507			470			525			533	
		Bound Anthocyanins [mg/L]											212			**355**			230			194	
		Tannins [mg/L]											1600			1750			1418			1259	
		Total IRPs [mg/L]											3030			3170			2720			2496	
	Cellaring to Bottle (days incl. Malolactic Fermentation)	Alcohol [%]					12.80%			12.90%			14.30%			14.60%			13.90%		in progress	14.50%	
		Residual Sugar [mg/L]					0			**600**			**500**			**500**			**750**			1100	
		pH					3.43			3.55			3.62			3.41			3.55			3.23	
		TA [mg/L]					6750			7010			6340			7900			7550			8800	
		Malic Acids [mg/L]					75			**850**	incomplete malo!		**530**	incomplete malo!		**1160**	incomplete malo!		500			400	
		Lactic Acids [mg/L]								1400			1300			1000			950			1000	
		Vol Acidity [mg/L]					67			**770**			**800**			**830**			980			1050	
		Total Anthocyanins [mg/L]					301	Phenolics measured 1.5 years after bottling		431			860			686	high Anthos, controlled Tannins!		661			606	
		Free Anthocyanins [mg/L]					306			320			677			432			471			399	
		Bound Anthocyanins [mg/L]					182			93	poor!		201	OK		235			191			160	
		Tannins [mg/L]					1332			425			2257			1529			1418			1337	
		Total IRPs [mg/L]					2412			1204			2950 ?			2761			2713			2722	
		Barrels used	870 days	2.5	50% new 09SegMor	870 days	2.5	50% new 09SegMor	960 days	1.5	50% new 11Rad	1050 days	2		1050 days	2		1110 days	2			1	
		# Rackings		3			3			4			3			3			2+			2	
		Cummulative SO2 add [ppm]		42	??		1287			1211			2612			1874			1136			135	
		Filtering					7	eggwhites								8	eggwhites			add PotCarb			
		# Bottles		860			860			420			540			500			524				
	Commentary	Highlights		Native fermentation			Enzymes + Yeasts + Bacteria, Cold soak + Extended Maceration; Eggwhites fining			Poor late harvest, Berry Sorting, Enzymes etc, 35% '12 Merlot			Good harvest. Monitoring berry maturity (ICV). New tank with cooling jacket			Good harvest; high phenolics, pressed before fermentation finished; Eggwhite fining			Phenolic measurement in vineyard, Poor harvest			Very poor harvest, Manual press,	
		Room for improvement		Data Collection			Berry Sorting, Temperature Management, Extraction Limit			Temperature Management, Yeast Nutrients. Incomplete Malo, Volatile Acidity			Incomplete malolactic fermentation. High Volatile Acidity			Incomplete malolactic fermentation. High Volatile Acidity			Overadjusted acidity, Residual sugar & incomplete malolactic fermentation. High Volatile Acidity. Incomplete mix for bottling			Residual sugar & incomplete malolactic fermentation. High Volatile Acidity	

During the following two years, 2011 & 2012, after Aran left, we became more numbers-oriented and diligently collected more data.

In 2013 David Fenyvesi joined, contributing his Hungarian winemaking experience. We started to measure phenolics with the help of WineXray, a service that converts spectral absorbance measurements into estimates of phenolic compounds in the wine. This, in turn, allowed us to fine-tune the fermentation process. We also started to document the winemaking process with a detailed flowchart and collected data more diligently.

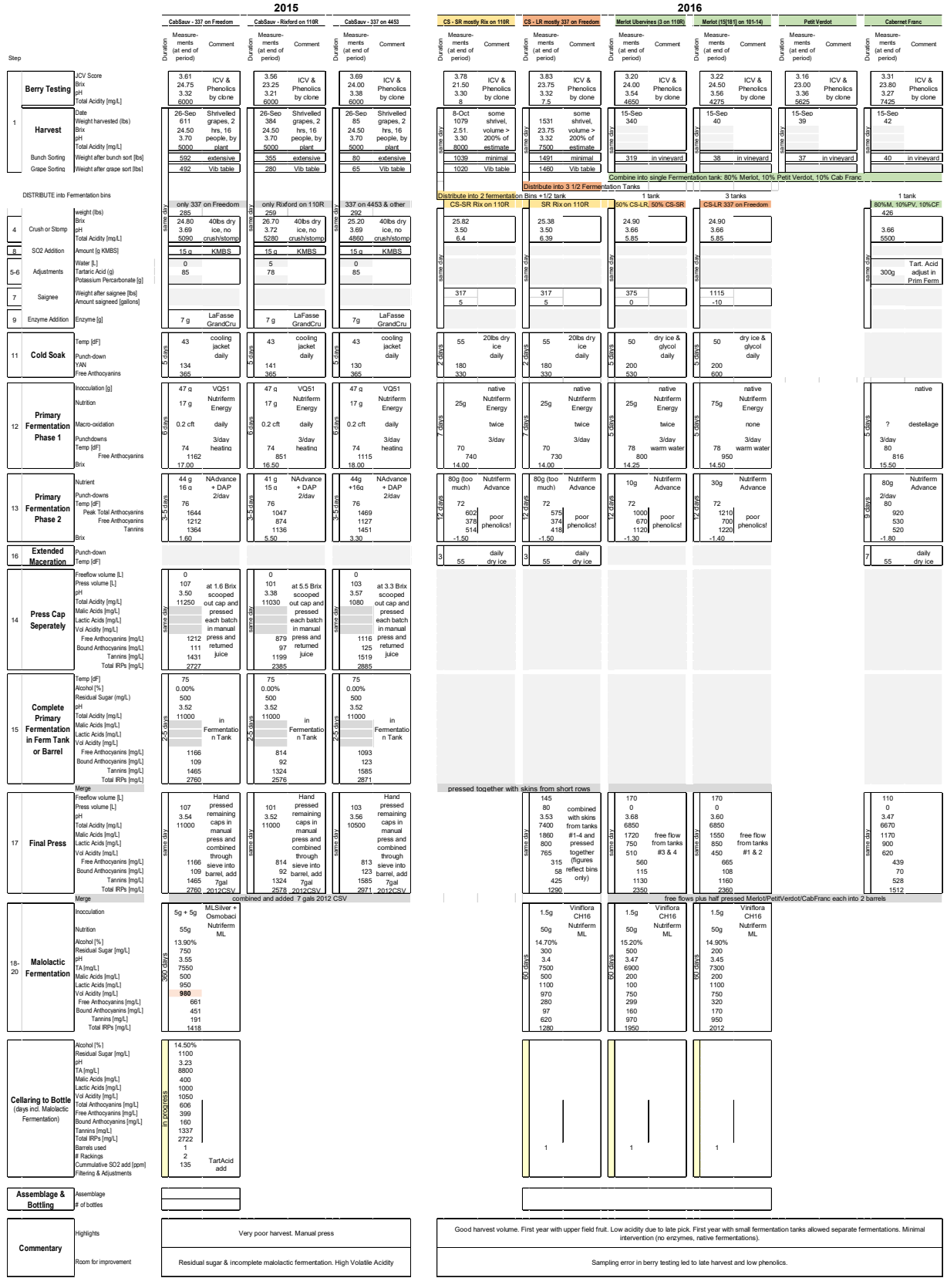
In 2014 we started to measure the phenolics in grapes after veraison to help to time the harvest better. We pressed the cap separately and before fermentation was finished to limit the uptake of tannins.

In 2015 we fermented the different clones separately in bins within the fermentation tank – this proved that the 337 clone was of higher quality than the Rixford clone (in term of extractable Anthocyanin concentrations)

By 2016 the new Upper Vineyard started to produce and, because Merlot matures a month earlier, we started running two harvests and two rounds of fermentations in sequence. We introduced new smaller fermentation tanks to fit inside the large tank to handle smaller lots, and we built a small crusher because stomping in new tanks became infeasible. Nicolas Vonderheyden replaced David, adding his Bordeau winemaking experience to the mix. This and input from UCDavis encouraged me to return to the more natural approach we had used in 2009: no enzymes, no sulfur, and no commercial yeasts.

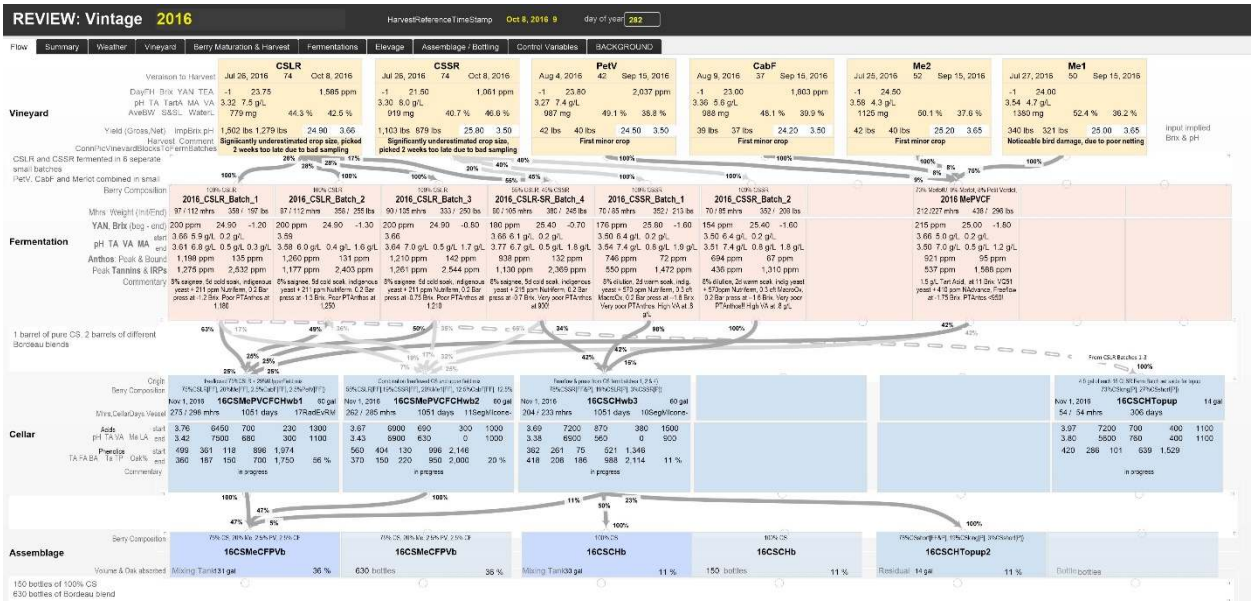
The process became more complicated. The graphic illustrates the difference between 2015 and 2016. In 2015 we had one harvest (cabernet), split the grapes into three fermentation buckets (by clone), and combined the fermented juice at press into a single barrel. In 2016 we harvested and fermented the grapes in the Upper Field (Merlot, Cab Franc & Petit Verdot) first in a single tank, used only the freeflow, and set the wine aside. Then we harvested the Lower Field. The long row grapes (337 clones) were saigneed and fermented in 4 separate fermentation tanks, and their freeflow combined with the free flow from the Upper Field into 2 barrels. The grapes from the short rows (Rixford clone) received the saignee from the long row grapes, were fermented in 2 separate fermentation tanks, then pressed together with the remaining skins of the long row grapes and filled one barrel.

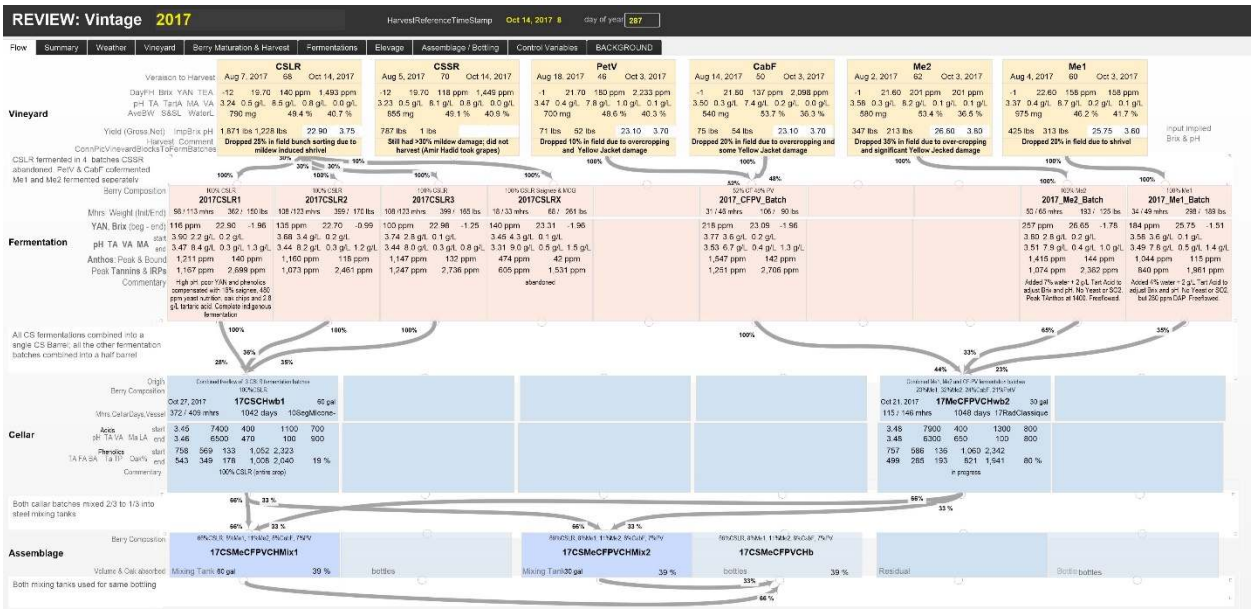
Wine Making Summaries 2015 & 2016

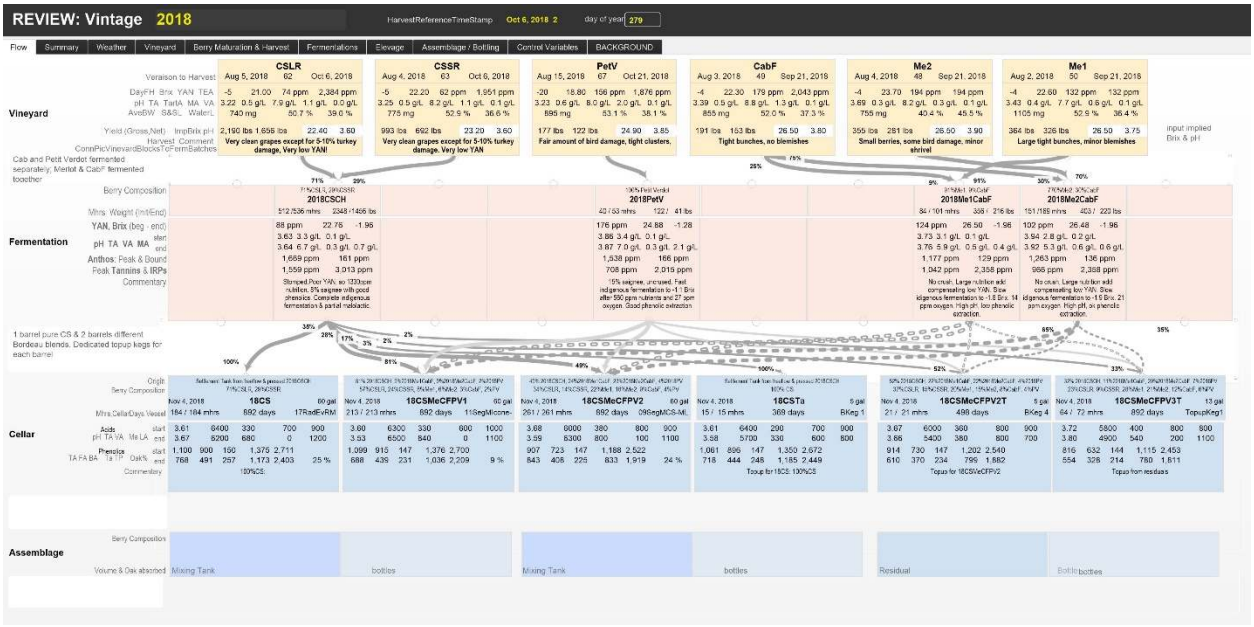


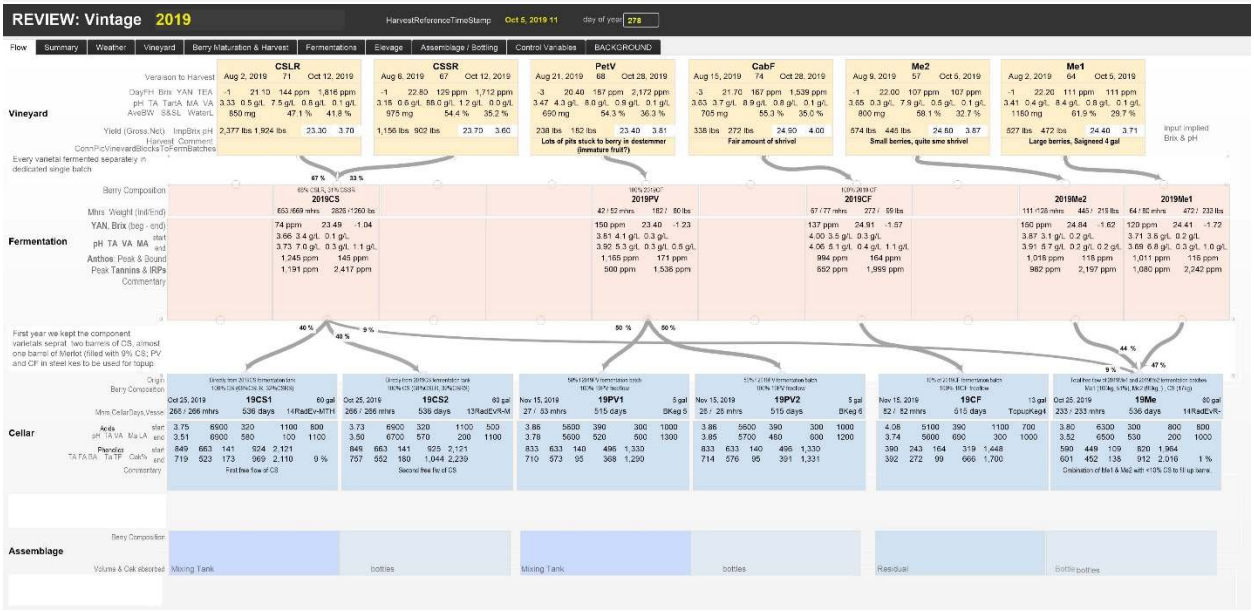
In 2017 we reached a limit in what we could handle with spreadsheets and decided to replace them with a relational database. The following pictures show screenshots of the “REVIEW Vintage”-layout for 2016 through 2020. Each shows in the orange top row the different harvest blocks, in the pink second row the different fermentation batches, and in the blue third row the different cellar batches. The boxes in the rows are connected with arrows indicating the flows between them. Each box shows critical measurements at the beginning and end of each step.

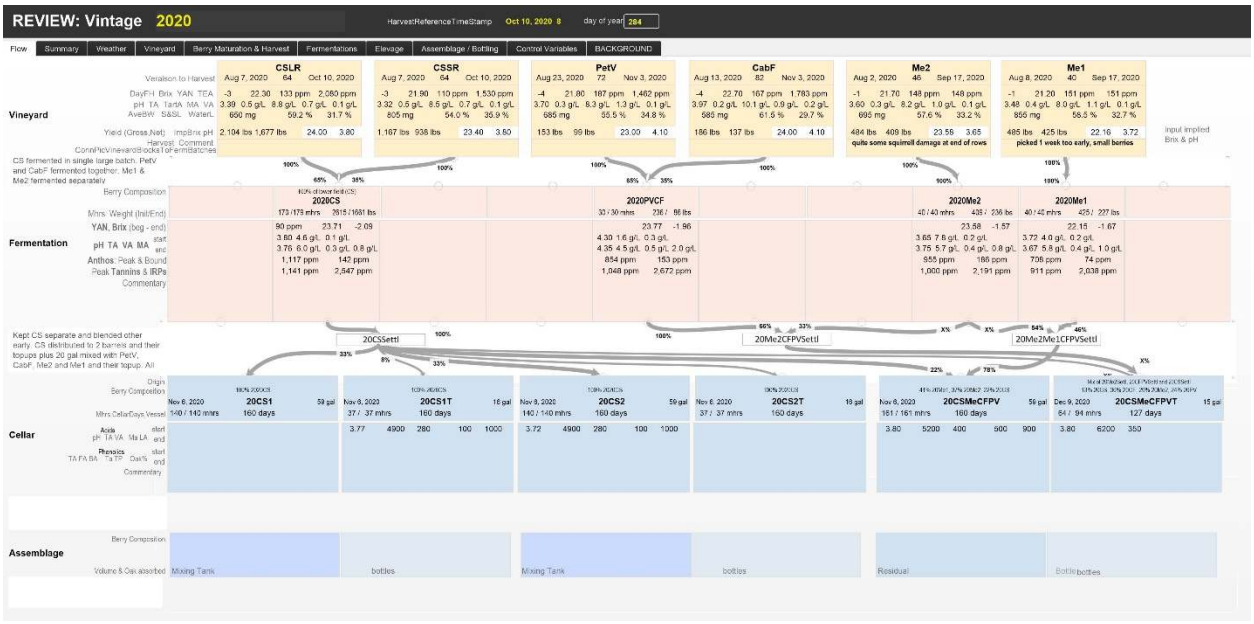
- We include the 2016 vintage to illustrate the process differences from vintage to vintage. In 2016 we fermented the Cabernet Sauvignon in 6 small batches and the Petit Verdot, Cabernet Franc, and the two Merlot blocks in a single small mixed batch. We pressed the wine into 3 barrels and one vessel for topup wine.
- In 2017 we fermented the Cabernet Sauvignon (CS) long-row block in four small fermentations (we abandoned the short-row block), we fermented the Petit Verdot (PV) and Cabernet Franc (CF) blocks together. We fermented the Merlot (Me1 & Me2) blocks separately. We then pressed the CS into one barrel, and we combined the PV-CF and the two Me fermentations into another barrel. The topup vessels are not shown
- In 2018 we combined the two CS blocks in one large fermentation batch, we fermented the PV block on its own, and we combined the CF and Me blocks in two small fermentations. Then we pressed into three barrels and three topup vessels, one pure CS, the other two, different mixtures of CS, PV, CF, and Me.
- In 2019, we again combined the two CS blocks in a single large fermentation batch, but we fermented the other four blocks separately. We then pressed the CS fermentation into two barrels, the Merlot fermentation combined with a bit of CS into a third barrel, and we PV and CF fermentation s into topup tanks.
- In 2020 decided to create separate dedicated topup tanks, one for each barrel. So, we fermented the CS blocks together and pressed them into two barrels, and attached topup tanks. We fermented the PV and CF blocks together and the Me blocks separately, and then we combined all with the left-over CS into a mixed barrel and dedicated topup.tank


