GRAPE & WINE ROADSHOW

Rutherglen Seminar

Tuesday 13th August, 2013

Why do varieties respond differently to drought and heat stress?
Mark Krstic

Practical strategies for reducing alcohol levels in wine
Paul Henschke

Morning Tea

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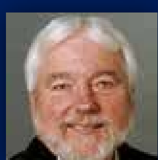
Vine Balance – how does it affect yield and quality?
Mark Krstic

VESDA – The new risk assessment tool for smoke taint
Ricky James, DEPI Victoria



Increasing red and white wine complexity with AWRI's Bayanus yeast
Paul Henschke

Lunch

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Tuesday 13th August, 2013

Pepper and Spice in Shiraz: what influences rotundone levels in wines?
Leigh Francis

Afternoon Tea

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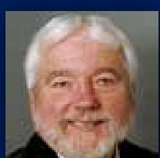
Tuesday 13th August, 2013

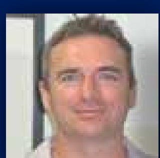
Energy for the future: moving towards onsite renewable biomass & solar technology

Richard Muhlack



Choose the right yeast to achieve the red wine style you want

Paul Henschke



Features of the AWRI website and closing comments

Mark Krstic

A W R I

The Australian Wine Research Institute

Why do varieties respond differently to drought and heat stress – and what does this mean for your irrigation management

Presented by:

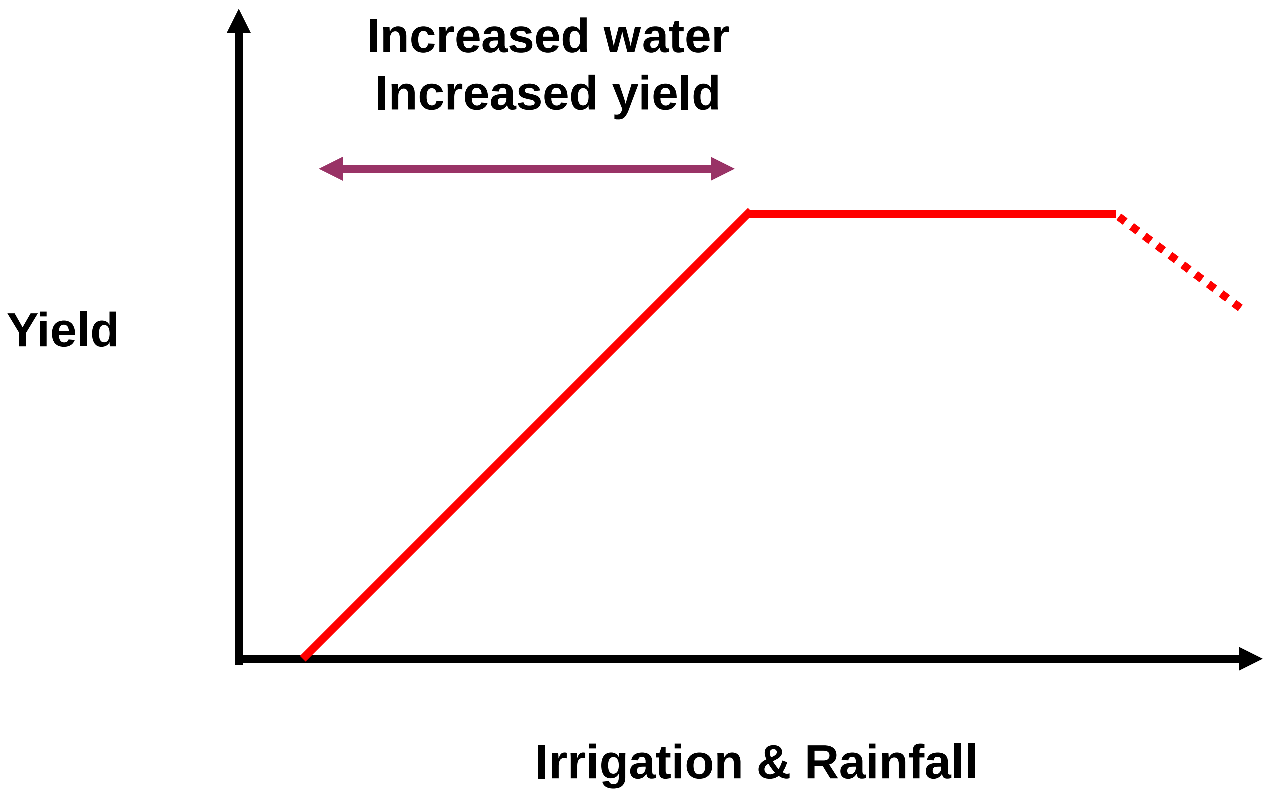
Mark Krstic

Presentation Overview

The Australian Wine Research Institute

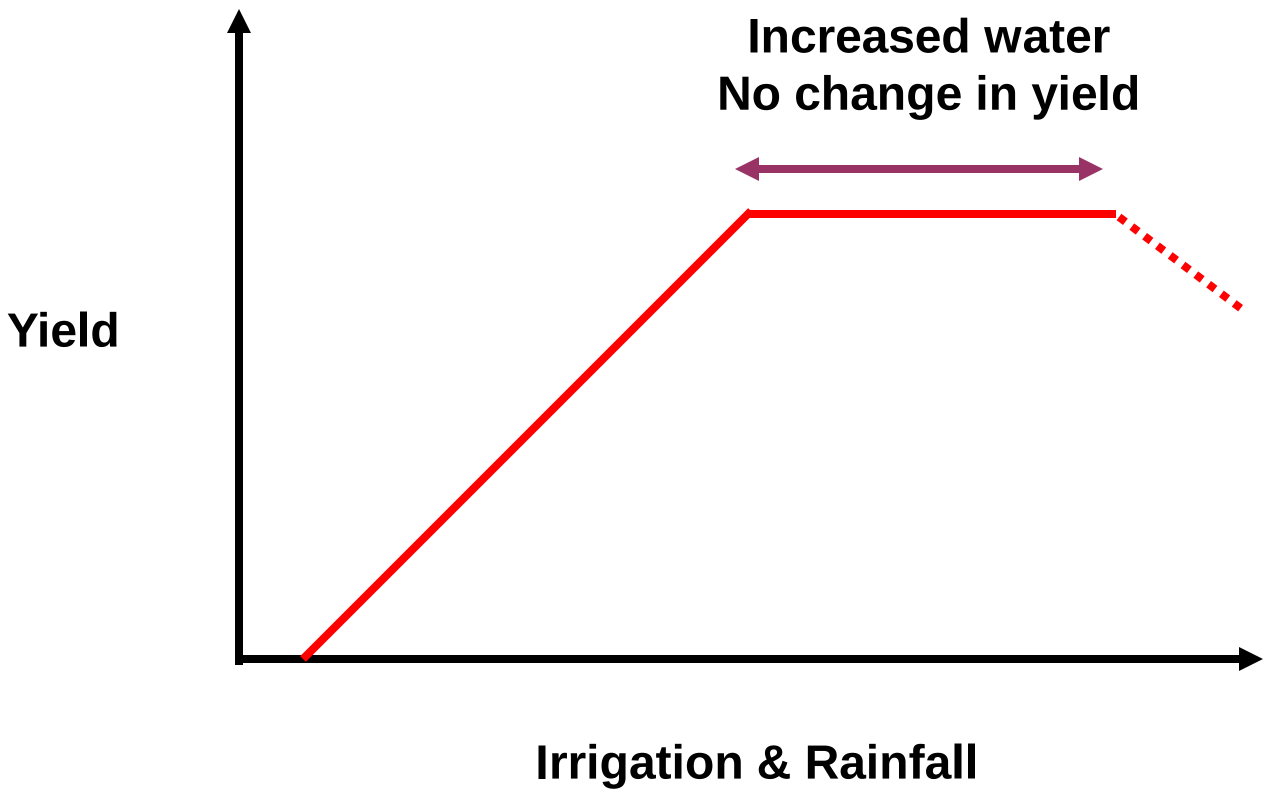
- Relationships between water, yield and quality
- How to grapevines respond to water stress
- The importance of soil in supplying water
- Understanding drivers of vine transpiration
- The influence of scion variety on water use
- The influence of rootstocks on water use

Relationship between water and yield



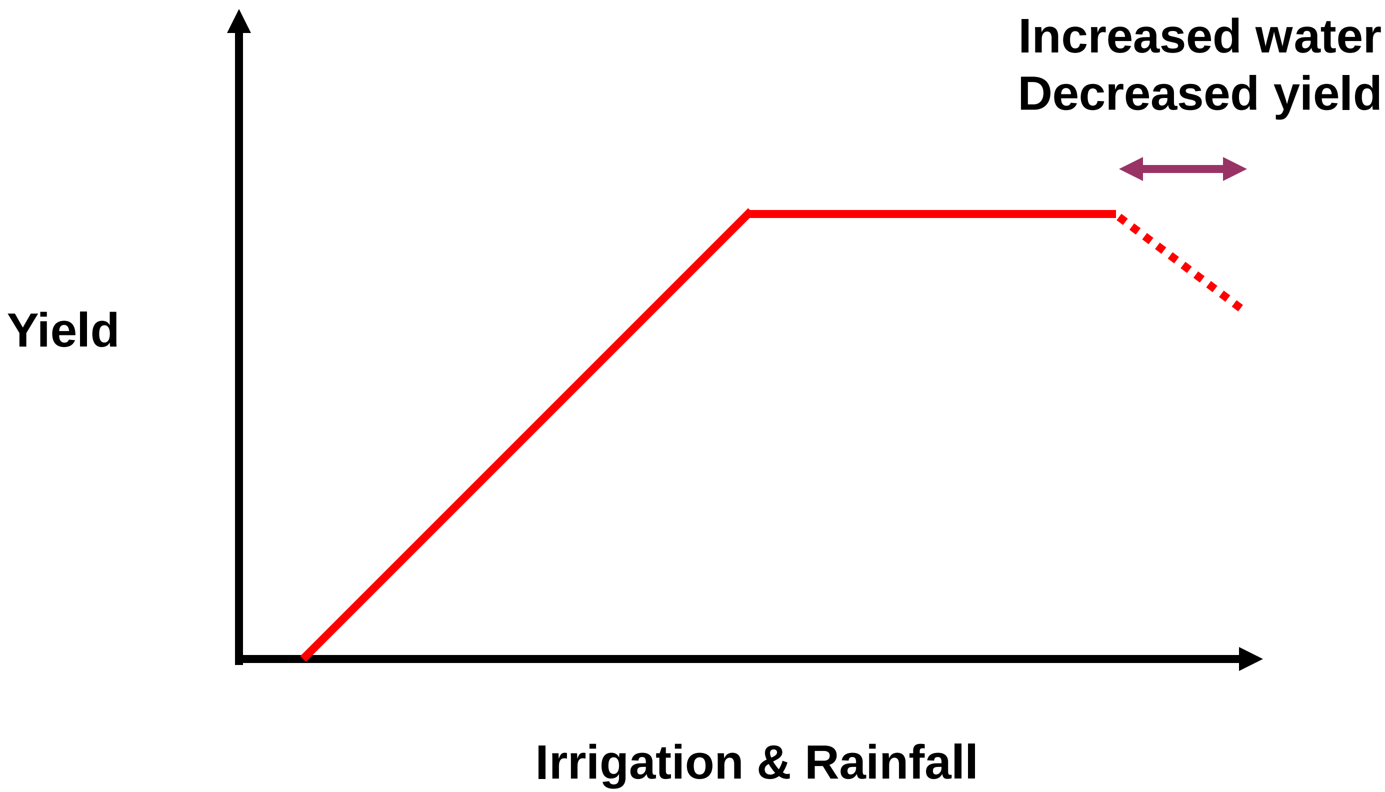
Relationship between water and yield

The Australian Wine Research Institute



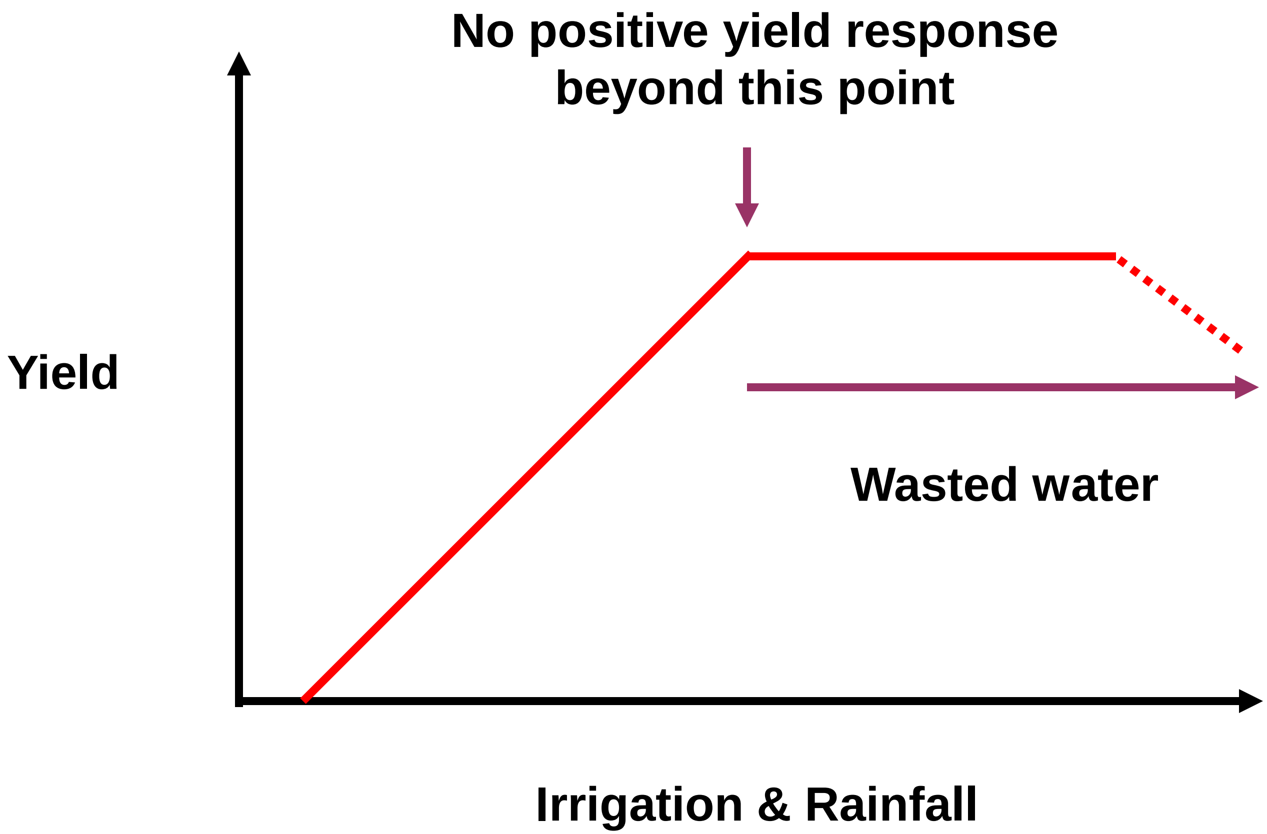
Relationship between water and yield

The Australian Wine Research Institute



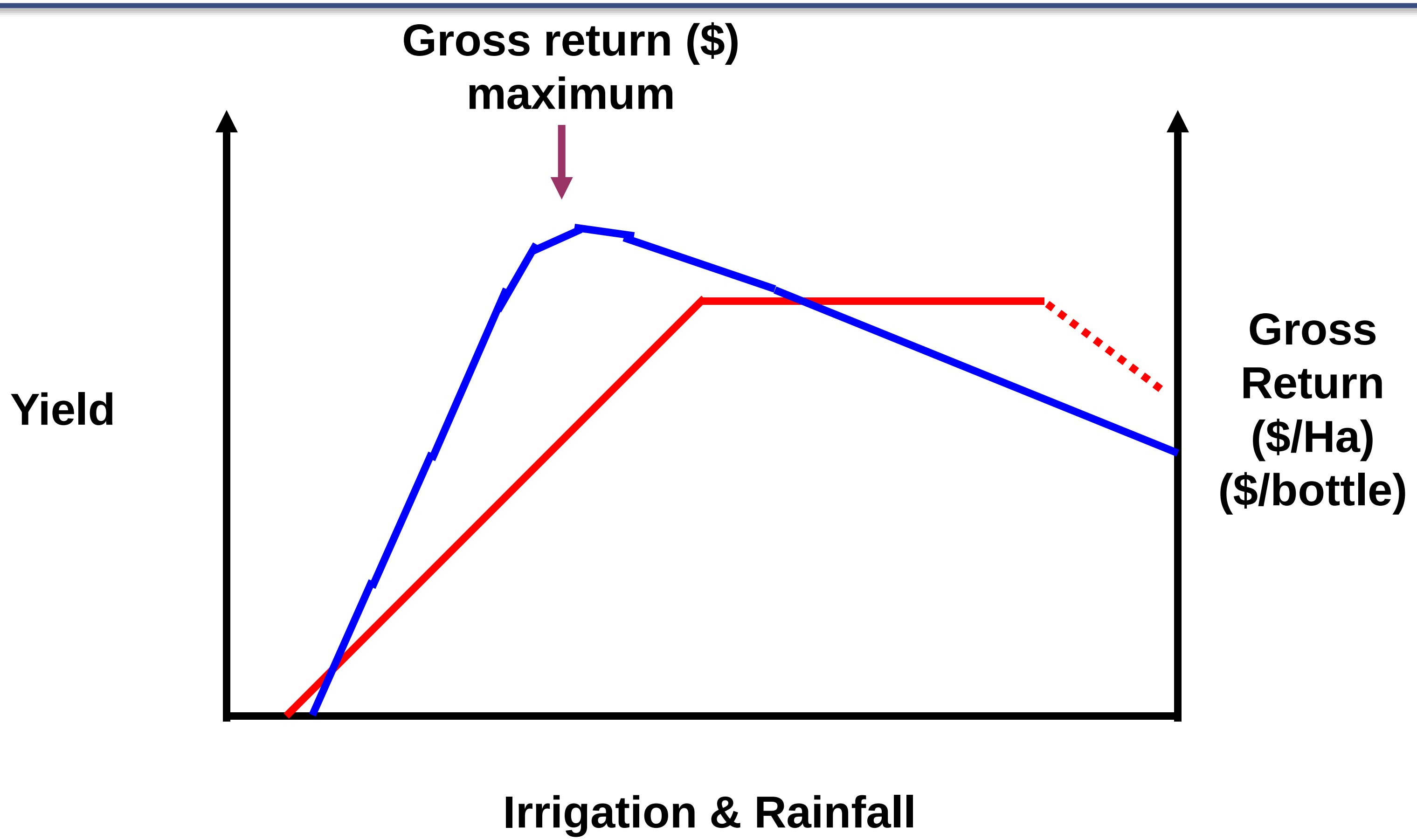
Relationship between water and yield

The Australian Wine Research Institute



It's not all about yield!!

The Australian Wine Research Institute



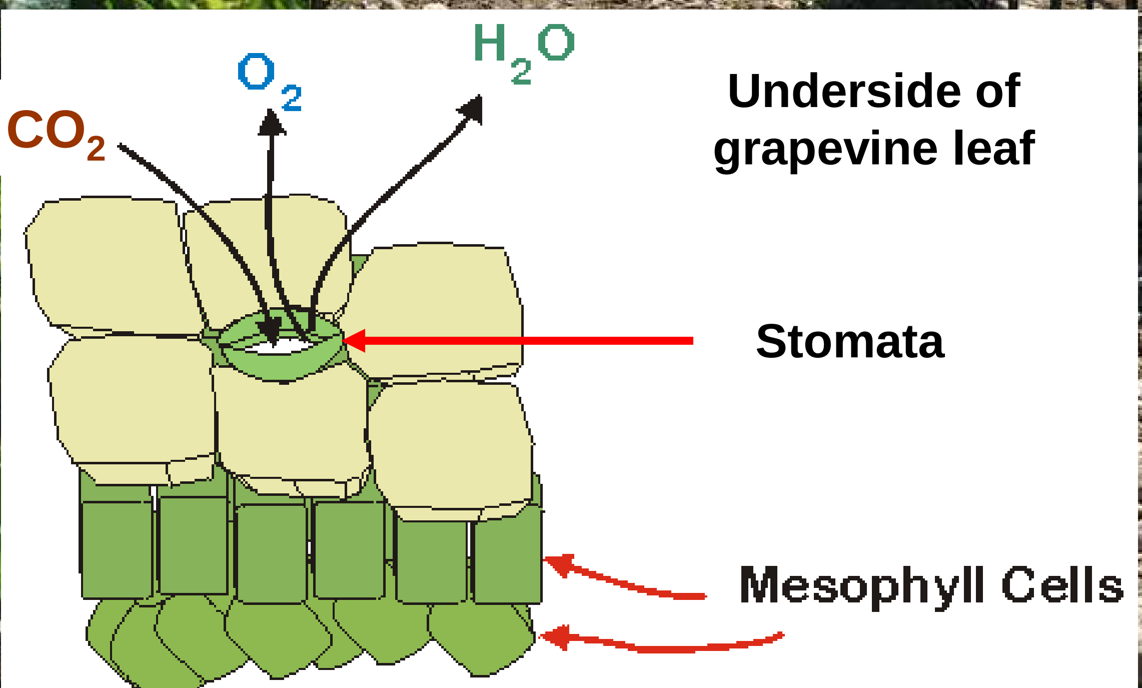
Quality is critical

What happens when we water stress plants ?

