The Australian Wine Research Institute

Evaluation of winemaking treatments in Australian Cabernet Sauvignon

Vintage trial 2018

The Objective of this trial

- To better understand winemaking techniques and strategies that can be used in Australian Cabernet Sauvignon.
- To evaluate the differences and be able to apply that information in a practical way which will assist winemakers to improve the quality and stylistic diversity of Australian Cabernet Sauvignon.
- To harmonise the terminology used to describe the stylistic differences.

Trial Design

- Produce a number of different types of wines from the same parcel of fruit by changing one variable at a time.
- Cabernet Sauvignon, vintage 2018, Padthaway, South Australia
- Three harvest dates

Treatment	Harvest Date	Planned	Actual
Early	7 March 2018	13.5° Bé	13.7° Bé
Mid	16 March 2018	14.5° Bé	14.7° Bé
Late	3 April 2018	15.5° Bé / or + 2 weeks	16.1° Bé

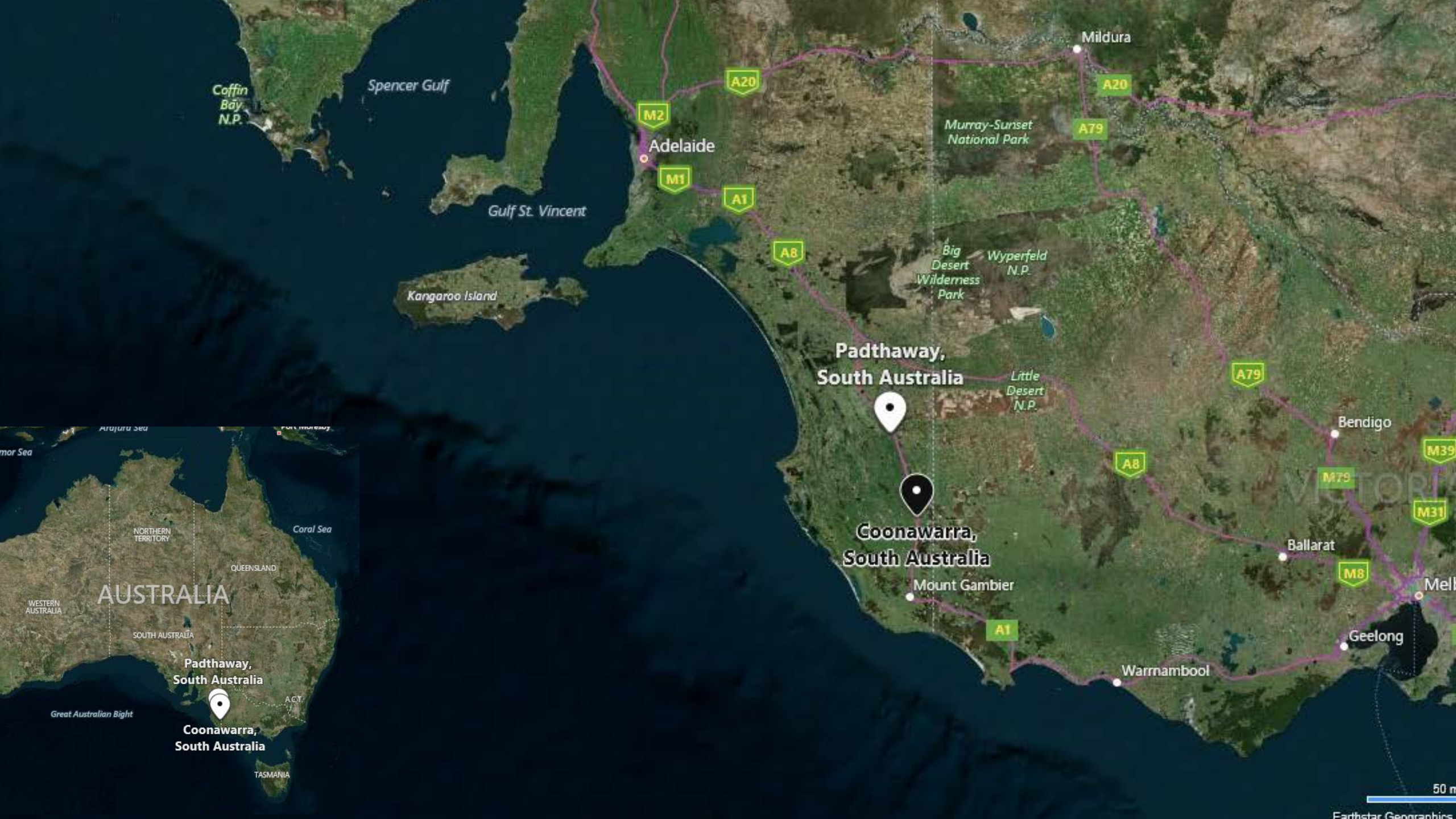
- Hand harvest

Please consider these things before changing your winemaking

- The apparent sensory differences caused by changing each winemaking variable might be different in other situations depending on many factors such as the fruit source, the yeast used, and the fermentation temperature.

- Please also note that because the ferments were not replicated, it is not possible to say for certain that particular sensory differences are wholly attributable to particular winemaking variables.

- The aim is to demonstrate potential sensory differences from changing winemaking variables, and we are not advocating any of the particular treatments.


