WASHINGTON STATE UNIVERSITY

Best Management Practices in Dealing with Vineyard Heat Stress in the Winery

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Overall wine issues?!!

- High pH, High TA
- High Brix -> High Ethanol
- Low Color, Low Tannin
- Low Color, High Tannin?
- Major Mitigation Strategies
- Acid Adjustment
- Modern Winemaking Strategies
  - Saignée and Fermentation Facilitation Liquid (water)
- Examples of vineyard vs winery control
  - Picking Decisions

Repercussions of Accelerated Ripening

- Acidity: Tartaric, Malic, H^+, K^+, Na^+
- Increases in pH due primarily to titration of acids with K^+ and Na^+ during ripening
- pH of untitrated H_2TA 11.7 g/L = 2.0
  - 23% exchange = pH 3.4
  - 40% exchange = pH 4.0
- Sourness: pH & TA
- Sourness primarily related to titratable acidity in higher pH wines (tartaric, lactic acids)
- Sourness in low pH wine both pH & TA
  - Tartaric, malic and lactic acid
- pH 3.5-3.6 is magical for both stability and sourness

Acid Adjustment

- Add Acid (Tartaric, Citric, Malic, Fumaric)
  - Typically added as a liquid concentrate to avoid mixing issues
- Early? Late? Both?
- How much? 1-2 g/L tops
- Ion Exchange
  - Demineralization process that trades out K^+ in wine for H^+ on resin
  - Column based method typically utilized in conjunction with filtration method to avoid fouling ion exchange beads

Cabernet Sauvignon Wines

Treatment	pH	TA (g/L)	Malic acid (g/L)	RS (g/L)	Alcohol % (v/v)	Lactic acid (g/L)	Acetic Acid (g/L)
Control	4.274 a	4.02 b	0.07	0.17	11.67	1.85 ab	0.40
Early	3.944 b	4.44 b	0.06	0.25	11.83	1.70 b	0.36
Late	3.742 c	5.21 a	0.06	0.21	11.76	1.77 ab	0.39
Ion	3.762 bc	5.18 a	0.06	0.23	11.82	1.86 a	0.38
p-value	*0.001*	*0.001*	0.479	0.104	0.665	*0.040*	0.624

- More significant pH and TA changes seen with later additions

Chardonnay MLF Wines

Treatment	pH	TA (g/L)	Malic acid (g/L)	RS (g/L)	Alcohol % (v/v)	Lactic acid (g/L)	Acetic Acid (g/L)
Control	3.869 a	3.74 b	0.01 b	0.38 b	13.35	2.03 a	0.13
Early	3.500 b	4.43 a	0.04 b	0.33 b	13.11	1.87 b	0.15
Late	3.141 c	4.71 a	0.26 a	0.46 a	12.74	1.74 c	0.13
Ion	3.510 b	4.43 a	0.02 b	0.35 b	13.11	1.96 a	0.12
p-value	*0.001*	*0.005*	*0.003*	0.015	0.145	*0.007*	0.276

- More significant pH and TA changes seen with later additions

Chardonnay NON-MLF Wines

Treatment	pH	TA (g/L)	Malic acid (g/L)	RS (g/L)	Alcohol % (v/v)	Lactic acid (g/L)	Acetic Acid (g/L)
Control	3.72 a	4.72 b	3.00 a	1.00 b	12.00 a	0.02	0.17 b
Early	3.35 a	5.95 b	2.90 b	1.83 a	11.93 a	0.02	0.20 a
Late	3.35 a	6.11 a	1.67 d	0.78 b	11.91 a	0.02	0.16 b
Ion	2.67 b	6.55 a	2.83 c	0.90 b	11.54 b	0.02	0.17 b
p-value	*0.013*	*0.001*	0.479	*0.002*	*0.01*	0.381	*0.008*

- Equivalent pH and TA changes with early and late adjustments
- Ion exchange was problematic with TA target with high buffering capacity

Acidity Conclusions

- The effectiveness of acid addition on high pH wines that had undergone malolactic fermentation was impacted by timing.
- The use of ion exchange to target wine titratable acidity and match pH worked effectively for the wines that had undergone malolactic fermentation.
  - The use of ion exchange may prevent further changes in wine acidity over time due to lower concentrations of potassium (ppt. of KHT, K_2T).
- Early and late additions of acid on high pH wine that has not undergone malolactic fermentation were equivalent.
- Ion exchange on wines to target titratable acidity is difficult to achieve with reasonable results for the pH. Further research is necessary to understand the profound changes we observed.

Project funded by Washington Wine Commission "Impact of Acid Addition Timing on Sensory Perception on Chardonnay and Cabernet Sauvignon Wines" Final Report Turned in June 2023

When to add acid?