Stomatal aperture reduced or closed

Water (H_2O) loss reduced

Gas exchange (CO_2 & O_2) reduced



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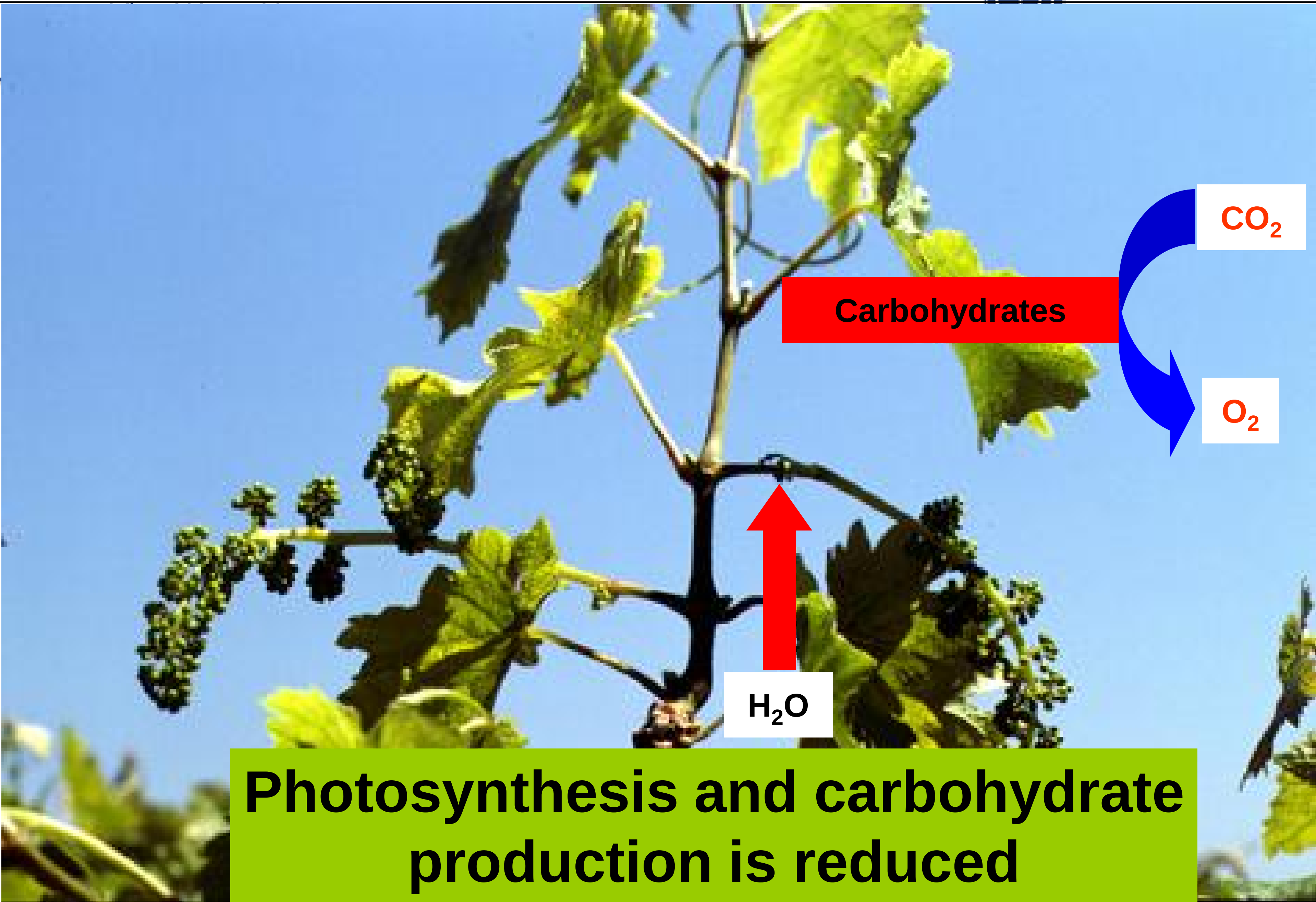
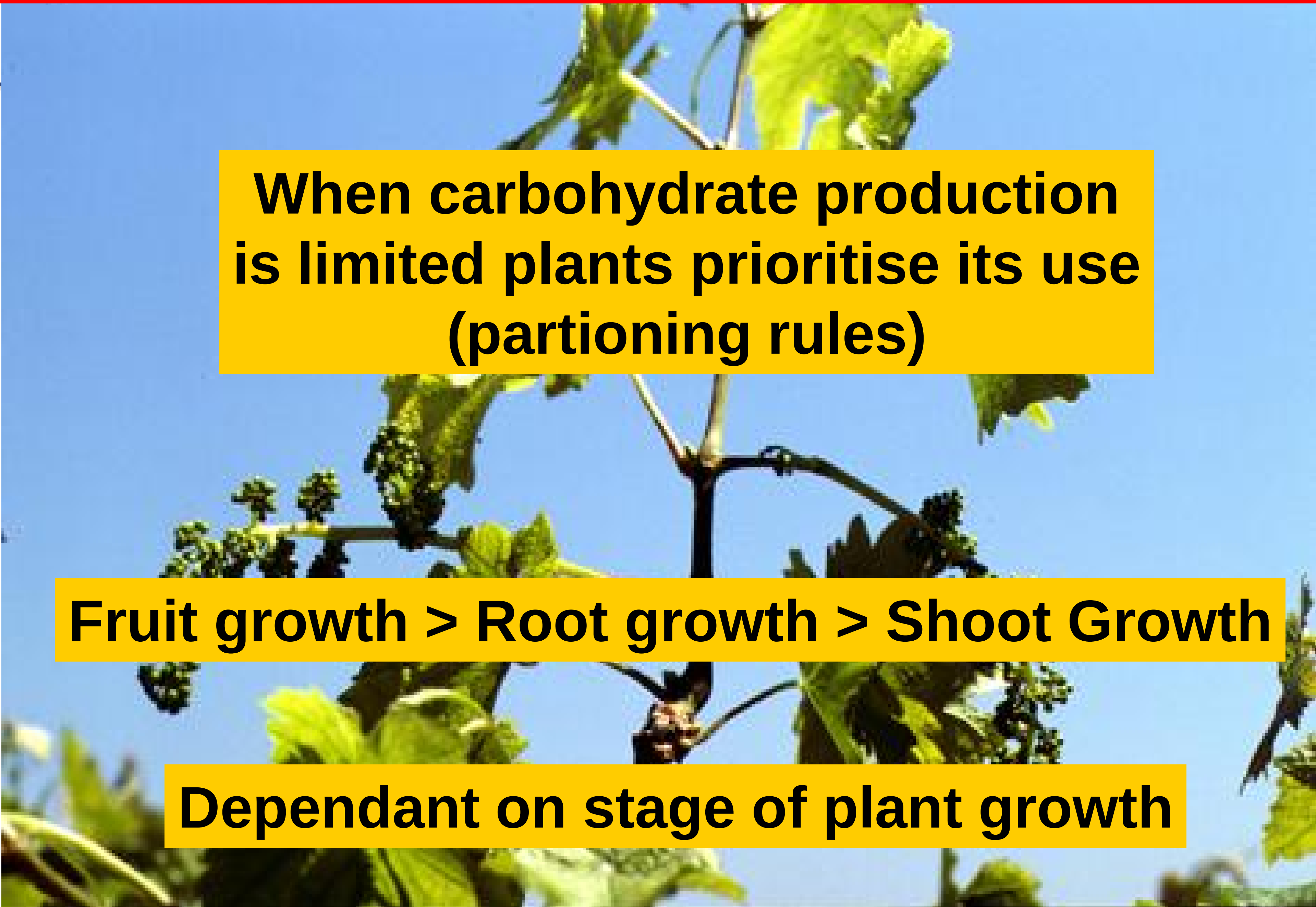


Photosynthesis and carbohydrate production is reduced

What happens when we water stress plants ?

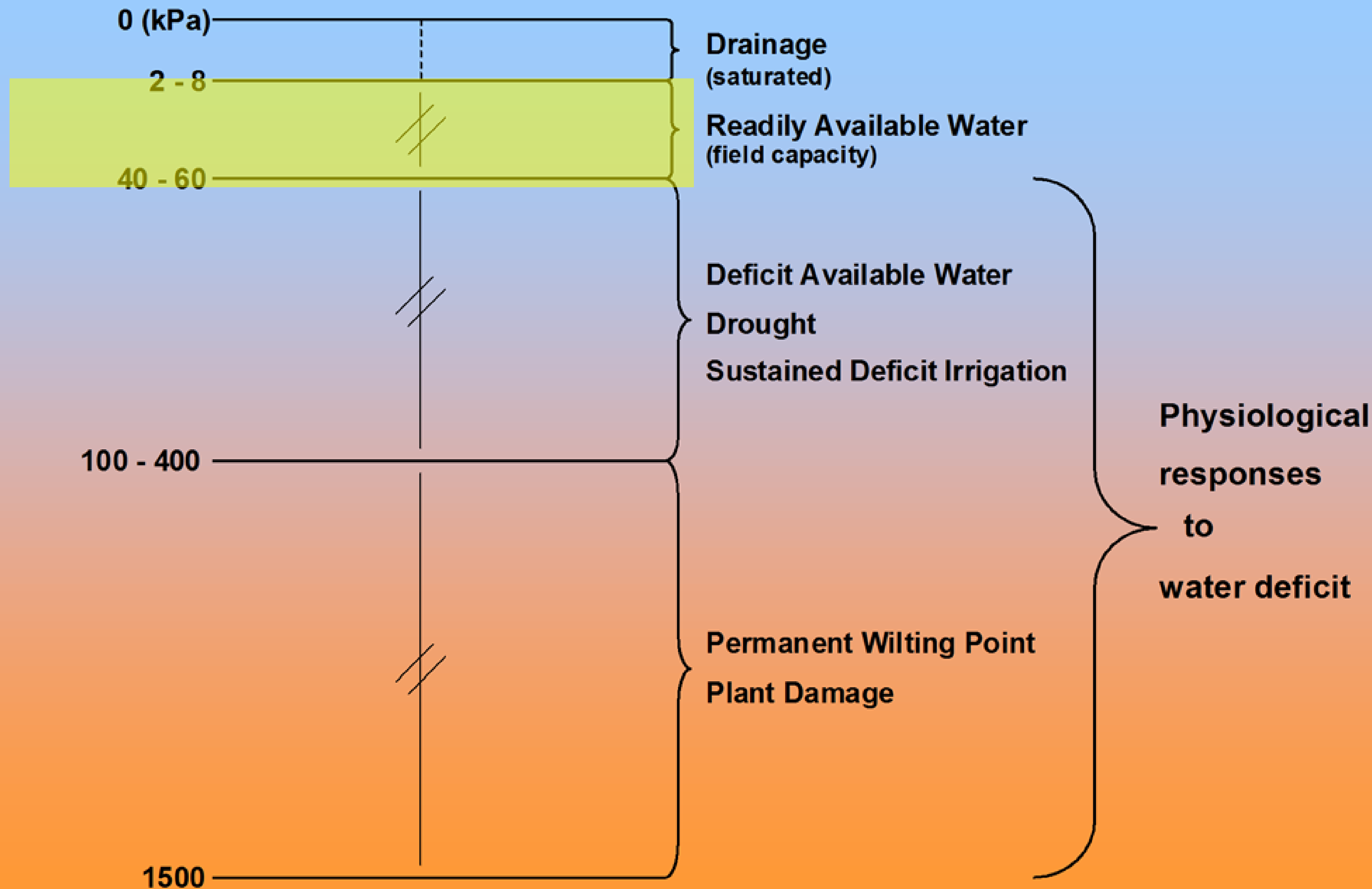


When carbohydrate production is limited plants prioritise its use (partioning rules)

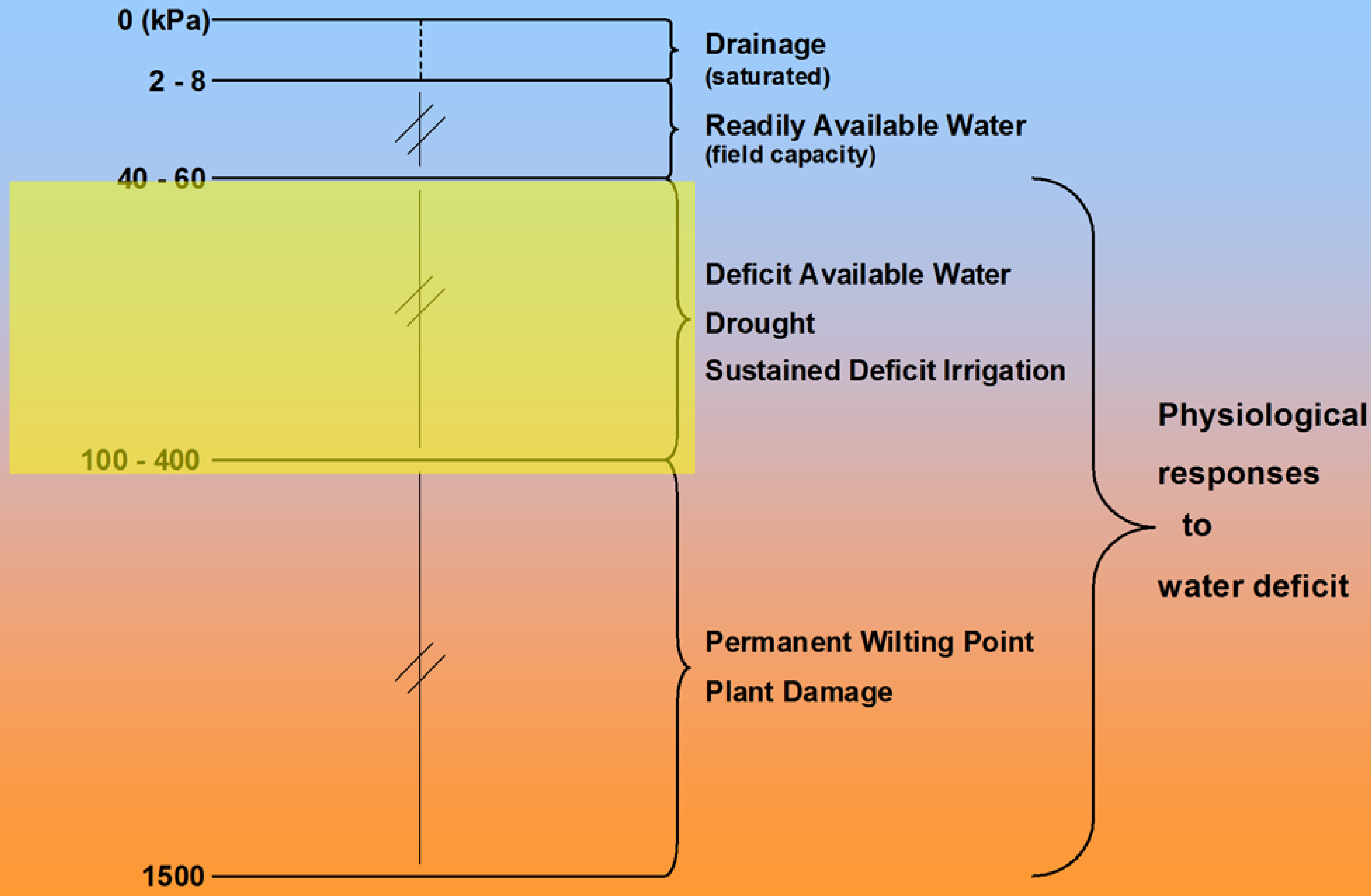
Fruit growth > Root growth > Shoot Growth

Dependant on stage of plant growth

Soils importance in supplying water to grapevines



Soils importance in supplying water to grapevines



What determines **whole vine** transpiration (water loss)?

- Vine leaf area
  - é Leaf area = é transpiration
  - é Shoot length, é leaf number = é leaf area
- Different varieties have different vigour characteristics and individual leaf area shape and dimensions
- The degree of leaf exposure important in determining overall rates of transpiration by leaves

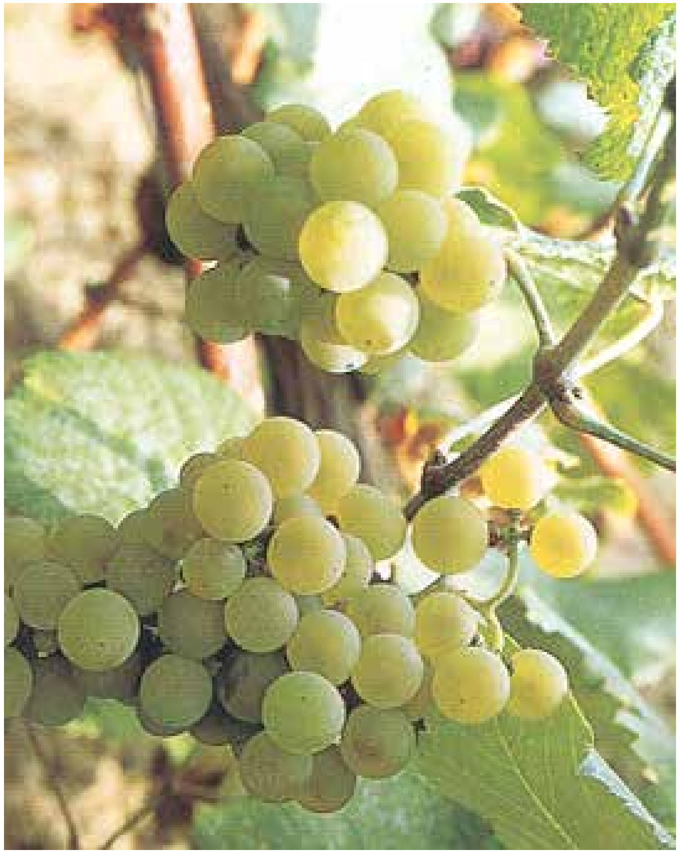
What determines **whole vine** transpiration (water loss)?

The Australian Wine Research Institute

- **Hydraulic conductivity**
  (ability to transport water from roots to shoots
  - Drying soil ¯ conductivity
- **Root system characteristics**
- **Soil water status**
  - Drying soil causes root signals → leaves → stomatal closure
  - Further soil drying → ¯ plant water potential → stomatal closure
- **Crop load**

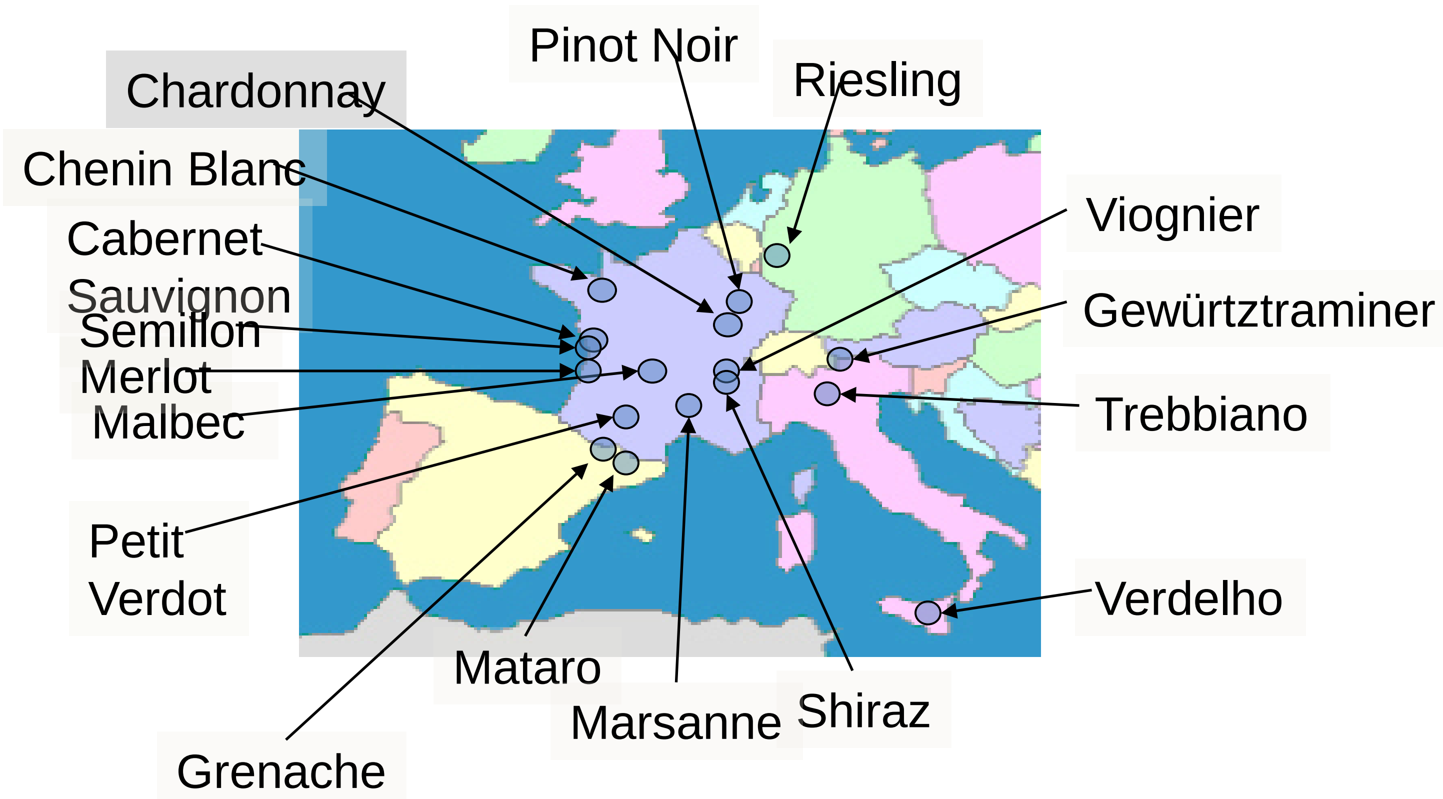
Effect of scion variety on water use

The Australian Wine Research Institute



Effect of scion variety on water use

The Australian Wine Research Institute



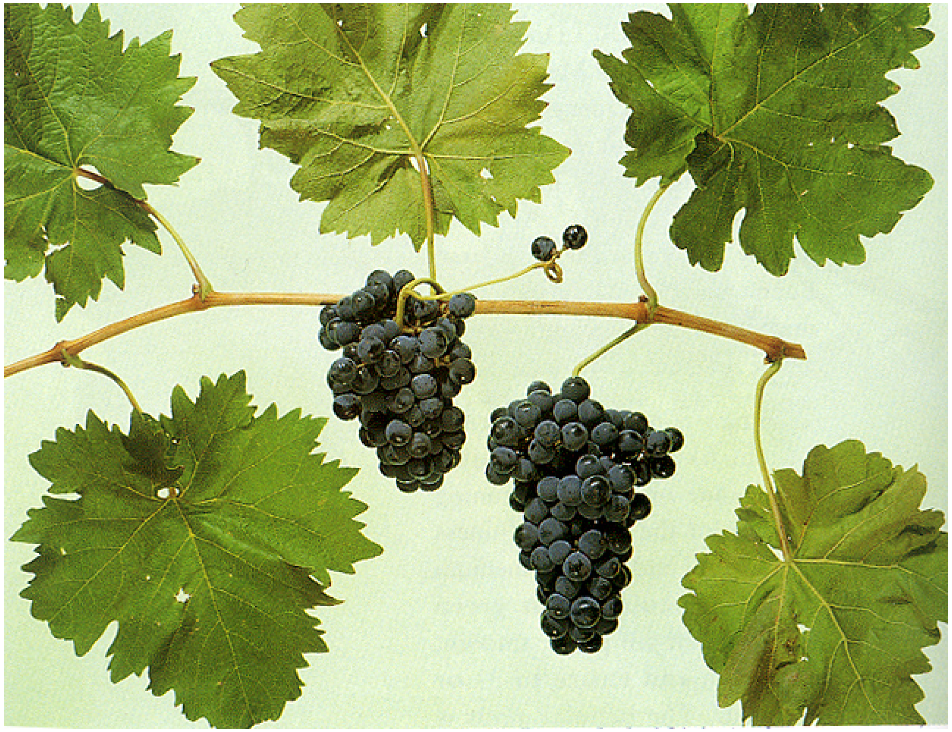
Probable geographic origins of *Vitis vinifera* varieties

Effect of scion variety on water use

- Hydraulic conductivity (ability to transport water from roots to shoots)
- Canopy size

How can scion variety influence water use?

- At the leaf level, differences in sensitivity to water stress
- Vary in stomatal response to the vineyard environment, particularly response to evaporative demand (VPD)



How can scion variety influence water use?

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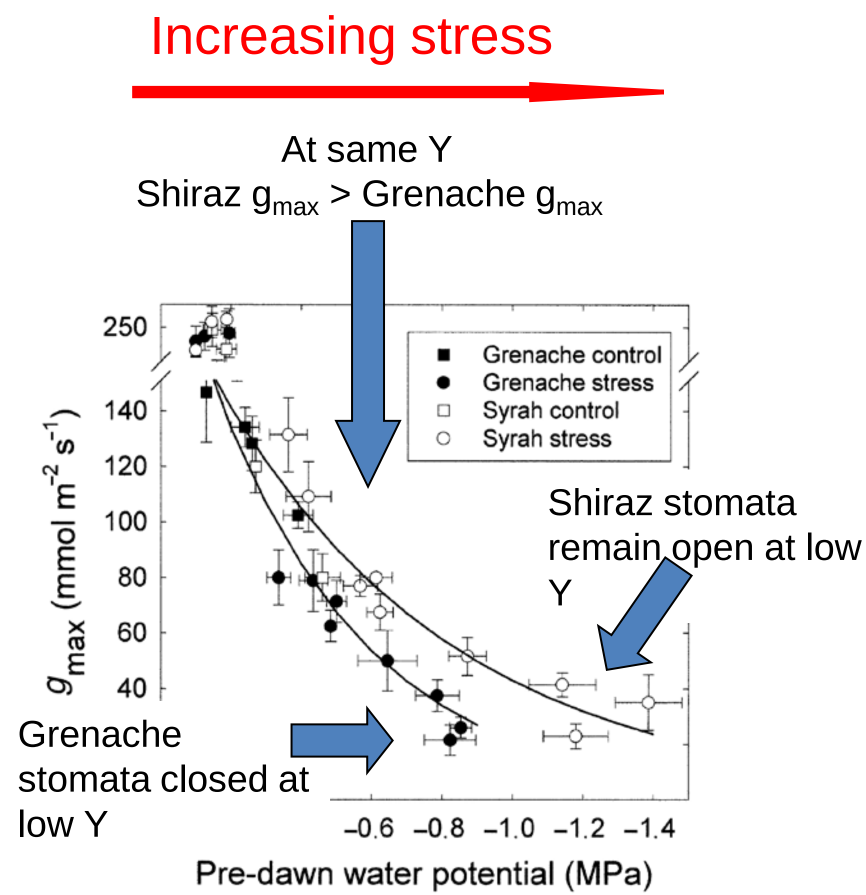
Stomatal behaviour in Shiraz & Grenache

- Under developing water stress, Shiraz and Grenache have very different strategies in terms of water use:
- Grenache has sensitive stomata which start to close at first signs of stress
- Shiraz has less sensitive stomata which stay open longer



How can scion variety influence water use?