Coffin Bay N.P.
Spencer Gulf
Gulf St. Vincent
Kangaroo Island
Adelaide
M2
M1
A20
A1
A8
Mildura
A20
A79
Murray-Sunset National Park
Big Desert Wilderness Park
Wyperfeld N.P.
Padthaway, South Australia
Little Desert N.P.
Coonawarra, South Australia
Mount Gambier
A79
Bendigo
M39
A8
M79
M31
Ballarat
M8
Geelong
Warrnambool
A1
Arafura Sea
Coral Sea
NORTHERN TERRITORY
QUEENSLAND
AUSTRALIA
WESTERN AUSTRALIA
SOUTH AUSTRALIA
A.C.T.
Great Australian Bight
TASMANIA
Padthaway, South Australia
Coonawarra, South Australia
50 m
Earthstar Geographics

- Clone: G9V3
- Trellis: Single wire sprawl
- Row; 2.8m X Vine 1.8m
- Elevation; 75 m
- Vine Age: Planted 1993
- Soil type: Deep sand

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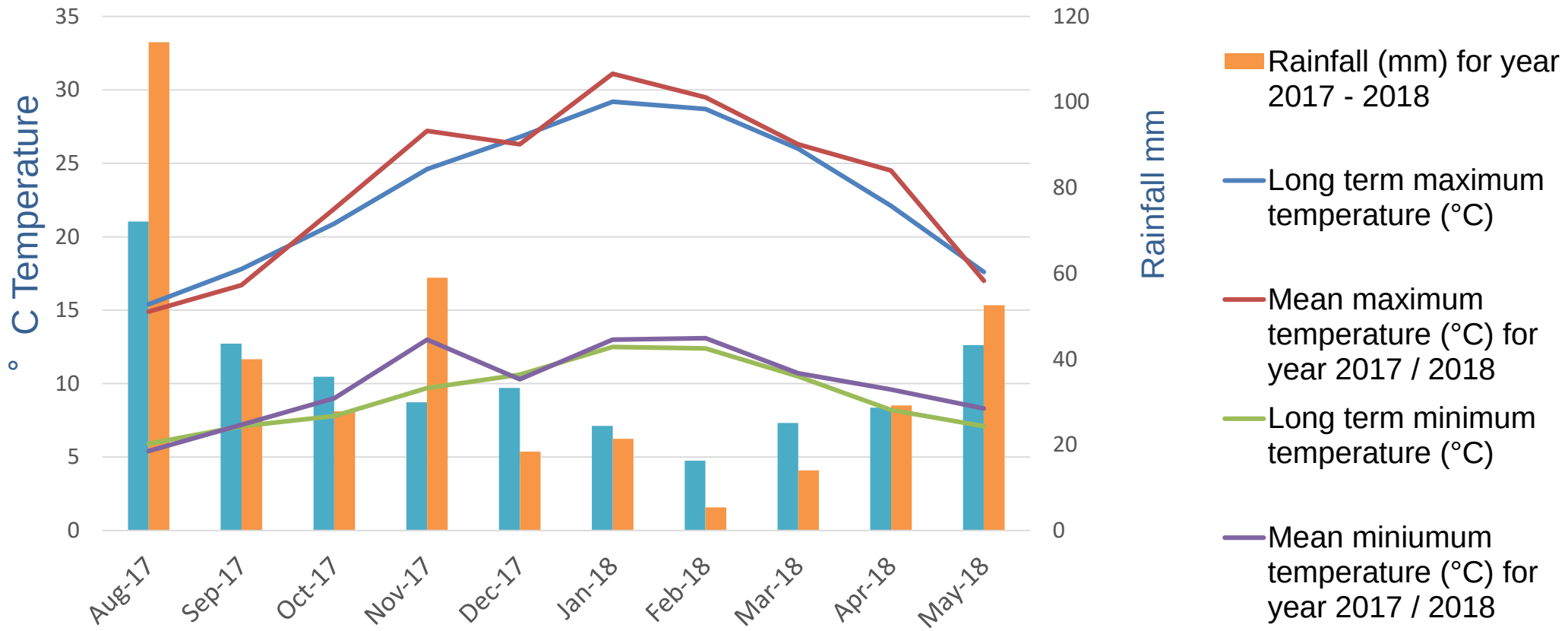
Temperature and rainfall in 2017 / 2018 growing season compared with long term average