REVIEW: Vintage 2016
HarvestReferenceTimeStamp Oct 8, 2016 9
day of year 282
Flow
Summary
Weather
Vineyard
Berry Maturation & Harvest
Fermentations
Elevage
Assemblage / Bottling
Control Variables
BACKGROUND
CSLR
CSSR
PetV
CabF
Me2
Me1
Vineyard
Yield (Gross,Net)
Harvest Comment
Berry Composition
Fermentation
Cellar
Assemblage
Volume & Oak absorbed
16CSMePVCFCHwb1
16CSMePVCFPVb
16CSMePVCFCHwb2
16CSMePVCFPVb
16CSCHwb3
16CSCHb
16CSCHTopup
16CSCHTopup2


REVIEW: Vintage 2017
HarvestReferenceTimeStamp Oct 14, 2017 8
day of year 287
Flow
Summary
Weather
Vineyard
Berry Maturation & Harvest
Fermentations
Elevage
Assemblage / Bottling
Control Variables
BACKGROUND
CSLR
CSSR
PetV
CabF
Me2
Me1
Vineyard
Yield (Gross,Net)
Harvest Comment
Berry Composition
Fermentation
Cellar
Assemblage
Volume & Oak absorbed
17CSCHwb1
17CSMeCFPVCHMix1
17CSMeCFPVCHMix2
17CSMeCFPVCHb
17MeCFPVCHwb2

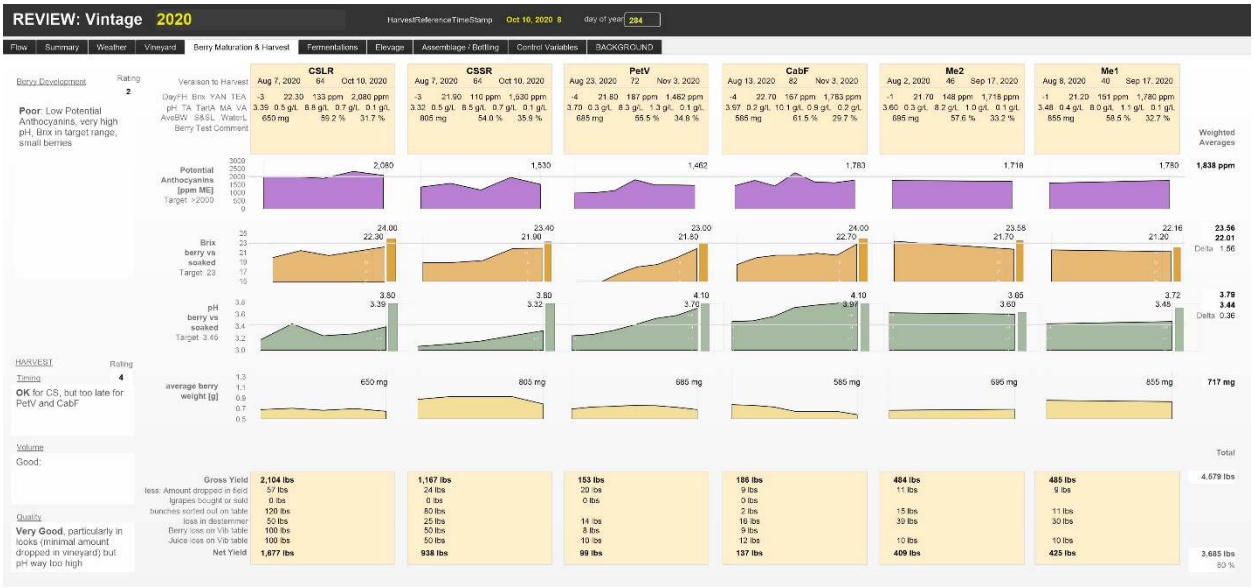

REVIEW: Vintage 2018
HarvestReferenceTimeStamp Oct 6, 2018 2
day of year 279
Flow
Summary
Weather
Vineyard
Berry Maturation & Harvest
Fermentations
Elevage
Assemblage / Bottling
Control Variables
BACKGROUND
Vineyard
Fermentation
Cellar
Assemblage
CSLR
CSSR
PetV
CabF
Me2
Me1
2018CSCH
2018PetV
2018Me1CabF
2018Me2CabF
18CS
18CSMeCFPV1
18CSMeCFPV2
18CSTa
18CSMeCFPV2T
18CSMeCFPV3T
19CS1
19CS2
19PV1
19PV2
19CF
19Me
2019Me2
2019Me1

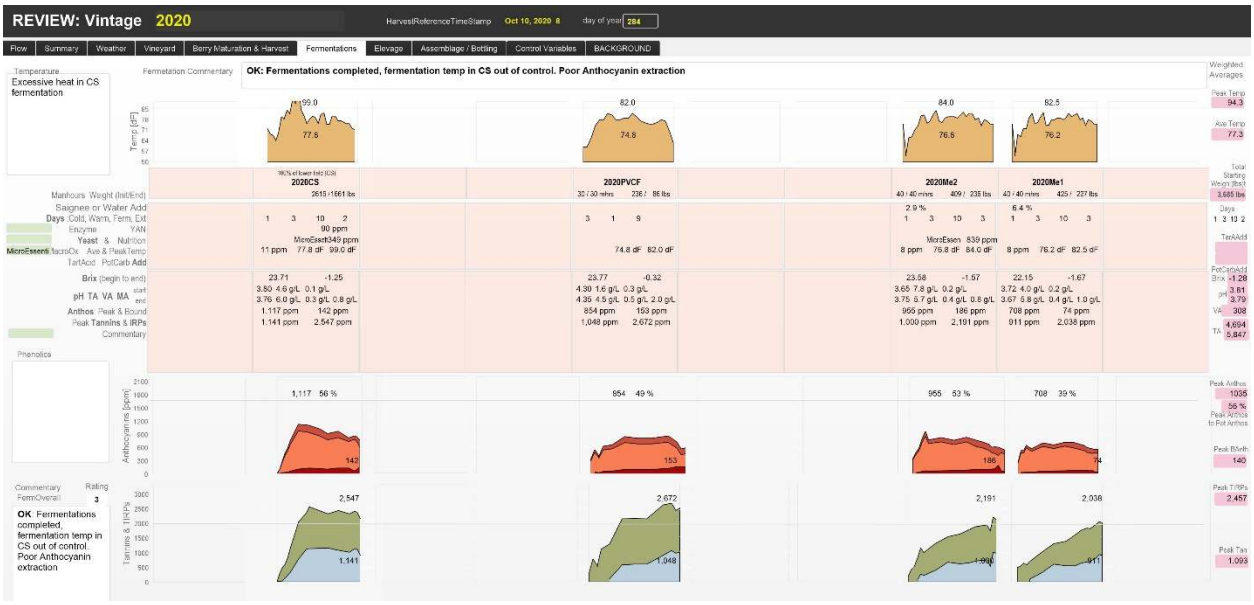

REVIEW: Vintage 2019
HarvestReferenceTimeStamp Oct 5, 2019 11
day of year 278
Flow
Summary
Weather
Vineyard
Berry Maturation & Harvest
Fermentations
Elevage
Assemblage / Bottling
Control Variables
BACKGROUND
Vineyard
Fermentation
Cellar
Assemblage
CSLR
CSSR
PetV
CabF
Me2
Me1
2019CSCH
2019PV
2019CF
2019Me2
2019Me1


REVIEW: Vintage 2020
HarvestReferenceTimeStamp Oct 10, 2020 8
day of year 284
Flow
Summary
Weather
Vineyard
Berry Maturation & Harvest
Fermentations
Elevage
Assemblage / Bottling
Control Variables
BACKGROUND
CSLR
CSSR
PetV
CabF
Me2
Me1
Vineyard
Fermentation
Cellar
Assemblage
20CSSettl
20Me2CFPVSettl
20Me2Me1CFPVSettl
2020CS
2020PVCF
2020Me2
2020Me1
20CS1
20CS1T
20CS2
20CS2T
20CSMeCFPV
20CSMeCFPVT
Mixing Tank
bottles
Residual

The next two screenshots are again from the “REVIEW: Vintage”-layout, but they show the Berry Maturation and the Fermentation tabs for more detail on the 2020 vintage

- The Berry Maturation tab shows how the different vineyard blocks matured and how the Potential Anthocyanins, PH, Brix, and average berry weight developed during the last weeks of berry maturation – these measures defined the selection of the respective harvest dates
- The Fermentation tab shows more details on each fermentation batch: the development of fermentation temperatures, and the extraction of Anthocyanins (bound and total) and other phenols (tannins and total)

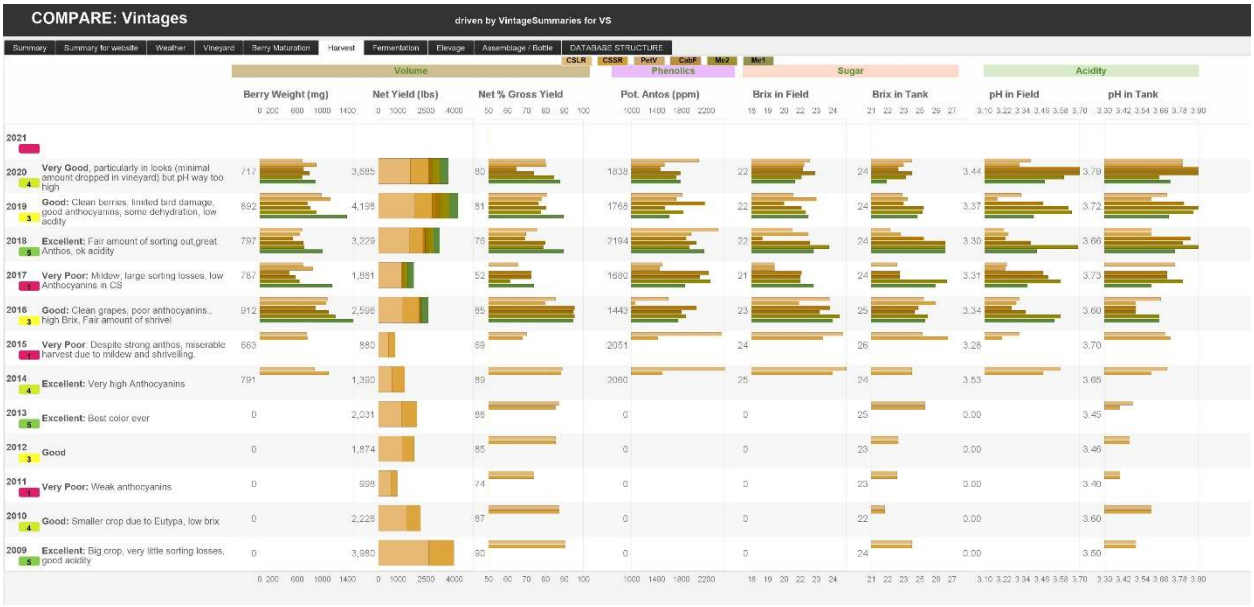


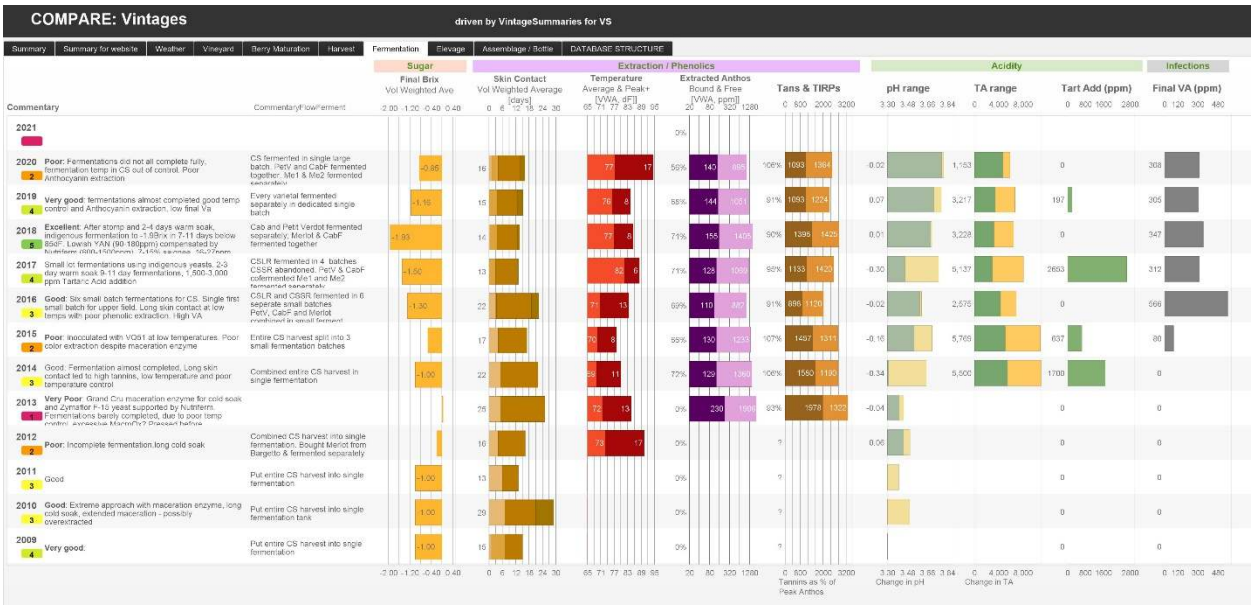


The final screenshots are from the “COMPARE Vintages”-layout and show average data for each vintage since 2009. The screenshots rate each vintage and provide a short commentary.

- Berry Maturation: shows the timing of Budbreak, Flowering, Mid-Veraison, and Harvest in days of the year. And for each harvest block, it shows Potential Anthocyanins, pH, starting Brix, and Average Berry Weight. From this perspective, 2009, 2013, and 2018 were the best vintages
- Harvest Volumes: shows for each block average Berry Weight, Net Yield (after sorting), Net Yield as % of Gross Yield (before sorting), Potential Anthocyanins, Brix (in the field and tank), and pH (in the field and tank). Note, we tend to underestimate the Brix in the field by 1-2 Brix and the pH in the field by around 0.3. Again, 2009, 2013, and 2018 ranked the best.
- Fermentations: show weightd average numbers across all fermentations in a given vintage: final Brix (target is smaller than -1.25), days of skin contact, average and peak temperatures, extracted Anthocyanins, Tannins and TIRPs (Total Iron-Reactive Phenols), pH, Total Acidity and Tartaric Acid additions as well as final Volatile Acidity. From a fermentation perspective, 2018 ranked the best and 2013 the worst (we mishandled that fermentation)

.





A pdf file of the Winery Section as of May 30, 2021, is available here

Previous page: Home

Top of this page: Go

Next Page: Cleaning & Sanitation

Last updated: May 11, 2021

Step #0: Cleaning & Sanitation

Most faults in wine quality are a consequence of juice or wine coming in contact with dirt and spoilage microbes in the air and on contact surfaces (vessels, piping, tools, etc.). Therefore we spend a significant amount of energy and time keeping the winery and cellar clean and sanitized. In this context, “cleaning” refers to the physical removal of organic and inorganic soils, “sanitation” means inactivating 99.9999% of spoilage microbes.

On this page, we describe:

- The five steps of cleaning
- The equipment we use for cleaning, and

The five steps of cleaning

In general, the cleaning and sanitation process has five steps:

1. Warm water rinse to loosen up and remove debris
2. Cleaning cycle
3. Water rinse to remove cleaner residue and loosened debris
4. Sanitizing cycle
5. Cold water rinse, if necessary, to remove sanitizer.

We clean equipment each end of the day after it has been utilized (steps 1-3), and we clean and sanitize all equipment when it is taken out of storage before we use it. This page describes how we clean all harvesting and winery equipment; a particular page in the Cellar section explains how we clean barrels.

Water power-washes and rinses

We distinguish between three levels of purity in water used for cleaning, rinsing, and sanitation:

- Regular city water contains a fair amount of chlorine and should not be used on surfaces that come in contact with juice or wine. Chlorine can result in chemical reactions resulting in TCA, which is known as cork taint. We use regular city water only to power-wash floors

- Softened water: we dechlorinate all our city water used in the winery with a Kinetico 4040 salt-based, regenerative ion-exchange system (see www.Kinetico.com)
- Distilled or purified water

We use softened cold water in power washers to remove sugars and proteins, and we use softened hot water in power washers to remove tartrate buildups.

Cleaning cycle

We distinguish between three types of cleaners

- Caustic: NaOH, KOH
- Non-caustic / alkaline-based: sodium carbonate, potassium percarbonate, trisodium phosphate (TSP). We need to use citric acid to rinse after to neutralize alkaline residues.
- Acid Cleaners: Phosphoric / Nitric acid based

We use the following chemical solutions:

- Potassium Hydroxide / Caustic Potash (KOH)
- Sodium Percarbonate Na_2H_3CO, Dissolved in water, sodium percarbonate yields a mixture of hydrogen peroxide (which eventually decomposes to water and oxygen, sodium cations Na+, and carbonate CO2
- Trisodium Phosphate (TSP) Na_3PO_4

Note, biofilms are resistant to many chemical cleaners, so casual rinsing or washing is not sufficient. It is best to remove the films by scrubbing, brushing, or high-pressure washers.

- We use brushes to clean stainless steel surfaces
- Use scrubbing foam balls to clean the inside of hoses
- We circulate cleaning solutions through hoses with electrical pumps

We have used ultrasonic baths (generally used for jewelry) in the past but found maintaining the equipment cumbersome.

Sanitizing cycle

There is a wide choice of chemicals for use in the sanitizing cycle:

- Potassium-Metabisulfite (KMBS) , citric acid
- Chloride (Cl) - based compounds
- Iodine (I) - based compounds
- Sodium dioxide (SO_3) solutions; they need to be acidified to pH~3 and are corrosive
- Peracetic Acid (CH_3CO_3H) is also corrosive
- Star San: proprietary formulation including phosphoric acid and surfactants. No rinse is necessary. It should be used at a dilution of 0.15% or 1.5 mL per L.
- Food-grade Ethanol 70% is suitable for sanitizing punchdown tools, pipettes just before use

Our go-to sanitizing chemicals are Citric Acid, KMBS, Star San, and Ethanol, which we keep handy in spray bottles. When we clean oak barrels, containers with hard-to-clean crevices, or large equipment, we use ozone dissolved in water or as a gas or superheated steam

Equipment

Power washer

We use a regular gas-powered pressure washer for general cleaning of floors, walls, and general equipment.

Electric power washer with superheated steam

We use an electric power washer with a diesel-heated steam boiler to wash and sanitize large equipment (destemmers, sorting table, presses, tanks, etc., especially after harvest. The Delco DH2305 Electric power washer we use (https://manualzz.com/doc/24175308/delco-dh2305%E2%80%9Cdirect-drive%E2%80%9Dseries) is no longer available. It is beneficial for cleaning/washing off tartar films on crushing equipment and general clean-up. It is not 100% stainless steel, so residual rust particles can potentially be harmful to wine if not rinsed off subsequently.

Electric steam power washer:

We use a Swash Deluxe Steam Generator from Electrosteam we bought from ARS Enterprises in Calistoga, CA (https://www.electrosteam.com/applications/winery-steam/). It is not a pressure washer like the Delco mentioned above; it provides superheated steam and is built using stainless steel throughout. So its primary use is for sanitizing oak barrels (see Cellar section) and floors, walls, large winery equipment, etc.

Handheld steamer

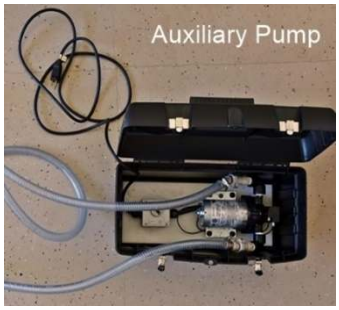
We use a PurSteam handheld electrical steamer purchased from Amazon for spot sanitizing valves and other small items with crevices. Any low-cost household steamer does an excellent job.

Ozone generator

We use an ozone generator from A2Z Ozone Inc (it is currently sold at Walmart) for sanitizing rooms and oak barrels after being washed and steamed. We also use it for deodorizing and sanitizing entire rooms.

Auxiliary pump

We use a Sureflow diaphragm pump assembly purchased from VA Filtration in Napa, CA (www.vafiltration.com) designed to clean the Sweetspotter (see Filtering – Reverse Osmosis in the Cellar section). For cleaning hoses, the pump circulates cleaning, rinsing, or sanitation solutions from a bucket through the hose back to the bucket.



Scrubbing ball

We use scrubbing sponge balls to clean and sanitize hoses. Scrubbing sponge balls come in various sizes and types (soft, semisoft, and hard). We insert them into hoses filled with cleaning solutions and drive them through with a pump.

Barrel washer

We built a special washer to wash, steam, and ozone oak barrels, because we could not find equipment that recirculates the washing fluid (and thus minimizes water usage) and fits into our small space. It is basically a wash-basin on wheels with an electric pump that feeds water to a spray-ball inside the barrel sitting on rollers above the basin. See Cellar Section for details on how it is used in the racking process.

Previous page: Winery Overview
Top of this page: Go
Next Page: Step #1: Assessing Grape Maturity
Last updated: May 15, 2021

Step #1: Assessing Grape Maturity

Picking the grapes at the right time is critical. Timing depends on the maturity of the grapes, the outlook for inclement weather, and a picking crew's availability. The most vital aspect is grape maturity assessment; it takes weeks.

Ideally, all grapes reach the same final level of maturity at the same time. In reality, they do not. Proper pruning and canopy management can narrow the time window of final maturity so we can harvest all grape bunches on the same day. We sample the grapes in the vineyard every week and test them – when the average reaches specific characteristics, we pick. There are four aspects to consider in getting to the picking decision:

1. **Weather and soil humidity**: how much sunshine have the grapes received over the growing season and how much water was added through irrigation to fine-tune the grapes' condition during the last 4-5 weeks?
2. **Sampling**: How do we sample the grapes to be analyzed so the sample represents the range of maturity in the entire vineyard?.
3. **Chemical Analysis**: what chemical measurements do we take to decide whether the grapes have reached maturity and how will the results affect our winemaking process?
4. **Taste Analysis**: how can we consistently evaluate the taste of the grapes during their final weeks of maturation?