The Australian Wine Research Institute

Defining stomatal behaviour

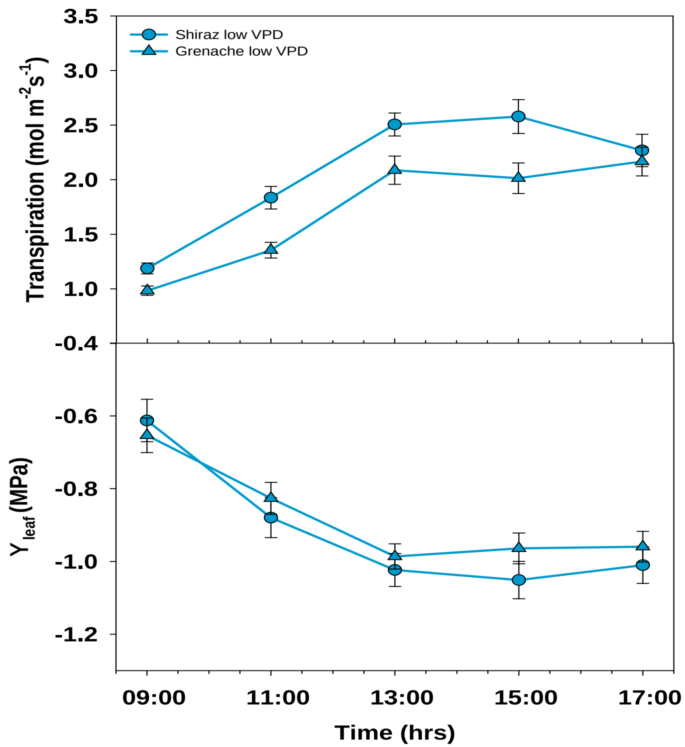
- Shiraz will tend to keep stomata open using more stored soil water
  = anisohydric stomatal behaviour

- Grenache will tend to close stomata in response to high VPD, maintaining soil moisture for longer
  = isohydric stomatal behaviour

How can scion variety influence water use?

The Australian Wine Research Institute

Implications of iso- & aniso-hydric behaviour



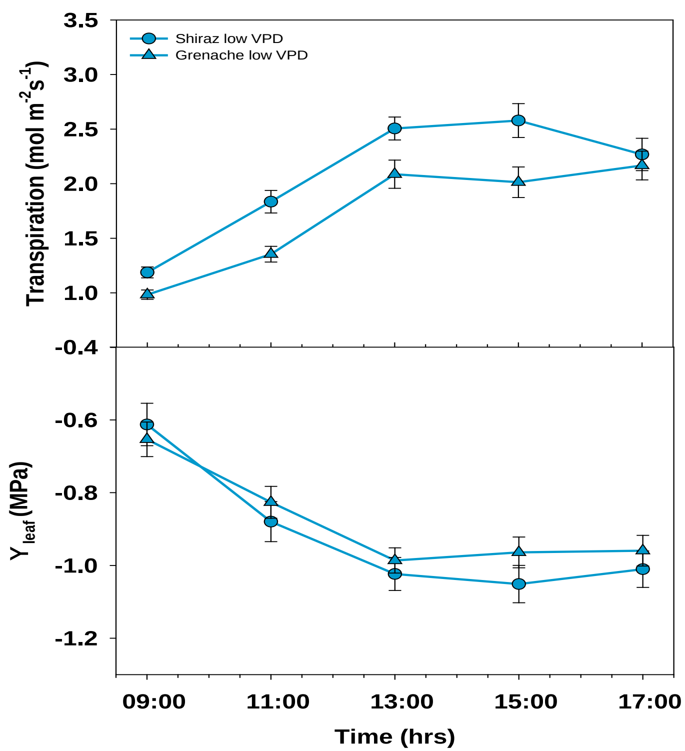
Low VPD
(cool day)

Soar et al. (2006) Aust J Grape Wine Res 12: 2-12

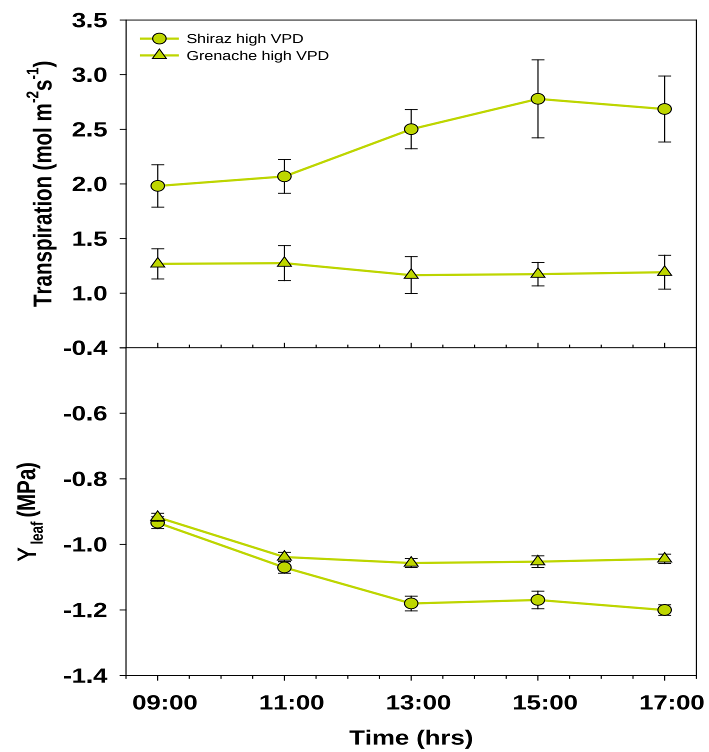
How can scion variety influence water use?

The Australian Wine
Research Institute

Implications of iso- & aniso-hydric behaviour



Low VPD



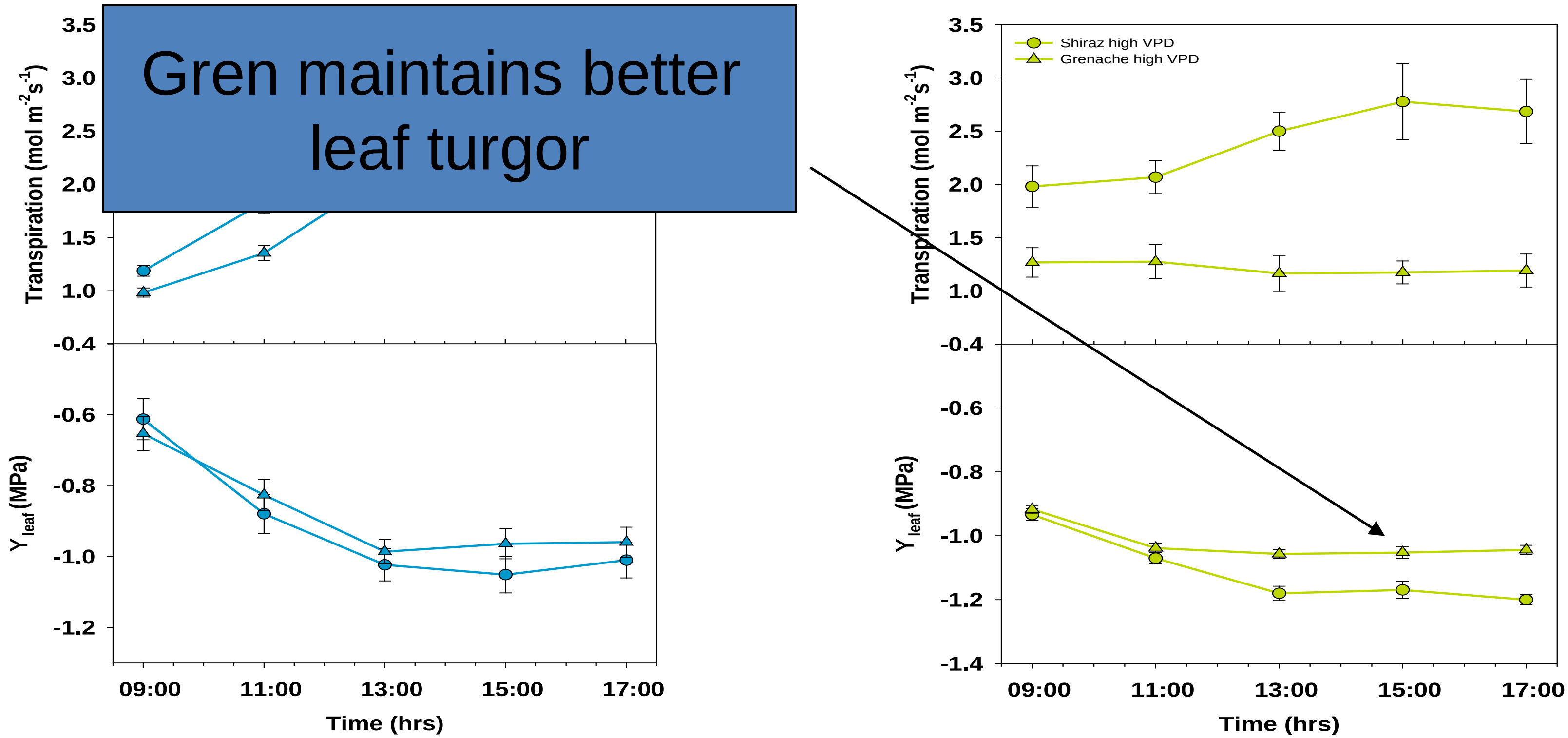
High VPD
Hot day

Soar et al. (2006) Aust J
Grape Wine Res 12: 2-12

How can scion variety influence water use?

The Australian Wine Research Institute

Implications of iso- & aniso-hydric behaviour



Low VPD

High VPD
Hot day

Soar et al. (2006) Aust J Grape Wine Res 12: 2-12

How can scion variety influence water use?

The Australian Wine Research Institute

Importance of stomatal response

- Differences between varieties for stomatal response means that irrigation strategy should be considered

- For example, an optimist like Shiraz may benefit from short, more frequent irrigations while a pessimist like Grenache may benefit from longer, less frequent irrigations.

How can scion variety influence water use?

The Australian Wine
Research Institute

Irrigation strategy can influence stomatal behaviour

- eg partial rootzone drying (PRD) causes Shiraz to change from normal optimistic behaviour to pessimistic behaviour

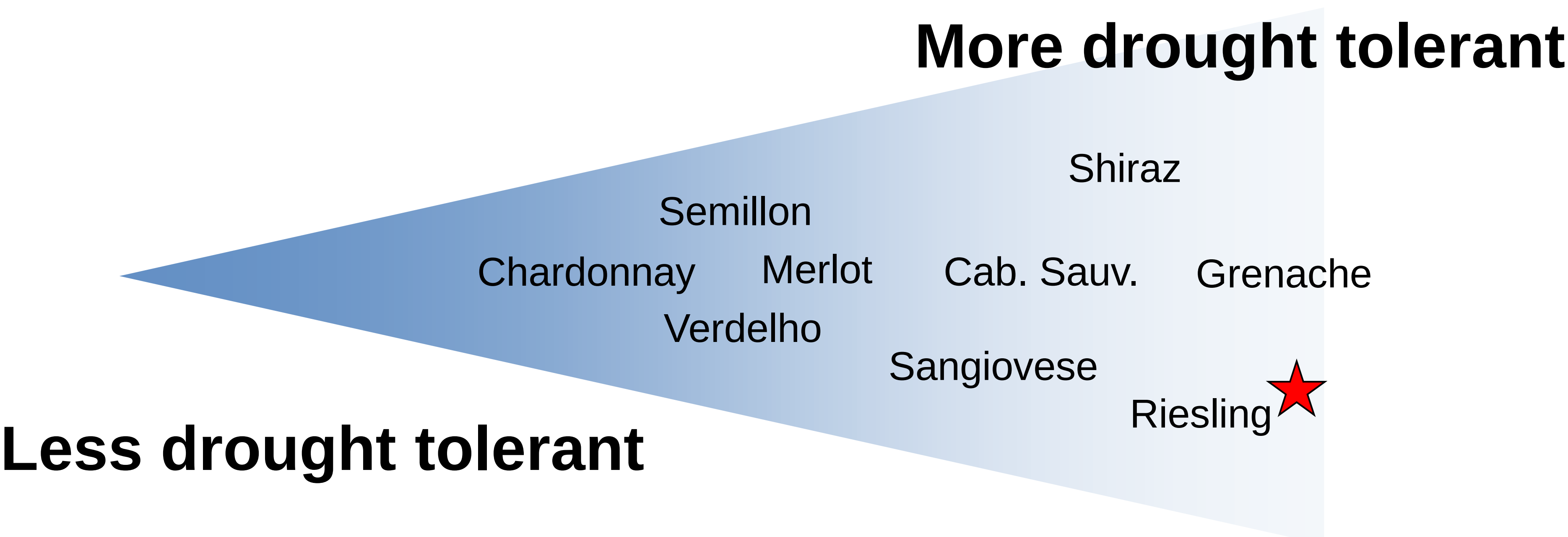
- as a result, water-use use efficiency is increased

How can scion variety influence water use?

The Australian Wine Research Institute

Ranking varieties by water-use strategies

- Preliminary results of ongoing study (B. Loveys et al.)
- Rankings based on varietal response to VPD at the leaf level (primarily interactions between VPD, g_s, Y_L and ABA)



Rootstocks can influence water use

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Research Institute

Rootstock genotype can influence:

- Root biomass and architecture
- Hydraulic conductivity
(water uptake/movement into roots & shoots)
- Canopy leaf area
- Stomatal conductance
- Canopy transpiration
- Yield
- Drought tolerance
- Salinity tolerance

Rootstocks can influence water use

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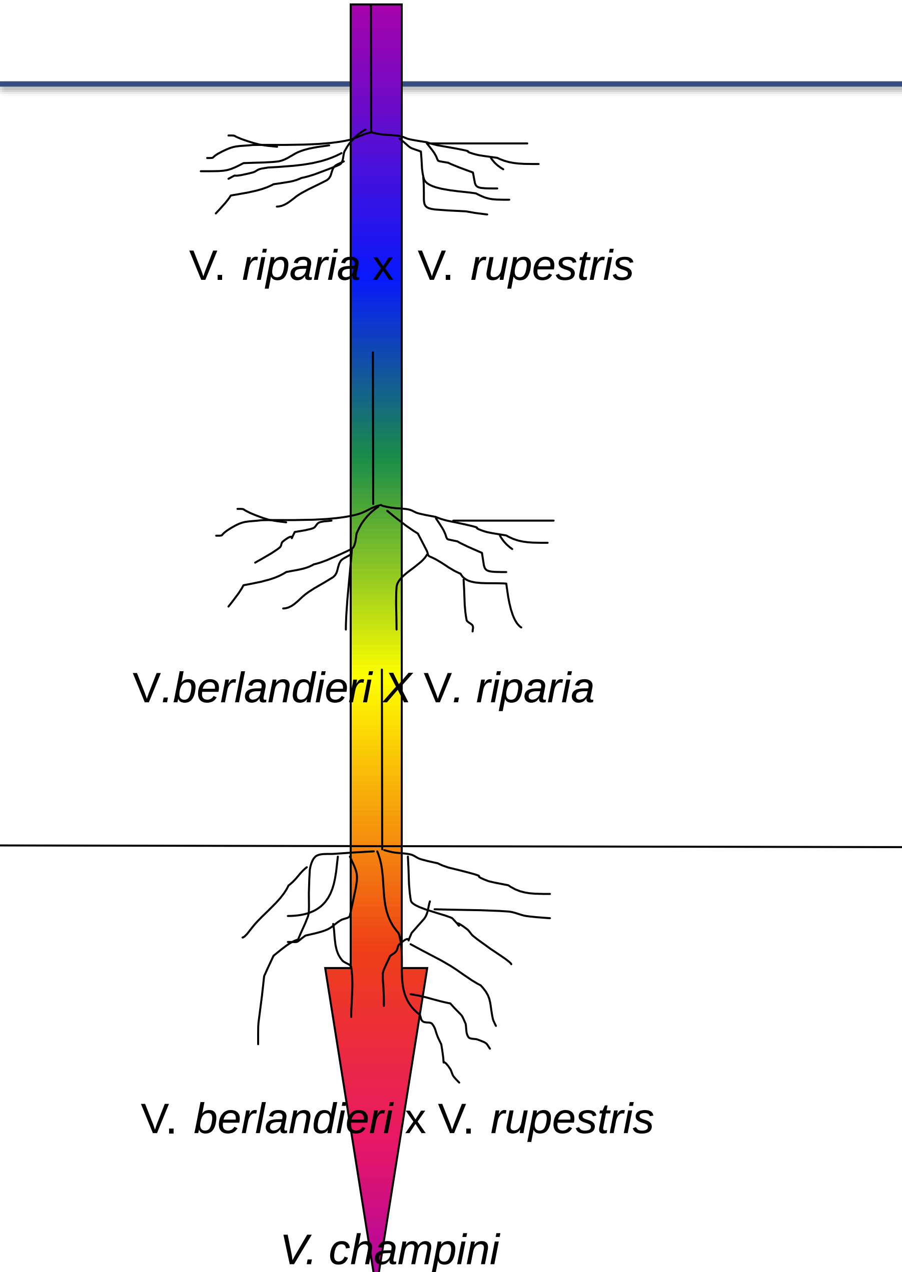


e.g. 101-14, Schwartzman, 3309

e.g. SO4, 5C Teleki, 5BB Kober

e.g. 110 Richter, 1103 Paulsen, 99 Richter
140 Ruggeri

e.g. Ramsey

Source: Dry, N. (2007)

Conclusions

The Australian Wine
Research Institute

- An understanding of plant water use is necessary to understand how grapevines cope with drought and heat
- Grapevines use various mechanisms to reduce water use under drought conditions
- But not all varieties behave in the same way: some varieties are OPTIMISTIC and some are PESSIMISTIC: knowledge of this behaviour may aid water management decisions

Conclusions cont.

- Optimistic and pessimistic behaviour is the result of several different ‘characteristics’
- Rootstocks can influence water use and response to drought and heat
- Drought exacerbates heat stress and thus irrigation management (if irrigation is available) before and during heat waves is critical

References and further reading

Dry, N. (2007) Grapevine Rootstocks. Phylloxera and Grape Industry Board of SA/Lyrthrum Press.

Mullins MG, Bouquet A, Williams LE (1992) 'Biology of the grapevine.' (Cambridge University Press: Cambridge)

Schultz HR (2003) Differences in hydraulic architecture account for near-isohydric and anisohydric behaviour of two field-grown Vitis vinifera L. cultivars during drought. Plant, Cell and Environment 26, 1393-1405.

Soar CJ, Speirs J, Maffei SM, Penrose AB, McCarthy MG, Loveys BR (2006) Grape vine varieties Shiraz and Grenache differ in their stomatal response to VPD: apparent links with ABA physiology and gene expression in leaf tissue. Australian Journal of Grape and Wine Research 12, 2-12.

Walker RR, Blackmore DH, Clingeleffer PR, Tarr CR (2007) Rootstock effects on salt tolerance of irrigated field-grown grapevines (Vitis vinifera L. cv. Sultana). 3. Fresh fruit composition and dried grape quality. Australian Journal of Grape and Wine Research 13, 130-141.

AWRI

The Australian Wine Research Institute

Practical strategies for reducing alcohol levels in wine

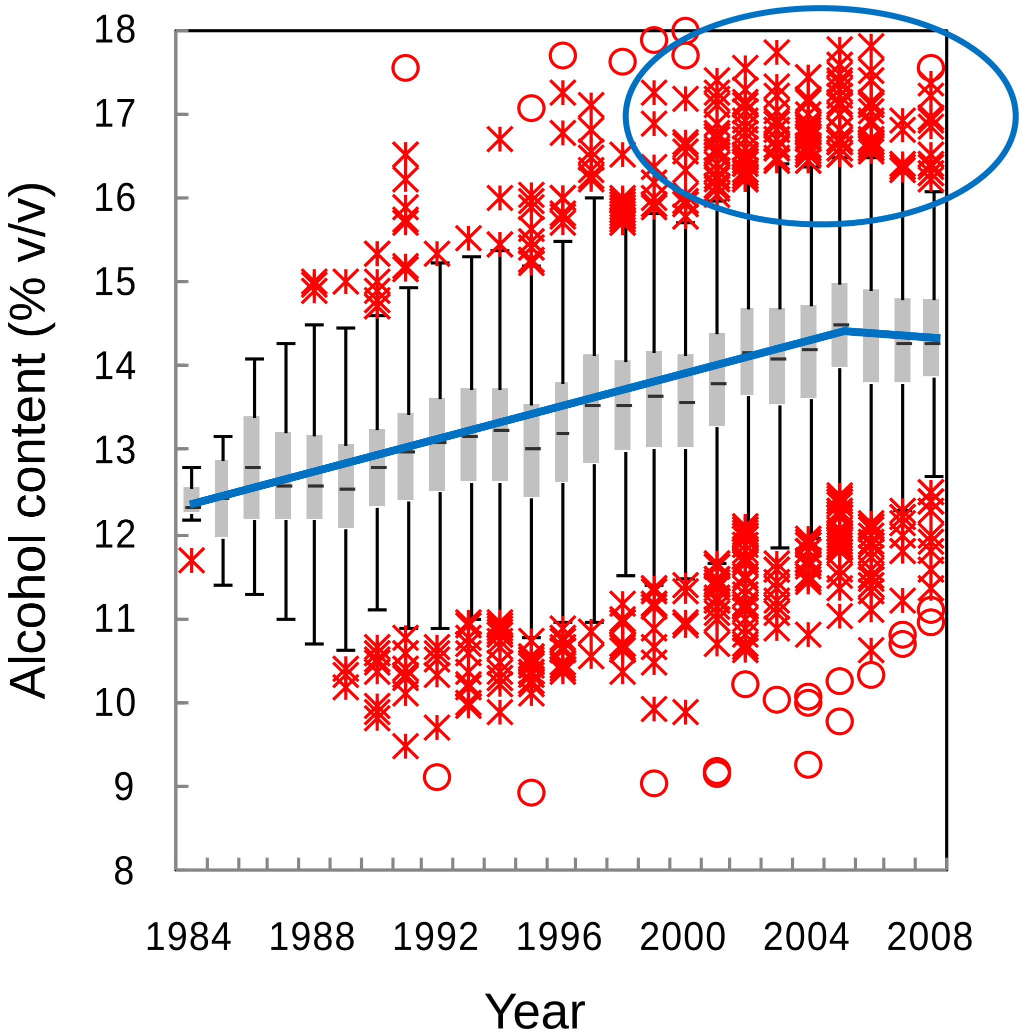
Presenter: Paul Henschke

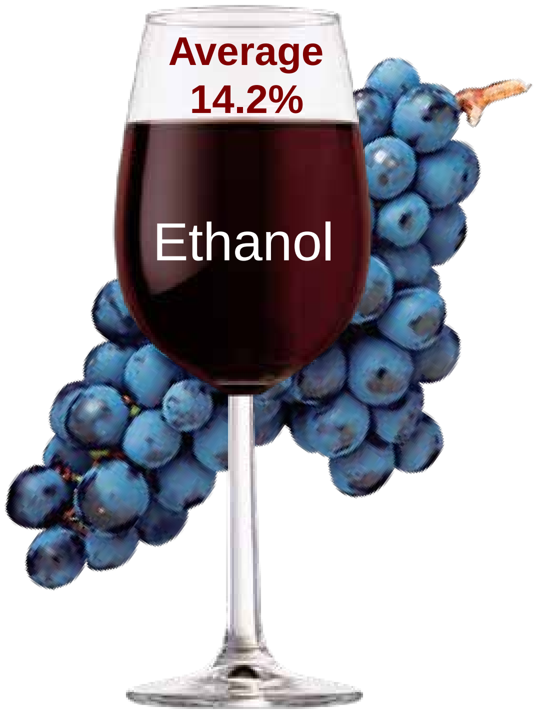
Principal Research Microbiologist

Cristian Varela, Darek Kutyna, Adrian Coulter, Keren Bindon, Richard Gawel, Creina Stockley, Richard Muhlack, Peter Dry, Leigh Francis, Markus Herderich, Sakkie Pretorius*, Paul Henschke, Chris Curtin, Paul Chambers

*Formerly AWRI

Alcohol in Australian Wine





Why is alcohol increasing?

Grape maturity enhances rich, ripe fruit flavour, and colour intensity.

Decreases the unripe green and vegetal flavours.

Greater maturity leads to higher sugar content.

Higher sugar equals higher alcohol levels.