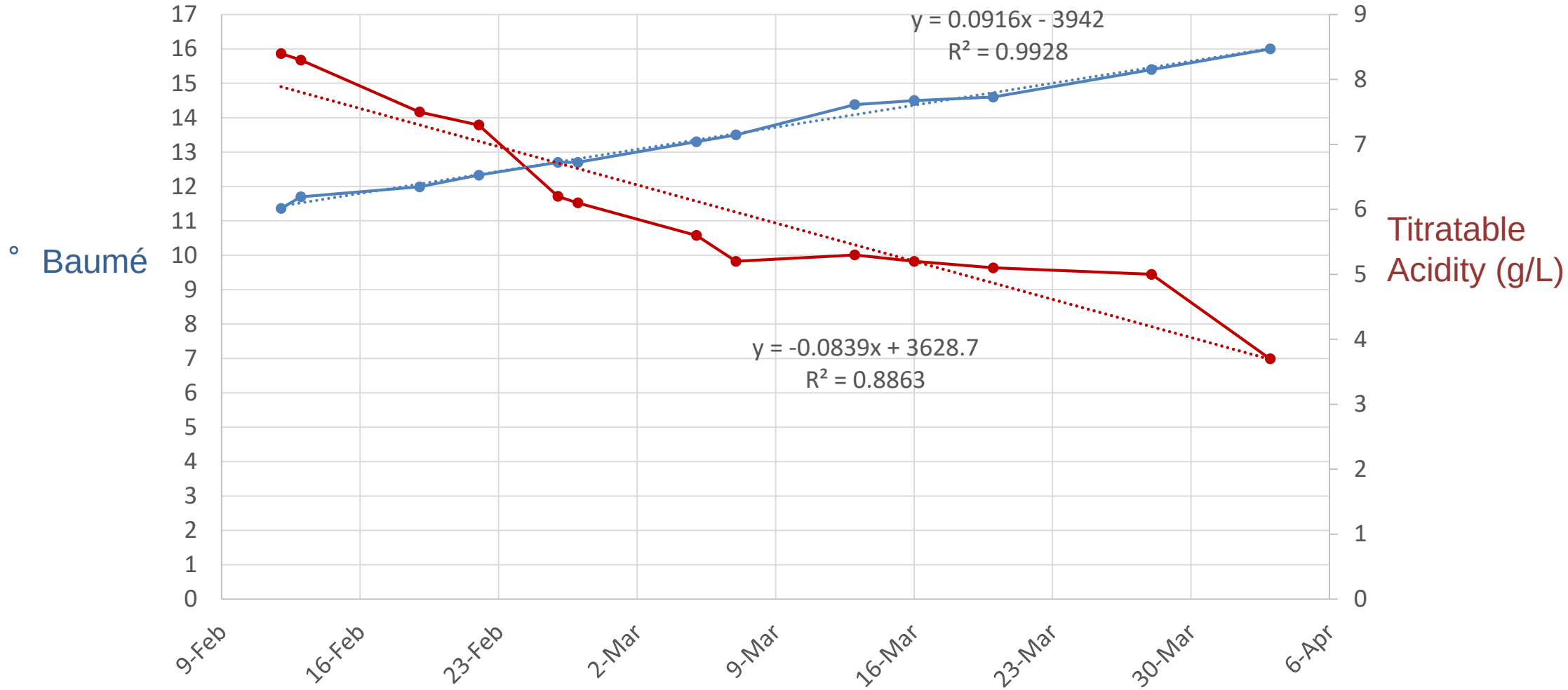
Warmer and drier year

No disease pressure

Overall very high standard, good colour and flavour



Vineyard assessment: Maturity data



The Winemaking

- Standard winemaking practices applied (based on the treatment design, some individual treatments will differ).
  - Fruit chilled to <10˚ C overnight then processed the following morning.
  - 50mg/L SO_2 @ 500 L/t of crush volume,
  - No enzyme added at crushing or preferment
  - TA adjusted to pH 3.50 as required.
  - DAP addition (2 x 200 ppm additions, at day 2 and day 4, post primary inoculation).
  - 100 – 150 kgs ferments, no replicates
  - Inoculated with yeast Lalvin BDX @ 100 mg/L
  - 2 hand plunging per day
  - Pressed at 0-2˚ Bé
  - Racked off primary lees when <0.2g/L G&F

The Winemaking

- Inoculated with MLB Lallemand VP41 @ 10mg/L added 48 hours post primary inoculation (considered as co-inoculation).
- Racked when MLF complete, +80 mg/L $S0_2$.
- Stored @ 0° C until bottling
- Cross flow @ bottling (no membrane)
- Bottled September 2018
- Analysis performed early November 2018

This tasting

- These wines are
  - Unfined
  - Not blended
  - No oak
- 30 mins to taste
- Use treatment #2 as your “control” for wines 1-15
- Use treatment #3 as your “control” for wines 16-17
- Comment on differences, on colour, flavour profile, structure, acid and tannin balance.

Treatment 1 – Early harvest [13.5˚ Bé]

- Crushed and destemmed
- Ferment temp peaked at 24 – 26˚ C, 13 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
13.5 Early Harvest	13.9	0.8	0.9934	3.69	6.4	<0.05	0.59	44	82

- Malic Acid (H_2M) 2.50 g/L
- 0.5 g/L Tartaric acid (H2T) added

Treatment 2 – Desired harvest [14.5˚ Bé] (Control)

- Crushed and destemmed
- Ferment temp peaked at 24 – 26˚ C, 14 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
14.5 Be Desired (Control)	15.1	0.5	0.9931	3.54	7	<0.05	0.6	47	85

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 3 – Late harvest [15.5˚ Bé] or ~2 weeks later

- Crushed and destemmed
- Ferment temp peaked at 24 – 26˚ C, 19 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
15.5 Late harvest	16.5	1.6	0.9929	3.76	7	<0.05	0.4	44	106

- H_2M 2.09 g/L
- 3.5 g/L H2T added

Benefits of later harvesting in Cabernet Sauvignon is to reduce green herbaceous characters