Finally, we try to forecast, as we measure, when we will likely end up picking and what volume we can expect from the harvest. Quality, date, and volume forecasts help us organize the picking crew/party and decide on the subsequent fermentation processes.

The following paragraphs explain what we do in detail.

Weather and soil humidity

On the last page in the vineyard section, we described how we monitor weather conditions during the growing season. A critical weather-related leading indicator for maturity used throughout agriculture is Cumulative Growing Degree Days ("CGDD"). We track this number throughout the year and pay particular attention during the last four weeks. The goal is to reach around 2000 CGDDs before picking.

We can increase soil humidity with irrigation. We do not irrigate the vineyard except in very dry seasons and during the final weeks of maturation if we need to prevent sugar from shooting beyond our target of 24 Brix before the grapes have reached physiological maturity (as measured by Taste Analysis). Consequently, we track CGDDs, temperature lows and highs, humidity lows and highs, and irrigation amounts during the final weeks.

Sampling

The second task is to decide how we sample. The goal is to sample in the areas which provide the full range of berry maturities. The best time to easily spot degrees of berry maturity is during veraison, when the berries turn from green to blue. So we look at

- The planting map to make sure we sample all the different clones
- The veraison map when 90% of the berries are blue to make sure the maturity differences are representative for the entire vineyard, and
- The projected crop load map to make sure we have enough fruit to sample

In 2017 we selected, as in 2016, six sample areas.

- In the Lower Field: the north-east corner of the long rows to sample the “Freedom” and “4453” roots with 337 cabernet clones. In the northeast corner of the short rows to catch the “110R” roots with “Dr. Emmet Rixford” cabernet clones, and the boundary between the short and long rows to capture the 2009 replantings, i.e., clone 337 on 4453 roots.
- In the Upper Field: The first half rows for each varietal. The graphic below shows the three maps and the selected sampling areas. The assumption is that differences in the maturity levels now, near picking, would be similar to the readily observable differences during veraison.

In 2018 we changed the selection of sampling areas because, both in 2016 & 2017, the sample results did not match well with the observations at harvest (for one, the final projected Brix levels were 2-4 Brix lower than what we got at harvest). So, in 2018 we sampled each block in the lower field uniformly, and we sampled the middle row of each block in the upper field.

Sample size: We collect weekly samples of 110 berries each, 100 berries for chemical analysis, and 10 berries for taste analysis for each block.

Chemical Analysis

We take a whole range of measurements and, from them, calculate sample averages.

- Sugar content (Brix): The sugar content of grape juice is the most straightforward measure of maturity. The industry norm is to pick when the sugar level has reached 22-28 Brix, depending on the style of the wine desired. Our target is 23.5 Brix when the juice is in the fermentation tank, but we focus more on maximizing potential Anthocanins (see below)
- Acidity (pH and Total Acidity, TA): At maturity, we expect a pH range of 3.3 to 3.5 and a TA range of 6 to 9 [g/L]. We also capture Tartaric, Malic & Gluconic Acids but are unsure what we do with the numbers. Finally, we capture Volatile Acidity to detect bacterial infestations.
- Nutrients (Alpha Amino Acids and Ammonia, which sum up to YAN, Yeast Assimilable Nitrogen): These are vital benchmarks for nutrition available for yeasts during

fermentation. We target YANs of 250 ppm; below that, we need to add nitrogen during fermentation.

- Projected Anthocyanin content (tANT): Anthocyanins are responsible for the finished wine's color intensity and mouthfeel. We press the sampled berries, then expose the skins and seeds to an alcohol solution at 130 ^{O}F for 2 hours, then press again and measure the phenolic components extracted by the alcohol solution. Our goal is to pick at the peeck of tANT, prefereably above 2,000 ppm.

We describe the laboratory processes in the Laboratory Section.

Physical Analysis

An alternative measure is to assess the maturity of the grapes by tasting their skin, pulp, and seeds individually. L'Institut Cooperatif du Vin (ICV), a wine advisory cooperative in Montpellier, France, has developed a handy methodology that we used in the past. It requires judgment for rating 18 different characteristics on a scale from 1 to 4. See the table below for the form we used:

ICV Detail Berry Sensory Analysis Scoresheet Date:

			Score Description				My score of sample		
			1	2	3	4	A	B	C
Visual	1	Berry Softness	Hard: bursts under strong pressure	Elastic: changes shape slightly under pressure but reverses quickly	Plastic: changes shape easily, takes a moment to get back to original shape	Very soft: changes shape easily under slight pressure, even squeezing			
	2	Skin Color around stalk	Pink, pale red	Red, light penetrates berries	Dark red: but not evenly colored around stalk	Blackish red: evenly colored			
	3	Stalk removal	Difficult: stalk tears the skin, takes pulp out	Moderate: stalk comes off with parts of the green pulp	Easy: stalk and brush includes only a little of the uncolored pulp	Very easy: stalk and pulp without pulp attached, brush is red			
Pulp Tasting squeeze pulp into mouth and separate out seeds	4	Pulp detachment & juiciness	Limited: pulp adheres strongly to skin, pulp mostly gelatine	Some: film of pulp adheres to skin and/or seeds, evident melting	Easy: pulp film only slightly visible on skin, juice is released from skin when squashed, almost complete melting	Total: no film of pulp on skin or seeds, no release of juice when squashed, complete pulp liquefaction			
	5	Sweetness	Lightly	Some	Pretty	Very			
	6	Acidity	High	Significant	Some	Low			
	7	Herbaceousness	Very Intense	Significant	Some	Absent			
	8	Fruit Aroma	Absent	Weak	Strong	Intense, jammy			
Skin Tasting chew skins till disintegrated	9	Disintegration after 15 chews	Very difficult small hard ball after 15 chews	Difficult evident fragments after 15 chews	Fairly easy mixture almost homogenous	Easy homogenous, solids gone before 15 chews			
	10	Tannin Intensity run tongue over palate	High tongue sticks to palate	Significant tongue slides with difficulty	Low tongue sticks slightly	Very Low tongue slides effortlessly			
	11	Astringency between lips & gum	Strong lip sticks, strong burning	Significant some burning	Moderate lip sticks slightly	Very Low lip slides			
	12	Skin Acidity	Strong	Significant	Moderate	Low			
	13	Herbaceousness	Intense	Significant	Some	Absent			
	14	Fruit Aroma	Absent	Weak	Strong	Intense, jammy			
Seed Tasting chew only if no green traces, otherwise lick	15	Seed Color	Green or yellow-green	Grey-brown with green traces	Grey-brown without green traces	Dark brown			
	16	Seed Hardness	Soft & elastic can be marked with nails	Soft outside, seed crashes like fresh almond	No soft outside most seeds are hard and cracks easily	All seeds are hard crack quickly and are crunchy			
	17	Tannin Intensity	High	Significant	Low	Very Low			
	18	Astringency	Astringent when licked already	Astringent at beginning of chewing	Some during chewing	None			

The process is:

- Step 1: Visual Inspection. Inspect the 4-5 berries and rate 1) the elasticity of the berry, 2) the color of the skin around the stalk, and 3) how easy it was to remove the stalk.
- Step 2: Pulp Tasting. Squeeze the pulp of the 4-5 berries into your mouth, separate the seeds with your tongue, and keep the seeds for the last step. While doing that, evaluate 4) how easy the pulp detached from the skin, 5) the sweetness of the juice, 6) its acidity, 7) its herbaceousness (herbal aroma), and 8) its fruit aroma. This takes some experience as all the ratings have to be done within 10 seconds.
- Step 3: Skin Tasting. Put the skins into the mouth and chew them hard 15 times or until they have entirely disintegrated into mush. Then evaluate 9) the level of disintegration after 15 chews, 10) the tannin intensity, 11) the astringency, 12) the skin acidity, 13) the herbaceousness, and 14) the fruit aroma.
- Step 4: Seed Evaluation. First, rate 15) the color and 16) the hardness of the seeds. If the rating is 3 or 4, chew the seeds and rate 17) their tannin intensity and 18) their astringency.

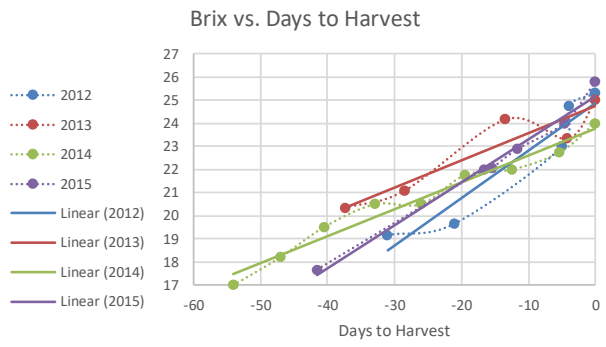
As the berries mature, the ratings move from 1 towards 4. Not all ratings reach 4 before the Brix level of the berries becomes excessive, or the weather turns too cold to finish maturation, and the grapes need to be picked regardless. The final scores provide input to winemaking to adjust the fermentation and maceration styles. We used this ICV process from 2013-2016 and then concluded it was inappropriate for our situation. We have far too few samples to benchmark our judgments accurately. So in 2017, we returned to a more straightforward approach: we rate how berries look, feel and taste using a range of 1 to 4 (from immature to fully mature). Essentially, we use an abbreviated ICV process.

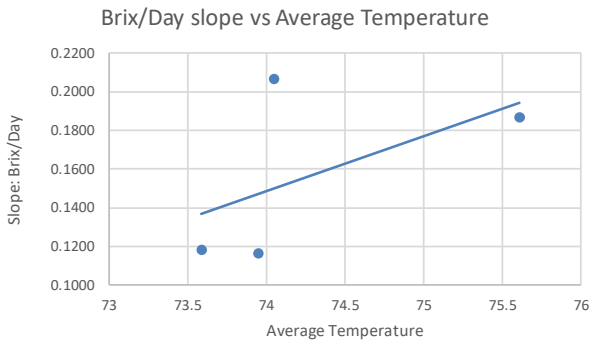
In summary: We endeavor to pick when the CGGD passed 2000, the sugar levels have passed 24 Brix, the average of average ICV scores exceeded 3.5, and the Anthocyanin levels are peaking.

Forecasting quality, date, and volume of harvest

Our quality forecasts are based mainly on the physical appearance of the bunches (e.g., mildew damage, bird damage, shrivel) and the projected potential Anthocyanin levels.

Our harvest date forecasts are based on the observed Brix level and the historical experience on how fast Brix levels increase over time at given ambient temperatures. The graphic on the right shows that in 2012 through 2015, the sugar levels have increased on average between 0.8 to 1.4 Brix/week. However, as shown in the graphic, there is no convincing correlation between that number and the average temperature during the week.





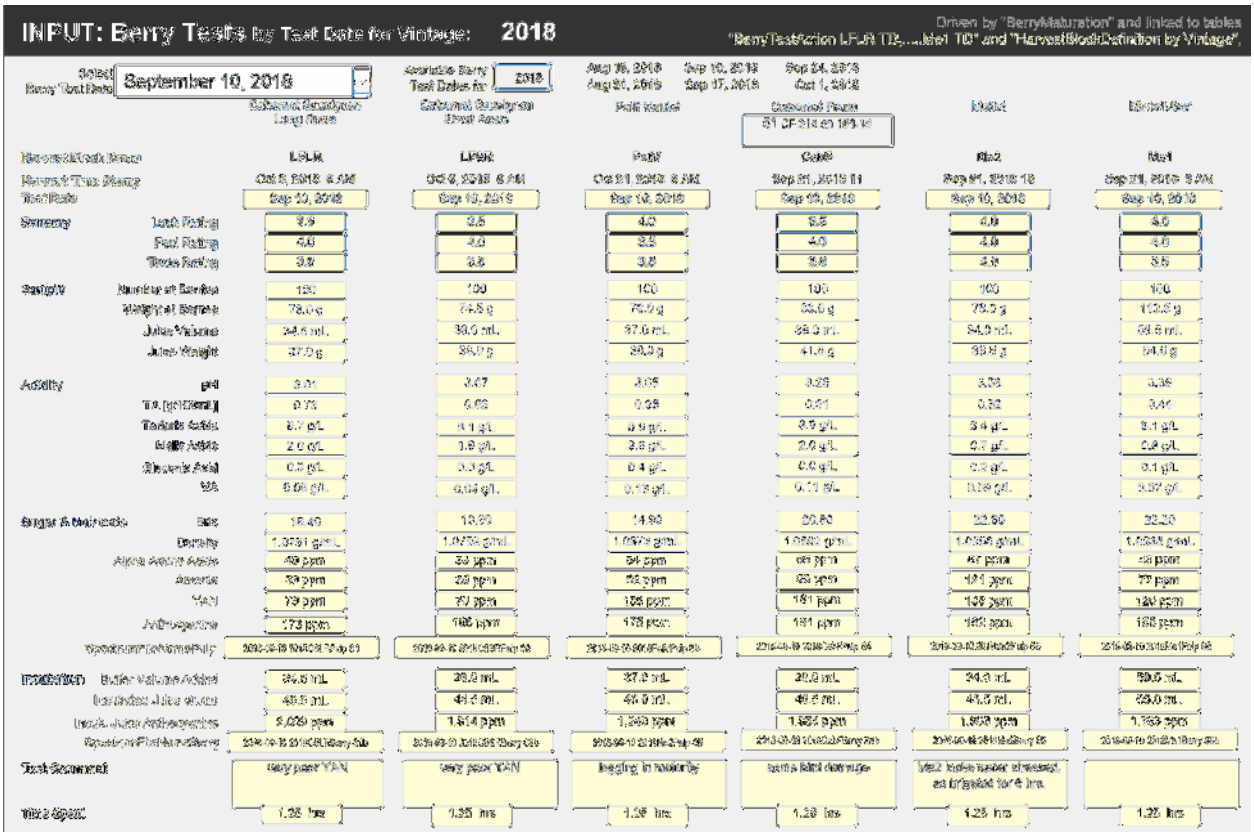
We also consider the observed evolution of potential Anthocyanin content and estimate when the peak will likely occur.

Our gross volume forecasts are based on estimates for each vine at veraison how big the current fruit load is as a percentage of estimated maximum load and averaging these numbers over each row. Then we estimate the full fruit load per plant in pounds for each varietal and multiply it with the average observed fruit load to get to an estimated harvest volume per row.

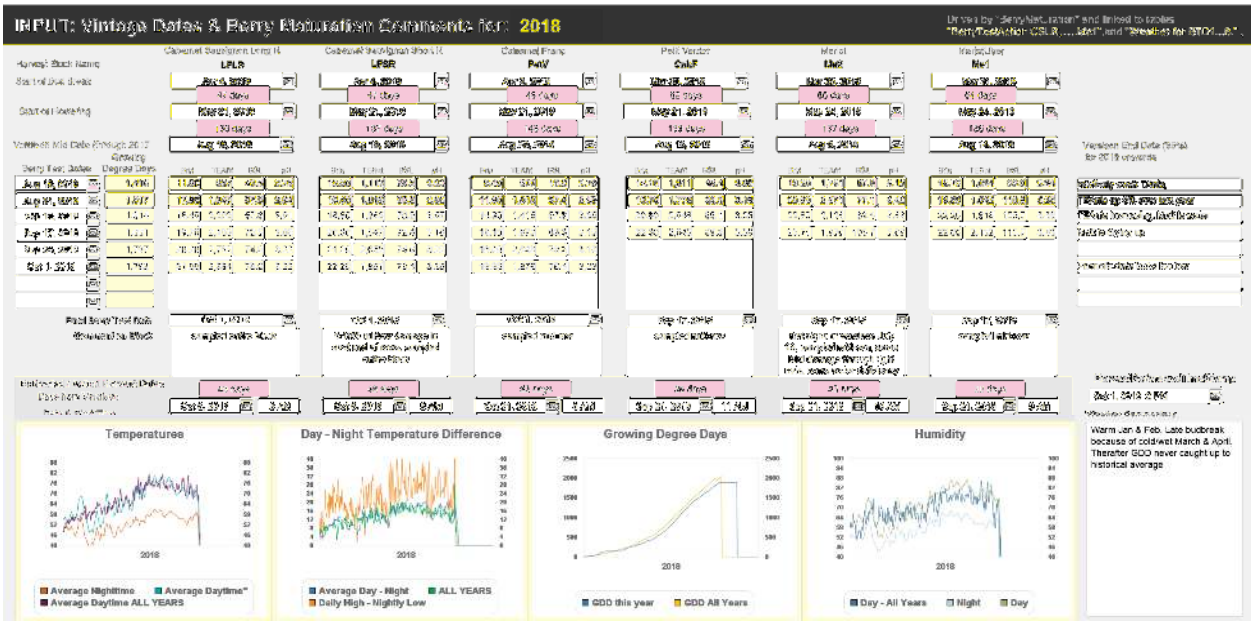
The quality and date forecasts are updated every week as we take and analyze our samples.

Data Management

We record observations for our six vineyard blocks in a single layout. The following screenshot shows, for illustration, the recordings on September 10, 2018. Since 2016, we use an Oeno FOSS analyzer to measure the acidity, sugar, and nutrient levels. For estimating potential anthocyanins, we use WineXRay. The Laboratory section provides details on the measurement protocols.

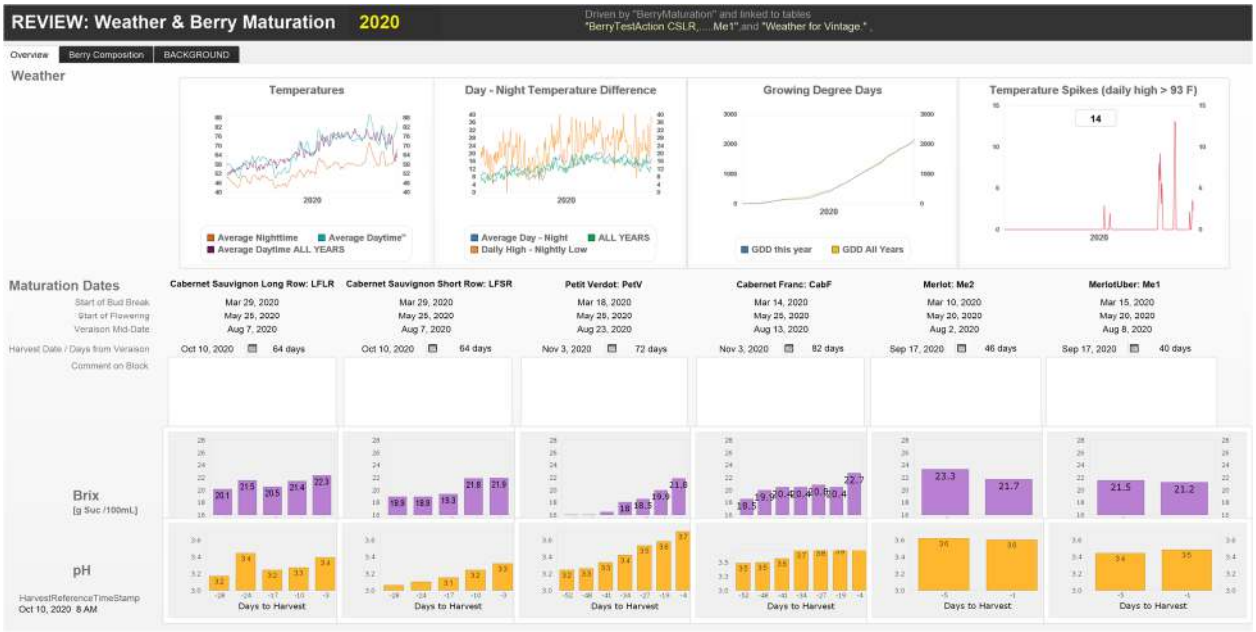


We monitor the progress of berry maturation and adjust the projected harvest dates after entering the berry test results. This screenshot shows the layout to review and adjust the dates on October 1, 2018:



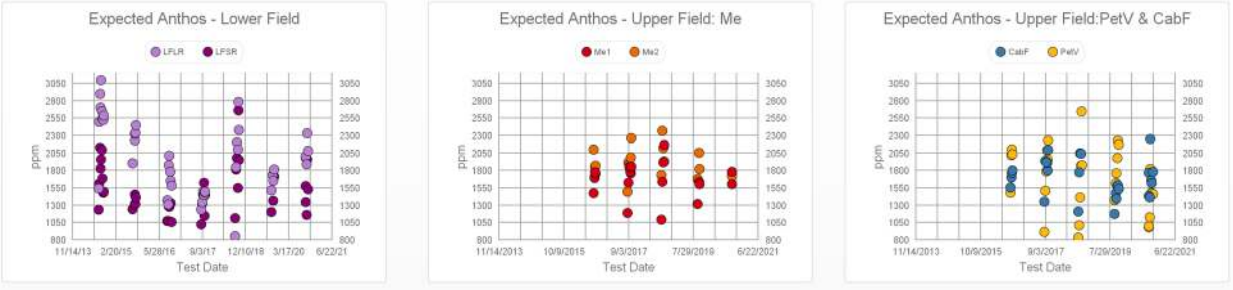
Tracking Results for the 2020 crop

The first tab in the layout “REVIEW: Weather & Berry Maturation” shows the maturation dates and Bric and pH levels measured in the berry tests for each block. Note, we started berry testing a bit late, so there were only two tests for the Merlot blocks



The second tab in the same layout shows the estimated levels of Potential Anthocyanins.the berry composition, the acid components and the nutrient levels.

The following chart shows the Extractable Anthocyanin measurements over the last six years (four years for the upper field). Note how 2018 stands out with high Anthocyanin levels.



The layout “REVIEW: FieldLocations – Fruitload” shows how we estimated fruit loads and harvest volumes for 2020.

In summary, our Grape Maturity Assessment led us to:

- Pick the Merlot blocks on September 17, with Potential Anthocyanins peaking around 1600. We estimated sugars around 21-22 Brix and pH relatively high in the 3.5-3.6 range. With an estimated 100% fruit load on Merlot Uber at 12 lbs/vine and Merlot at 7 lbs/vine, we estimated gross harvest yield at 480 and 450 lbs, respectively.
- Pick the Lower Field on October 10 with Potential Anthocyanin levels having peaked one week earlier at a high 2000-2300 ppm. Three days before harvest, the sugar levels reached around 22 Brix, and the pH remained low at 3.3 – 3.4. YAN levels were low at 120 - 130. With an estimated 100% fruit load yield of 15-16 lbs/vine, we estimated gross harvest yield at 2100 and 1200 lbs for the long and the short rows, respectively.
- Pick the Petit Verdot on November 3. Brix measured 21.8 and pH 3.7. We estimated 100% fruit load yield at 12 lbs/vine, resulting in an estimated gross harvest yield of 195 lbs.