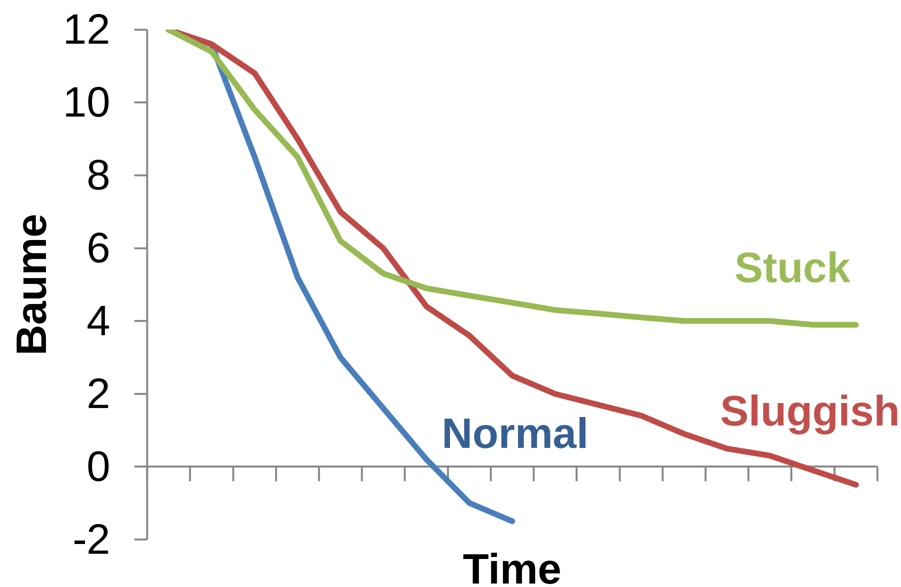
Why reduce alcohol?

15 % 14 % 13 % 12 %

Ethanol content

Wine & society

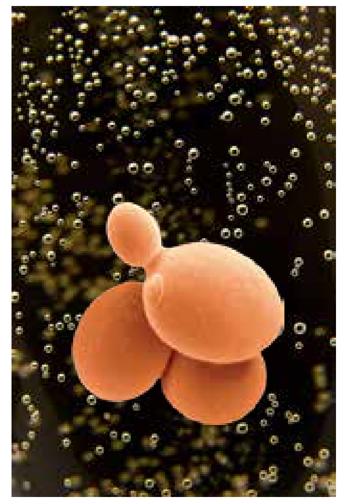
Alcohol abuse



How to reduce alcohol?

Viticultural practices

Winemaking practices



Fermentation practices

Post-fermentation technologies

Viticultural Practices

Trial with caution…

May cause excessive/delayed ripening at high crop loads or excessive bunch exposure

Trial with caution…

Harvesting earlier might increase green/vegetal characters; some yeast can lessen impact

Reduction of leaf area to fruit weight ratio

High LA/FW causes rapid accumulation and excessive sugar levels by the time that flavour or phenolic ripeness is judged to be optimal for a particular wine style

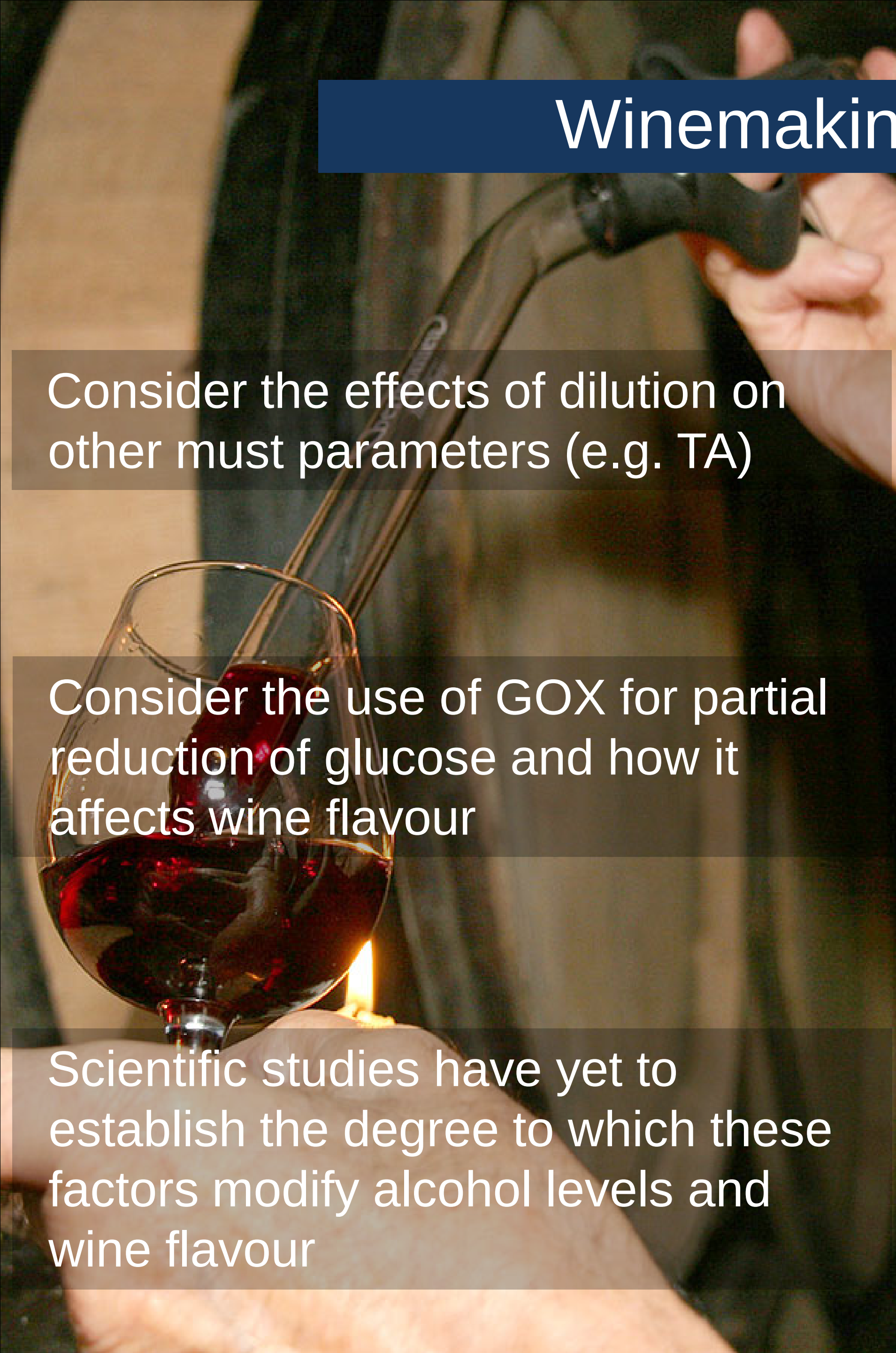
Pre-harvest irrigation

Substantial increase in pre-harvest irrigation volume does NOT appear to significantly effect sugar accumulation or alcohol concentration

Harvest earlier

Less sugar is present at harvest, which might have style considerations

Winemaking Practices



Consider the effects of dilution on other must parameters (e.g. TA)

Consider the use of GOX for partial reduction of glucose and how it affects wine flavour

Scientific studies have yet to establish the degree to which these factors modify alcohol levels and wine flavour

Blending

Grape musts high in sugar can be blended with low strength juice (LSJ) or condensate within regulations

Must treatment

Enzyme addition: Glucose Oxidase (GOX) converts glucose into gluconic acid and hydrogen peroxide in presence of (limited) oxygen.

Fermentation management and design

Evidence that higher fermentation temperatures decrease alcohol levels

Tank type and design have been indicated as important factors

Winemaking Practices

Large-scale studies have yet to establish the degree of alcohol decrease by AWRI 796

Choice of yeast strain

Strain AWRI 796 gives lower ethanol yield than several commercial wine strains

AWRI 796 is able to complete fermentation of musts prepared from high Baume fruit… attention to YAN and aeration are important in clarified musts

This yeast also produces higher titratable acidity (TA) than others

Post-Fermentation Technologies

More peer-reviewed research needed on potential side-effects of de-alcoholisation technologies

Management of mould development is a risk when barrels are exposed to high humidity for prolonged periods

CAUTION: Application of all winemaking methods must comply with wine regulations pertaining to the country of sale

Physical removal of alcohol

Membrane-based systems, Vacuum distillation, Spinning cone separation

Loss of alcohol by evaporation

During barrel maturation, both water and ethanol evaporate. Alcohol was reported to drop by 0.2% v/v when barrels were stored for 12 months at 15 ° C with relative humidity over 90%

Blending

Evaluate whether blending a high alcohol wine with one that is lower is a viable option

Sensory Impacts and Consumer Preferences

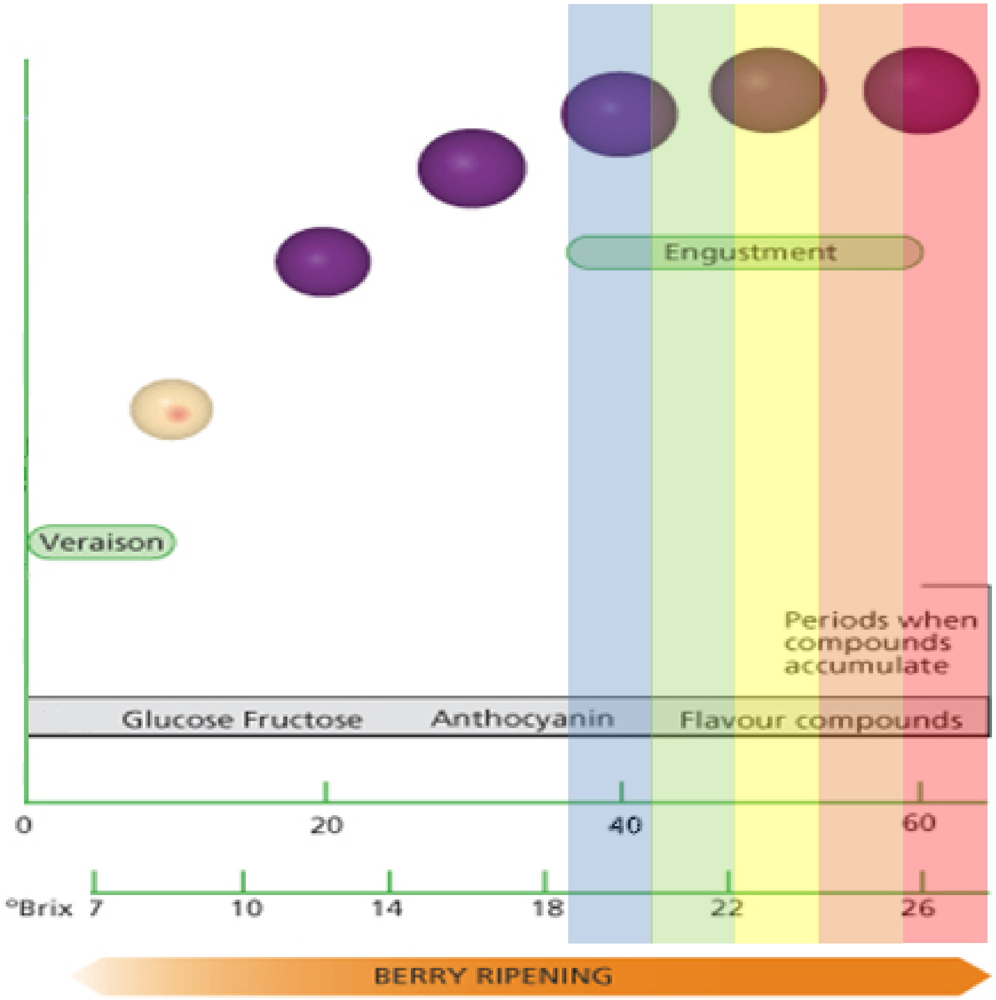
Consider your market segment when producing wines with high alcohol levels

For further information:

http://www.awri.com.au/industry_support/winemaking_resources/frequently_asked_questions/notes/reducing_alcohol_levels_in_wine.pdf

Or contact Adrian Coulter: 08 8313 6600; adrian.coulter@awri.com.au

The Maturity Trial: Does Alcohol Matter?



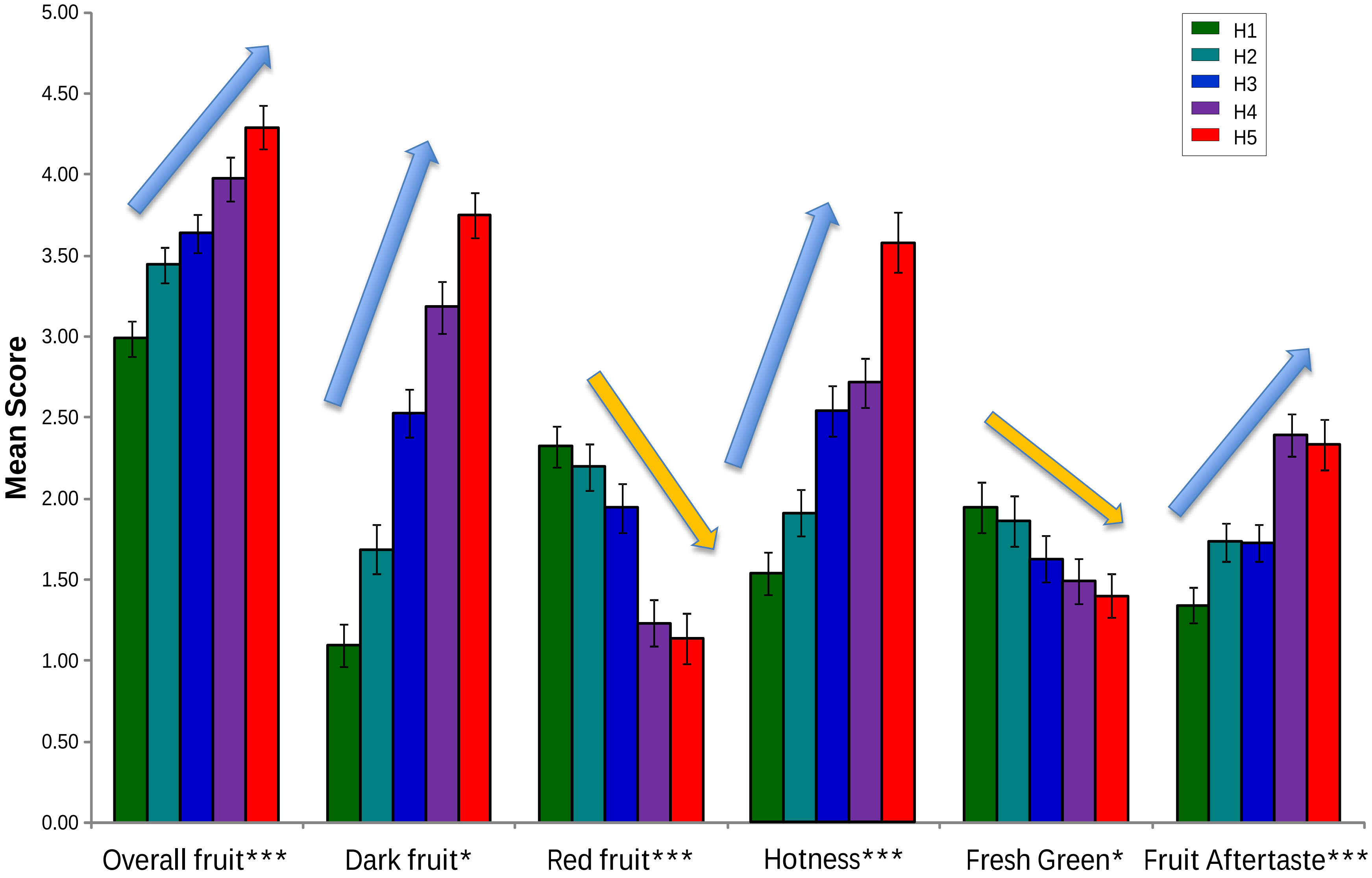
Cabernet Sauvignon grapes

Five harvesting times

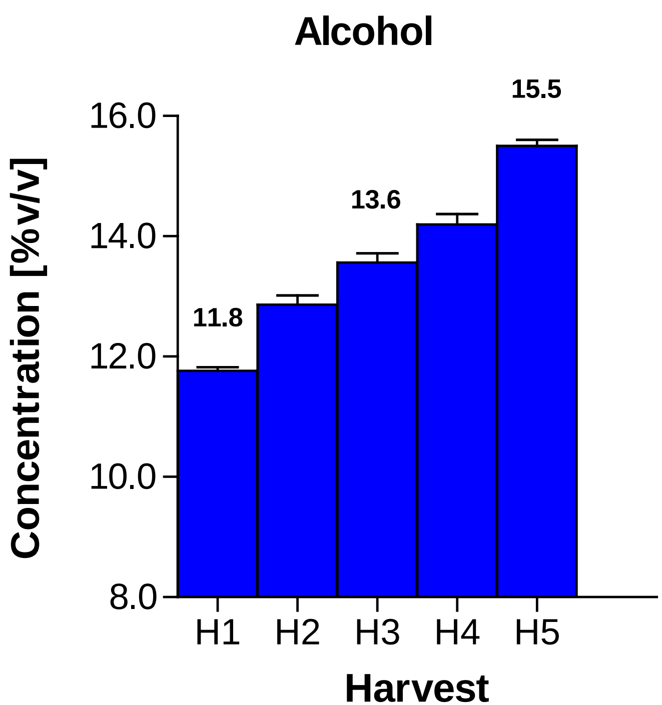
No malolactic fermentation

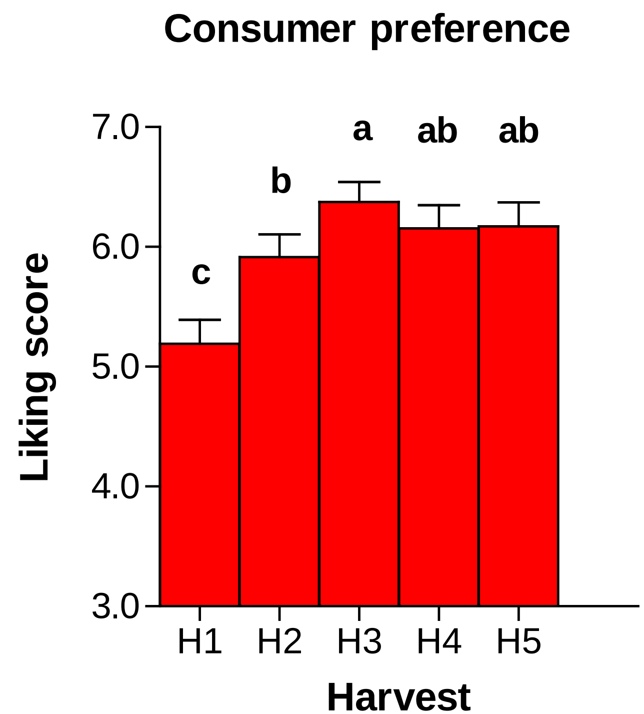
Alcohol concentration from:
11.8 % v/v to 15.5 % v/v

Some Sensory Data - Palate attributes



Consumer liking & alcohol content





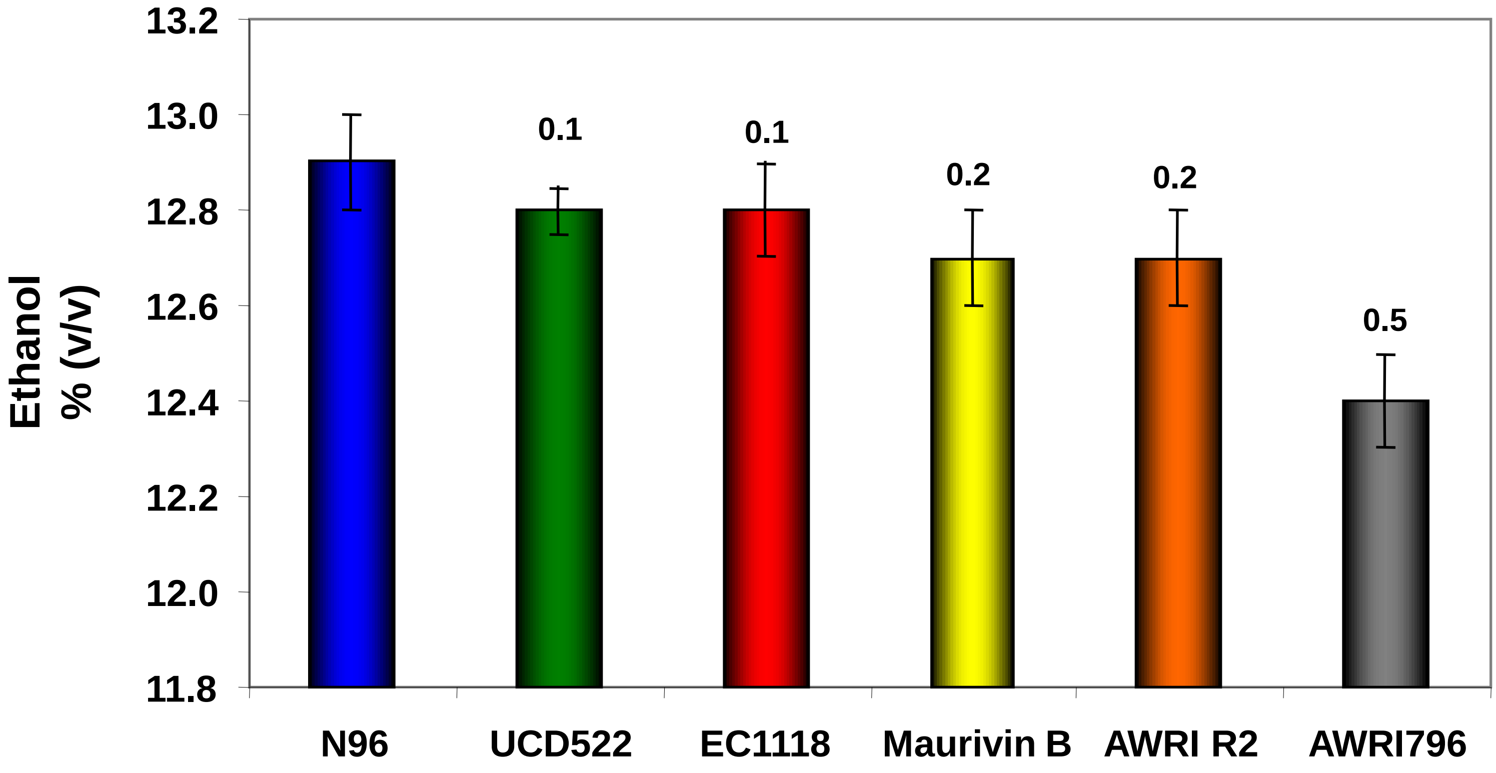
Harvesting earlier could deliver a wine that consumers prefer or like just as much and contains up to 2 %(v/v) less alcohol

Caution: One trial – one variety – one vintage

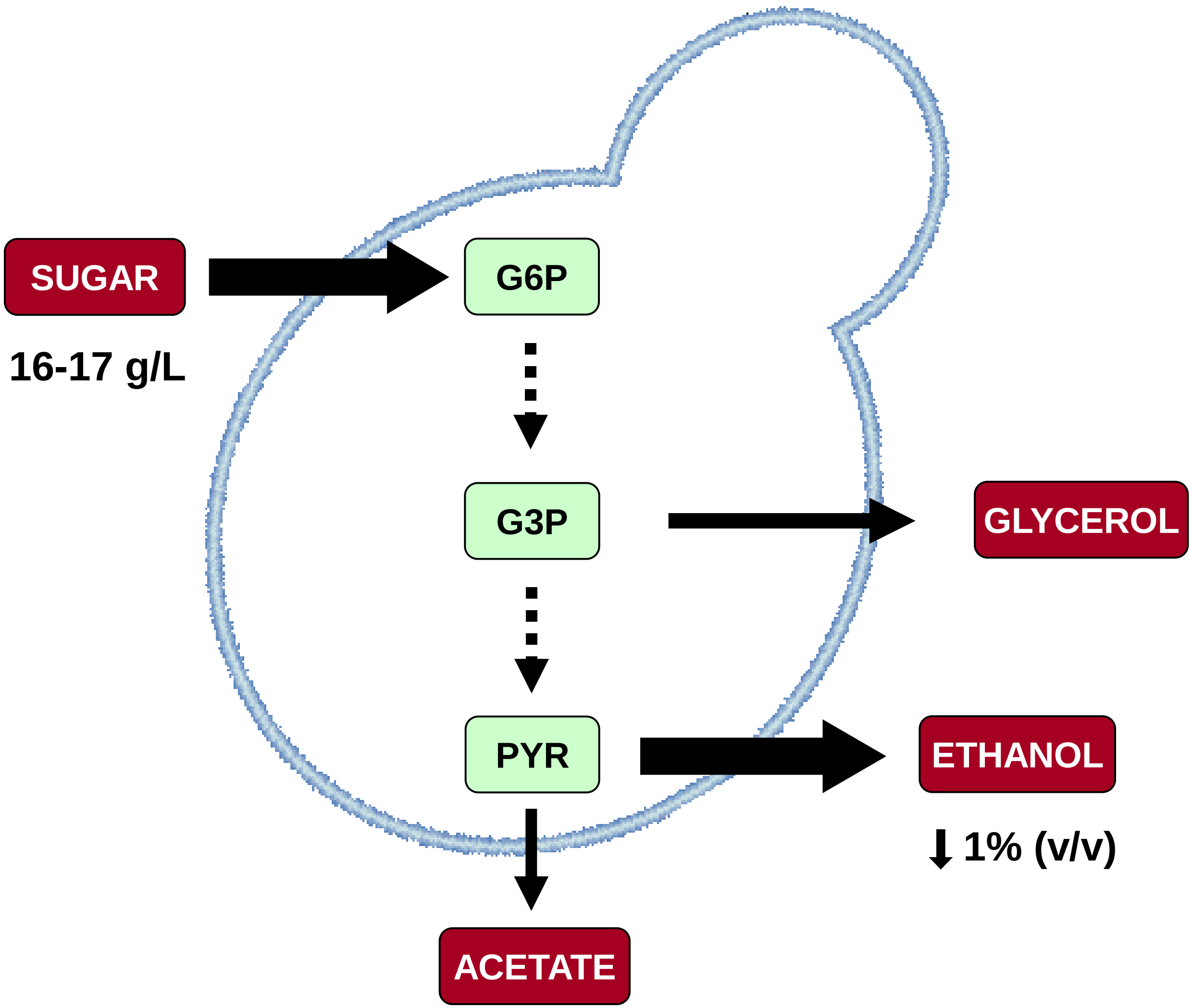
Aim

Produce an industrial wine yeast strain that generates less ethanol than existing strains