Treatment	IBMP (Iso buytyl methoxy pyrazine) [ng/L]	IPMP (Iso propyl methoxy pyrazine) [ng/L]	SBMP (Sec- butylmethoxy pyrazine) [ng/L]
Levels commonly found in wine	5 - 30	<10	<10
Descriptors	Green capsicum, herbaceous	Green bean, grassy, bell pepper	Earthy
13.5 Early Harvest	7	<5	<5
14.5 Be Desired (Control)	7	<5	<5
15.5 Late harvest	6	<5	<5

Treatment 4 – Whole berry [15.0˚ Bé]

- 100% Whole berries no crushing
- Ferment temp peaked at 24 – 26˚ C, 14 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
100% Whole Berry	15.0	0.6	0.9929	3.75	6.2	<0.05	0.67	46	81

- H_2M 2.15 g/L
- 2.5 g/L H2T added

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Treatment 5 – Saignée [15.0˚ Bé]

- 15% w/w of juice removed after 24 hrs (to allow cap to rise)
- Ferment temp 24 – 26˚ C, 14 days

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Saignee -15% run off	15	0.6	0.9935	3.54	7	<0.05	0.6	46	86

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 6 – Cold maceration (or cold soak) [15.0 ° Bé]

- +3° C for 5 days, heated to 15° C and inoculated
- Ferment temp peaked at 24 – 26° C, 15 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Cold Soak – 96 hrs	15.1	0.8	0.9927	3.55	6.6	0.11	0.6	48	102

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 7 – Extended maceration +21 days [15.0˚ Bé]

- +21 Days maceration on skins, post ferment
- Ferment temp peaked at 24 – 26˚ C, 16 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Extended Maceration - 21 days post EOF	14.6	0.6	0.994	3.56	7	<0.05	0.68	44	89

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 8 – Extended maceration +60 days [15.0˚ Bé]

- +60 Days maceration on skins, post ferment
- Ferment temp peaked at 24 – 26˚ C, 17 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Extended Maceration - 60 days post EOF	14.3	0.3	0.9945	3.57	7.2	<0.05	0.78	43	108

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 9 – Pectic Enzyme added [15.0˚ Bé]

- Enzyme added at crush, Novozyme VinoCRUSH classic @ 30ml/tonne
- Ferment peaked at temp 24 – 26˚ C, 14 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Pectic Enzyme addition	14.9	0.8	0.9947	3.44	7.3	<0.05	0.54	45	91

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 10 – Tannin addition [15.0˚ Bé]

- Identical to Treatment 2 except with an addition of tannin, 300 mg/L Laffort VR Supra Elegance added at crusher.

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Tannin Addition - 300ppm at EOF	15.0	0.7	0.9933	3.55	6.9	<0.05	0.6	46	87

- Ferment temp 24 – 26˚ C, 14 days
- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 11 – Hot ferment [15.0˚ Bé]

- Hot and rapid ferment with extra plunging
- Ferment temp peaked at 32 – 34˚ C, 14 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Hot & Rapid Extraction	15.2	0.7	0.9937	3.62	6.8	<0.05	0.59	46	83

- H_2M 2.15 g/L
- 2.5 g/L H2T added

Treatment 12 – High pH (Less acid added) [15.0˚ Bé]

- Less acid added compared with the other treatments
- Ferment peaked at temp 24˚ C, 14 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
High pH	15.1	<0.3	0.9929	3.9	6.7	<0.05	0.65	46	87

- H_2M 2.15 g/L
- 1.0 g/L H2T added

Treatment 13 – MLF Sequential [15.0˚ Bé]

- MLF inoculated upon completion of primary ferment
- Ferment temp peaked at 24 – 26˚ C, 12 day ferment

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
MLF Sequential	14.9	0.5	0.9933	3.58	6.7	0.08	0.55	48	98

- H_2M 2.15 g/L
- 2.5 g/L H2T added
- MLF completed +39 days, other co-inoc. treatments ranged from 11 – 50 days, ave 19 days

Treatment 14 – Eucalyptus [15.0˚ Bé]

- Identical to Treatment 2 except with the addition of 0.9 grams of eucalyptus leaves per kg of must added at beginning of ferment.

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Eucalyptus	15.0	0.9	0.9934	3.57	6.9	0.05	0.58	44	85

- Ferment temp peaked at 24 – 26˚ C, 14 day ferment
- H_2M 2.15 g/L
- 2.5 g/L H2T added

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Treatment 14 – Eucalyptus [15.0˚ Bé]