The next page will show that some of these estimates were significantly off the mark: actual Brix and pH levels turned out almost 10% higher.

Previous page: Sanitation
Top of page: Go
Next Page: Step 2: Harvest & Sort
Last updated: November 30,, 2021

Step #2: Harvest, Sort & Destem

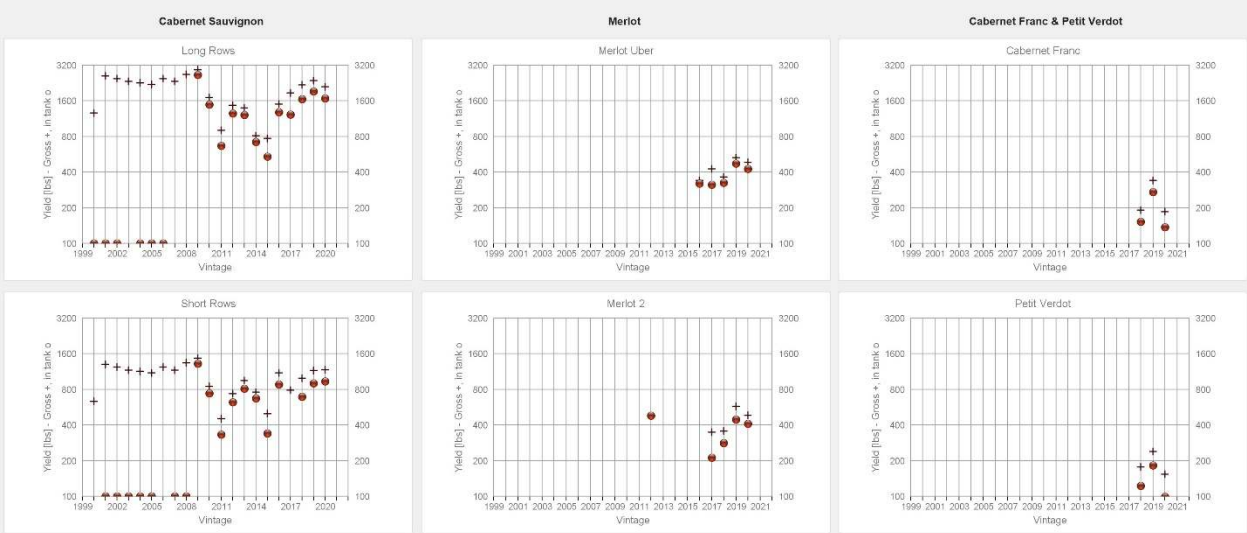
This page covers the harvesting of grape bunches in the field, sorting out bad bunches and debris, destemming the bunches, and then sorting out remaining waste among the grape berries. The result is clean grape berries in the fermentation tanks.

Picking the Grapes

A manual harvest involves organizing a large enough picking crew to harvest all the grapes during the morning hours before it gets too hot. Exposing picked grapes to sunshine and heat for more than 1-2 hours can severely reduce their quality. We usually organize a group of a dozen or so friends to show up in the morning, hand them picking bins and clippers and get the job done within a few hours. The bribe is a good lunch.

In 2013 we started to record the crop volume [lbs] by row. In 2014 we estimated the crop load for each vine and then recorded the crop volume for each vine at harvest (except for low-yielding vines, which we combined into groups of 2, 3, 4, or 5 plants). In 2015 we recorded crop loads for each vine but in 2016 returned to recordings per row.

These charts show the harvest volumes over the last 20 years. We show the gross yield in the field for each block and how much ended up in the fermentation tanks. The y-axis in the charts is on a logarithmic scale to highlight the relative changes over time.



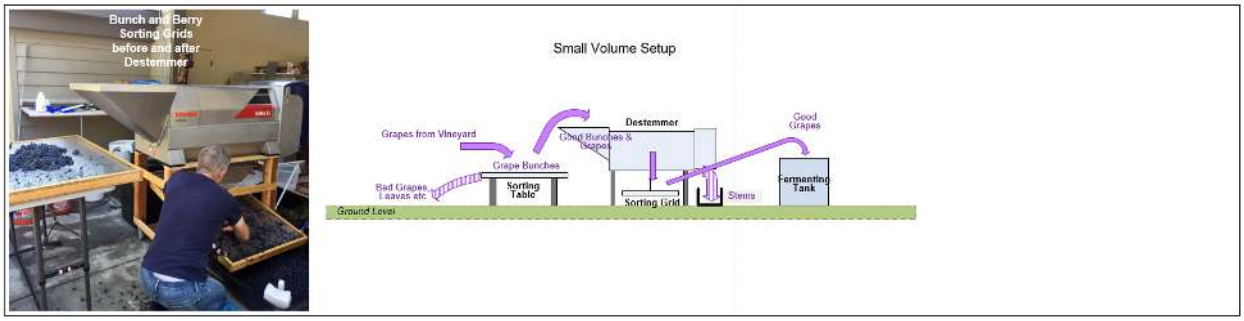
Three points of note:

1. We only started making wine in 2009, before we sold all our grapes.
2. The yield in the Cabernet Sauvignon blocks dropped significantly after 2009 because we battled a self-inflicted Eutypa infection of the vines. It took us almost ten years to recover from that mistake.
3. In 2016 the 4 blocks in the upper vineyard started producing Merlot, Cabernet Franc, and Petit Verdot.

Sorting, Destemming & Crush

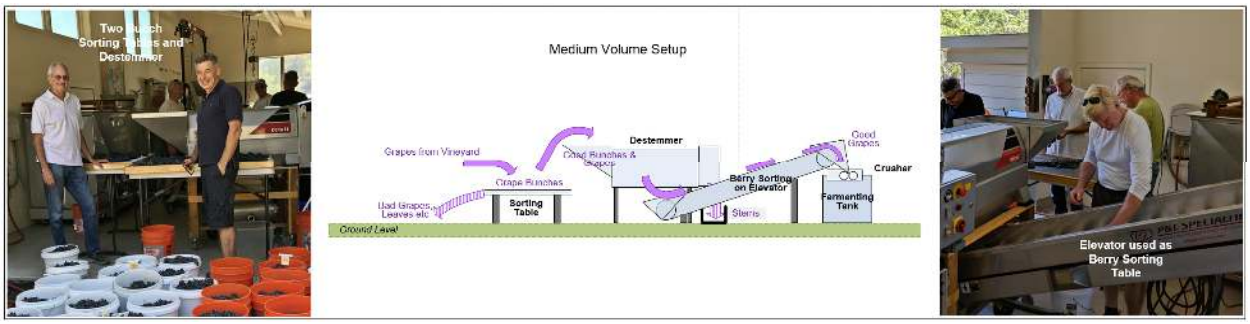
Bunch sorting is a labor-intensive manual process taking as long as picking. We pour picking bins of grape bunches one by one on a table, and helpers sitting around the table sort out by hand all the irregular, infected or damaged bunches, and berries. Good bunches and grapes are passed on to destemming. Bad material is discarded. The percentage of the discarded material varies between 2% in a good year (e.g., 2014) and >25% in a bad year (e.g., 2011, 2015, 2017). We use three different setups for sorting and destemming, depending on volume:

1. For small harvest volumes below 300 lbs, we use a single Bunch Sorting table from which we throw clean bunches into a Destemmer. The destemmer detaches the berries from the stems. The grape berries fall on a Berry Sorting grid from which we scoop the clean berries into a small fermentation tank. This is a two-person operation. We use a Delta E1 Destemmer from Bucher Vaslin (http://bvnorthamerica.com/wp-content/uploads/2013/07/Delta_E1_ang_avril_2007.p°F), which can efficiently process 1 ton of grapes per hour.

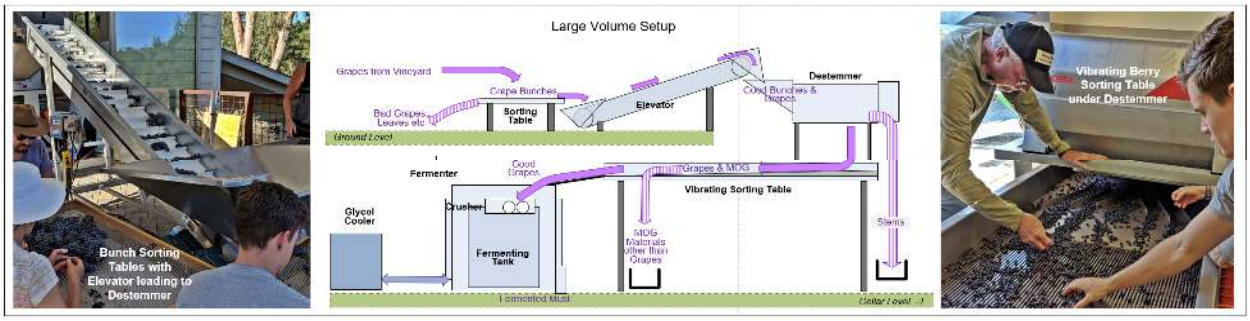


2. For medium-size harvests (300 – 1200 lbs), we add another bunch sorting table and a Grape Elevator, which we use as a platform for berry sorting. We may use a Crusher, which crushes the berries before they fall into the Fermentation Tank. The grape elevator was manufactured by P&L Specialties, Santa Rosa, CA (pnlspecialties.com).

The Crusher is a modified electric grape crusher from Williams Brewing, San Leandro, CA (williamsbrewing.com). This is a 5-8 person operation.

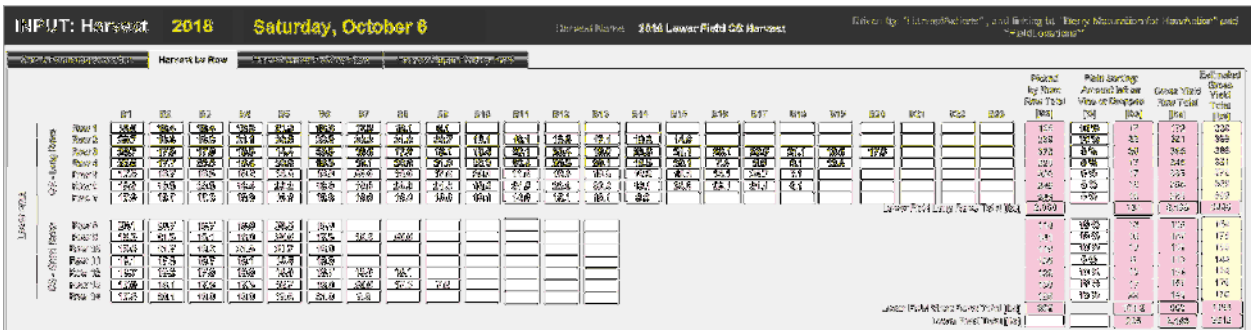


3. We add another bunch sorting table for larger harvests, and we mount the destemmer on top of a TRV15 Vibration Table from Bucher Vaslin (http://bvnorthamerica.com/wp-content/uploads/2013/07/TRV20-35-50_ANG_2006-11.p°F) on which we sort out bad berries and MOG (Material Other than Grapes). Under the sorting table, a pan collects juice from damaged grapes and MOG. That juice can be filtered and poured into the fermentation tank, or it can be counted as part of the “Saignee” and used elsewhere or discarded. At the end of the sorting table, a Grape Crusher can be inserted to break the grape skins before the gapes fall into the Fermentation Tank. This is an 8-12 person operation.

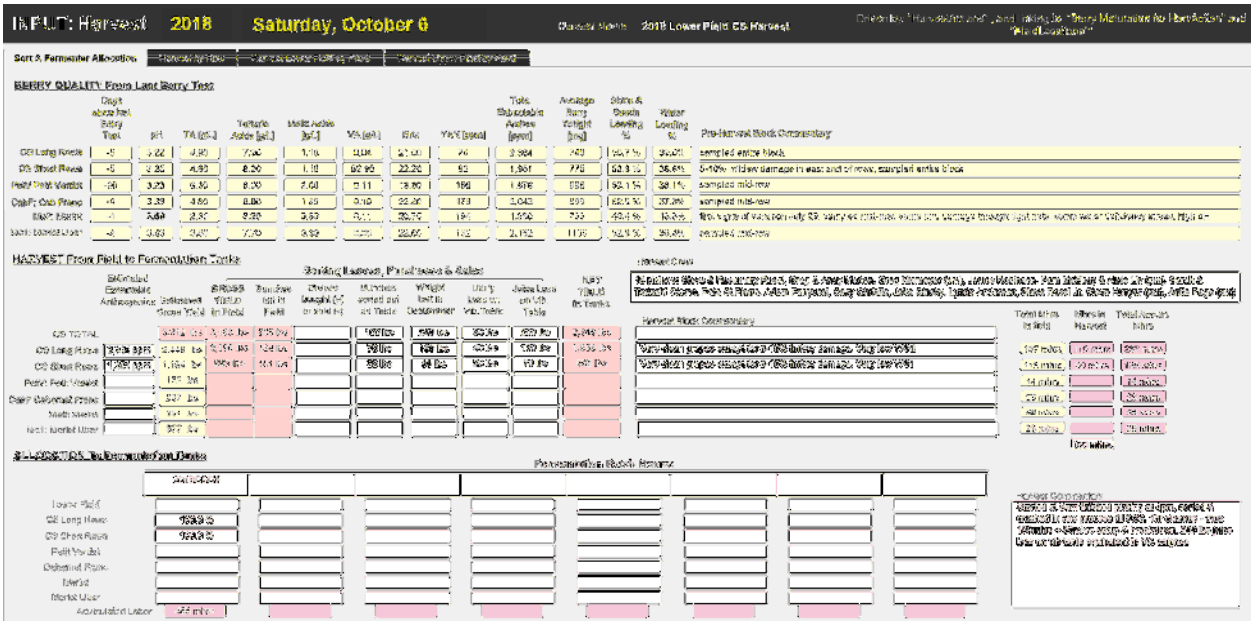


Data Management

We use the HarvestActions table is to record the weight of bunches collected with picking bins for each row or vine and the estimated percentage of weight left on the vine or dropped in the vineyard for each row. This screenshot shows how the weights were recorded by row for the 2018 harvest of the lower field (in 2018 we used 5-gallon buckets to collect grape bunches)



Next, we use the HarvestActions table record the sorting losses (bunch sorting, destemming, berry sorting, unused saignee from the vibration table) and how the net yield is allocated to different fermentation tanks. This screenshot shows the losses and allocations for the same harvest



This layout also summarises the grape quality as recorded in the berry tests. It provides an opportunity to record commentaries on the quality of each block and the harvest overall. It shows the labor input (in total manhours) accumulated to date for the must in each fermentation tank.

Tracking Results

The following screenshot provides details on the 2020 Harvests across all vineyard blocks, and all the way on the right margin, it summarizes volume-weighted average data across all blocks.

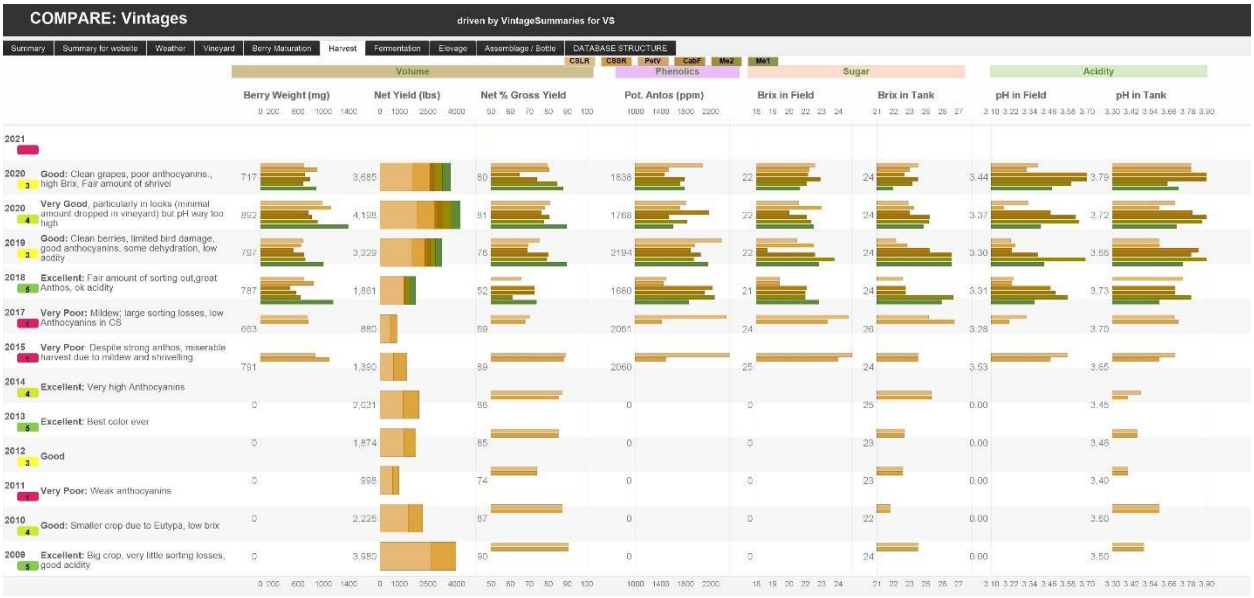
Note the following:

- The estimated Anthocyanin levels averaged 1858 ppm, slightly below our target minimum of 2000 ppm. Thus the juice is expected to be somewhat weak in color and phenolic content.
- The sugar levels measured in the field just before harvest averaged 22 Brix, significantly underestimating the average sugar levels measured in the tank: 23.58 Brix, slightly higher than our target of 23 Brix. We could have harvested a bit earlier.
- The pH levels measured in the field averaged 3.44, close to our target of 3.5, but significantly underestimated the final pH in the tank averaging 3.79. We lost too much acidity in the grapes during the last weeks of maturation and should have harvested a week earlier on average.

The following two screenshots compare the 2020 harvest with all previous vintages. Note

- The comparison of berry maturation across vintages confirms the observations above.
- Net yields were high (total ~3700 lbs) despite relatively low average berry weights of less than 720 mg. We harvested more but smaller berries in 2020.
- We lost more acidity in 2020 than in any other year. The average pH in the tanks, at 3.79, was higher than ever before.

Clearly an average harvest at best.



Previous page: Winery Overview

Top of page: Go

Next Page: Steps 3-11: Upfront Wine Making Decisions

Last updated: November 27, 2021

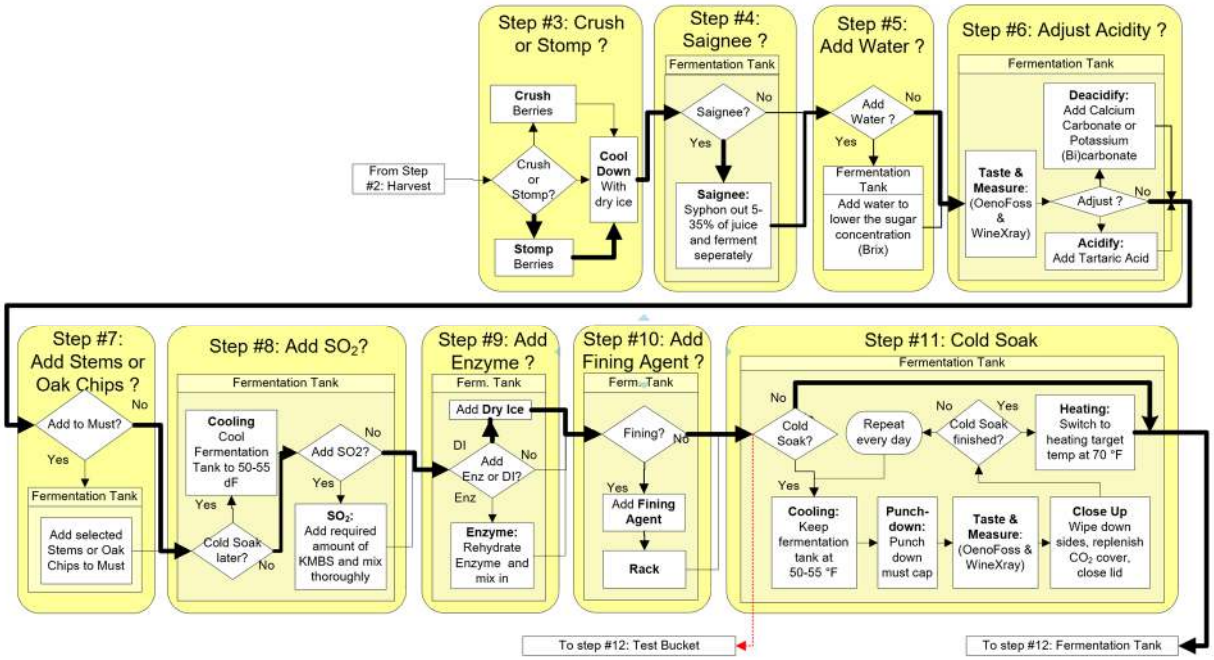
Steps 3-11: Upfront Wine Making Decisions

Nine decisions have to be taken when the clean berries are ready to drop from the berry sorting table into the fermentation tank. We decide depending on the quality of the berries and the intended style of wine.

- **Step #3: Crush or Stomp?** We decide whether we want to break the skins of the grapes with motorized rollers (crush) or with our feet or punchdown tool (stomp), or not at all (resulting in Full Berry Fermentation)
- **Step #4: Saignée?** We decide whether to increase the concentration of flavors by syphoning off a percentage of the liquids. This increases the "skins & seeds"-to- "liquids" ratio. The juice that is syphoned off can be used to produce rosé wine or discarded.
- **Step #5: Lower Brix?** We decide whether we need to lower the sugar level (Brix) by adding water.
- **Step #6: Adjust Acidity?** We decide whether we need to adjust the pH up (add carbonates) or down (add tartaric acid) now. This can be done now or later, anytime before bottling.
- **Step #7: Add Stems or Oak Chips?** We decide whether we want to add back some of the stems into the must to adjust flavor profile or add Oak Chips to adjust the phenolic extraction
- **Step #8: SO_2 or native Fermentation?** We decide whether to ferment with yeasts native in the vineyard and winery or with cultured yeasts purchased from external providers. If we decide to use cultured yeasts, we need to add SO_2 now to prevent spoilage of the fruit and to kill off any indigenous yeasts
- **Step #9: Add Enzymes or Dry Ice?** We decide whether we want to increase the extraction of desirable components in the skin artificially, pulp and seeds into the juice by adding enzymes that break down cell walls. Adding dry ice also breaks down cell walls where berries touch the ice; it is less effective but has the added benefit of initiating a cold soak.
- **Step #10: Add Fining Agents?** We decide whether we want to add fining agents to bind and precipitate spoilage bacteria (important for musts with low acidity, when SO2 is not as effective in controlling microbes).
- **Step #11: Cold Soak?** We decide whether we want to extract desirable skin components and pulp into the grape juice before fermentation is converting the juice into

alcohol. Again the idea is to get more aromas and flavours. Soaking needs to be done at a low temperature of around 50-55 ºF to prevent spoilage.