- Potential benefits of early additions:
- Microbial Control?
- Large inoculum of yeast & bacteria may make this unnecessary
- For sequential inoculations this may be more important
- Two additions will likely be necessary
- Simultaneous fermentation may provide protection against unwanted microbial growth
- Late acid adds don’t seem to have as many benefits other than efficiency of acid add

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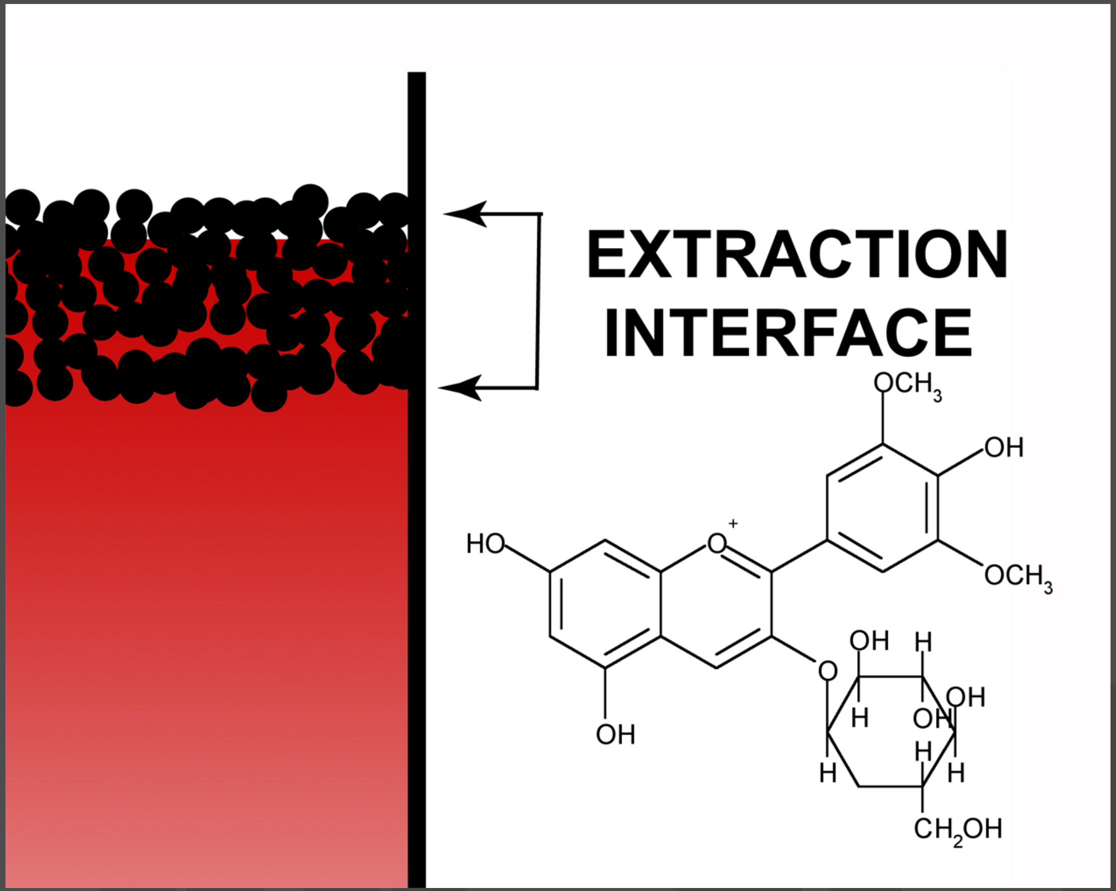
Increasing Anthocyanins

- **Anthocyanins** are the water-soluble pigments that are extracted from the skins of the grapes.
- Anthocyanins react with tannins to form polymeric pigments
- Best technique to increase color
  - Saignée not cold soak
  - Removal of free run juice before fermentation
  - Increase of skin/seed to juice ratio
  - Used to simulate variation in berry size w/out change in berry composition.
  - Practical Matters:
  - 5-18% juice removal is easy at 25-32% is very difficult
  - Must eventually becomes a rock