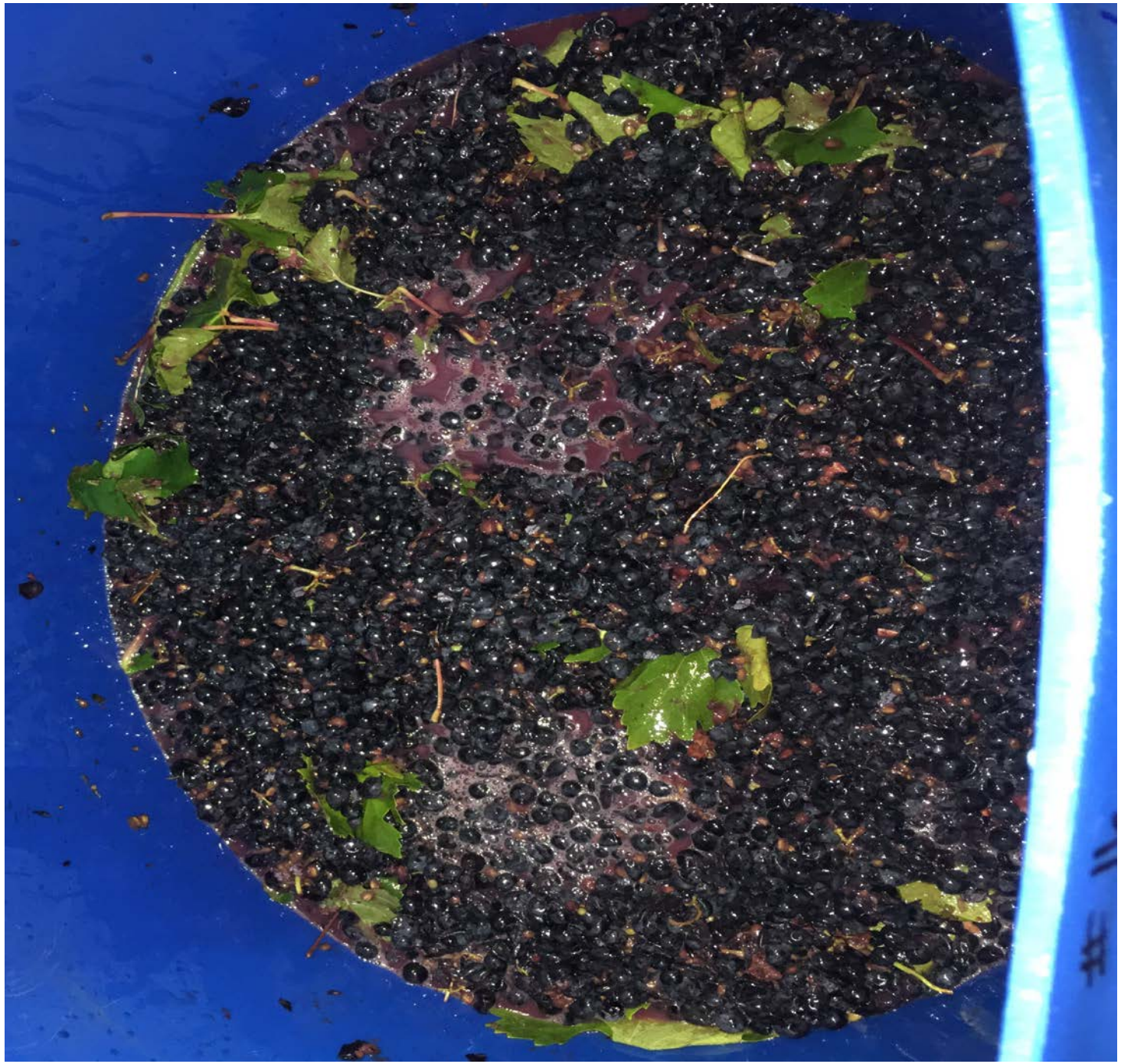
Treatment	1,8 cineol (mg/L)	α terpineol [µg/L]
14.5 Be Desired (Control)	<2	24
14.5 Be Eucalyptus (+0.9g/kg)	33	32

Treatment 15 – Material other than grapes (MOG) [15.0˚ Bé]

- Identical to Treatment 2 except with an addition of 6.6 grams of petioles, leaves and canes per kg of must added at beginning of ferment.

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
MOG	14.9	0.7	0.9931	3.53	6.9	<0.05	0.64	46	87

- Ferment temp 24 – 26˚ C, 14 days
- H_2M 2.15 g/L
- 2.5 g/L H2T added



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Treatment 15 – Material other than grapes (MOG) [15.0˚ Bé]

Treatment	Ethyl decanoate [µg/L]	Ethyl octanoate [µg/L]	Ethyl hexanoate [µg/L]
14.5 Be Desired (Control)	<50	119	201
MOG	<50	73	134

Treatment 16 – Water dilution [16.1˚ Bé]

- Late harvested must diluted to 15˚ Bé

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Water Dilution	15.2	0.3	0.9929	3.66	7.3	<0.05	0.39	46	89

- Ferment temp 24 – 26˚ C, 15 days
- H_2M 2.09 g/L
- 3.5 g/L H2T added

Treatment 17 – Water replacement [16.1° Bé]

- Late harvested, predetermined volume of juice drained off then replaced with water and diluted to 15° Bé
- Ferment temp 24 – 26° C, 15 days

Treatment	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L Acetic	FSO2 ppm	TSO2 ppm
Water Replacement	15.2	0.3	0.9928	3.64	7.2	<0.05	0.37	46	90