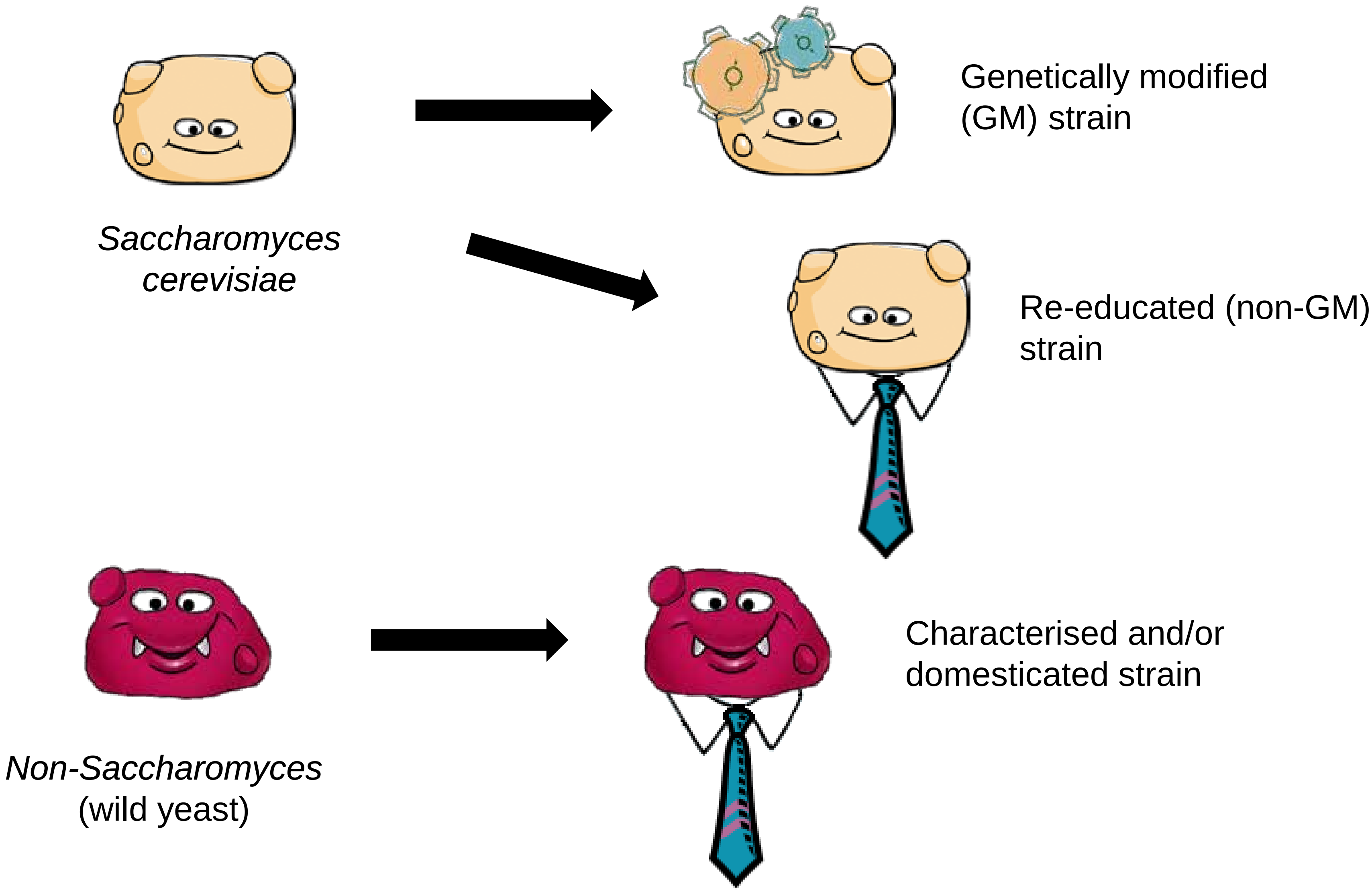
Existing variation between wine yeasts



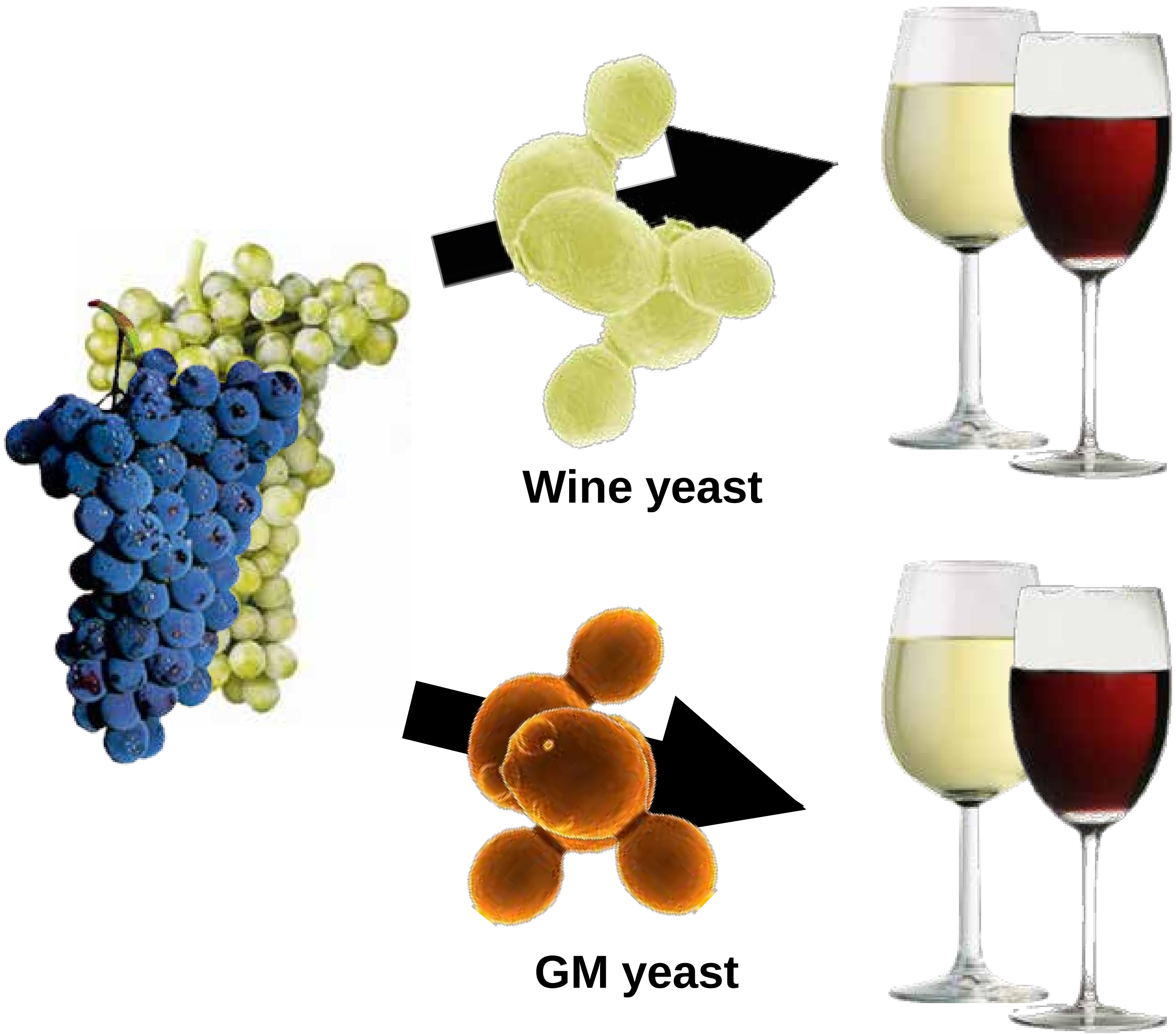
Where does variation arise?



Low-ethanol yeast – three strategies



Best GM low-alcohol yeasts



AWRI1631
Ethanol
15.7 %(v/v)

Glycerol
9 g/L

Acetic acid
0.2 g/L

AWRI2531
Ethanol
13.3 %(v/v)

Glycerol
30 g/L

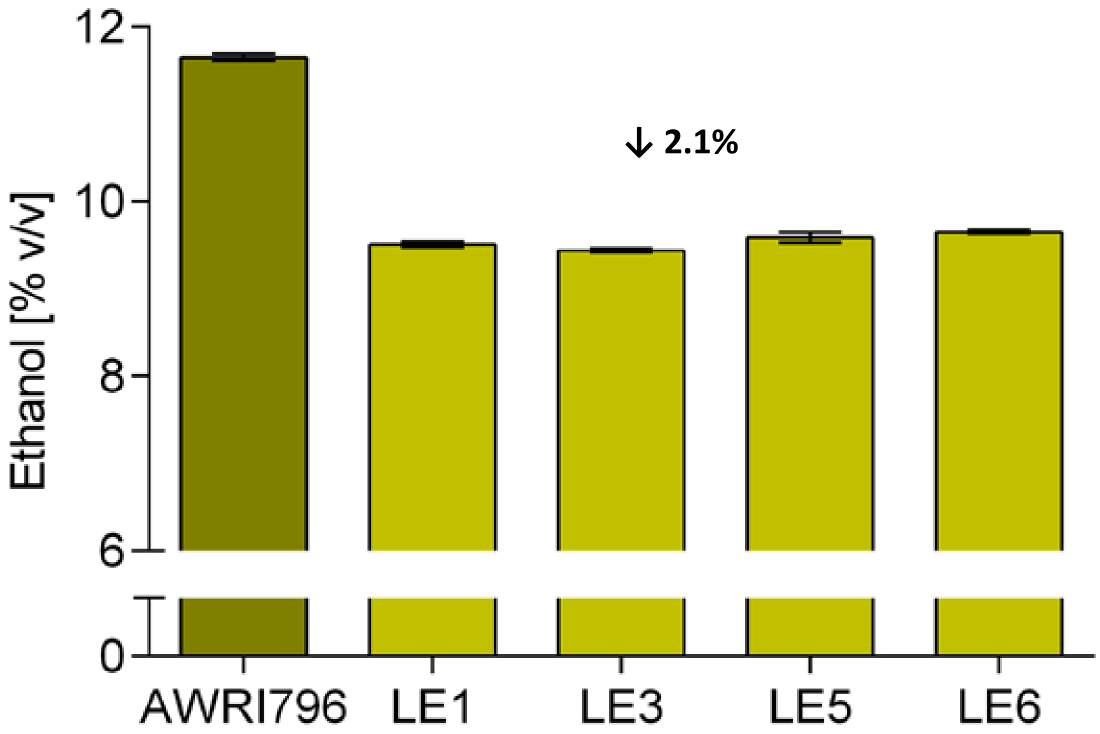
Acetic acid
0.2 g/L

AWRI2532
Ethanol
12.2 %(v/v)

Glycerol
40 g/L

Acetic acid
0.5 g/L

Best pilot non-GM approach

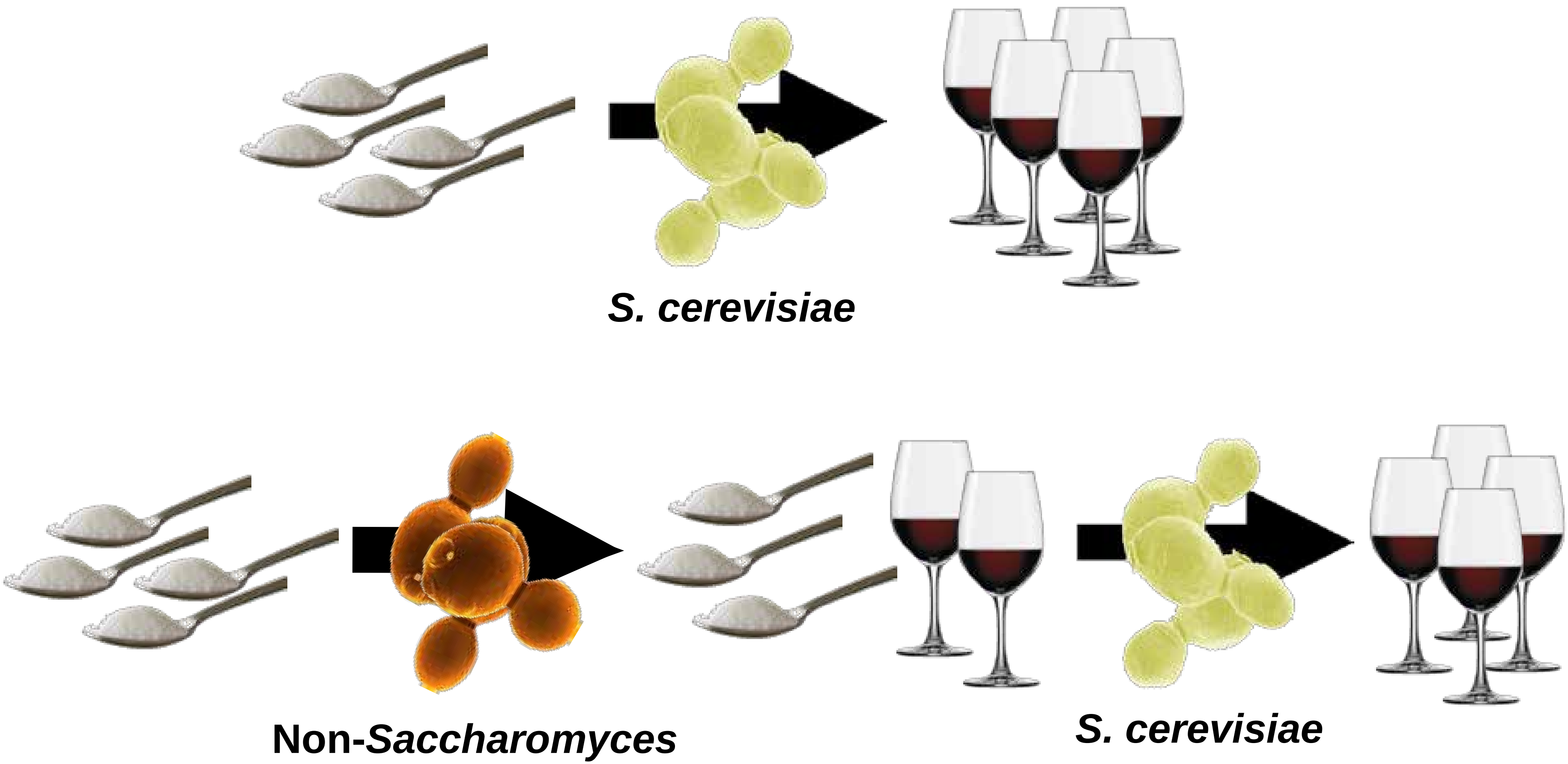


Chardonnay
Anaerobic conditions
22C

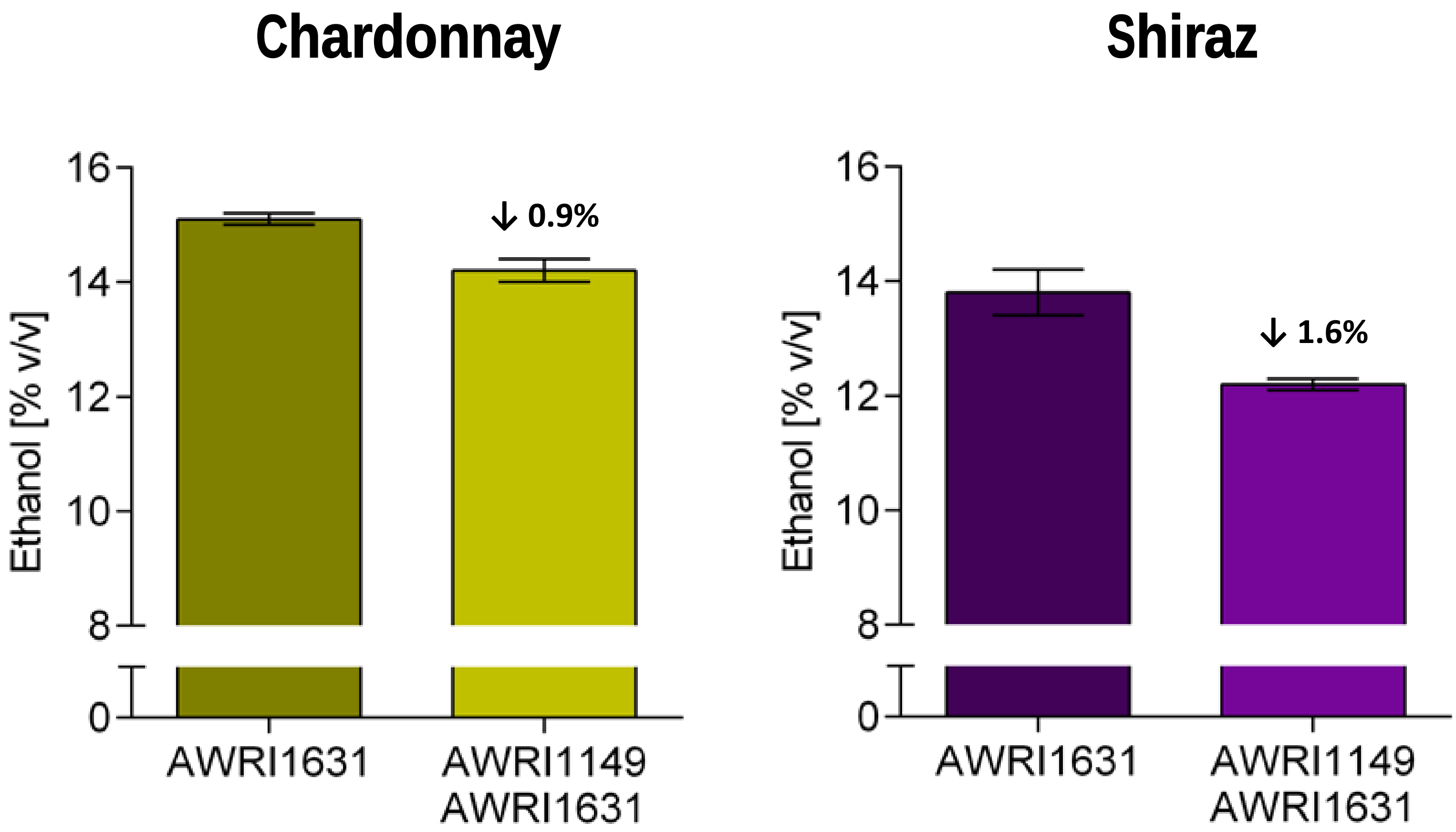
Non-*Saccharomyces* strains

- 50 Non-*Saccharomyces* strains
- Sequential inoculation
- Aerobic and anaerobic conditions

Sequential inoculation



Best non-*Saccharomyces* strain



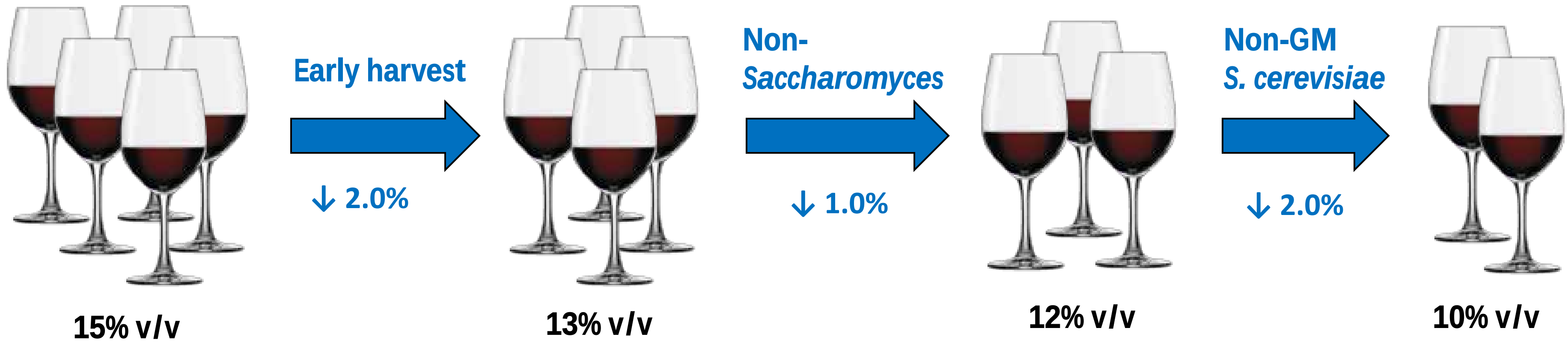
Summary

- Holistic approach on how to reduce alcohol in wine
  - Combinations of strategies for small reductions can lead to significant decreased yield of alcohol

- Experimental fermentation strategies in progress
  - GM yeast show great promise
    - AWRI2532 produces 3.5% v/v less ethanol, might have quality-sensory issues
    - AWRI2531 produces 2.6% v/v less ethanol and shows less quality-sensory issues
  - Non-GM strains, to date, show a promising but smaller decrease in ethanol yield of 1 – 2% v/v than seen with GM strains

Summary

- Holistic approach on how to reduce alcohol in wine.
- Consumer study key to understand alcohol preferences.
- GM low-alcohol yeasts fundamental for the development of non-GM strains.
- Non-*Saccharomyces* strains show potential for alcohol reduction.



The Australian Wine Industry Position on Gene Technology

’It is the Australian wine industry’s position that no genetically modified organisms be used in the production of Australian wine’

wfa Winemakers’ Federation of Australia

Acknowledgments

AWRI – Alcohol Content Advisory Group

Creina Stockley (IDS)
Keren Bindon (Tannin group)
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Richard Gawel (Biochemistry)
Richard Muhlack (Industry Applications)
Peter Dry (IDS)
Leigh Francis (Sensory)

Systems Biology

Paul Chambers
Anthony Borneman
Simon Schmidt

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Angela Contreras
Claudio Hidalgo

Sensory team

Helen Holt
Patricia Osidacz

AWRI Management

Markus Herderich
Sakkie Pretorius

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gwrdc
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Bioplatforms Australia

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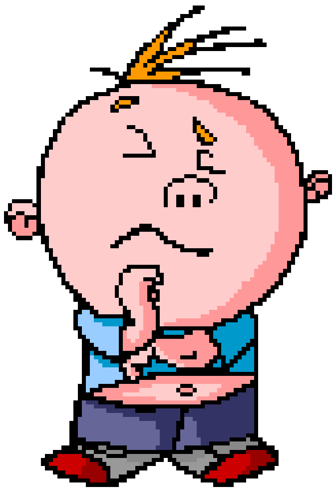
AWRI

The Australian Wine Research Institute

Vine balance – how does it affect yield and wine quality?

Mark Krstic

Case study



Which block would your winemaker choose?