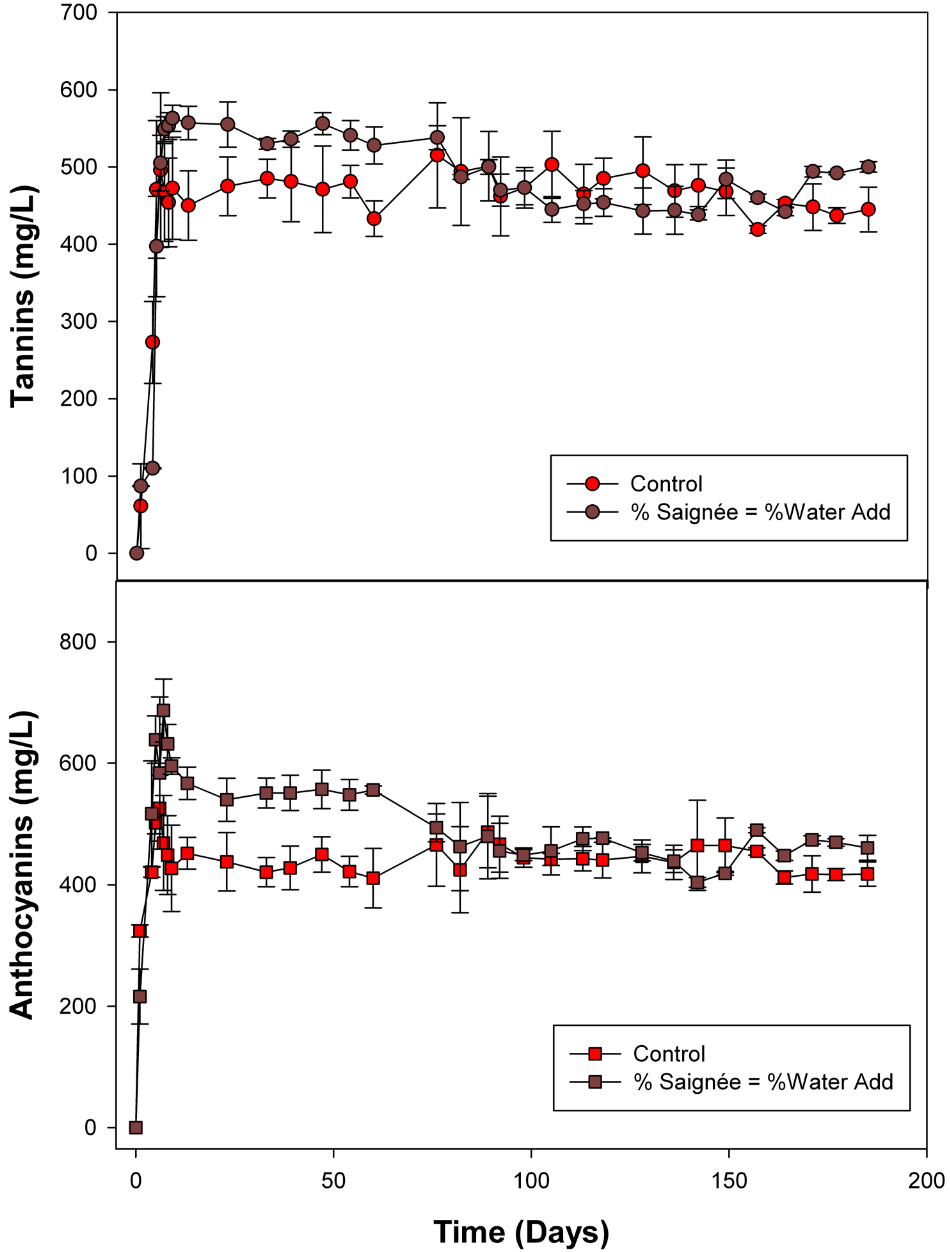
Saignée, and Fermentation Facilitation Liquid

- High Brix fruit has higher solids to juice ratio: higher intensity
- If water add in winery favorable ratio lost but new lower ethanol target
- Saignée volume targeted for water addition
  - New volume from removal is used to target water/acid addition
  - In theory: New wine will have lower alcohol and more phenolics
- In practice:
  - Insignificant increase in anthocyanins, tannins and similar sensory profile as control (water back)
  - Large Saignée (16% total removal) results in wine with significantly greater tannins, anthocyanins and more astringent*