- H_2M 2.09 g/L
- 3.5 g/L H2T added

Analysis summary

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Treatment	Treatment #	ALC %	G&F g/L	SG g/L	pH	TA @ 8.2	Malic g/L	VA g/L (as acetic acid)
13.5 Early Harvest	1	13.9	0.8	0.9934	3.69	6.4	<0.05	0.59
14.5 Mid Harvest	2	15.1	0.5	0.9931	3.54	7	<0.05	0.6
15.5 Late harvest	3	16.5	1.6	0.9929	3.76	7	<0.05	0.4
100% Whole Berry	4	15.0	0.6	0.9929	3.75	6.2	<0.05	0.67
Saignee	5	15.0	0.6	0.9935	3.54	7	<0.05	0.6
Cold Maceration	6	15.1	0.8	0.9927	3.55	6.6	0.11	0.6
Extended Maceration 21 days	7	14.6	0.6	0.994	3.56	7	<0.05	0.68
Extended Maceration 60 days	8	14.3	0.3	0.9945	3.57	7.2	<0.05	0.78
Enzyme	9	14.9	0.8	0.9947	3.44	7.3	<0.05	0.54
Tannin	10	15.0	0.7	0.9933	3.55	6.9	<0.05	0.6
Hot & Rapid	11	15.2	0.7	0.9937	3.62	6.8	<0.05	0.59
High pH	12	15.1	<0.3	0.9929	3.9	6.7	<0.05	0.65
MLF Sequential	13	14.9	0.5	0.9933	3.58	6.7	0.08	0.55
Eucalyptus	14	15.0	0.9	0.9934	3.57	6.9	0.05	0.58
MOG	15	14.9	0.7	0.9931	3.53	6.9	<0.05	0.64
Water Dilution	16	15.2	0.3	0.9929	3.66	7.3	<0.05	0.39
Water Replacement	17	15.2	0.3	0.9928	3.64	7.2	<0.05	0.37

Phenolic analysis

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- We need to consider these factors when interpreting the phenolics data on the following slides.
- As well as being single replicates of each treatment, the potential for errors in some of the analytical methods used, are substantially higher compared to analyses such as alcohol or pH.
- Therefore, although there is a lot of interesting data here, any differences between the treatments may be larger or smaller than they appear on these slides.

Wine colour density (absorbance units)

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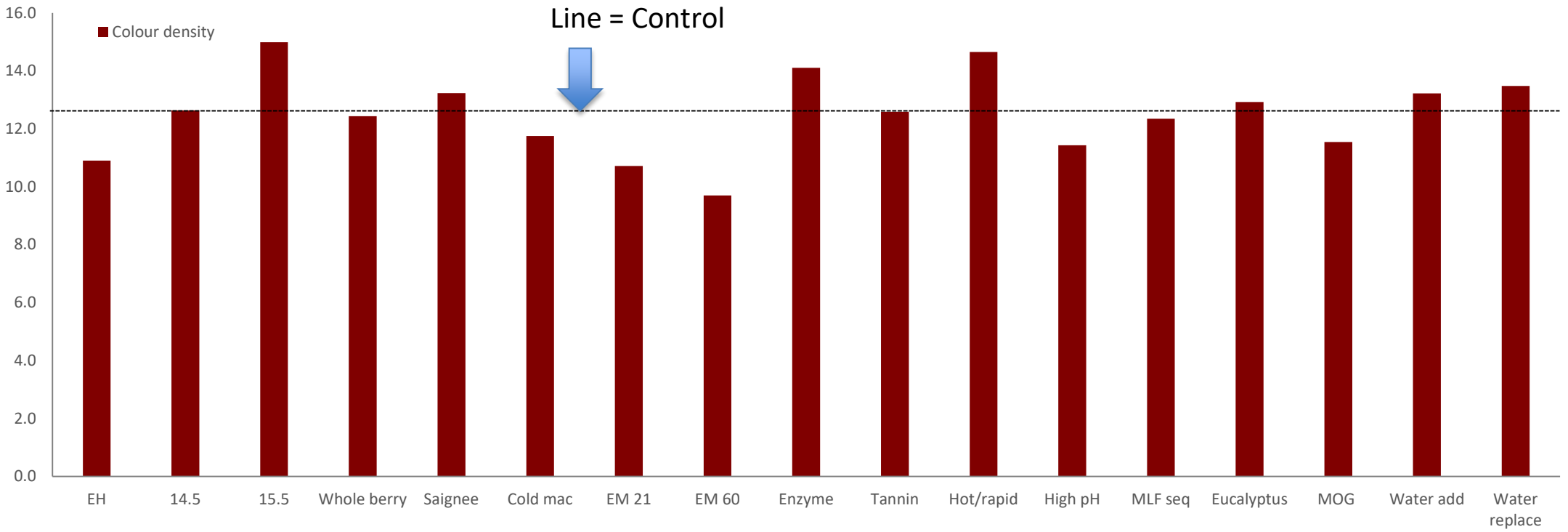
- Relative to early harvest, the 14.5 and 15.5 harvests saw corresponding increases in colour density
- The only treatments which caused notable increases in colour density were enzyme and hot/rapid
- Saignee, water addition/replacement marginally affected colour but unlikely to be visually significant
- Extending maceration reduced colour density (found previously in Shiraz to increase)



Wine Hue (absorbance ratio, no units)