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- Cabernet Sauvignon/cool climate

A: 8 t/ha

B: 3 t/ha

Cabernet Sauv./cool climate

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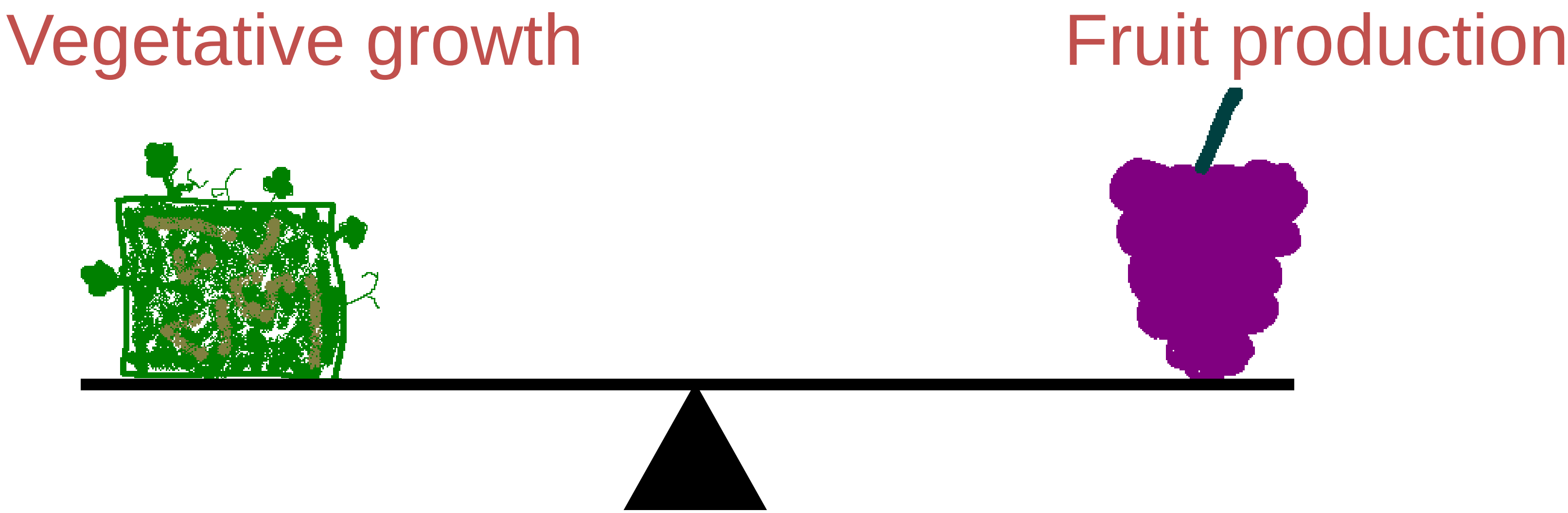
Which block would your winemaker choose?

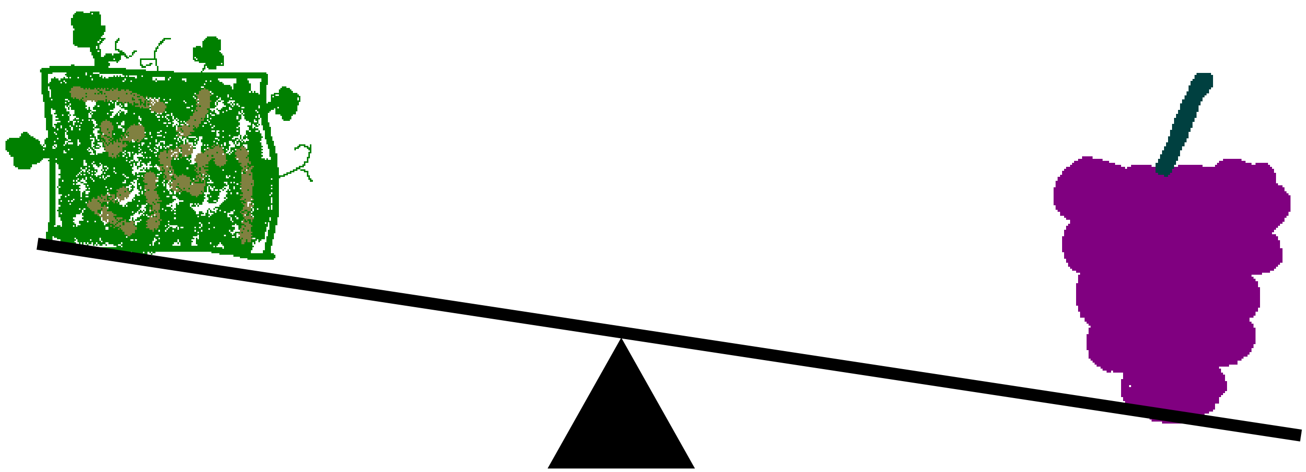
A

B

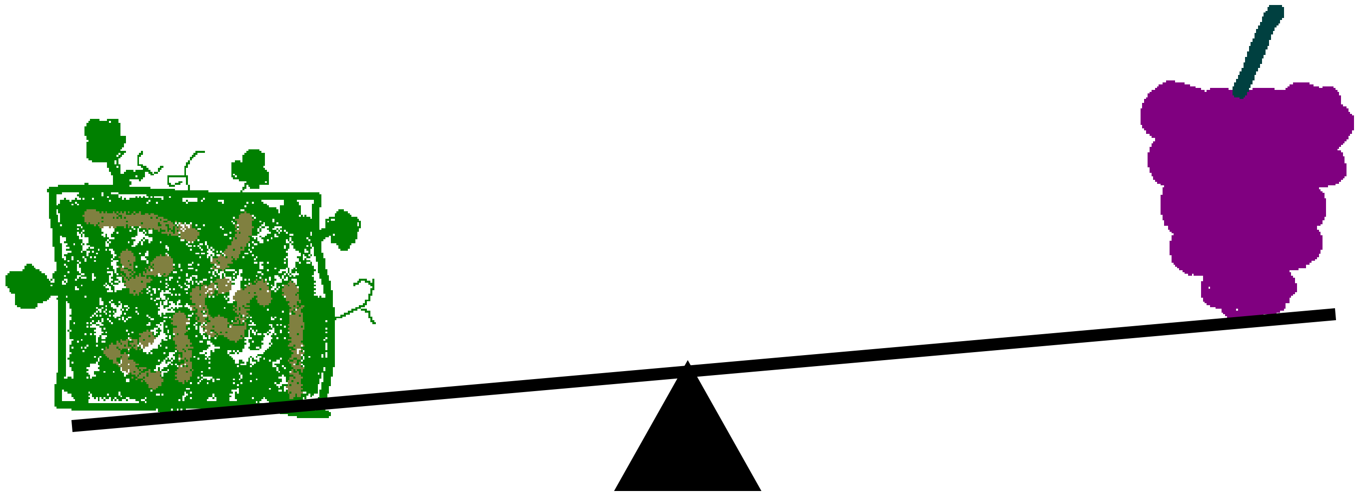
‘Balance is achieved when vegetative vigour and fruit load are in equilibrium and consistent with high fruit quality’
Gladstones (1992) Viticulture and Environment



‘overcropping’



excessive vigour; undercropping



The Indices of Vine Balance

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1. Fruit yield to pruning weight

(Y/P, Ravaz Index)

- Recommended range for Y/P is generally between 5 and 10

Cool climates

Hot climates

This is easy to calculate

Fruit yield to pruning weight contd

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Y/P = 6

Y/P = 2

The Indices of Vine Balance

2. Leaf Area to Fruit Yield ratio (LA/Y)

- Recommended range:

  0.5 to 1.5 m^2/kg

Hot climates

Cool climates

Divided canopies

Single canopies

Measuring leaf area

- Sampling and counting
- Measure pruning weight
  - LA (m2) = PWT (kg) x 6.6

What else can you use to estimate balance?

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- Cessation of shoot growth by veraison

Can this be quantified?

A diversion to Bordeaux

Source: van Leeuwen et al. (2004)

- Terroir study
- 3 soil types
  - 'dry' = gravelly
  - 'moist' = clay subsoil
  - 'wet' = sandy + roots in contact with high water table
- Cab Sauv, Cab Franc, Merlot

What were the seasonal factors most closely associated with vintage rating?

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- Yield?
- Berry size?
- Sunshine?
- Temperature?
  - mean or day degrees
- Length of ripening period?
- Rainfall?

What were the seasonal factors most closely associated with vintage rating?

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- ~~Yield?~~
- ~~Berry size?~~
- ~~Sunshine?~~
- ~~Temperature?~~
- ~~Length of ripening period?~~
- Rainfall? – flowering to harvest yes

What were the seasonal factors most closely associated with vintage rating?

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- Best vintages where water supply to vine from flowering to harvest was most limiting
- Either soil effect or seasonal effect or both
- Water deficit prior to veraison ⟶ early cessation of shoot growth

Cessation of shoot growth by veraison

- Why is this significant?
- Diversion of resources to fruit?
  - Or some other factor?
- Diversion of resources to roots?
  - ® increased supply of hormones from roots to ripening fruit?

Vine balance

- Berry weight/size
- Yield

Are these good indicators of vine balance?

Yield and vine balance

C grade
20 t/ha

A grade
5 t/ha

Bunch thin to 5 t/ha
Improved balance?

Bunch thin to 5 t/ha
Improved balance? No
Same wine quality as B? No

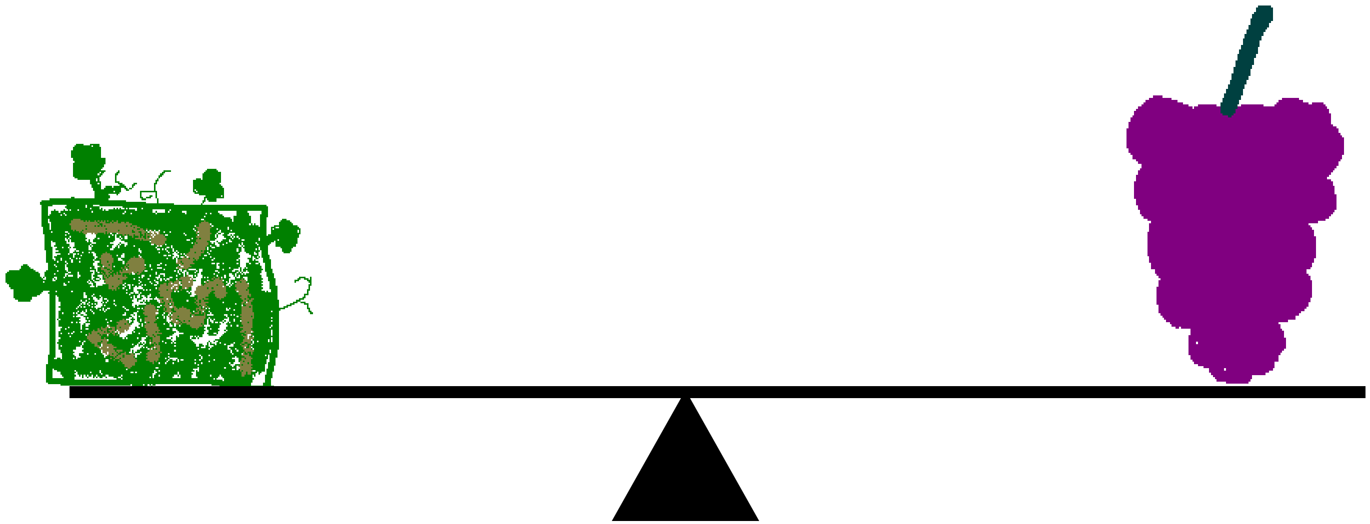
Yield

- low yielding vineyards MAY produce better wine than high yielding
- However, it is not necessarily the low yield *per se* — rather it is where the vines are grown and the way that they are managed that determines the quality.

Yield reduction

- Yield reduction (e.g. bunch thinning) does not automatically ensure good wine quality
  - And it may decrease quality
- But there may be a yield limit above which quality decreases
  - Perhaps root system is involved

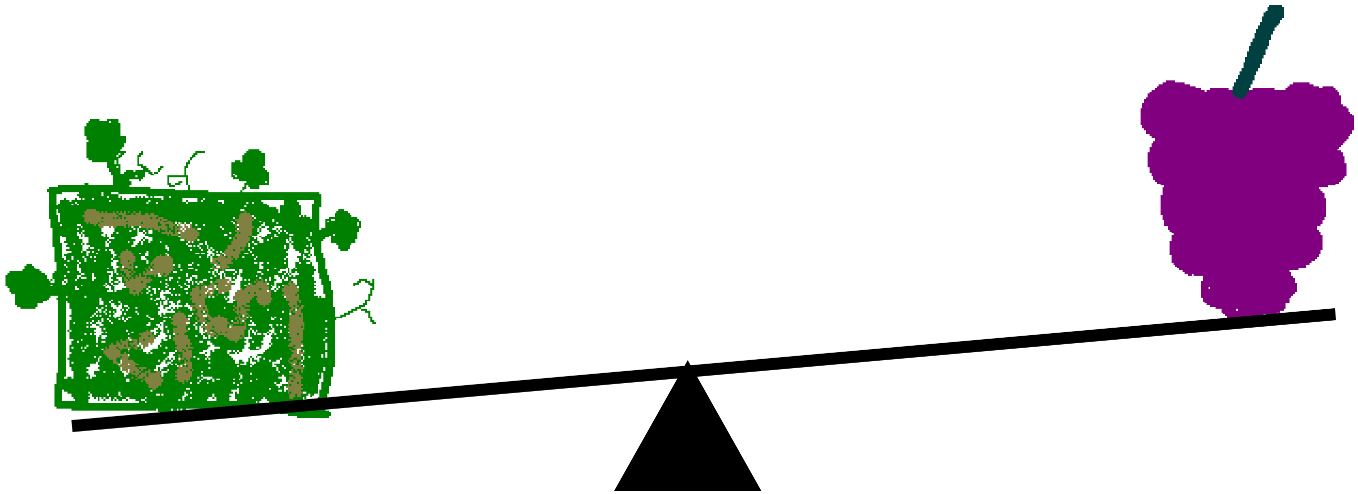
How to Achieve Balance



How to Achieve Balance: some principles

- Need to achieve balance prior to veraison
- Need to develop adequate LA for ripening
- Avoid excessive shoot vigour

What do you do if vineyard is like this?



- control vegetative growth by inducing mild to moderate water stress

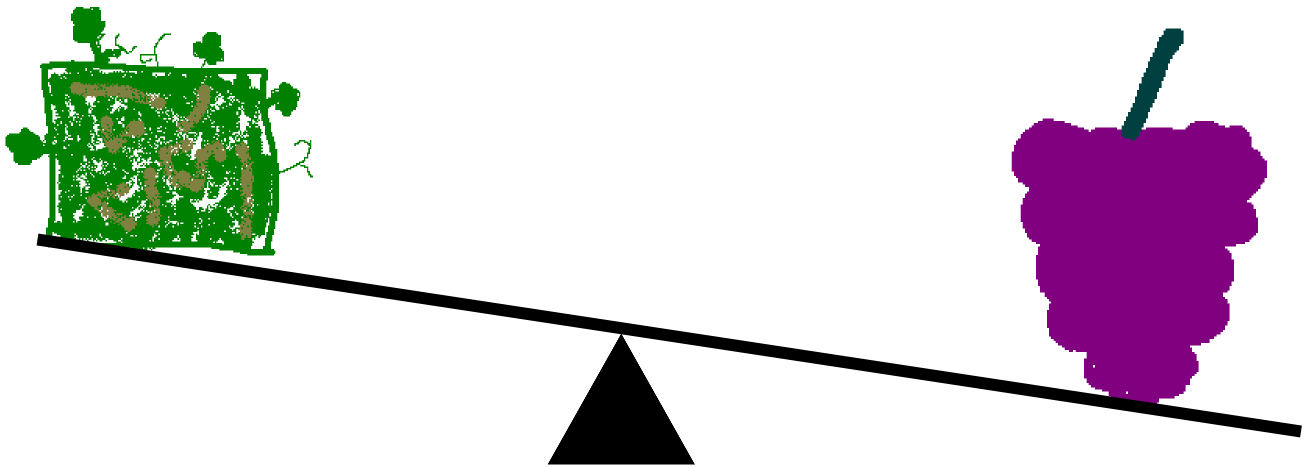
Irrigation management

Soil management

How to switch off shoot growth by veraison

- Limit water (and to lesser extent N) supply
  - Relatively easy in low rainfall climate
- In high rainfall must have low capacity soils

What do you do if vineyard is like this?



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- Yield control
  - Pruning level
  - Bunch thinning

Does yield regulation lead to improved wine quality?

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Perhaps – but it depends on:

- The starting point
- How and when it is done
- May only be effective if it improves vine balance
  - It will be ineffective if it disrupts vine balance
  - and causes sugar ripening to be too advanced relative to flavour ripening

Does FW/PW correlate with wine quality?

- Cab Sauv, single vineyard, Calif (Dokoozlian et al. 2011)
- Bunch thinning 3 weeks after fruitset

Treatment	Yield t/ha	FW/PW	Days to reach 24° Brix (relative to BA)
‘Undercropped’ UC	4	3	-12
‘Balanced’ BA	15	8	0
‘Overcropped’ OC	30	14	+11

Does FW/PW correlate with wine quality?

The Australian Wine Research Institute

- Cab Sauv, single vineyard, Calif (Dokoozlian et al. 2011)
- Bunch thinning 3 weeks after fruitset

Treatment	Yield t/ha	FW/PW	Days to reach 24° Brix	OAV damascenone at 24° Brix
'Undercropped'	4	3	-12	200
'Balanced'	15	8	0	380
'Overcropped'	30	14	+11	160

Does FW/PW correlate with wine quality?
(Dokoozlian et al. 2011)

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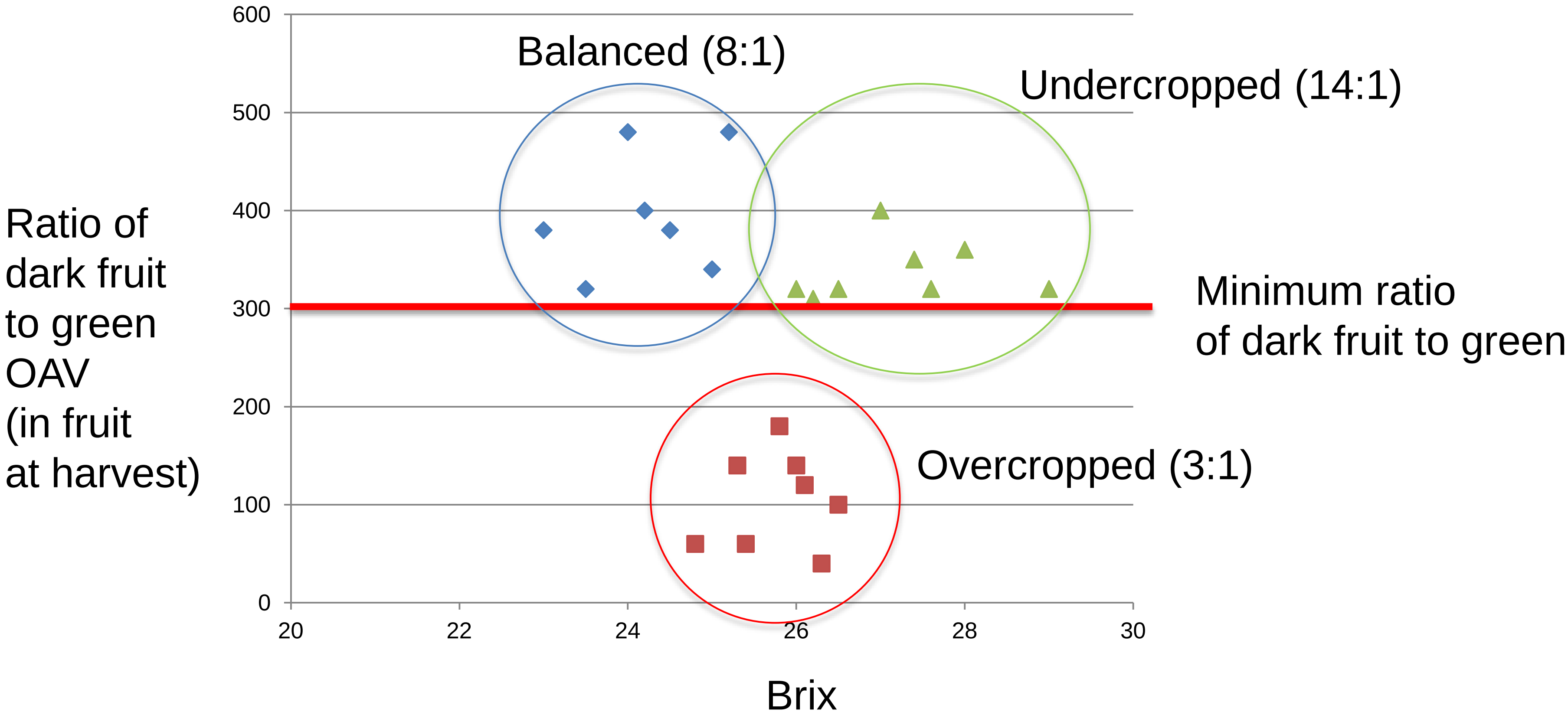
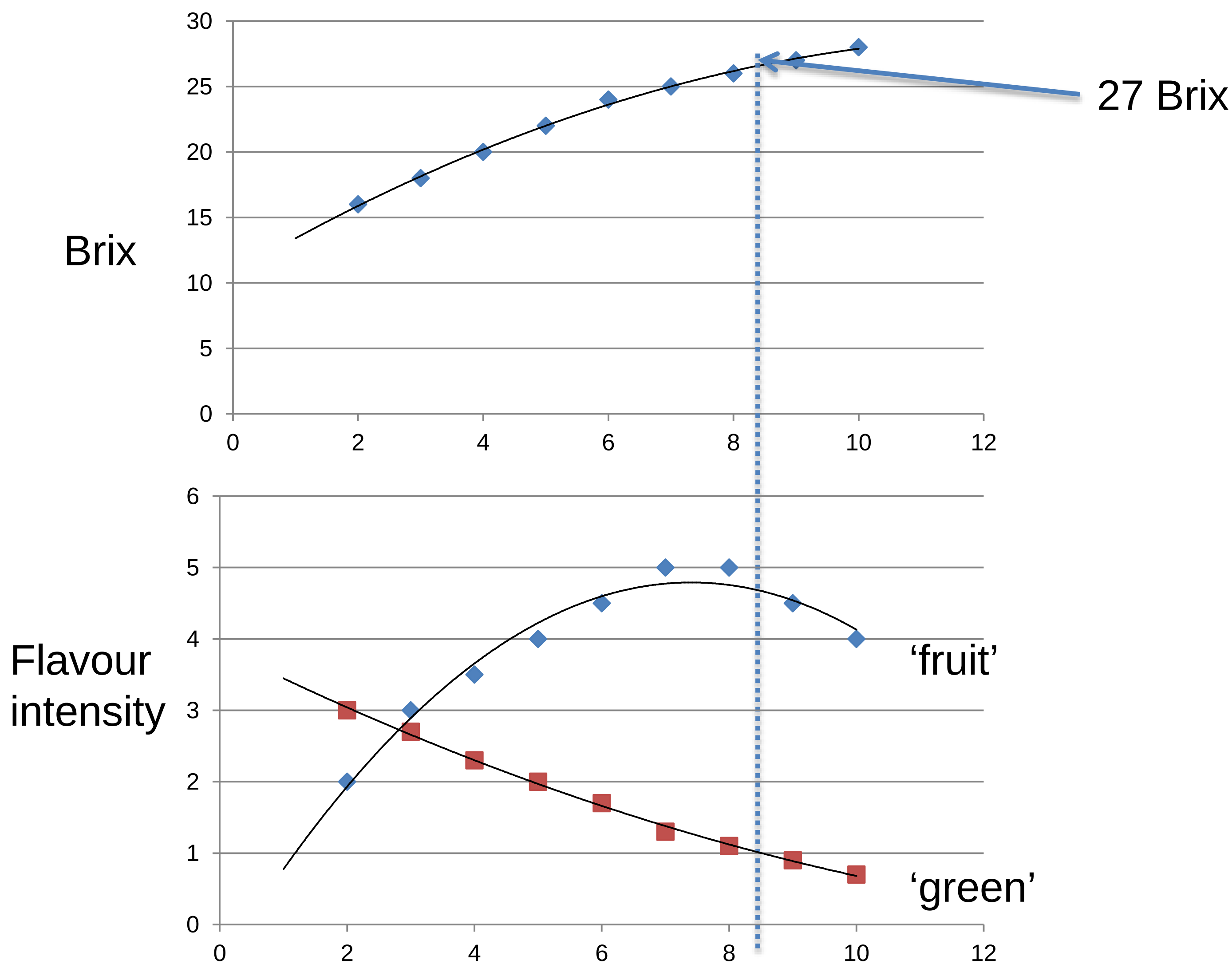