This chart shows the detail process and the choices made in 2020



Natural style winemakers tend to stay away from using cultured yeasts, enzymes, oak chips, acidity adjustments, and fining agents; interventionist winemakers tend to use all available tools in the box. The following paragraphs describe the choices and actions in detail

Step #3: Crush, Stomp, or Full Berry Fermentation?

At this juncture, the pulp and juice in the grapes have the color of white wine. However, it turns red during cold soak and fermentation as phenolic compounds from the skin and seeds dissolve into the juice. This transfer can be accelerated by breaking the skins of the grapes before they are dropped into the fermentation tank, a process called crushing or stomping the grapes:

Crushing is usually accomplished by passing the berries between two rollers spaced at a slightly smaller distance than the berries' diameter. Care must be taken not to crush the seeds inside the berries because that would release unwanted chemicals into the juice.

We built our Crusher to sit on top of a fermentation tank in 2016 based on components salvaged from hobby-winery crushers sold by Williams Brewing.com. An electric motor drives two rollers over a set of external gears. A funnel guides the grapes to be crushed to fall between the rollers, and the crushed berries drop into the fermentation tank. The picture shows the Crusher over a fermentation tank and fed by buckets.

Stomping is accomplished by a person stepping into the fermentation tank and on the grapes. This is old-fashioned, and the job is usually reserved for virgin maidens when available [increasingly challenging to find given the weight required!]. The alternatives are grown-ups (possibly in wet-suits) or stainless steel robots. Stomping is considered somewhat gentler on the grapes than breaking the cell walls with rollers.

If the grapes are very ripe, they tend to break open during destemming and crushing, or stomping may not be necessary at all.

If the grapes are left whole, then, during subsequent fermentation, the yeast will need to enter the berry through the small hole created when the berry stem was removed. This takes longer and is called **Full Berry Fermentation.**

Step #4: Saignée?

Saignée (from French, meaning “bleeding”) is one method for producing rosé wine. It started, though, with the intent to remove liquid from the grape must before the juice gets exposed to skins. The idea is to increase the “skin-to-liquids” ratio by removing liquids upfront so that the remaining liquids get more exposure to the color and tannins that are extractable from the skins and seeds. The purpose is to increase the flavor and color density of the wine. Saignee is often

used in a bad-weather-year when the grapes did not get enough warmth and sunshine to fully mature. The juice is either separated as fallout from the vibration table or siphoned off within 1-2 hours after destemming. The slightly pink juice is either discarded or fermented separately to produce rosé wine.

Using a vibrating berry sorting table, as we do, automatically diverts some juice before the berries reach the fermentation tank. If sifted to eliminate MOG (Materials Other than Grapes), this juice can be poured back into the fermentation tank, discarded, or used elsewhere.

Step #5: Add Water?

We pick the grapes when they are ripe. Simplistically ripeness is measured by the amount of sugars accumulated in the berries. A good guideline is: berries are ripe when sugars reach 23-25 Brix (i.e., grams of sucrose per 100 grams of juice). A better way to evaluate ripeness is to taste the juice, skins, and seeds or measure accumulating Anthocyanins.

Particularly in a year with heatwaves, Brix levels at harvest may reach 26-27. If left to ferment, this amount of sugar will lead to alcohol levels close to or over 16%, negatively affecting the taste of the wine. Therefore it is advisable to reduce the sugar concentration before fermentation or reduce the alcohol level later with reverse osmosis. The easiest way to reduce sugar concentration is to add distilled water – the rule of thumb is: a 10% reduction in Brix or projected alcohol is accomplished by adding 10% of water. In most countries, the law prohibits commercial wineries from adding significant amounts of water to must; but we can do what we like since we do not sell our wine.

Step #6: Adjust Acidity?

Acidity affects the wine in many ways: microbial activity, protein tartrate stability, malolactic fermentation, color, flavor, and aging potential. Therefore, adjusting the acidity is an integral part of the winemaking process. Adjustment is advisable when the must has a pH below 3.2 or above 3.7 or a Titratable Acidity (TA) above 7.5 or below 5.0.

Also see: http://winemaking.jackkeller.net/acid.asp

Increasing acidity: The addition of acid to grape juice, must, or wine decreases the pH and increases the TA of the wine. The low pH will make SO_2 more effective against oxidation and bacterial infections. Reduced use of SO_2 preserves color intensity and increases the aging potential of the wine. The amount of acid needed to correct the acidity deficiency depends on the total acidity, the pH, and the buffer capacity of the juice, must, or wine. The choice is between adding tartaric, malic, or citric acids as they will affect the pH, TA, and taste of the wine differently. The general guidelines are

- One g/L addition of Tartaric acid will increase the TA by about 1.0 g/L and decrease the pH by 0.1 pH units.
- One g/L addition of Malic acid will increase the TA by about 1.12 g/L and decrease the pH by 0.08 pH units.
- One g/L addition of Citric acid will increase the TA by about 1.17 g/L and decrease the pH by 0.08 pH units.

Adding acid can result in some precipitation of potassium tartrate (KHT), affecting both pH and TA. Therefore, it is highly advisable to make acid additions in small steps or do a bench test with the must at hand before making any additions.

Decreasing acidity: Red wine is usually put through a “malolactic fermentation” (see Step #17) after the fermentation of sugars into alcohol. In that step, malic acid is converted to lactic acid, increasing the pH by around 0.2, decreasing the TA by around 2, and softening the acid's mouthfeel. If that projected reduction is not substantial enough, deacidification with precipitation agents may be necessary at this juncture. The deacidification agents precipitate some tartaric acid in the form of insoluble salts.

- Calcium Carbonate $CaCO_3$ forms carbon dioxide and precipitates calcium tartrate (CaT). However, this introduces a risk of calcium tartrate instability.
- Potassium Bicarbonate ($KHCO_3$) and Potassium Carbonate (KH_2CO_3) deacidify grape juice, must, or wine, possibly improving quality or rounding off-flavors. They both form carbon dioxide and precipitate potassium bitartrate.

With the double salt method, we can reduce tartaric and malic acid. Double salt deacidification is a technique in which we take up to 20% of the volume to be treated and add all the CaCO3 calculated needed for the total volume. The goal is to precipitate tartaric and malic acid in roughly equal parts. The high pH over 4.5 produced in this fraction is to facilitate this.

A bench trial should be performed before any intervention.

Step #7: Add Stems or Oak Chips?

Do we want to add some of the stems (removed in the destemmer) back into the must? This is often done with Pinot grapes that are low in phenolics but less with other varietals. The goal would be to add more tannins to the wine. We have not added any stems back to date.

If desired, a small amount of specially treated oak chips can be added to the must to improve the projected flavor profile of the wine. Purveyors of these oak chips claim they can enhance the binding of anthocyanins and round out the mouthfeel; others can mask green flavors. Some argue oak chips are a substitute for soaking and fermenting in oak barrels. The jury is still out on the effectiveness of oak additions.

Step # 8: Add SO_2

Sulfur dioxide (SO_2) is the oldest and arguably one of the most important additives used in winemaking. When present in sufficient concentration, SO_2 has five major effects in wine/musts: (1) SO_2 is a strong antimicrobial agent and provides a protection against a wide array of detrimental microorganisms; (2) it is an effective antioxidant that consumes oxidants such as hydrogen peroxide or quinones formed during the course of wine/must oxidation; (3) it can inhibit polyphenol oxidase enzymes present in grapes; (4) it reversibly binds and bleaches wine pigments, particularly monomeric anthocyanins; and (5) it reversibly binds aldehydes and ketones produced by oxidation or during fermentation, rendering them non-odorous (**Waterhouse et al. 2016**)

There are four different instances when SO_2 is added to must and wine:

1. After grape sorting and before cold soak, fermentation will be done with commercial yeasts (i.e., step #8). The purpose here is to kill off all native non-saccharomyces yeasts and bacteria upfront and protect the wine from accidental spoilage
2. After the malolactic fermentation has finished, to protect the wine during cellaring
3. During cellaring whenever we top up or rack a barrel (every 1-2 months).
4. Just before bottling to protect the wine in the bottle

SO_2 is added to most wine made today', but there is a clear tendency to reduce the amount used – particularly for the very high-end and artisan wines. The less SO_2 is used, the higher the risk of spoilage. Thus very clean grapes and winery/cellar equipment become even more critical. Details on how to measure SO_2 concentrations and how much to add are provided in the Laboratory section.

The first opportunity to reduce the use of SO_2 is right up front: before fermentation.

- SO_2 kills off bacteria and spoilage material carried into the winery from the vineyard with the grapes or have over-wintered in the winery. At this juncture, SO_2 also kills off any native non-saccharomyces yeasts. This is desirable in high-volume operations when laboratory-grown yeasts of known origin and characteristics are used to ensure consistent fermentations and wine quality. These cultured yeast are derived from samples collected in the most prestigious highest quality vineyards in the world. Since different yeasts applied to the same grapes produce wines with varying taste profiles, yeast selection is a key decision for the winemaker.
- On the other hand, native yeasts that arrive with the grapes provide "terroir" or individuality/uniqueness to the wine produced, making native fermentations attractive to artisanal winemakers. Their use, however, increases the risks of stuck fermentations, a significant production headache. One way around this conundrum is to extract yeast cultures in the vineyard and grow selected strains in the laboratory, then clean the grapes when they come in with SO_2 and subsequently inoculate with the in-house grown cultures, thus preserving the "terroir." This, however, is only economically viable for very high-end wineries.

So, if the intention is to do a native fermentation, it is better not to add any SO2 at this juncture or limit the addition to less than 20 ppm (parts per million, or grams per metric ton).

Step #9: Add Enzymes?

Enzymes are catalysts for biological reactions. Enartis Vinquiry (www.enartisvinquiry.com) and Laffort (www.laffort.com) are the leading developers and producers of enzymes for the wine industry. Some enzymes are used before and during fermentations to accelerate the break-down of grape cell walls so that preferred tannins from cell walls (compared to less preferred tannins from the seeds) are more readily released into the juice. The result is improved color stability of the wine and softer tannins.

Step #10: Add Fining Agents?

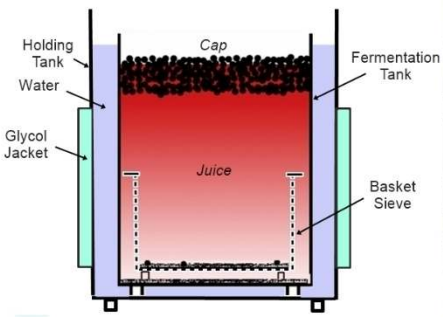
SO2 does not work effectively to control bacterial infections when the acidity of the must is low (i.e., pH above 3.7). In this case, we may decide whether to add a fining agent to bind and precipitate spoilage bacteria. For an example and more detail, see the Enartis video http://www.enartis.com/us/focus-on/webinars/high-ph-red-winemaking_5744.htm.

Step #11: Cold Soak?

A further technique to increase the release of color (and to a lesser extent tannins) from the grape walls into the juice is to let the crushed or stomped grapes soak in their juice at around 50°F for a few days before fermentation starts. The low temperature prevents spoilage and an accidental onset of fermentation. During cold soak, the must has to be covered with a blanket of Argon or CO_2 to avoid oxidation, and the grapes need to be agitated and punched down daily. There are two ways to achieve this: either by adding a daily dose of dry ice (which reduces the temperature and releases CO_2) or cooling down the fermentation tank with glycol. Using dry ice has the added benefit of breaking down cell walls (effectively flash freezing at the contact points). In 2013 we switched to an insulated fermentation tank with a cooling jacket fed with glycol from a refrigeration unit. The fermentation tank was built by Santa Rosa Stainless Steel (www.srss.com) on specification; the refrigeration unit is a Kreyer Chilly Max (www.kreyer.com) bought from MoreWinePro (www.morewinepro.com).

As the skins separate from the juice, they start forming a cap because skins are less dense than the liquid. This cap dries out unless the juice is pumped over or the cap is punched down into the juice regularly. We prefer to punch down as it does not involve pumps.

In 2016 we introduced four new smaller fermentation tanks designed to sit inside the glycol-cooled larger tank in a water bath. The first purpose was to allow fermentations in smaller batches. The second purpose was to allow early removal of skins and seeds before the fermentation is finished by



introducing a basket sieve at the bottom of each tank. The third purpose was to allow for better temperature management during cold soak and fermentation. The tanks were custom-built again by Santa Rosa Stainless Steel.

The twice-daily cold soak/punch-down process is:

Lift the tank cover

Punch down the must to the extent possible.

Take out samples to taste and analyze.

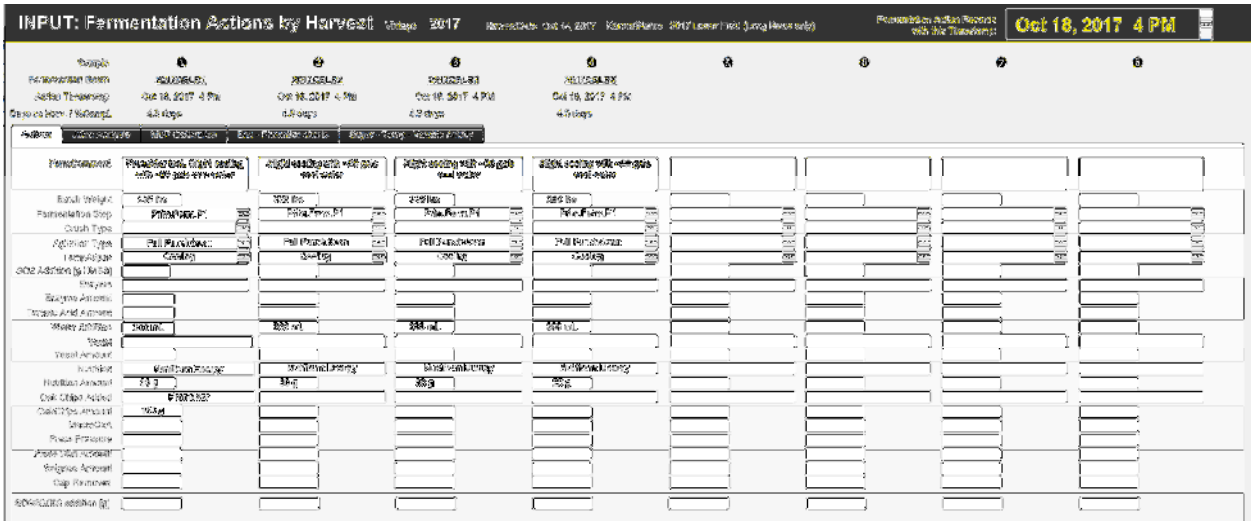
Squeegee and wipe down the inside walls of the tank with disinfectant (weak KMBS solution on a paper towel), cover the must with a new blanket of Argon or CO2, and lower the tank cover.

We take two 2 ml samples and centrifuge them for 4 minutes at 13,500 rpm to measure the chemical properties. Then we use one sample for the OenoFoss instrument to measure Brix, Density, pH, VA, TA, Tartaric Acids, Gluconic Acids, Malic Acids, Alpha Amino Acids, and Ammonia. We use the second sample to measure phenolics: we measure the transparency at various wavelengths in the ultraviolet-to-visible spectrum and transmit the spectral data to wineXray.com, which instantly returns the phenolic results (Free and Total Anthocyanins, Anthocyanins Bound to Tannins, Protein-Precipitable Tannins and Total Iron-Reactive Phenolics). For a more detailed description of the process and the meaning of these measures, read the Laboratory section.

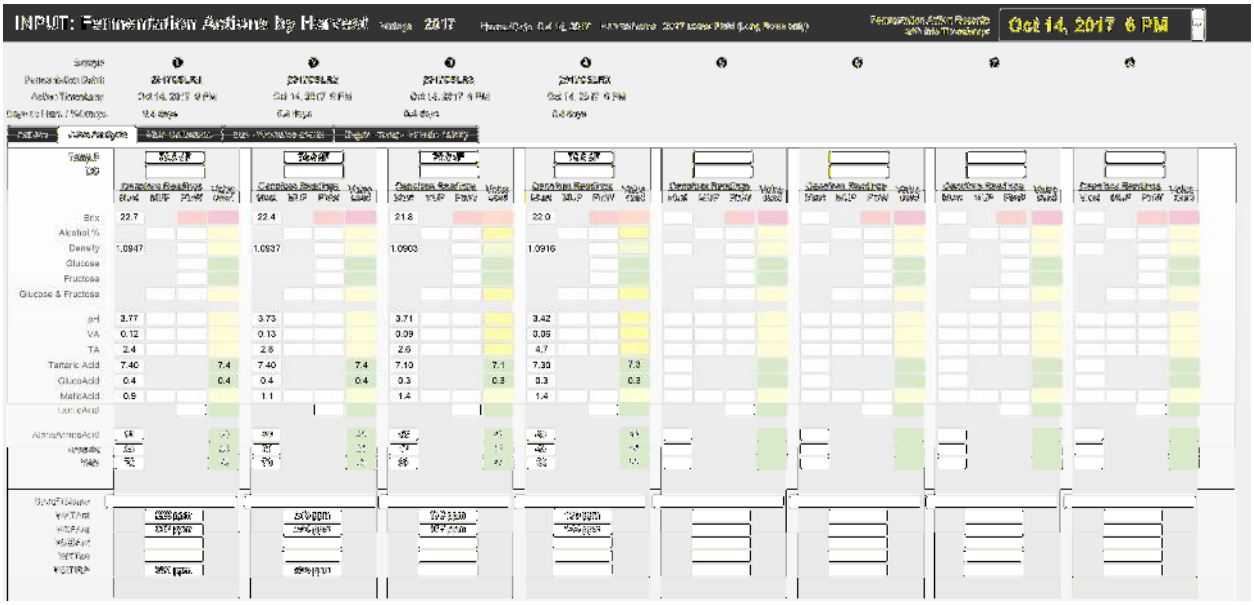
Data Management

We record data at least daily for all fermentations running simultaneously for a given harvest date with the “INPUT: Fermentation Actions by Harvest” layout. It can accommodate up to 8 simultaneous fermentation batches. This layout has five tabs: the first to input actions, the second to input measurements of chemical properties, the third to set the boundaries for the “MUF” (Must under Fermentation) calibration, and the fourth and fifth to review results graphically.

This screenshot shows the “Actions” tab of the input layout on October 14, 2017, at 6 pm, when we re-allocated the saignee on the vibration/berry sorting table from fermentation tanks 1, 2 & 3 to fermentation tank 4.



This screenshot shows the “Juice Analysis” tab at the same time



Note, we only have “Must” readings in the chemical analysis because the fermentation had not started yet.

The other three tabs are irrelevant at this juncture.

Tracking Results 2020

As indicated in the process-flow graphic at the beginning of this page, we made the following choices in 2020:

- We stomped all four fermentation batches (CS, CF-PV, Me1 & Me2).
- We discarded the juice falling off the berry sorting tables – effectively a 7% saignee.
- We made no additions of any sort (no water, acidity adjustment, stems or chips, SO2, Enzymes, or Fining Agents)
- We used dry ice to cool down the berries as they fell into the respective fermentation tank, equivalent to a 1-day cold soak.

Over the years we have learned to minimize adjustments and interventions, by managing fruit characteristics in the vineyard and timing the harvest correctly. We now shy away from adding water or sugar, from adjusting acidity or using enzymes and SO2.

Previous page: Step #2: Harvest
Top of page: Go
Next Page: Step #7: Primary Fermentation Phase 1
Last updated: November 28, 2021

Step 12: Primary Fermentation Phase 1

Fermenting grape juice into wine is about transforming sugar into alcohol with yeast. This happens in a complex web of chemical reactions which are not yet fully understood. The level of Brix measured in grape juice translates linearly into the percentage of alcohol the wine will have: 24 Brix in must yields around 13.5% alcohol in wine.

Fermentations consist of two successive phases:

- Phase 1: Lag & Exponential growth phase. First, the yeast microbes need to adjust to the environment (temperature, pH, etc.). As soon as the adjustment is complete, the yeast cells divide and grow in number exponentially while at the same time converting sugar. This takes a few days, during which significant energy is dissipated in heat, and rising temperatures and oxygen is consumed. Next, berries start to disintegrate, and skins begin to float up to create a cap that needs to be broken up and submerged with regular punch-downs.
- Phase 2: Stable & Exponential Decline Phase. This is when the yeast cells systematically convert sugar into alcohol. CO_2 is generated, and temperatures tend to fall because the fermentation's energy dissipates. The cap of skins needs to be punched down regularly. The yeast cells start to die off when the sugar and other nutrition get scarce when the alcohol level gets too high, or the temperature falls too low.

A fermentation is called successful when all the sugar is consumed by the time the yeasts have died. The opposite is a stuck fermentation when sugars are still present after the yeasts die and new yeasts need to be added to restart the fermentation. This is cumbersome and can be prevented by managing temperatures and yeast nutrients and selecting the appropriate yeast strains for the grape variety at hand and winemaking style.

Choice of Yeasts

Different yeast strains produce different tasting wines even when applied to the same grapes. There are thousands of different yeast strains, many naturally available concurrently in the environment. So the challenge for the winemaker is to choose among three alternatives:

1. Fermentation with Indigenous Yeasts: We rely on the mix of yeast strains that happen to be attached to the berry skins brought in or survived in the winery from previous fermentations. This choice creates wines that genuinely reflect the local terroir, but there is a risk that the fermentation may not complete successfully.
2. Fermentation with Industrial Yeasts: We kill the indigenous yeasts with SO_2 in Step #8 above and inoculate the must with a known, commercially available yeast or yeast derived from the own vineyard and propagated. This choice reduces the risks of stuck fermentations but adds uniformity to the wine produced.
3. Fermentations with both: We start with Indigenous Yeasts but then, in phase 2, introduce Industrial Yeasts to make sure the fermentation finishes without a hitch.

For our first vintage (2009) decided to go with a native fermentation to establish a benchmark for what happens without interventions. In the subsequent six years, 2010-15, we used commercially propagated yeasts to reduce the risks of stuck fermentations and record which yeasts were doing the fermentation. Then, as we gained more confidence in our ability to control the fermentation process, we returned to native fermentations in 2016.