**Harbertson et al. 2008: Study done at SMWE Canoe Ridge*

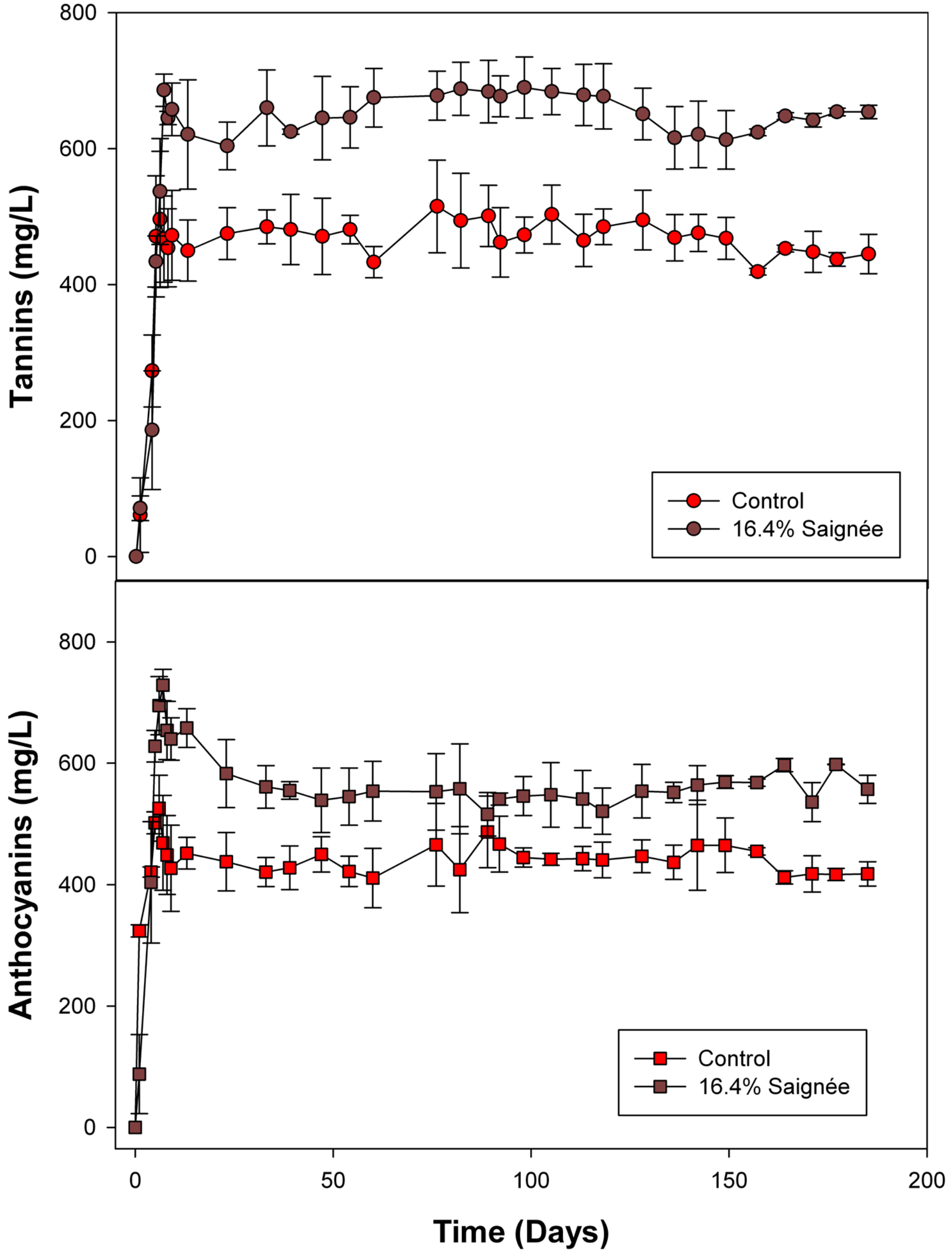
WSU

Saignée = Water

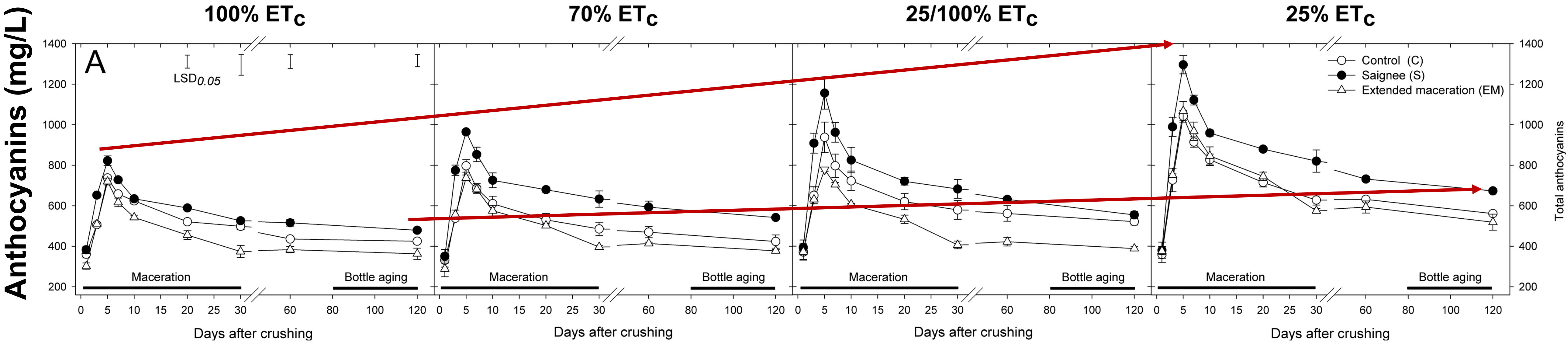


	Control	Saignée = Water
Juice Removal (%)	0	18.1
Water Addition (%)	18.7	18.1
Volume Change (%)	18.7	0
Initial Brix	28.3	28.1
Brix post Add	24.3	24.1