Each point = single rep

Hypothetical Undercropped



Hypothetical 'Balanced'

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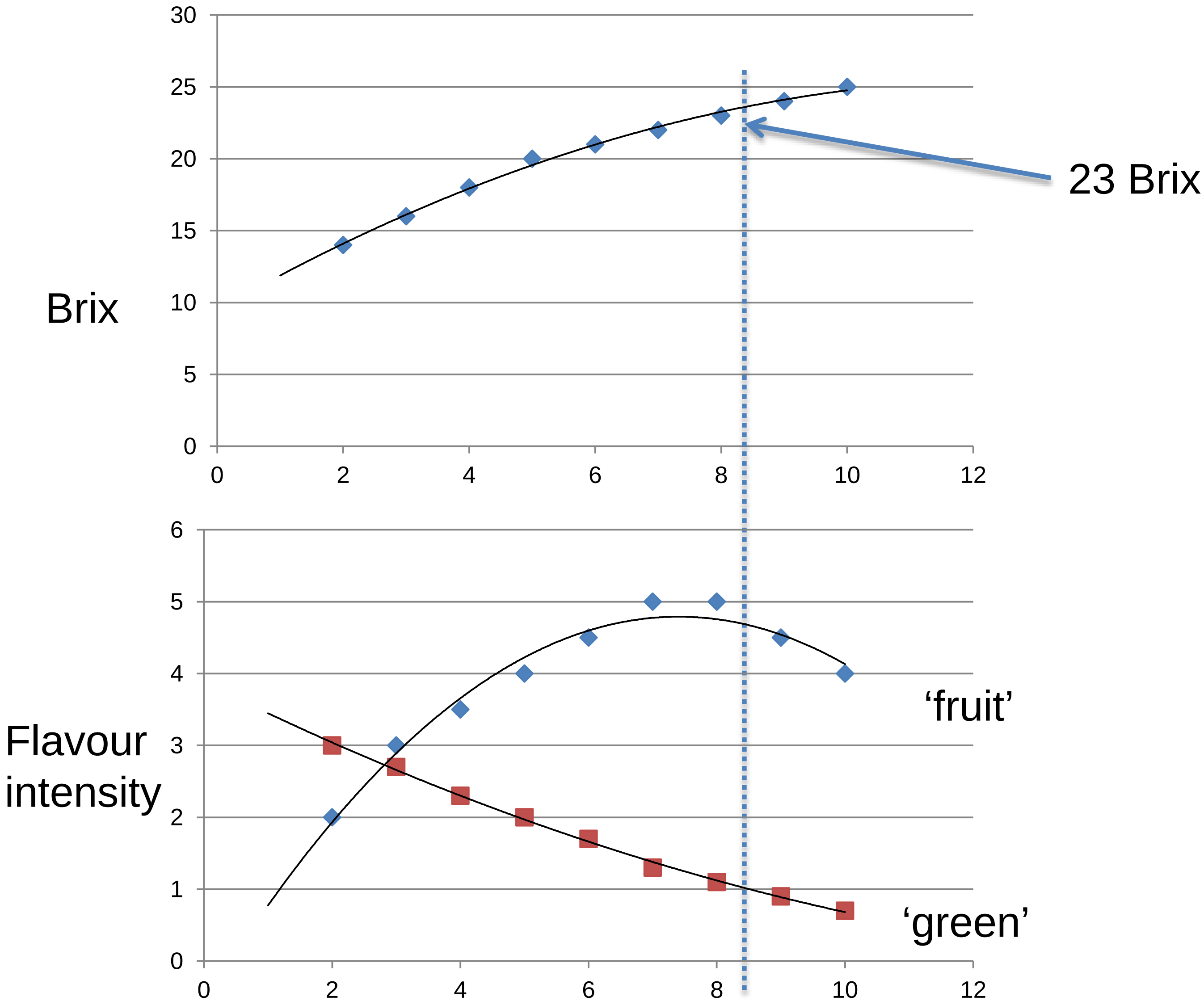

Take home messages

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- Indices of vine balance are useful guide
- But use other indicators as well
- Low yield does not mean good balance
- Control of shoot growth before veraison is important
  - It is better to achieve vine balance earlier in season rather than later
- The timing and method of yield control must be appropriate for the site

Further reading

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- Bindon et al. (2008a) Aust J Grape and Wine Res. 14, 91-103
- Dokoozlian, N. et al. (2011) Some new perspectives on the impact of vine balance on grape and wine flavour. Proc. 17th GIESCO meeting, Asti-Alba Italy: 407-409
- Dry et al. (2005) What is vine balance? Proc.12th Aust Wine Ind Tech Conf, Melbourne, 2004; pp. 68-74
- Poni et al. (2009) Aust J Grape Wine Res 15, 185-193
- Roby and Matthews (2004) Aust J Grape Wine Res 10, 74-82
- Scheiner et al. (2010) Amer. J Enol. Vitic. 61(3), 358-64
- Van Leeuwen et al. (2004) Am J Enol Vitic 55, 207-217

A novel method of yield control

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- Leaf removal in bunch zone just before flowering (E-L 19)
  - Approx 8 basal leaves
  - Manual or mechanical
  - No lateral shoots removed
- Yield reduced by 20 to 70% mainly due to fewer berries/bunch
- Varieties used: Semillon, Tempranillo, Graciano, Carignan, Sangiovese, Barbera, Trebbiano, Ciliegiolo
  - Mostly warm climates

Poni et al (2009), Scheiner et al. (2010)

A novel method of yield control

The Australian Wine Research Institute

- Positive effects:
  - Reduced bunch compactness
  - Reduced Botrytis
  - No detrimental effect on Brix
  - Increased concentration anthocyanin and other phenolics
  - Partial recovery of LA to give later bunch protection

Why does it work?

Early vs late bunch thinning?

- Early is more economical than later
- But if too early may stimulate shoot vigour
- In a high rainfall climate,
  - leave high bud number to reduce shoot vigour
  - then bunch thin relatively late e.g. at veraison
- In dry climate can use severe pruning to reduce bunch load knowing that water stress will control shoot vigour

VESDA- Developing tools to assist land mangers and industry.

Ricky James- Centre for Expertise in Smoke Taint Research.
DEPI, Rutherglen.

Department of
Environment and
Primary Industries

State Government Victoria

Overview

Tools for Industry

Tools for land managers.

Smoke taint research relatively new so nothing fit for purpose.

How much smoke????

Determine the relative impacts of controlled burning and wildfire.

•Evaluation of smoke detection monitoring as a tool for measuring smoke intensity and duration of presence and therefore exposure to fruit.

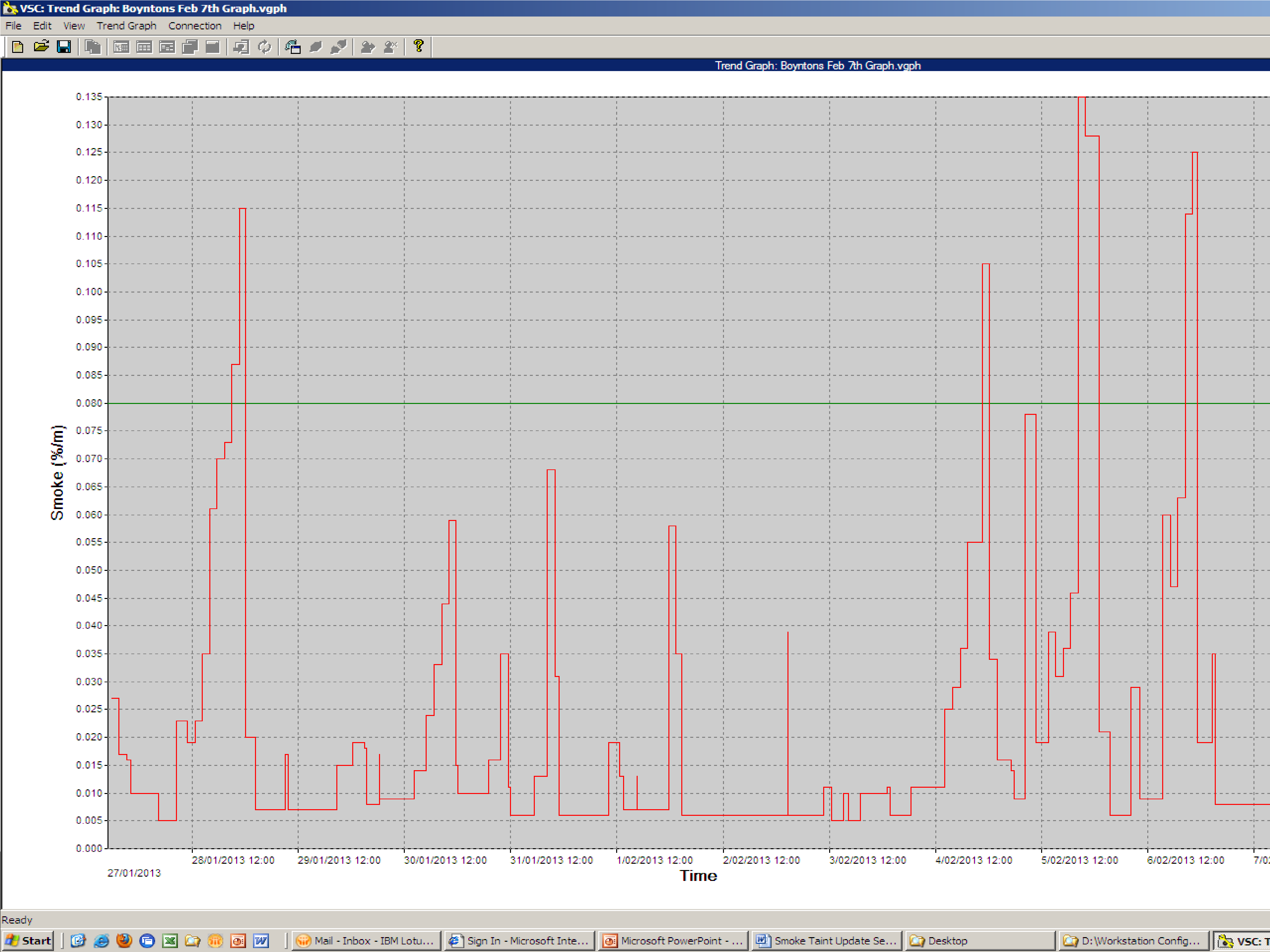
What we know/what we want to know???

Level of smoke taint is a combination of-

- Intensity of smoke- just like wine, very subjective, need to put a number on it.
- Duration of exposure-how long has the smoke been in the vineyard?

VESDA

- Very Early Warning Aspirating Smoke Detection
- Early warning alarm systems for sealed electrical and telecommunications cabinets.
- Retro fit units to be used in external environment to monitor smoke in vineyards.
- Ability to objectively measure smoke intensity over time and log this data over extended periods and multiple smoke events.


VSC: Trend Graph: Boyntons Feb 7th Graph.vgph
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Trend Graph: Boyntons Feb 7th Graph.vgph
Smoke (%/m)
0.135
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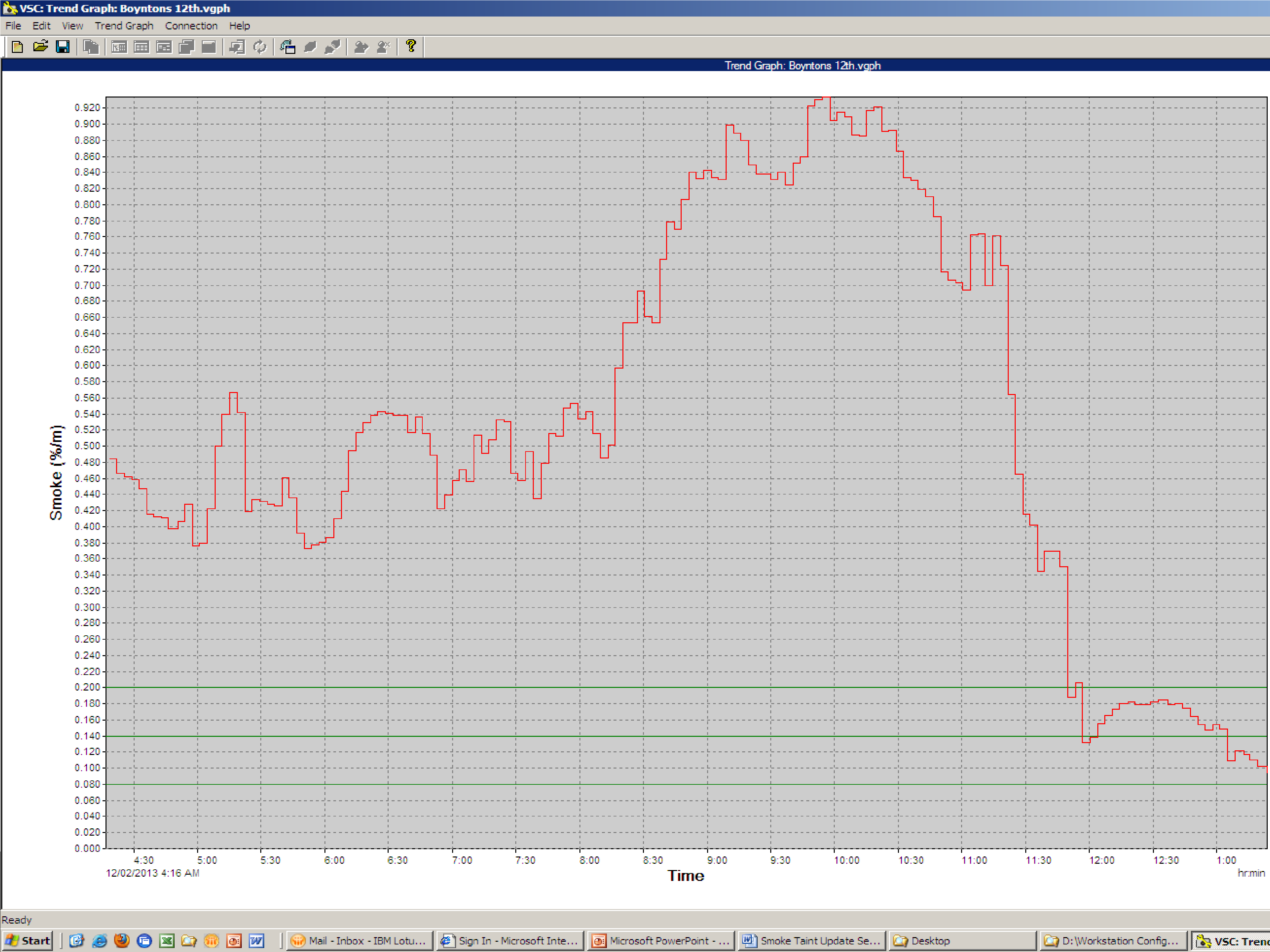
VSC: Trend Graph: Boyntons 12th.vgph
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Trend Graph: Boyntons 12th.vgph
Smoke (%/m)
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hr:min
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Mail - Inbox - IBM Lotu...
Sign In - Microsoft Inte...
Microsoft PowerPoint - ...
Smoke Taint Update Se...
Desktop
D:\Workstation Config...
VSC: Trend

Positives and Negatives

- + Affordable price for industry- approx $2500
- + Logs intensity and duration
- + Simple installation and data collection
- + Real time data to monitor controlled trials.
- + Local production, knowledge and experience.
- - Not ‘fit for purpose’. External conditions.
- - False positives- dust, moisture, Winnie Blues
- - Very sensitive- logs every change in concentration
- - Correlations with EPA air Quality data.

Next Steps

- Adjust software to enable more suitable and reliable data to be collected.
- Correlation between Obs/m and visual horizon data.
- Ability to create a network across a region when best opportunity arises
- Monitor numerous locations in the one region to compare smoke intensity, duration and affect on fruit.

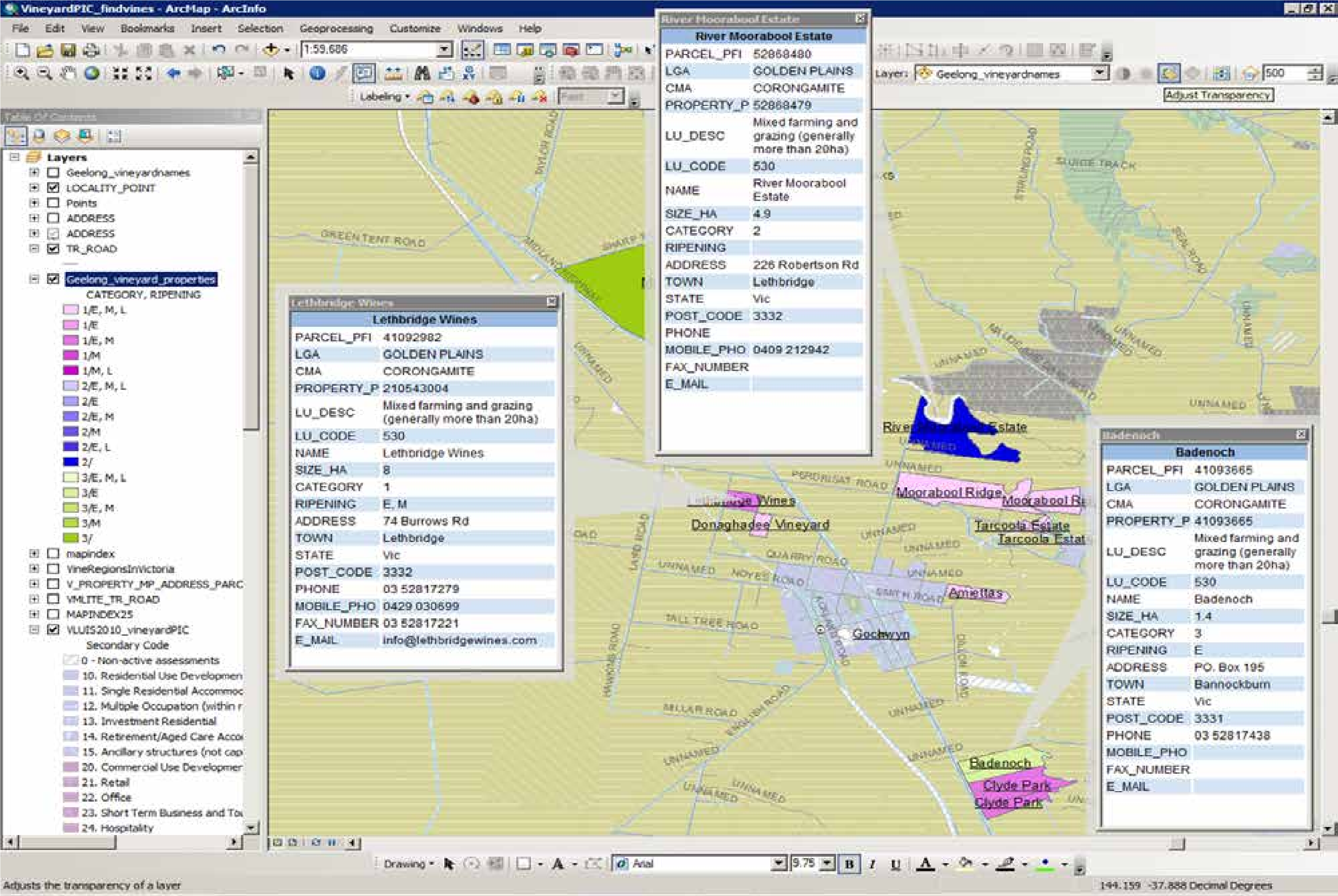
Who, What and Where??

Project Management Plan- Objective 6

Develop and evaluate a risk assessment tool to enable industry and land managers to determine suitable burning periods based on varietal sensitivity and grapevine development.

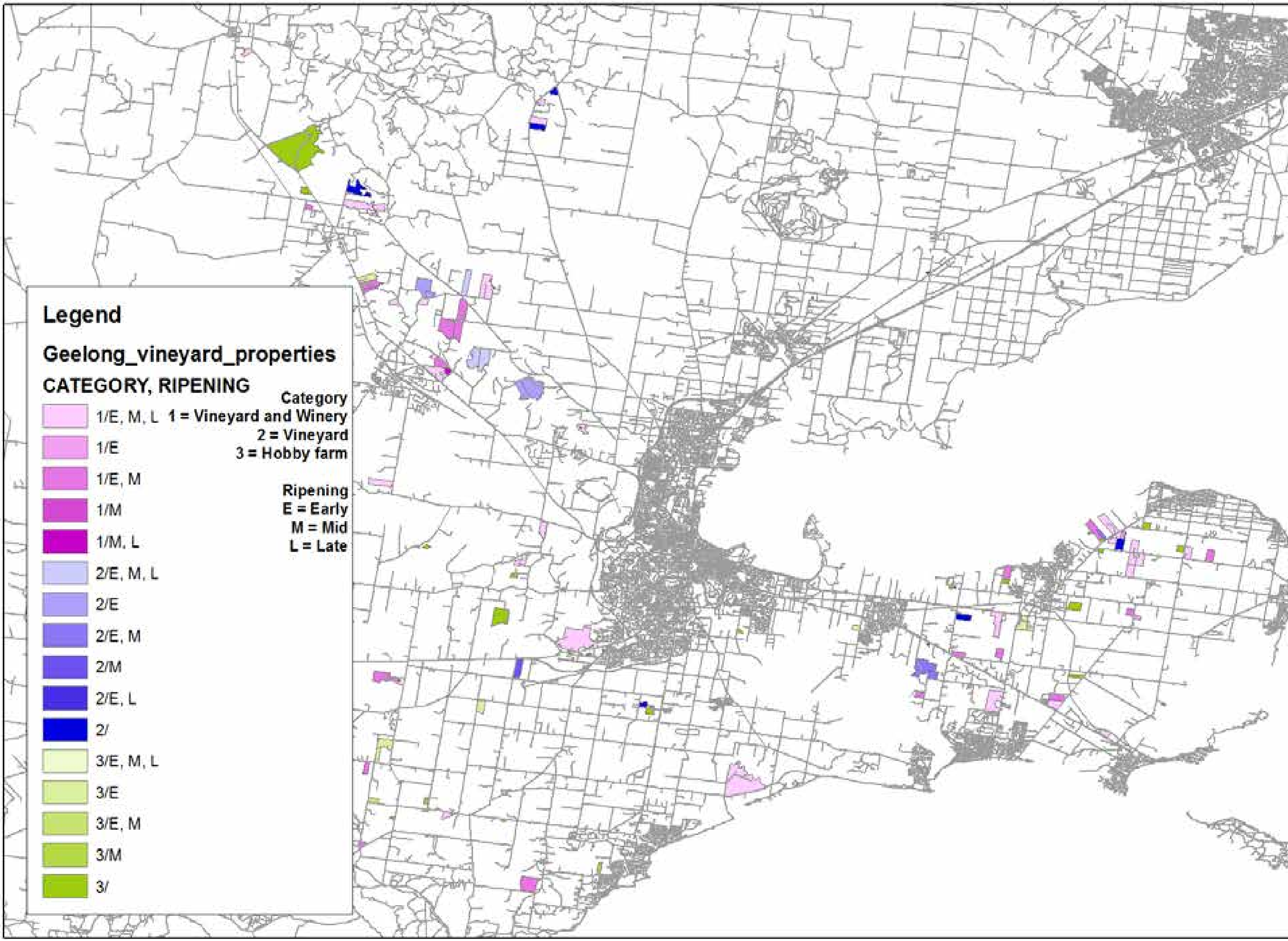
Fit for purpose mapping for land managers and industry

- VLUIS- Victorian Land Use Information Survey
- Biosecurity Victoria- PIC Codes
- DEPI- Fire Management
- Victorian Wine Industry
- DAFWA- STAR Model



Department of
Environment and
Primary Industries

State Government Victoria


Legend
Geelong_vineyard_properties
CATEGORY, RIPENING
1/E, M, L
1/E
1/E, M
1/M
1/M, L
2/E, M, L
2/E
2/E, M
2/M
2/E, L
2/
3/E, M, L
3/E
3/E, M
3/M
3/
Category
1 = Vineyard and Winery
2 = Vineyard
3 = Hobby farm
Ripening
E = Early
M = Mid
L = Late

Wine Related Research @ DEPI

Smoke Taint- Mark Downey

Tannin measurements in Winegrapes and resulting wines- Rachel Kilmister

Impacts of global warming on grape phenology, vine growth and grape quality- Rachel Kilmister

Soil Health- Ian Porter and Jacky Edwards

Phenology – Veraison
Heated Chamber @ +2 DegC.