Yeast Nutrient

The essential yeast nutrient is Nitrogen which is metabolized by yeast to synthesize proteins. Nitrogen stimulates yeast multiplication, keeps yeast metabolism active, prevents H_2S and mercaptan formation, and stimulates aroma production. Nitrogen is provided as Yeast Assimilable Nitrogen (YAN). YAN is composed of ammonium ions and amino acids. Ammonium ions are the favorite ‘food’ of yeast. Easy and fast to use, ammonia impacts mainly yeast growth and population. Amino acids are harder to be assimilated. They impact yeast growth, health, and efficiency through fermentation as much as aroma production.

Berries contain YAN naturally. The optimal concentration for a healthy fermentation is between 150 and 350 mg per liter of must, depending on its sugar content. The rules of thumb are:

- For good population growth of yeast, we need at least 150 mg/L of YAN
- For converting sugars to alcohol, we need 10 mg/L/Brix of YAN (e.g., for must with a sugar concentration of 25 Brix, we need 250 mg/L of YAN)
- Too much YAN (>350 mg/L) produces off-flavors and increases stress conditions, possibly leading to stuck fermentations.

Artisan winemakers prefer to minimalize the use of additives of any sort, including nutrients. We used no nutrients in 2009, then used them 2010 through 2015 as suggested by commercial yeast manufacturers. In 2016 and 2017, we used nutrients sparingly, only when fermentations showed signs of stalling. In 2018 through 2020, we added significant amounts of nutrients because the level of YAN in the must was very low, below 100 for the Cabernet Sauvignon blocks. In the future, our goal is to manage the vineyard to get the YAN to 150-200 mg/L, so we can minimize additions.

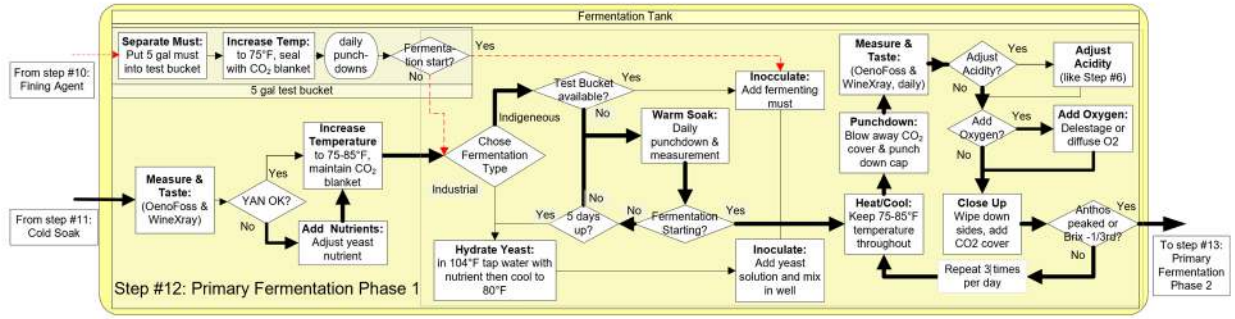
Process Steps for Primary Fermentation Phase 1

When we use commercial yeast and nutrients, we need to hydrate the yeast in a nutrient solution. Here are the steps we go through:

- We make sure the must has an adequate concentration of nitrogen – food for the yeast. We measure YAN (Yeast Assimilable Nitrogen) and adjust yeast nutrients in the next step as required.
- We hydrate the required amount of additional yeast nutrient in 2 liters of 104°F tap water as specified by the supplier.
- We carefully hydrate the yeast in the solution; this process is essential to ensure that the yeast cells assimilate to the environment: We add the yeast, stir gently, and let the suspension stand for 20 minutes. Then we mix in 2 liters of grape juice and let the solution stand until it cools down to the temperature of the must in the fermentation tank + 15°F
- We pour the acclimated solution into the fermentation tank and start the punchdowns.

When we go for native fermentation, we may set a bucket or two of crushed grapes aside a week earlier, punch it down daily, and watch for the fermentation to start indigenously. The bucket is ready to be used to inoculate the main fermentation tanks when the fermentation is active (i.e., producing enough CO2 to form a 1-2 inch cap in the bucket). The alternative is to wait until the fermentation starts on its own; this creates a “Warm Soak” waiting period of 3-4 days.

Here is the process chart:



We may want to add nutrients at inoculation, mainly if the YAN level measured in Step #6 above is below 120 mg/L.

During fermentation, we need to repeatedly remix the skins and the juice a) to promote extraction of essential flavors from the skins into the juice and b) to add minute amounts of oxygen required by the yeast. This can be accomplished by punch downs (punching the skins down into the juice) or pump-overs (pumping the juice from the bottom of the tank and spraying it over the cap). We prefer punchdowns because we don't want to use pumps.

The punchdown process is:

- Three times a day, take the tank cover off and blow off the Argon or CO2 blanket with a fan
- Punch down the cap making sure not to crush seeds at the bottom of the tank (picture on the right). Decide whether to increase the oxygen supply in the must further. If yes, macro-oxygenate once a day during the first 3 days: Inject 10-20 ppm of pure oxygen through a diffusion stone into the must (equipment - the picture on the right). Note, we can only measure the amount of oxygen injected, but not the amount that bubbles up and is not

absorbed.We are currently exploring to monitor oxygen concentration in the must in real time by monitoring the Oxygen Reduction Potential (ORP) with a probe from Accuro Ltd, New Zealand (www.accuro.tech)

- An alternative to punchdown is delestage. Delestage is the french term for draining the fermentation tank into a holding vessel, leaving the remaining skins exposed to air for 20 to 100 minutes, and then pour the contents of the holding vessel back over the skins into the tank. Delestage should not be repeated more than three times and should be followed by a punchdown at least 16 hours later. (see this article for a good description https://winemakermag.com/237-delestage-fermentation-techniques). Note, we cannot measure the amount of oxygen supplied in the Delestage process.
- Take another tasting sample and comparison taste.
- Take two 2mL samples for chemical analysis once a day. Enter results into new records of the FermentationActions table.
- Squeegee and wipe down inside walls of the tank with disinfectant (KMBS solution on a paper towel), cover the must with a new blanket of Argon or CO2, if the fermentation is not yet producing enough CO2 itself, and put the tank cover back on
- Adjust heating or cooling to keep the temperature in 70-80 °F range

Around 3-4 days following inoculation, we expect to see a peak in the level of Free Anthocyanins (hopefully above 1,000) and sugar levels having dropped 1/3rd in Brix. At this point, we move on to Fermentation Phase 2.

Dealing with Fermentation Problems

A long lag phase or abrupt stop in the conversion of sugars to alcohol indicates a problem. An abrupt stop in fermentation activity can happen as a consequence of a severe temperature drop – no longer an issue for us since we can control the temperature in our fermentation tank. A problematic delay in the onset of fermentation activity is indicated when the lag phase is longer than five days. This can happen when:

- A native fermentation is attempted with indigenous yeasts. It may help to raise the temperature, but it is safer to switch to inoculation with industrial yeast instead.
- The yeast used for inoculation did not develop properly. This can be confirmed by counting the density of viable yeast cells under a microscope. It should have reached 10

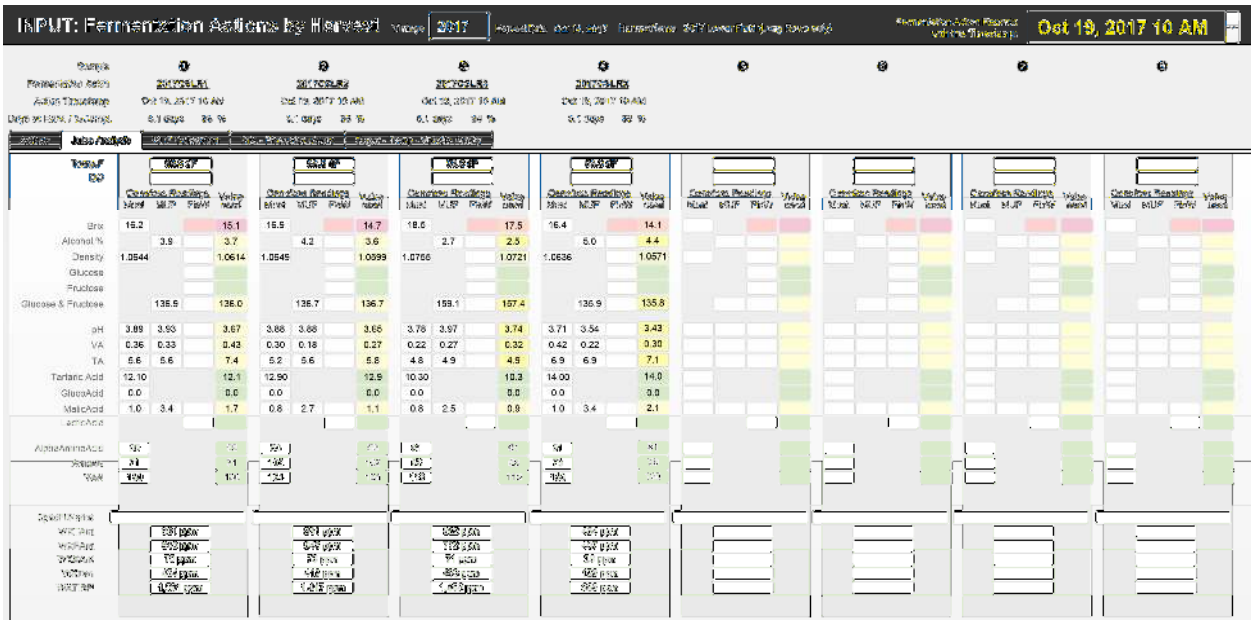
to 100 million cells / mL - an analysis better left to a commercial lab (e.g., Enartis). The remedy is to re-inoculate

- There is a nutrient deficiency as indicated by low YAN levels relative to the Brix level of the must. The remedy is to add more yeast nutrition.
- There are toxins or spoilage microbes in the must. This can be confirmed by lab analysis of the must revealing excess SO2, pesticides, copper or iron residuals, or spoilage microbes. For example, if the analysis indicates Lactic Acid Bacteria as spoilage microbes, then the must should be treated with Lysozyme and SO2. If the analysis indicates non-microbial toxins, then fining is recommended with Bentonite, yeast hulls, or an industrial product like Enartis Cellferm.

When restarting a fermentation, it is advisable to use a special yeast that ferments vigorously and can adapt to high alcohol, high volatile acidity, and low nutrition needs.

Data Management

Data management is identical to what we described in Steps 3-11, with one exception. We measure the chemical properties twice, using both the “Must” and the “MUF” settings on the OenoFoss equipment. This is because the measurements for MUF (Must Under Fermentation) are not calibrated and need to be interpolated to calibrated Must-measurements. The following screenshot shows the “Juice Analysis” tab for October 19, 2017, at 10 am.



Tracking Results for 2020

We made the following choices in 2020.

We had four fermentation batches, one for each of the Merlot batches, one large one for the Cabernet Sauvignon, and one for the mix of Cabernet Franc and Petit Verdot Petit. In all instances, we waited 2-4 days until the fermentation started on its own but had to add significant amounts of nutrition 500 -1500 ppm) to compensate for the low YAN levels (85 – 175 ppm). We used Microessentials from Gusmer. We reached one-third of sugar depletion in 2-3 days before the Anthocyanins peaked. We infused between 8-11 ppm of pure oxygen. We had a problem with the Cabernet Sauvignon fermentation: it overheated probably because excessive injection of oxygen accelerated the growth of yeast cells. The picture illustrates the overflowing tank.

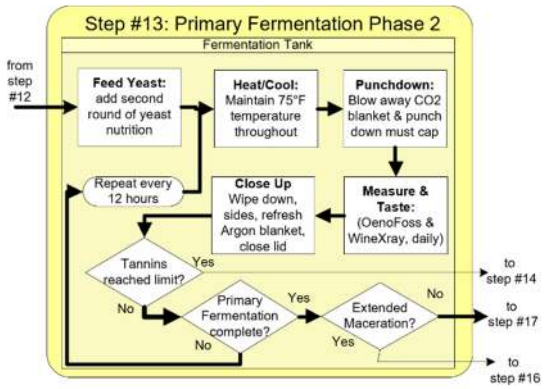
We will review the results at the end of Step 17.

Previous page: Steps #2-11: Upfront Winemaking Decisions
Top of page: Go
Next Page: Step #13: Primary Fermentation Phase 2
Last updated: November 27, 2021

Step 13: Primary Fermentation Phase 2

Phase 2 of the Primary Fermentation represents the steady-state and the rapid decline in the yeast population. We may need to add more nutrient supplements. We reduce the number of daily punch-downs to two. When the temperature drops, we switch to heating to keep the temperature between 75 and 85 °F. Now we watch Tannins and Bound Anthocyanins rise: The target for the Tannins is 110% of the Anthocyanin peak, the target for the Bound Anthocyanins is 20% of the Anthocyanin peak.

Here is the detailed process graphic



The phase 2 punch-down process is:

- Take the tank cover off and blow off the accumulated CO2 with a fan
- Twice a day, punch down the must while making sure not to crush seeds at the bottom of the tank.
- Take tasting samples and measure chemical properties and temperature once a day.
- Squeegee the inside walls of the tank and wipe with a paper towel sprayed with KMBS solution. If sugar depletion is above 90%, cover the must with a new Argon blanket because CO2 production has diminished.

Press before Fermentation is Finished?

The critical decision for the winemaker in this phase is whether to remove the skins & seeds before the fermentation is finished. Early pressing is advised when the tannin levels get too high for the desired style of wine. So we watch out for Tannin levels to rise above 110% of the previous Anthocyanin peaks. If this happens before fermentation is complete, we consider to

- either scoop out the bulk of the skins, press them separately, pour the extracted juice back into the fermentation tank, and let the fermentation finish in the fermentation tank,
- alternatively, press the entire must before the fermentation is finished and then finish the fermentation in the settling tank without further skin and seed contact.

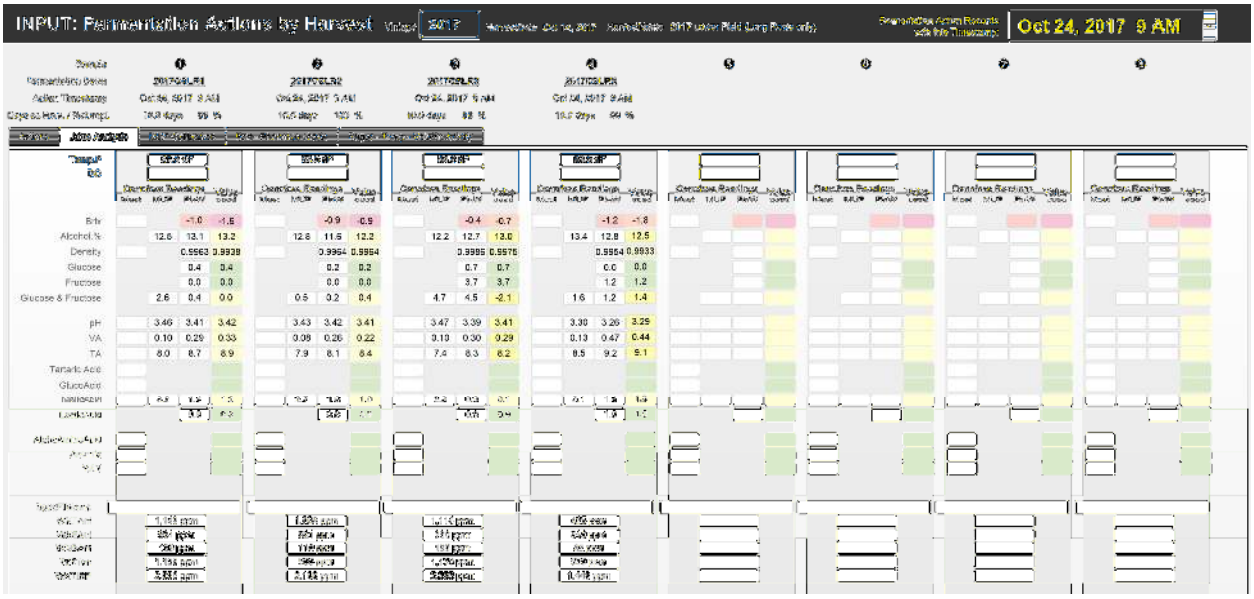
If Tannin levels stay below 110% of the previous Anthocyanin peak, we continue the punch-downs until fermentation is complete, i.e., Brix at -2. At that point, we will decide whether to look for further tannin extraction by extending the maceration or to go to pressing.

Dealing with Fermentation Problems

A sluggish fermentation is indicated when the daily reduction in the sugar level slows down before reaching 8 Brix or when the sugar reduction stalls entirely before reaching -2 Brix within three weeks of inoculation. The causes of a sluggish fermentation are the same as discussed on the previous page covering Phase 1: lack of nutrients due to the exhaustion of available supplies, toxins, volatile acidity, or spoilage microbes. For these causes, the remedies are the same: adding nutrients, fining with Bentonite, or adding Lysozyme. Alternatively, a fermentation can turn sluggish in phase 2 if the fructose/glucose ratio of the remaining sugars is out of balance; in this case, reinoculation with a special yeast capable of handling fructose is recommended.

Data Management

Data Management is identical to the process in Step 12, with one exception. We measure the chemical properties twice, using both the “MUF” and the “FinW” settings on the OenoFoss equipment. The following screenshot shows the “Juice Analysis” tab for October 24, 2017, at 9 am



Tracking Results for 2018

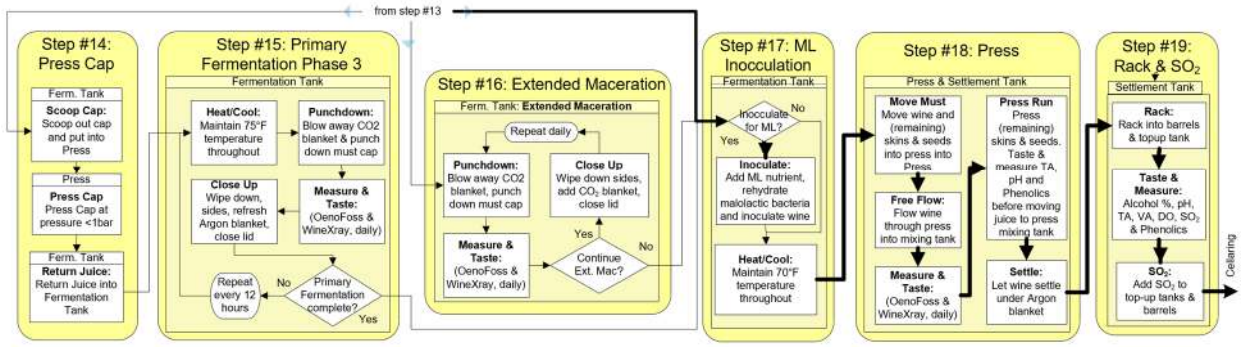
In 2018 we made the following choices: We did not apply a second batch of nutrients at the beginning of Phase 2 because we had used Microessentials which has a delayed availability. All fermentations completed except the Petit Verdot batch which stalled at -1 Brix, despite heating the musts to keep temperatures in the high 70's. Tannin extractions never exceeded the Anthocyanin peaks, so there was no need for pressing early. We decided to delay any addition of Tartaric Acid despite the low acidity levels (pH remained over 3.6 in all 4 fermentations)

We will review the results at the end of Step 18

Previous page: Step #12: Primary Fermentation Phase 1
Next Page: Steps #14 - 19: Extended Maceration to Press
Last updated: November 27, 2021

Steps 14-19: Extended Maceration to Press

Here is the detailed process chart; the thick lines indicate the path taken in 2020:



Step #16: Extended Maceration

On completion of Primary Fermentation, we can consider extending the maceration to extract more Tannins and increase the level of Bound Anthocyanins. Because the alcohol level is now high, Extended Maceration will extract relatively more seed tannins which can be beneficial if seeds were very ripe and if the addition of nutty/almondy taste is desired. We keep the temperature at 70 °F and continue with one punch-down per day for up to ten days (depending on taste).

The Extended Maceration punch-down process is:

- Take the tank cover off.
- Punch down the must while making sure not to crush seeds at the bottom of the tank.
- Take two 2mL samples for chemical analysis.
- Taste sample and decide whether to continue or end extended maceration.
- Wipe down the walls of the tank with disinfectant (KMBS solution), cover the must with a new blanket of Argon or CO2, and put the tank cover back on

Step #17: Inoculating for Malolactic Fermentation\

In Malolactic Fermentation, bacteria transform malic acids into lactic acids. This reduces the young red wine's acidity and harsh fruitiness and helps create a rounder mouthfeel. These

bacteria occur naturally in the vineyard on the grape skins and find their way into the must during crush. If an earlier SO_2 addition killed the bacteria, they may be purchased from specialized laboratories/providers and added back. If the Primary Fermentation was done naturally (i.e., no SO_2 was added at crush), then the Malolactic Fermentation is often also left to occur on its own.

Malolactic Fermentation, particularly when induced by naturally occurring bacteria, can take months to complete and is often only successful if the temperature of the wine remains around 70 dF for an extended period. It helps to add specialized nutrition to support the malolactic bacteria and accelerate the conversion. Thus we have three choices:

- Leave it to chance: rely on the naturally occurring bacteria, assuming they were not killed off at crush
- Middle road: Support the naturally occurring bacteria with specialized nutrition to accelerate the conversion
- A safer bet for rapid conversion: Inoculate the young wine with commercial bacteria and matching nutrition.

We regularly measure malic and lactic acids (as part of the OenoFoss protocol) and monitor progress. Here is a more detailed discussion of the process and potential pitfalls from MoreWine.com: https://morewinemaking.com/articles/5_steps_to_mlf

Up to 2018, we used to inoculate with malolactic bacteria only after pressing, when the young wine was already racked into barrels, and we kept the barrels above 60 dF. Given our mixed success, we changed the timing in 2018 and started malolactic fermentation when the fermentation finished, before extended maceration, if any, and before pressing.