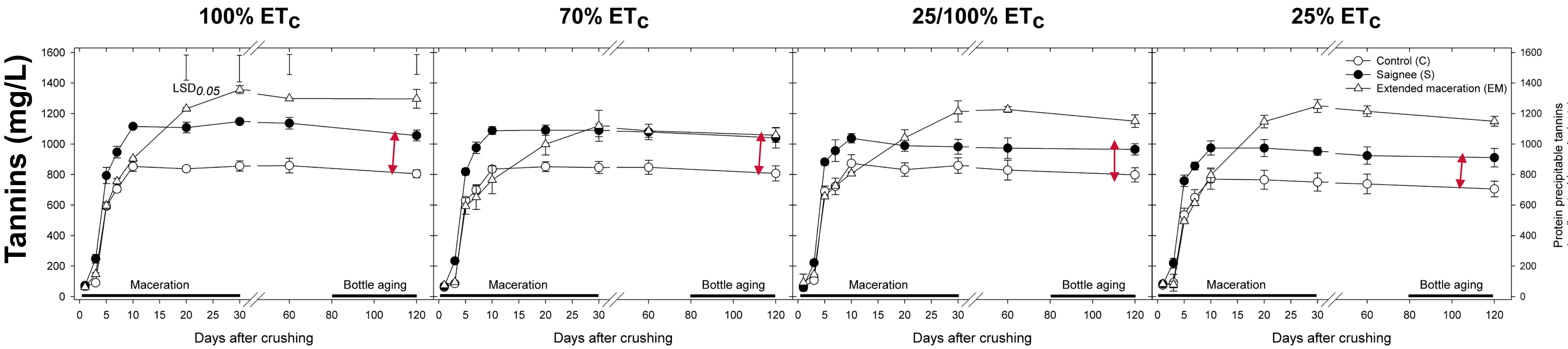
Large Saignée



	Control	2xSaignée
Juice Removal (%)	0	32.7
Water Addition (%)	18.7	16.4
Volume Change (%)	18.7	-16.4
Initial Brix	28.3	27.7
Brix post Add	24.3	24.2



Impact of saignée on pigments evident but diminishes over 120 days



Berry size impacts effectiveness of saignée. ≥1 g/berry works best; ≤ 1 g/berry diminished returns

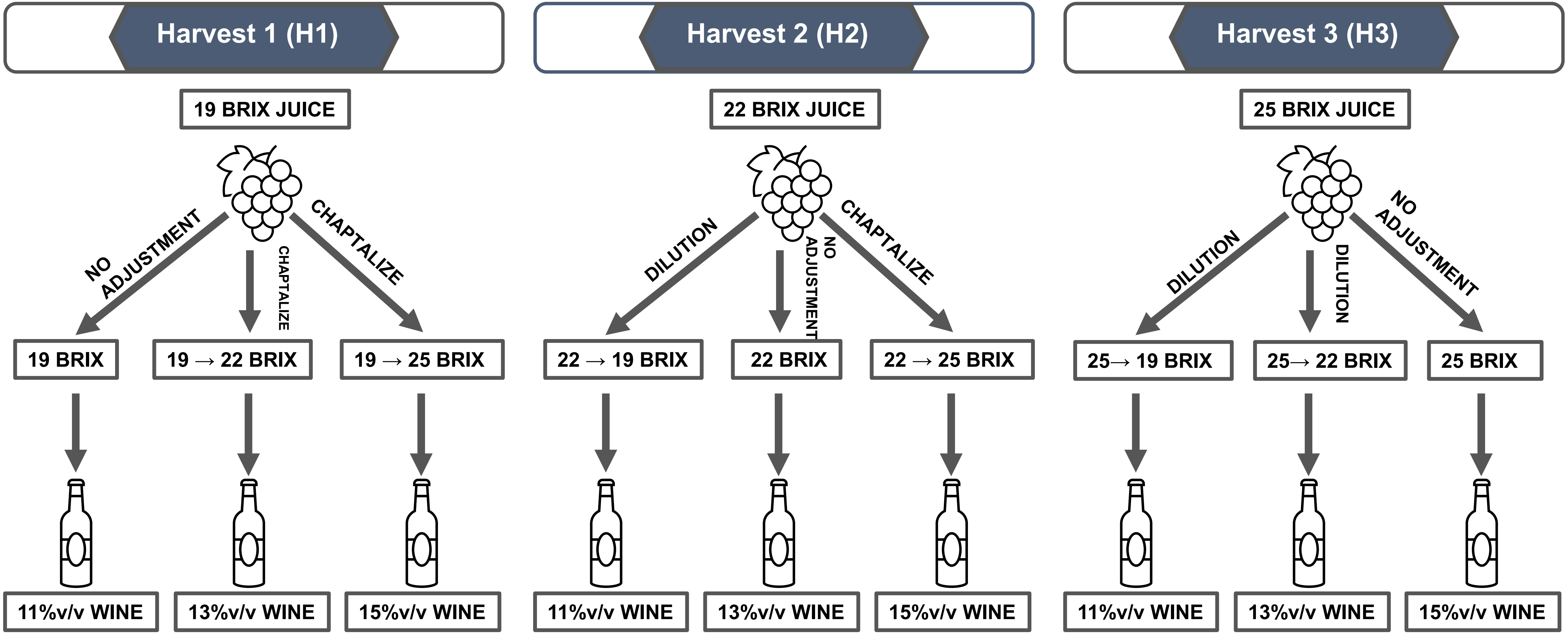
Ripening and Alcohol

- Sugar, acid, tannins, aroma compounds all change with more ripening
- But how do I control what matters most?
- I am afraid you are the "man behind the curtain"
- A discussion for another day