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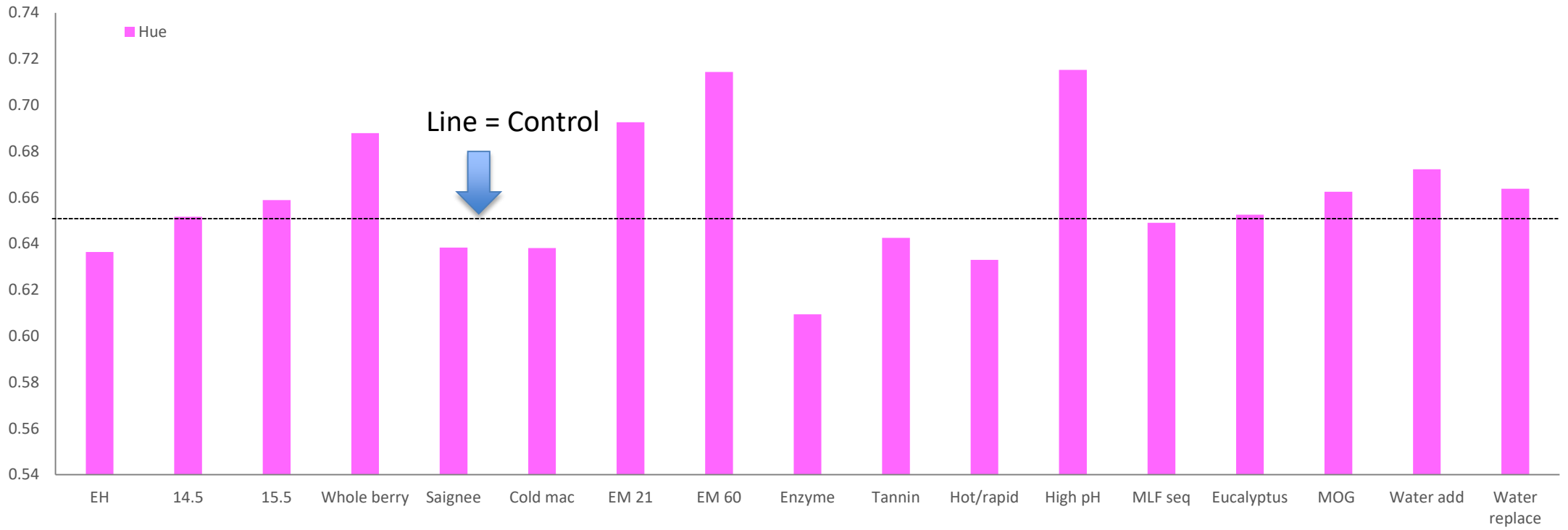
- Increases in hue were due to relative increases in 420 nm (brown colour) to 520 nm
- Whole berry, extended maceration (time independent) and high pH increased hue most likely due to browning
- Small increases in hue also seen with water addition/replacement



Non-bleachable pigment (absorbance units)

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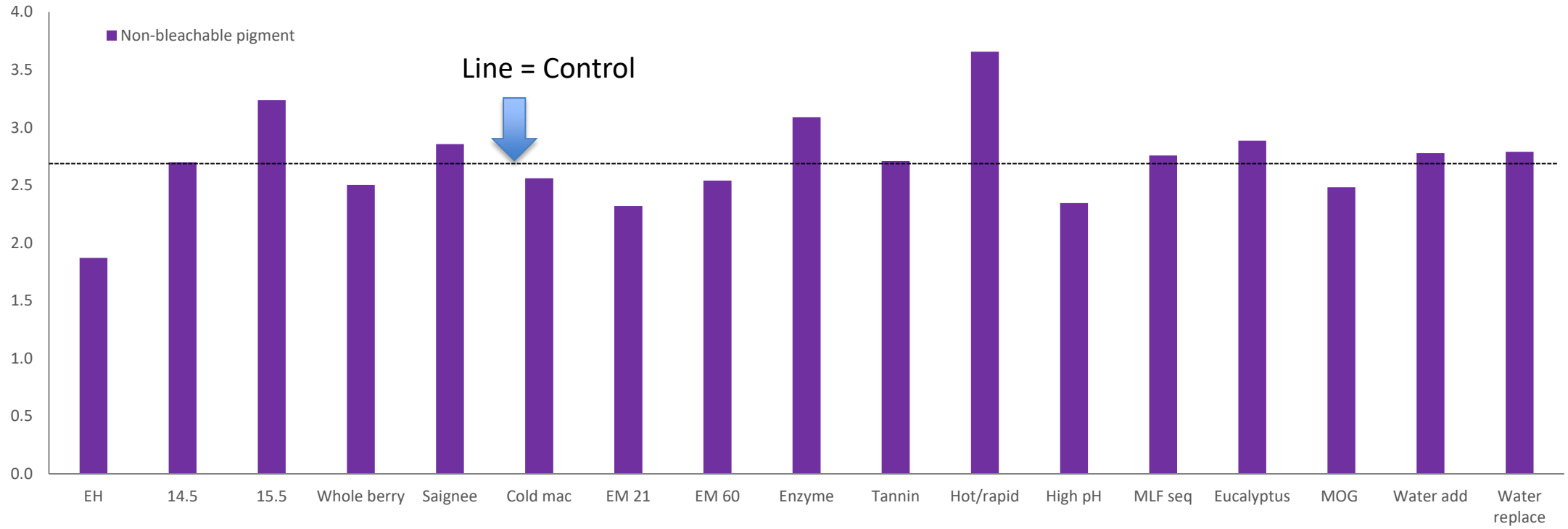
- As expected, delaying harvest increased non bleachable (stable, SO_2 resistant) wine colour which corresponded also to increased colour density
- Non-bleachable pigment increases tracked with colour density increases for enzyme and hot/rapid
- This was not necessarily a correlation with tannin, some treatments increased tannin but not necessarily colour or non-bleachable pigment