Steps #14,15 & 18: Pressing Decisions

We initiate pressing when

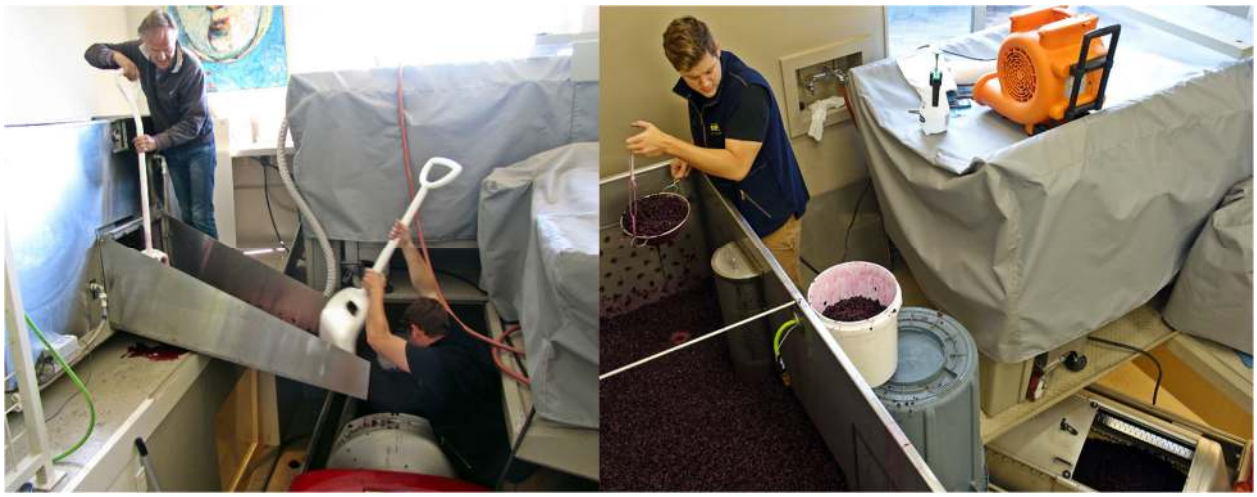
- Primary Fermentation (step #13) was incomplete when Tannin levels reached 2000 or 110% on previous Anthocyanin peak, or
- Primary Fermentation (step #13) completed in the fermentation tank, and tannin levels were high enough to skip Extended Maceration, or
- Extended Maceration finished.

If we press before Primary Fermentation is complete, we press the cap only. We scoop the cap out of the fermentation tank into the press, press and return the pressed juice to the fermentation tank, and complete the primary fermentation.

Suppose the fermentation was not completed before pressing due to high tannin extraction during Phase 2 of the Primary Fermentation. In that case, the fermentation now needs to be completed in the fermentation tank. The process for this Step #15 is:

- Take test samples, stir, and then recover with Argon blanket
- Taste and measure (OenoFoss & WineXray)
- Keep the temperature at 70 °F and continue the daily process until Brix reaches -1.5.

The side-by-side pictures show the two alternatives of pressing. On the left: When we press all the must (after the primary fermentation is completed), we first drain the juice into the press and then move the must over a steel channel into the press. On the right: When we press the cap only, we scoop out the cap in 5-gallon buckets, empty the buckets into the press, press and return the pressed juice to the fermentation tank by buckets.



We use a 1.5-ton bladder press: Bucher Vaslin XPro 5 (http://www.buchervaslin.com/en-bucher-France-bucher-pneumatic-presses-16-22-26.html), which, we now realize, is overkill for our requirements. We extract the additionally required juice at very low pressure (0.2 to 0.3 bar only) from the must in multiple rounds. This is called the Press-Run. The remaining pressed

must (now called pomace) is scooped out and distributed in the vineyard as fertilizer for the next season.

For small fermentation batches, we don't use the big bladder press. Instead, we use a small manual press which saves in setup and cleaning efforts. There are two types. In modern manual bladder presses, water pressure fills a bladder which presses the must outside against a stainless steel sieve. In old-fashioned screw presses, a wood lid is pressed down by a big screw, and the juice escapes laterally through a vertical wood lattice. We have used both types for the small lots from the upper vineyard. The picture on the right shows the two types.

Step #19: Mixing, Racking & SO2 Protection

We usually mix the free-run and press-run juice from different Fermentation Batches into what will become Cellar Batches in separate Settling Tanks. Because the fermentations are staggered time-wise, the mixing and holding of the young wine in the Settling Tanks can extend from a few days to a few weeks. During this time, dead yeast cells and other solid material sink to the bottom as sediment. To keep the malolactic fermentation progressing, we maintain a temperature of around 70 dF. We protect the young wine in the settlement tanks with an Argon gas cover to prevent oxidation and growth of microbes on the surface.

When all the fermentation batches are mixed as desired, and the dead yeast and other materials have settled at the bottom of the Settlement Tanks, we decide how much SO2 to add for protection and then siphon the young wine into Cellar Batch containers (barrels and top-up tanks). Until 2019, we regularly added the standard requirement of 30ppm free SO2 equivalent (see Step #8) at this juncture. Since then, we limited SO2 additions, if any, partly because the elevated pH of the 2019 and 2020 vintages made SO2 ineffective and we managed to keep infections at bay with more aggressive sanitation protocols (e.e. regular steaming of barrels)

Data Management

Data Management for Steps 14 to 16 is identical to Step 13.

Tracking Results 2018

In 2018 we made the following decisions:

- We did not press any of the fermentations early, nor did we extend the maceration periods after the fermentations were complete. The tannin and anthocyanin levels were adequate without.
- We pressed the two Merlot - Cabernet Franc ferments in the old-fashioned manual screw press and combined the juice for settlement into a single stainless steel barrel.
- We pressed the Cabernet Sauvignon ferment in the large bladder press and settled the juice in the large Settling Tank
- We free-flowed the Petit Verdot ferment into two glass carboys for settlement.
- Finally, we mixed, at varying ratios, the different settlement tanks into 3 French barrels (one new, two neutral) and five topup tanks. The goal was to get one barrel of 100% Cabernet Sauvignon, two barrels of different Bordeaux-style mixes and separate topup tanks which reflect these mixes.

The following spreadsheet shows the allocations to barrels (green) and topup tanks (white):

Cellar Batch Name		18CS		18CSTa		18CSTb		18CSMeCFPV1		18CSMeCFPV1T		18CSMeCFPV2		18CSMeCFPV2T		18CSMeCFPV3T	
FINAL COMPOSITION	CS	60	100%	5	100%	5	100%	48.60	81%	4.05	81%	29.34	49%	2.61	52%	4.25	32%
	CSLR		*71%*		*71%*		*71%*		*57%*		*57%*		*34%*		*37%*		*23%*
	CSSR		*29%*		*29%*		*29%*		*24%*		*24%*		*14%*		*15%*		*9%*
	Me1		0%		0%		0%	4.81	8%	0.40	8%	12.98	22%	1.01	20%	3.76	28%
	Me2		0%		0%		0%	3.60	6%	0.30	6%	9.71	16%	0.76	15%	2.81	21%
	CabF		0%		0%		0%	2.02	3%	0.17	3%	5.44	9%	0.42	8%	1.57	12%
	PV		0%		0%		0%	1.00	2%	0.08	2%	2.52	4%	0.19	4%	0.87	7%
		60.00		5.00		5.00		60.02		5.00		60.00		5.00		13.26	
FINAL IMPLIED COMPONENTS	CS	60.00	100%	5.00	100%	5.00	100%	48.60	81%	4.05	81%	29.34	49%	2.61	52%	4.25	32%
	Me1CabF	0.00	0%	0.00	0%	0.00	0%	5.26	9%	0.44	9%	14.20	24%	1.11	22%	4.11	31%
	Me2CabF	0.00	0%	0.00	0%	0.00	0%	5.16	9%	0.43	9%	13.93	23%	1.09	22%	4.03	30%
	PV	0.00	0%	0.00	0%	0.00	0%	1.00	2%	0.08	2%	2.52	4%	0.19	4%	0.87	7%
		60.00		5.00		5.00		60.02		5.00		60.00		5.00		13.26	

Previous page: Step #13: Primary Fermentation Phase 2
Top of Page: Go
Next Page: Fermentation Batch Review (Steps 3-19)
Last updated: November 27, 2021

Fermentation Batch Review (Steps 3-19)

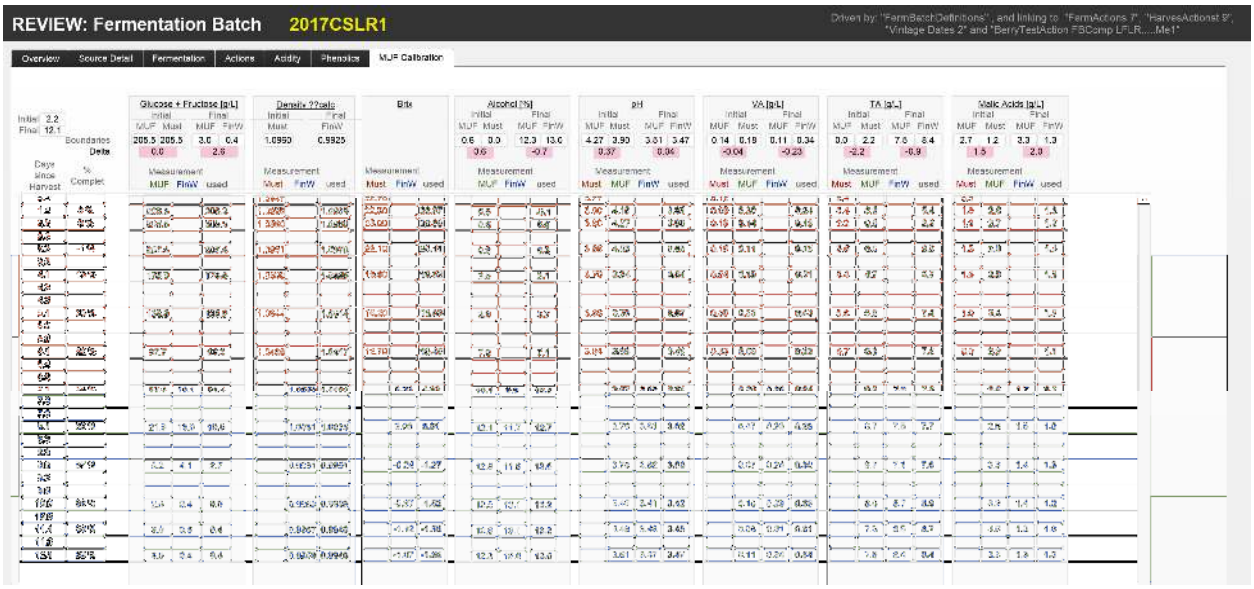
Data Management

To review each Fermentation Batch, we designed a layout that pulls all berry tests and fermentation actions data together. The goal is to provide a context to explain the actions taken and the results achieved in a uniform format across all fermentations all vintages. The "REVIEW: Fermentation Batch" layout has seven tabs:

- MUF Calibration: is used to review the calibration and adjustments made to the OenoFoss "Must-Under-Fermentation" measurements
- Phenolics: is used to correct the results from WineXRay's phenolic component estimates, which tend to show aberrations due to sampling errors in the spectral analysis
- Acidity: is used to review the different measurements of acidity and comment on the effect of acidity adjustments
- Actions: This is used to review and comment on all actions taken during fermentation
- Fermentation: This is used to review and comment on the progress of the fermentation
- Source Detail: This is used to review and comment on the quality of harvest blocks which make up a fermentation batch
- Overview: sums up all the commentaries and data in the previous six tabs.

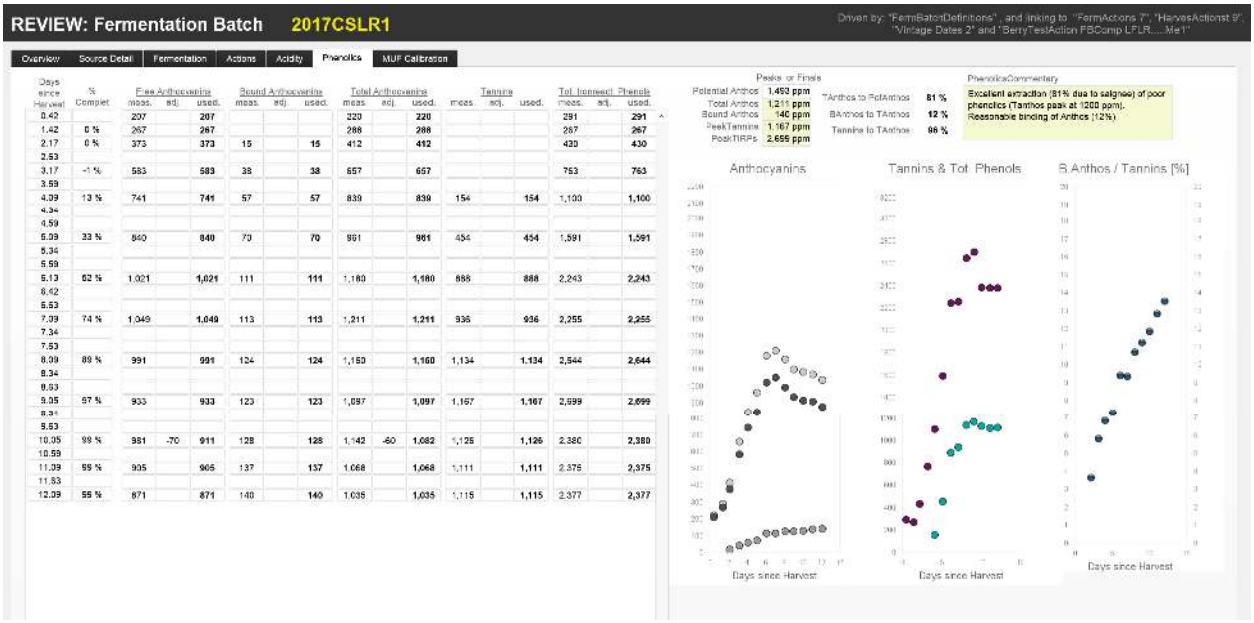
In the following paragraphs, we show the screenshots for each tab using the actual data for the 2017CSLR1 fermentation batch

MUF Calibration tab



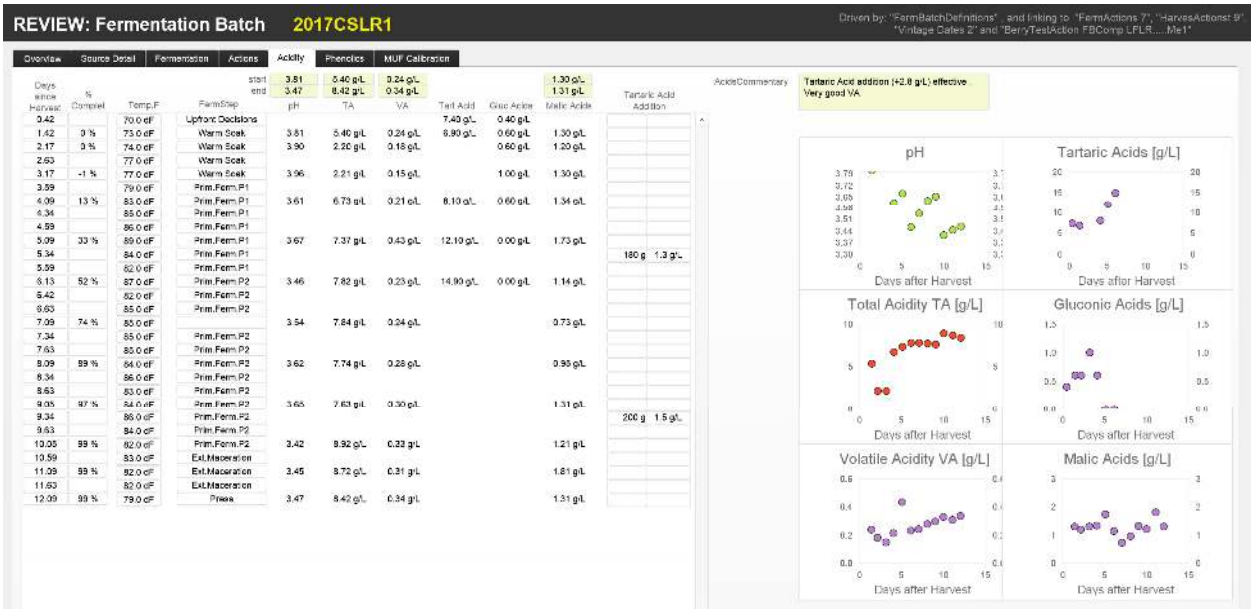
This tab shows the OenoFoss measurements of the chemical properties and the adjusted values. An adjustment has to be made to the raw “MUF / MustUnderFermentation”-measurement because OenoFoss only provides calibrated measurements for “Must” and for “Finished Wine.” Note, we need to input the boundary conditions in this table for the adjustments to happen. An explanation of how the adjustment is calculated can be found in the Laboratory section.

Phenolics tab



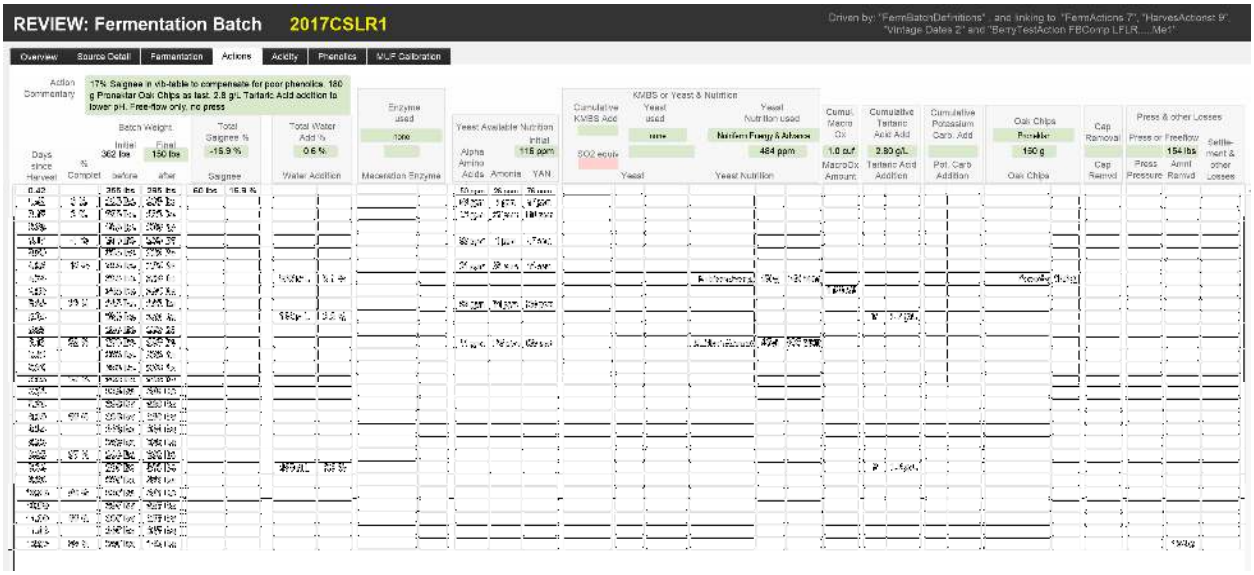
The Phenolics tab reviews the phenolic results provided by WineXray based on the measured spectrum of each sample. Impurities occasionally distort the measured spectra in the sample. As a consequence, the phenolic results are distorted. We use this layout to make manual adjustments to the phenolic results by inspecting the graphs and eliminating outliers. Again, we input the yellow fields during the review to summarise the results.

Acidity tab



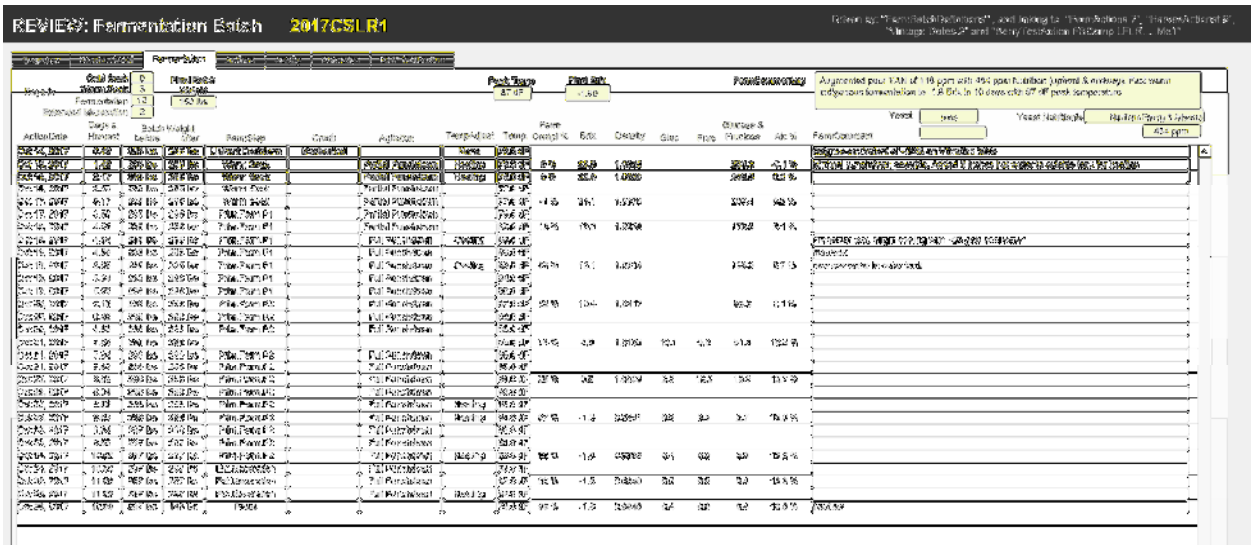
The Acidity tab shows the evolution of the OenoFoss-based measurements of pH, TA, VA, Tartaric Acid, Gluconic Acid, and Malic Acid, and the timing of the Tartaric Acid additions, if any. Note, the table shows the adjusted values described in the MUF-Calibration tab. We complete the yellow fields during the review to summarise the results.

Actions tab



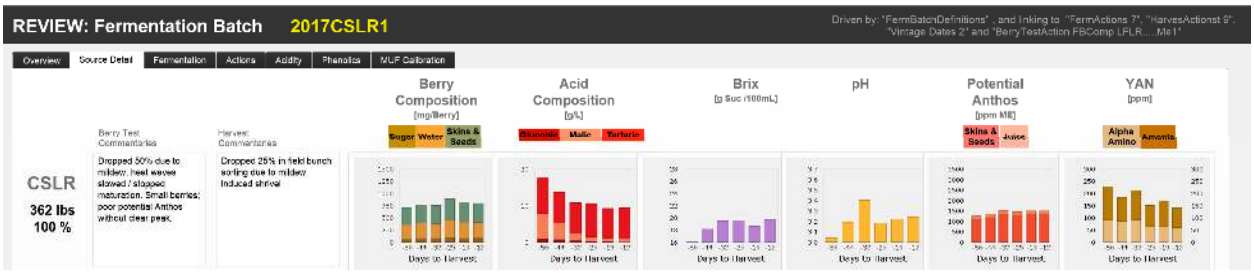
The Actions tab reviews the actions taken during winemaking. The steps include saignee, additions of water, enzymes, yeasts, nutrition, sulfur, oxygen, tartaric acid oak chips, and the removal of skins and seeds in pressing. This tab allows reconciling the batch weights throughout all steps. Again, we enter summary data in the yellow fields during the review process.