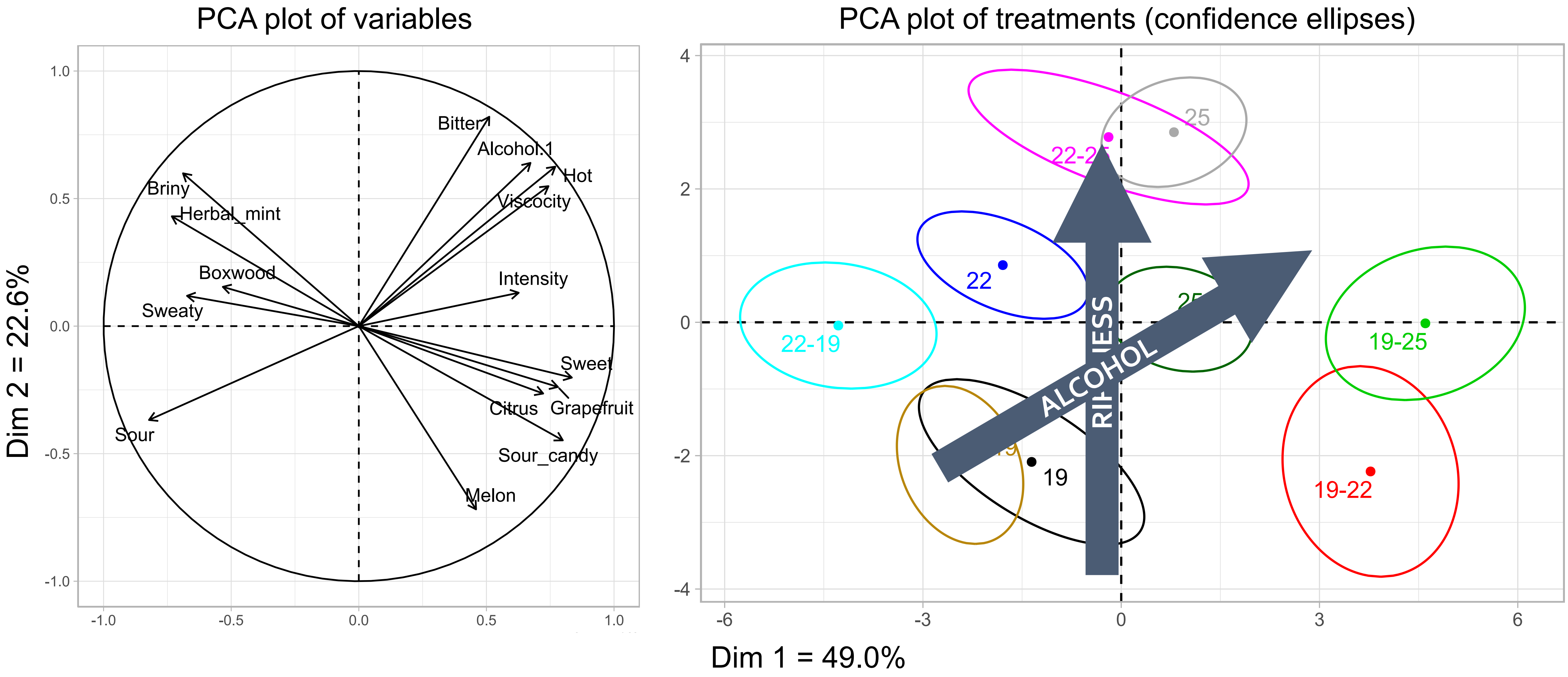
Finite

- Acid adjustment: Do it early, do it often. Ion exchange is the best solution for complete control.
- Saignée and fermentation facilitation: Go big or don’t bother
- Saignée methods work best when the fruit is not dehydrated
- Impacts of heat on ripening, tannins, aroma compounds are actively being investigated
- Do we have time?
- Otherwise ”Stay Tuned”