Wine Tannin (mg/L)

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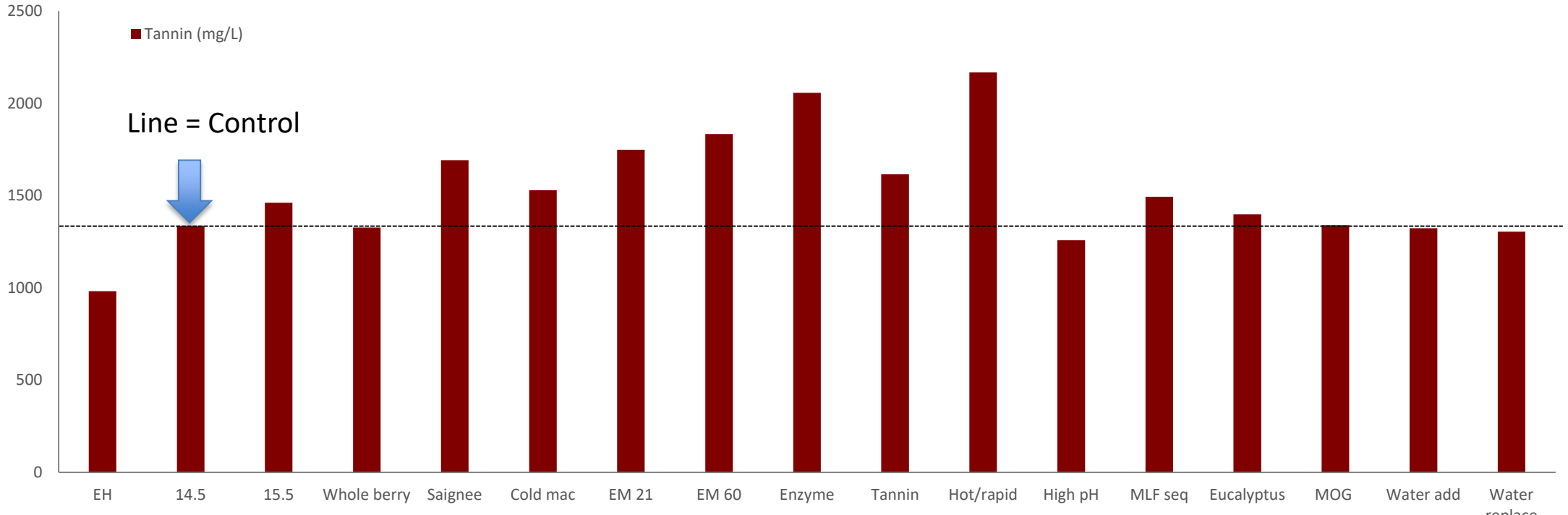
- Tannin increased with delayed harvest, as found in other studies - but not from 14.5 to 15.5.
- Enzyme and hot/rapid increased tannin the most (associated with increases in colour)
- Saignée increased tannin (but less effective for colour)
- EM at both 21 and 60 days increased tannin markedly (but reduced colour)
- Smaller tannin increases for cold maceration and tannin addition
- Other treatments had only small impacts on tannin concentration



Tannin Composition

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- Treatments can change tannin concentration but need to look at which type of tannin
- Structural changes may be:
  - skin (trihydroxylated tannin; Tri-OH) versus seed (galloylated; %gall) extraction
  - Tannin molecular mass or mean degree of polymerisation (mDP) relates to the size of the tannin (may impact astringency)
- Delaying harvest increased mDP and skin tannin only in the 15.5 treatment.
- Enzyme caused increases in mDP but not overt effects on extraction from skin or seed.
- Hot/rapid increased tannin but did not change composition to a large extent. This may mean that overt effects on astringency were not present
- Saignée increased mDP and the proportion of skin tannin

Tannin Composition

The Australian Wine Research Institute

- Treatments can change tannin concentration but need to look at which type of tannin
- Structural changes may be:
  - Skin (trihydroxylated tannin; Tri-OH) versus seed (galloylated; %gall) extraction
  - Tannin molecular mass or mean degree of polymerisation (mDP) relates to the size of the tannin (increases may impact astringency)
- Delaying harvest to 15.5; saignée and water addition/replacement all increased mDP and % TriOH (skin tannin); largest changes for water addition.
- Enzyme caused increases in mDP but not proportional extraction from skin or seed.
- Tannin increases in EM at both 21 and 60 days by extraction from seeds (higher %gall) but mDP was not affected (reduced in other studies).
- Tannin addition did not change tannin composition (often the tannin in products is oxidised and poorly resolved using the methods)

A copy of this presentation will be forwarded to you, if you have provided your e-mail address

Please fill out the evaluation form and hand this to the presenter

Watch out for the Chardonnay trial in 2020!

Acknowledgement

Wine Australia for Australian Wine

This Grape and Wine Roadshow Workshop program is supported by Australia's grapegrowers and winemakers through their investment agency, Wine Australia, with matching funds from the Australian Government.