Fermentations tab



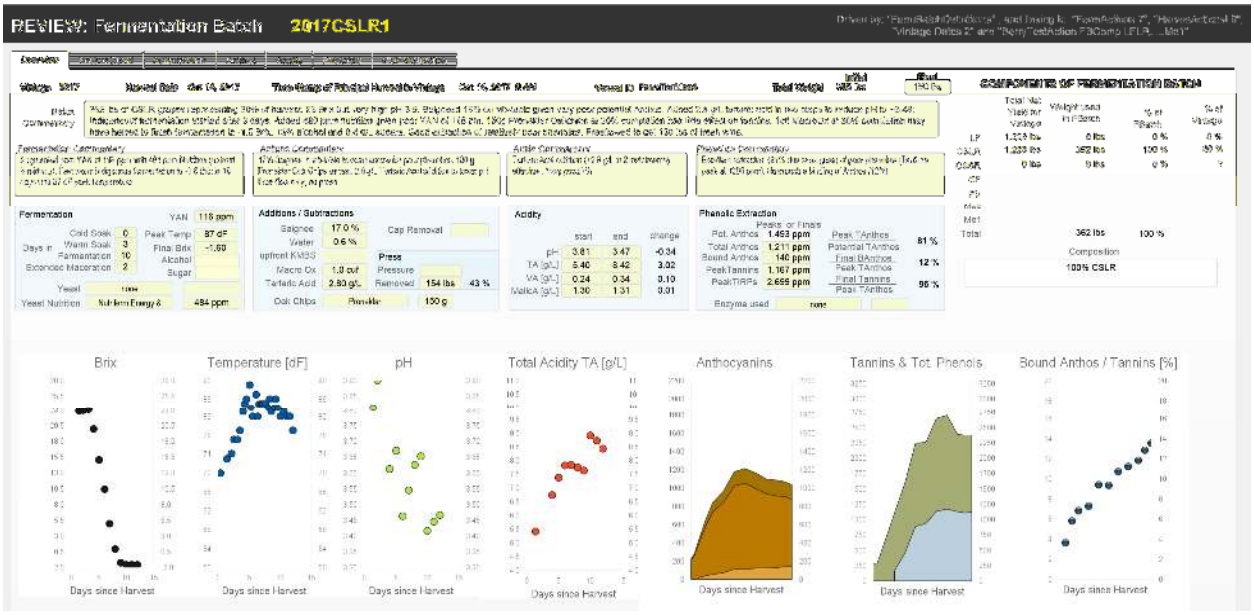
The Fermentations tab reviews the progress of the fermentation in terms of fermentation step and conversion of sugars to alcohol as measured by completion %, Brix, density, glucose, fructose, and alcohol. This tab also lists all the action comments. Again, we enter summary data in the yellow fields during the review process.

Source Detail tab



This tab shows the berry test results of the components making up the fermentation batch. In this instance, the 2017CSLR1 batch consisted of only one component, grapes from the CSLR block. In other instances, we would see multiple rows of graphs in this layout – one for each component.

Overview tab

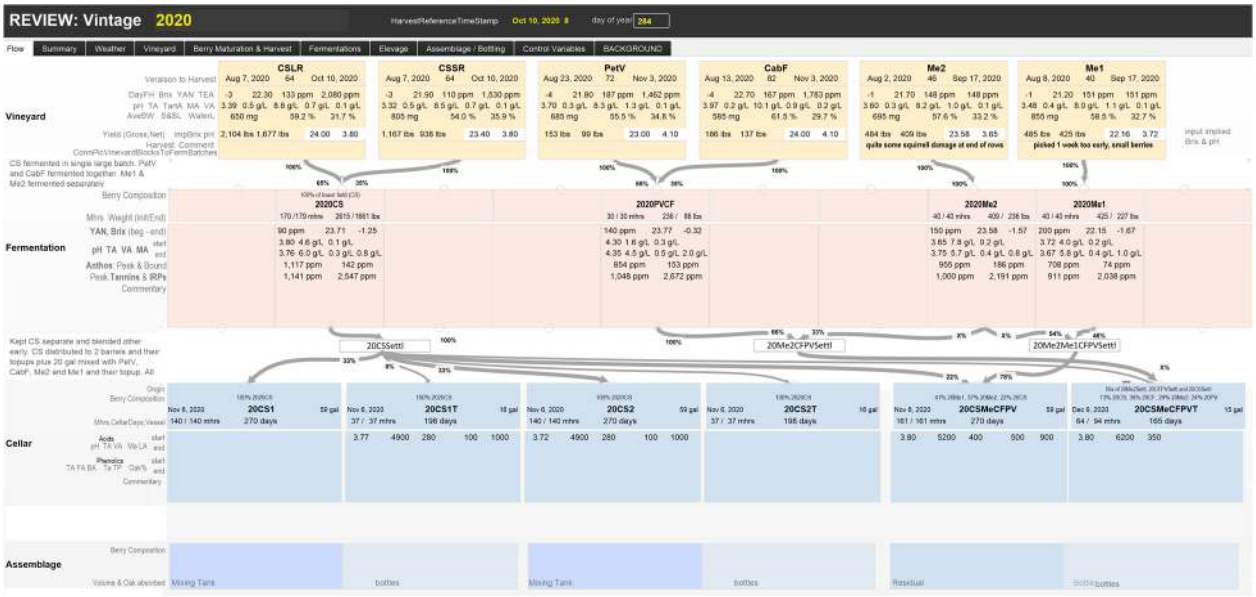


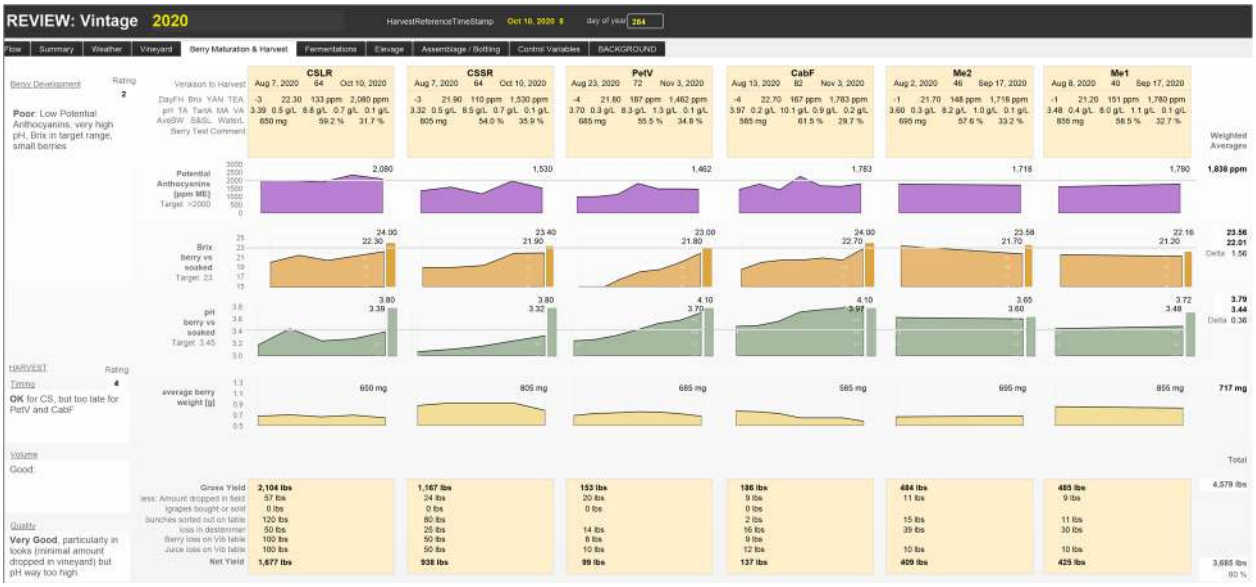
The Overview tab pulls together all the information added in the yellow fields in the previously discussed tabs. The goal of the fermentation batch review is the write a Batch Commentary that summarises all the information collected.

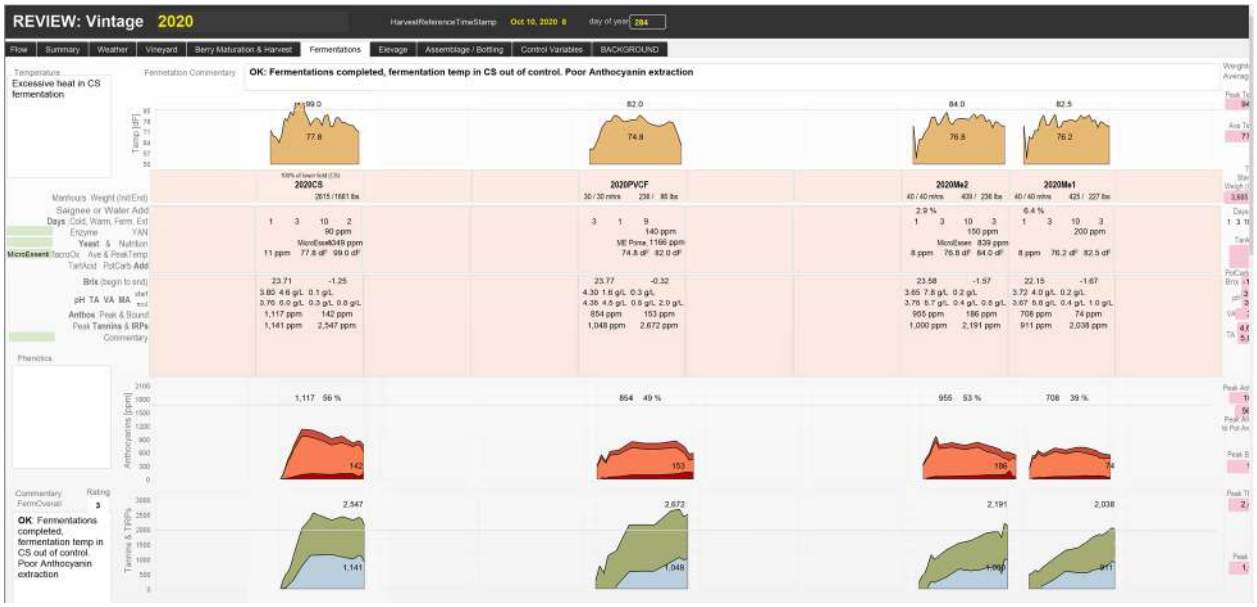
Tracking Results for 2020

Currently, the “REVIEW: Vintage” layout provides the best overview of what we did with the 2020 vintage. We described it already on the Winery Overview page. Note, in 2020, we defined separate Settlement Batches to mix different fermentations and let them settle. The following three screenshots show

- the flows from harvest blocks through fermentations to settlement
- more detail on the berry maturation and harvest conditions
- comparative data on the different ferments

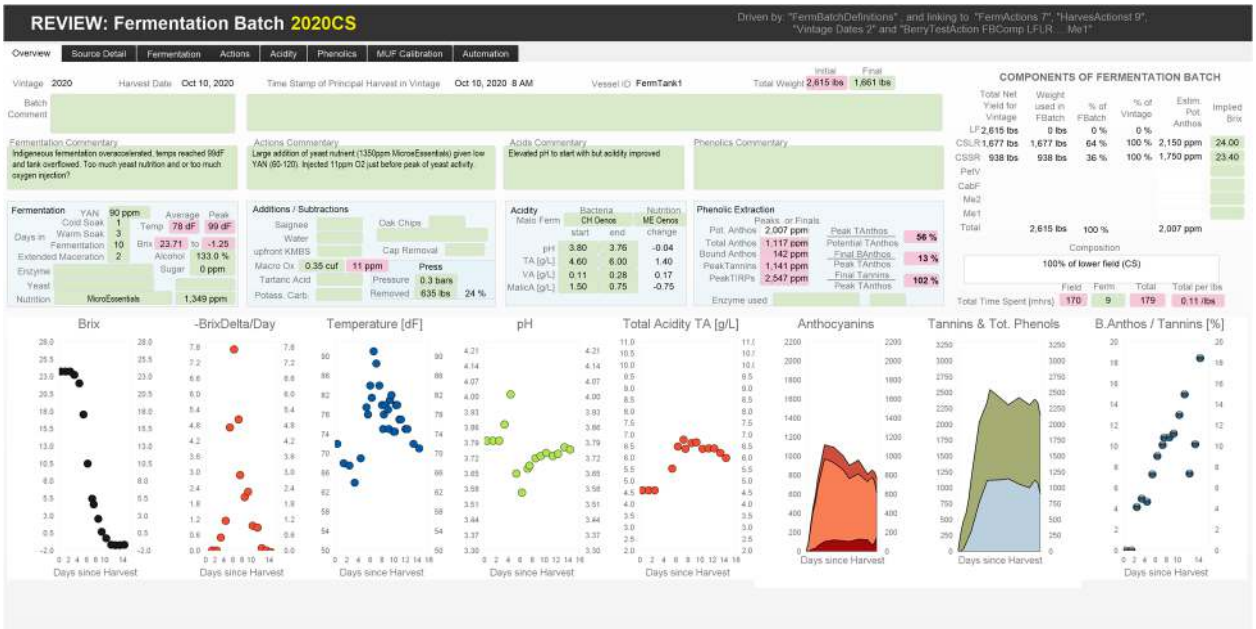


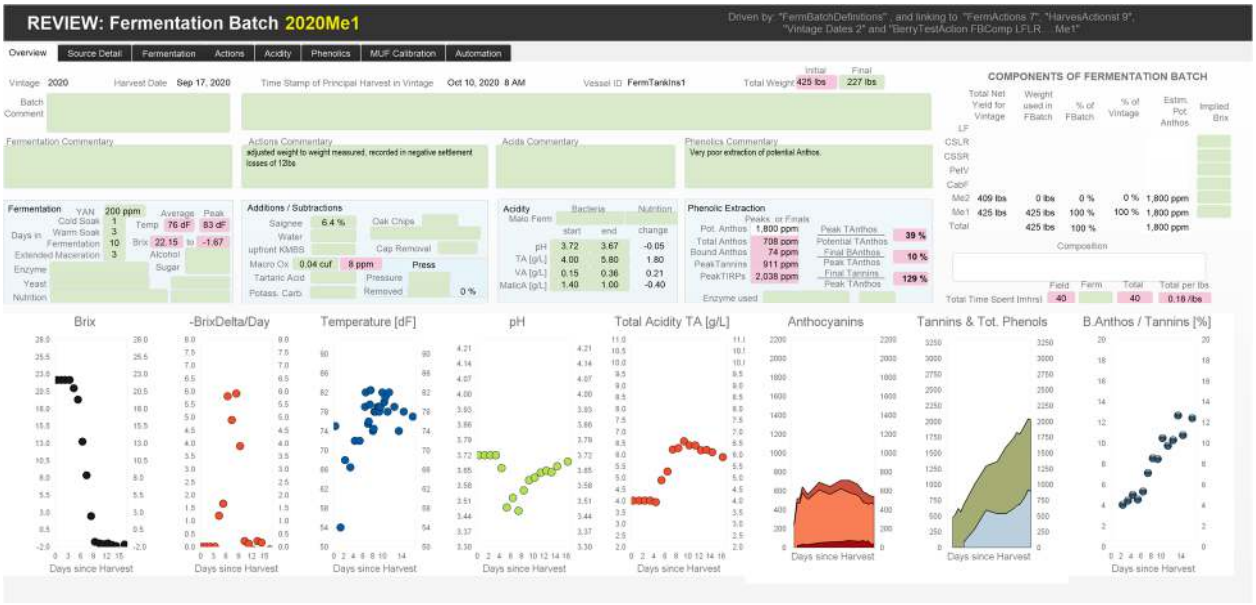


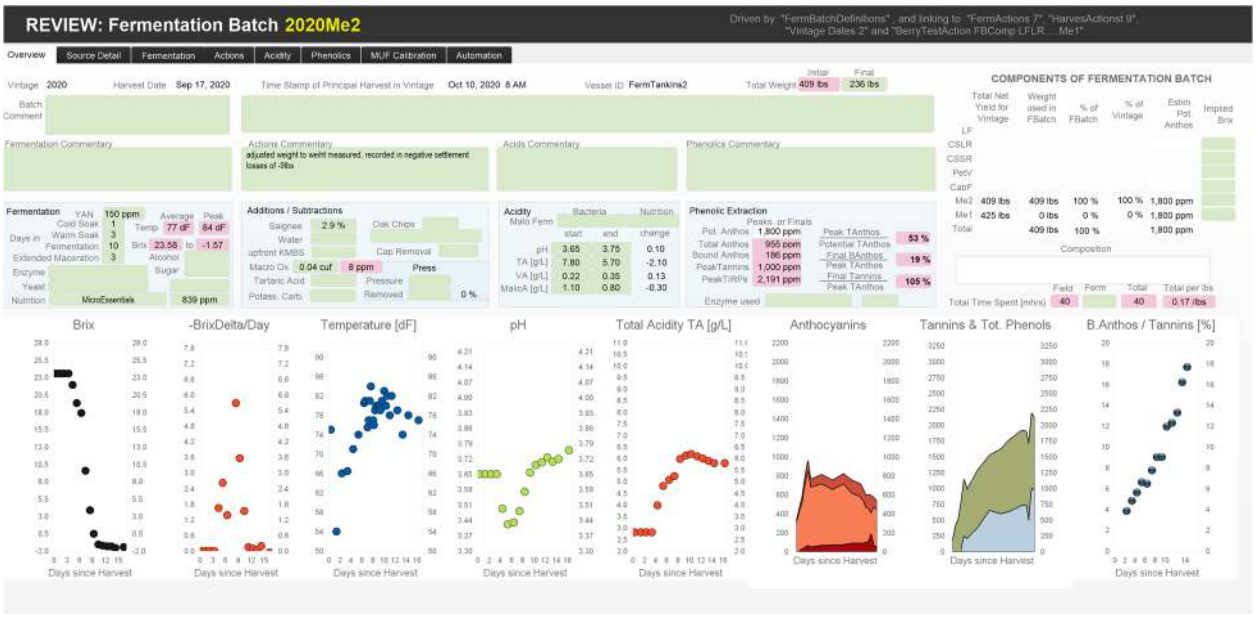


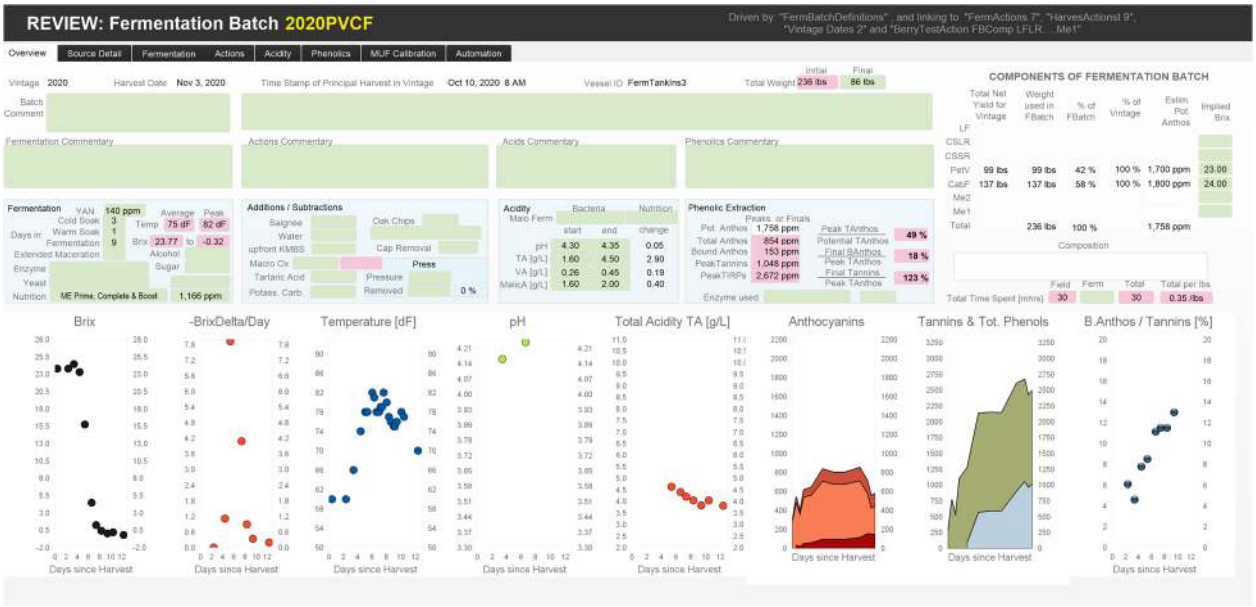
The following screenshots show the Overview tab of the “REVIEW: Fermentation Batch” layout for each of the 4 fermentations, all indigenous. Note

- the temperature peak in the CS fermentation
- the similarity of the two Merlot fermentations, and
- the very high pH in the CFPV ferment




REVIEW: Fermentation Batch 2020Me1
Overview
Source Detail
Fermentation
Actions
Acidity
Phenolics
MUF Calibration
Automation
COMPONENTS OF FERMENTATION BATCH
Brix
-BrixDelta/Day
Temperature [dF]
pH
Total Acidity TA [g/L]
Anthocyanins
Tannins & Tot. Phenols
B.Anthos / Tannins [%]
Days since Harvest


REVIEW: Fermentation Batch 2020Me2
Overview
Source Detail
Fermentation
Actions
Acidity
Phenolics
MUF Calibration
Automation
COMPONENTS OF FERMENTATION BATCH
Brix
-BrixDelta/Day
Temperature [dF]
pH
Total Acidity TA [g/L]
Anthocyanins
Tannins & Tot. Phenols
B.Anthos / Tannins [%]
Days since Harvest



In each of these layouts, the commentaries have not yet been written

On completion of all fermentations, we settled the CS in one large tank, and we combined the Me1, Me2, and CFPV fermentations in two separate settlement tanks. From there, we created three cellar batches, two CS and once CS-Me-CF-PV mix, each consisting of a full barrel and dedicated topup tank.

Previous page: Step #14-19: Extended Maceration to Press
Top of Page: Go
Next Page: Cellar
Last updated: November 28, 2021