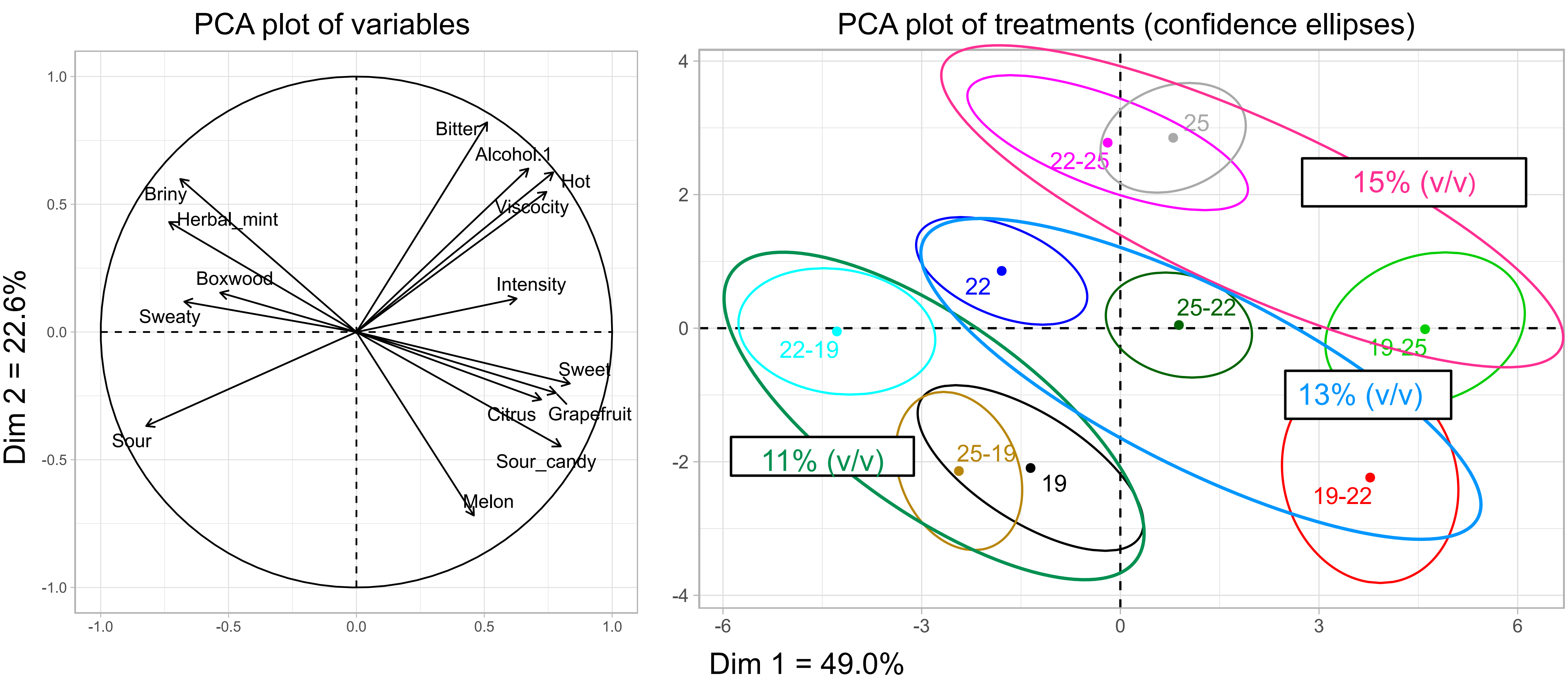
Experimental Design: Sauvignon blanc



VIN13 Yeast: Aromatic cold tolerant yeast, thiol release



PCA plot of variables
PCA plot of treatments (confidence ellipses)
Dim 2 = 22.6%
Dim 1 = 49.0%
Bitter
Alcohol.1
Hot
Viscocity
Intensity
Briny
Herbal_mint
Boxwood
Sweaty
Sour
Sweet
Citrus
Grapefruit
Sour_candy
Melon
1.0
0.5
0.0
-0.5
-1.0
4
2
0
-2
-4
-6
-3
3
6
25
22
22-19
19-25
19
19-22
ALCOHOL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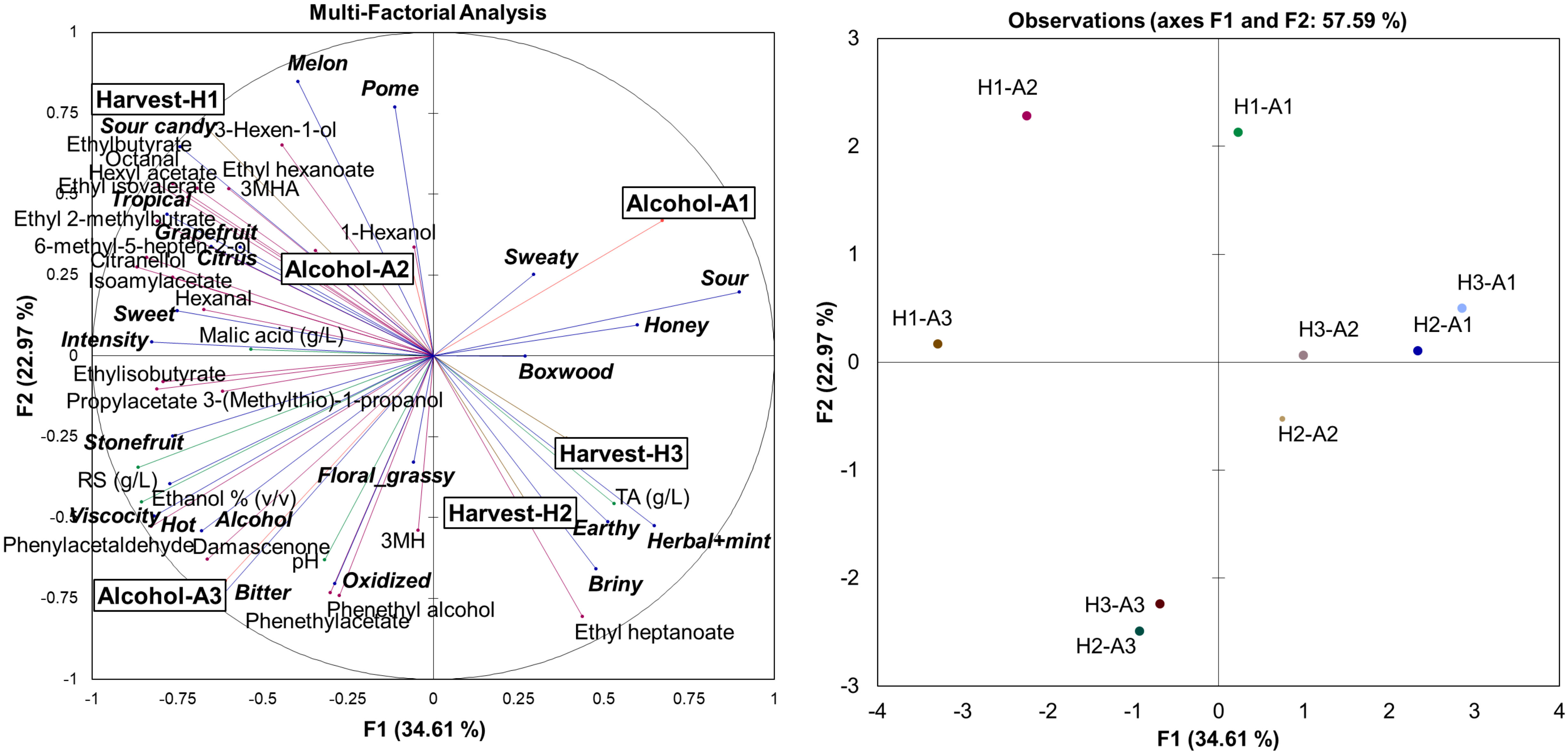
Intensity
Sweet
Citrus
Grapefruit
Sour
Sour_candy
Melon
25
22-25
15% (v/v)
22
25-22
22-19
19-25
13% (v/v)
11% (v/v)
25-19
19
19-22
Dim 2 = 22.6%
Dim 1 = 49.0%


Multi-Factorial Analysis
Harvest-H1
Harvest-H2
Harvest-H3
Alcohol-A1
Alcohol-A2
Alcohol-A3
Melon
Pome
Sour candy
3-Hexen-1-ol
Ethylbutyrate
Octanal
Hexyl acetate
Ethyl hexanoate
Ethyl isovalerate
3MHA
Tropical
Ethyl 2-methylbutrate
Grapefruit
1-Hexanol
6-methyl-5-hepten-2-ol
Citranellol
Citrus
Isoamylacetate
Hexanal
Sweet
Intensity
Malic acid (g/L)
Sweaty
Sour
Honey
Boxwood
Ethylisobutyrate
Propylacetate
3-(Methylthio)-1-propanol
Stonefruit
RS (g/L)
Ethanol % (v/v)
Floral_grassy
Viscocity
Hot
Alcohol
Phenylacetaldehyde
Damascenone
pH
3MH
TA (g/L)
Earthy
Herbal+mint
Briny
Oxidized
Bitter
Phenethyl alcohol
Phenethylacetate
Ethyl heptanoate
F1 (34.61 %)
F2 (22.97 %)
-1
-0.75
-0.5
-0.25
0
0.25
0.5
0.75
1
Observations (axes F1 and F2: 57.59 %)
H1-A2
H1-A1
H1-A3
H3-A1
H3-A2
H2-A1
H2-A2
H3-A3
H2-A3
F1 (34.61 %)
F2 (22.97 %)
-4
-3
-2
-1
0
1
2
3
4

Conclusions

- Harvest date and alcohol adjustment had significant impacts on wine sensory and volatile composition
- Harvest impacted the type of significant aroma compounds present however alcohol impacted the amount/intensity in relation to their sensory impact
  - Odor active compounds were generally well correlated with known descriptors e.g. 3-MHA-Grapefruit; Ethyl butyrate-Sour Candy etc.
- We recommend for Sauvignon blanc grown in warmer regions to pick early (18-19 Brix) and chaptalize to emphasize aromatic intensity and improve mouthfeel
- Due to shifting climate winemakers may need to adapt winemaking and picking decisions to match desired wine style