23/12/11 29/12/11 4/1/12 20/1/12

Questions???

Increasing red and white wine complexity with AWRI's *bayanus* yeast (AWRI 1176 &1375)

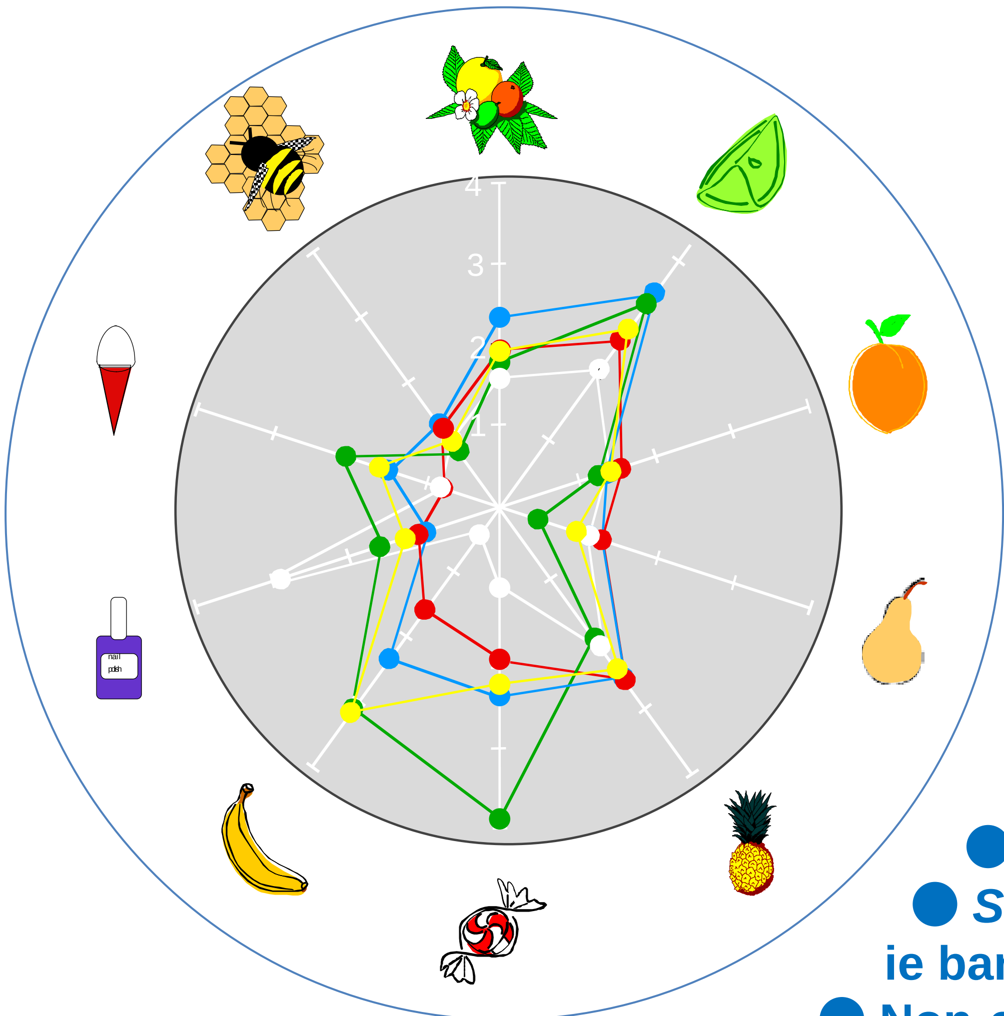
Paul Henschke

Principal Research Microbiologist

Why consider Non-Conventional yeasts

The Australian Wine Research Institute

Mean Aroma Intensities



Impact of strains of *S. cerevisiae* yeast on aroma profiles of Chardonnay wines

YEAST

- EC1118
- AWRI 835
- AWRI 796
- ICV D47
- AVISE

- *Sc* strains modify wine aroma profile
- *Sc* strains affect some aromas strongly, ie banana, but not others, ie honey
- Non-conventional yeasts often exist in fermentation – but what is their impact?

Source: Jane, Gawel & Henschke (1995) AWITC Procs

What does *Saccharomyces bayanus* offer winemakers?

The Australian Wine Research Institute

- ‘natural – isolated from nature’
- found in cool climate grape musts, eg Alsace, NZ, etc
- related to *S. cerevisiae* – familiar winemaking technology
- novel winemaking properties
- demonstrated potential in white and red wines

- AWRI 1375
- AWRI 1176

Novel properties of *Saccharomyces bayanus*

The Australian Wine Research Institute

Property	*S. cerevisiae*	*S. bayanus*
Fermentation temp.	10 – 35°C	6 – 30°C
Optimum growth temp.	> 30°C	25 – 30°C
	‘mesophilic’	often ‘cryotolerant’
Formation of:		
acetic acid	low – high	low
ethanol	wide range	< *S. cerevisiae*
glycerol	wide range	> *S. cerevisiae*
malic acid	neutral/degrade	neutral/produce
succinic acid	low – medium	medium – high

How is *S. bayanus* related to *S. cerevisiae*

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S. bayanus *Saccharomyces sensu stricto*

72% *S. pastorianus*

26% *S. kudriavzevii*

26% *S. mikatae*

22% *S. paradoxus*

20% *S. cerevisiae*

? *S. cariocanus*

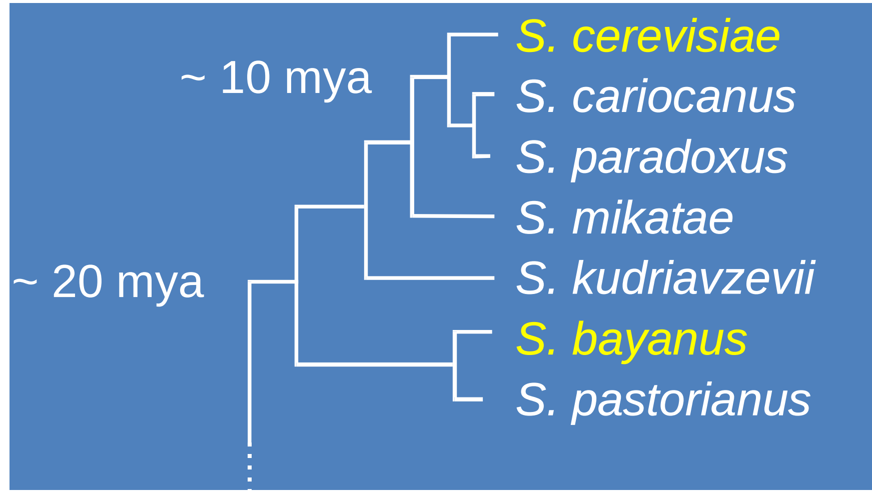
Saccharomyces sensu lato

< 20%

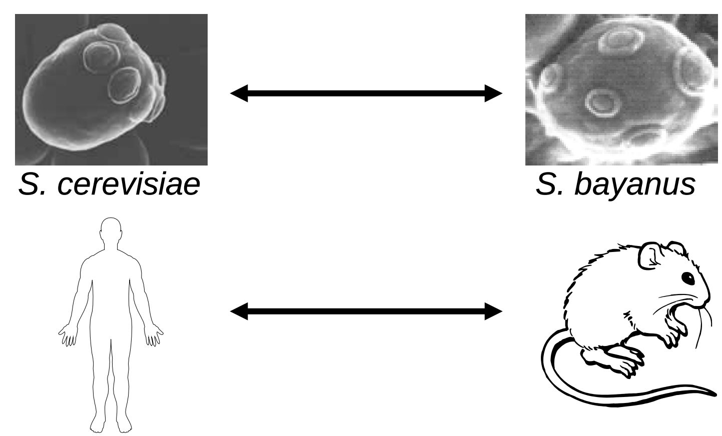
Non-*Saccharomyces* yeast

< 10%

Naumov *et al*, Vaughan-Martini *et al*, Yamada *et al*



http://genome.wustl.edu/projects/yeast



Demystifying ‘bayanus’ confusion

The Australian Wine Research Institute

S. cerevisiae var. *bayanus* ¹ *S. bayanus*

S. cerevisiae var. *bayanus* ü
race *bayanus* ý = *S. cerevisiae*
type *bayanus* þ

eg Prise de Mousse, Lalvin EC1118, Maurivin PDM, AWRI 838

AWRI 1176
AWRI 1375 = AWRI *S. bayanus* selections from cold-stored Chardonnay juice

Lalvin S6U = natural hybrid between *S. cerevisiae* and *S. bayanus*

AWRI 1505 = AWRI hybrid bred from *S. cerevisiae* and *S. bayanus*

White Wine Fermentation

White fermentation properties of *S. bayanus*

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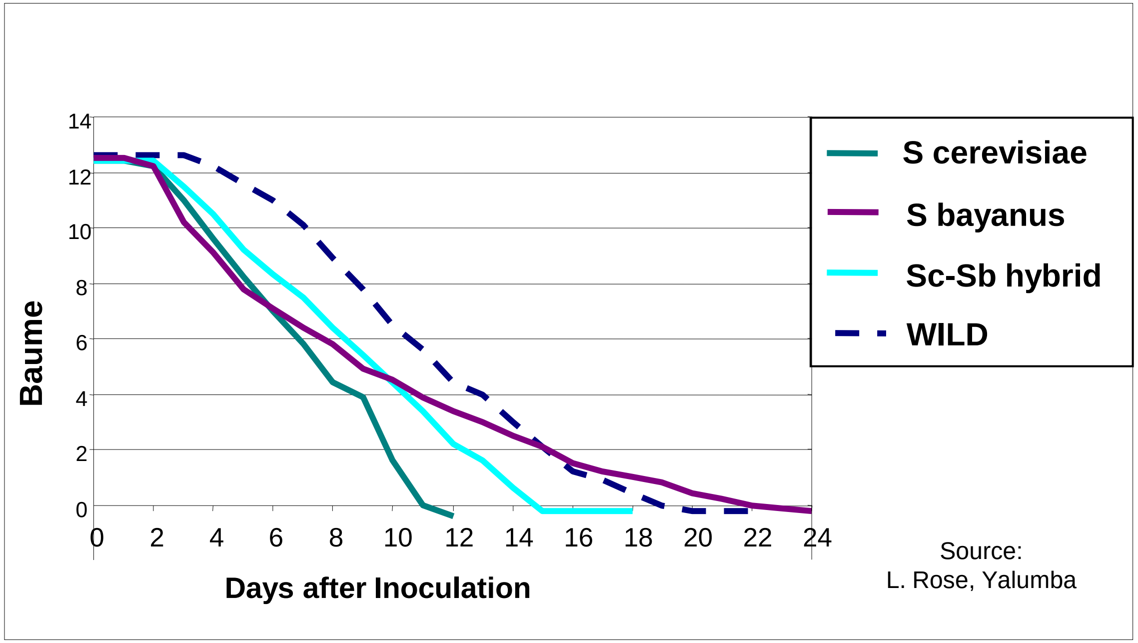


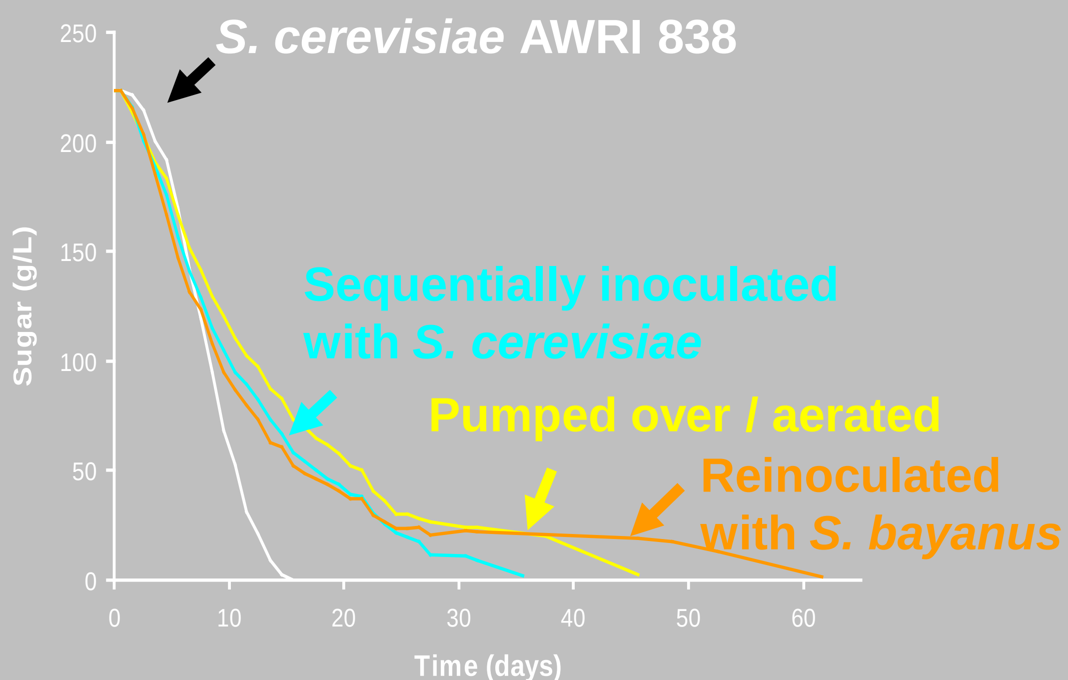
Overall low fermentation vigour

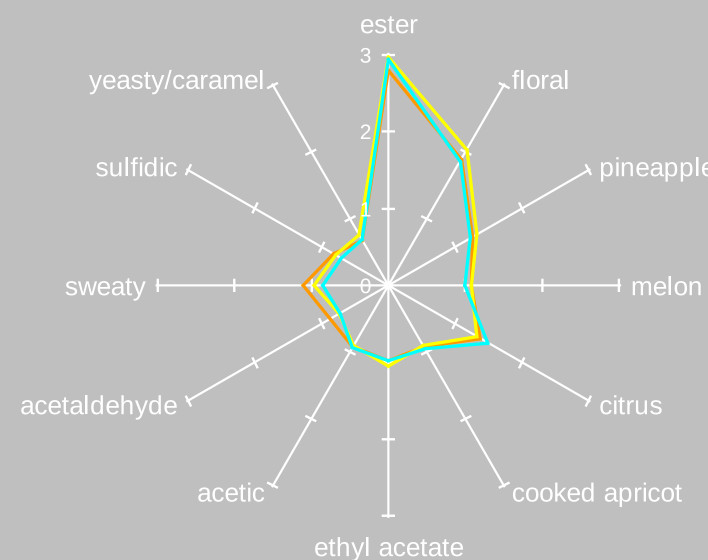
- During first half of fermentation, kinetics similar to *S. cerevisiae* strains
- Second half can become slow with risk of sticking

Practical strategies for ensuring complete fermentation with *S. bayanus* (AWRI 1375)

The Australian Wine Research Institute

Chardonnay: enzyme-cold settled, filtered (bright) juice





Eglinton & Henschke (2004) Procs 12AWITC pp. 288

All treatments tested promoted fermentation

Mid-ferment inoculation with *S. cerevisiae* recommended

All rescue treatments had no impact on aroma

Proving beneficial for barrel fermentation and lees stirring

Chemical analysis of Chardonnay wines

The Australian Wine Research Institute

Analysis	AWRI 838	AWRI 1176	AWRI 1375
sugar (g/L)	0.6	0.1	0.1
alcohol (% v/v)	13.2	13.1	13.3
acetic acid (g/L)	0.4	0.1	trace
malic acid (g/L)	2.2	1.9	2.0
succinic acid (g/L)	0.5	1.0	1.1
glycerol (g/L)	5.1	8.6	7.9
pH	3.4	3.4	3.4
TA (g/L)	6.8	6.5	6.5
total SO_2 (mg/L)	67	87	89

Aroma characteristics of *S. bayanus* in Chardonnay

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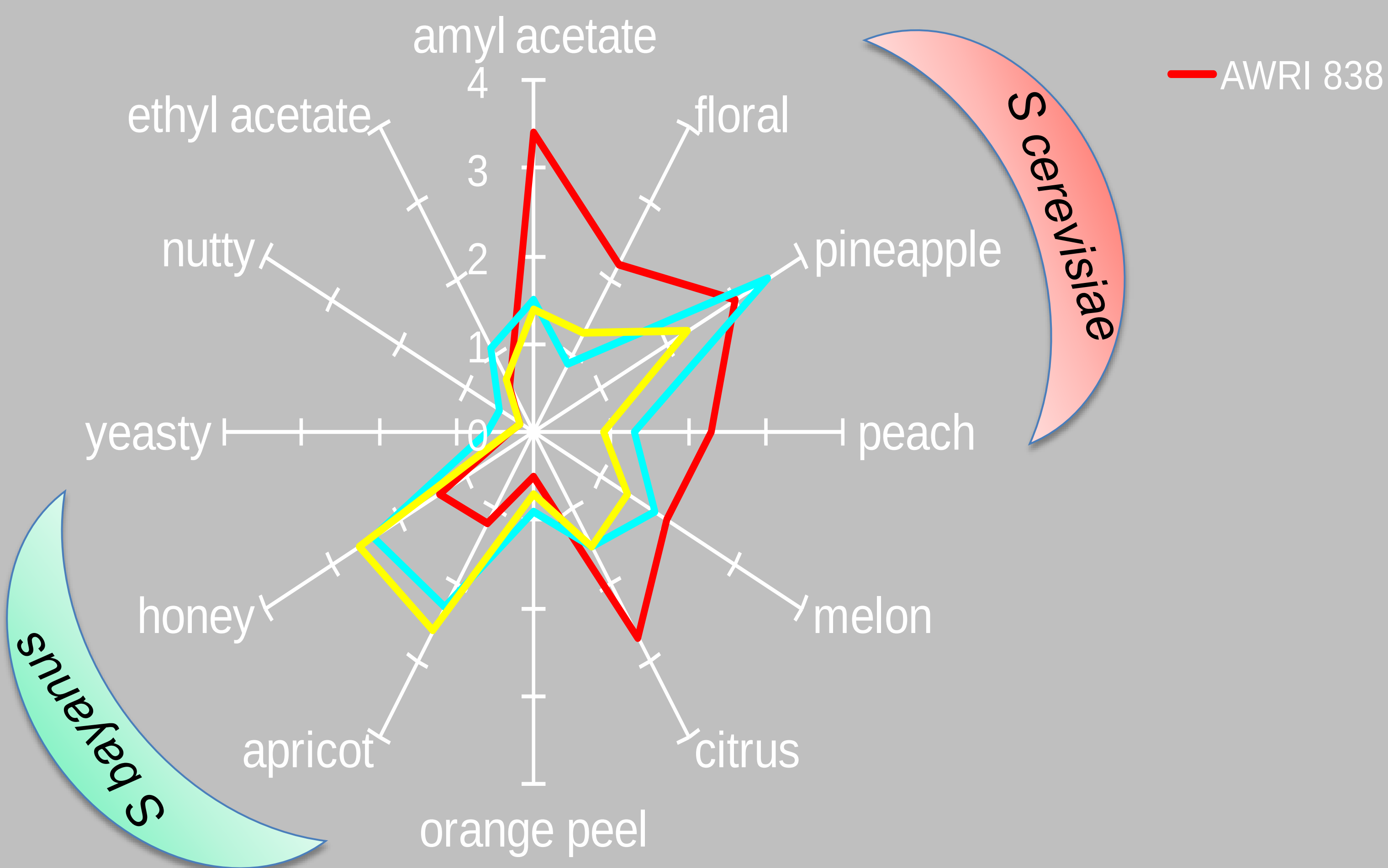
S.cerevisiae enhances floral and estery attributes



S. bayanus enhances savoury_and marmalade attributes

Lab-scale winemaking
M.Fogarty, Hons Thesis, UA 1999

Aroma descriptors for Chardonnay wines

The Australian Wine Research Institute

Ferment type	Yeast	Aroma attribute
Laboratory scale	*S. cerevisiae*	floral (estery), honey, green apple
	S. bayanus	floral (estery), apricot, lime, caramel, flor sherry, malt, dusty, chocolate
Commercial scale	*S. cerevisiae*	estery, pineapple, peach, floral, ethyl acetate
	S. bayanus	estery, pineapple, citrus/lime, melon, banana, passionfruit, guava, peach, floral, apricot, honey, nutty

S. bayanus → Greater diversity of aroma attributes, including complex savoury profile

Mouthfeel of *S. bayanus* wines

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- Lower apparent acidity
- Increased length ('persistence')
- Increased palate weight ('fullness'/viscosity)
- Increased 'warmth'
- Improved oak integration

Barrel fermentation
Lees stirring – barrel/tank

Red Wine Fermentation

S. bayanus red fermentation properties – fermentation kinetics with different YANs

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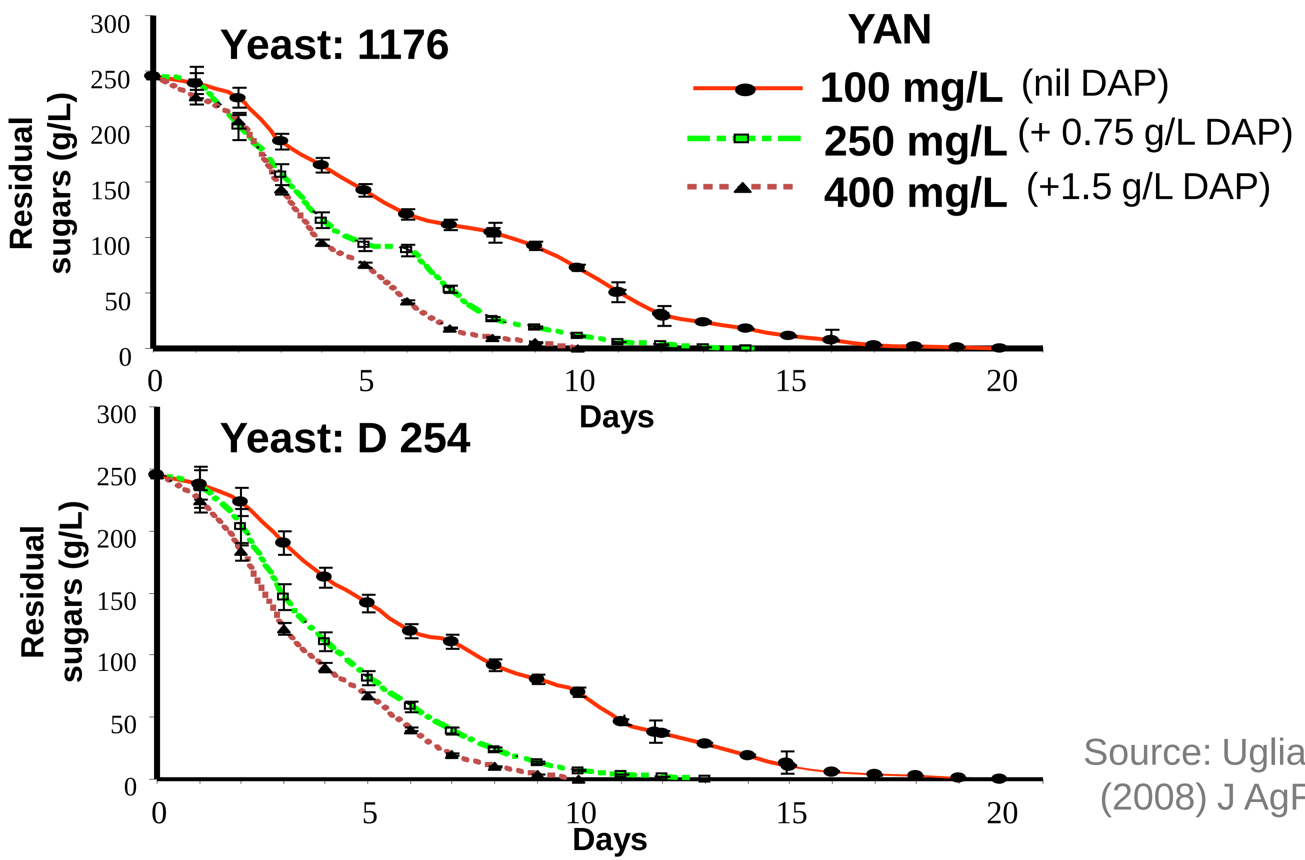
Shiraz must (macerated), 22°C



Source: Ugliano et al. (2008) J AgFdChem

Although S. bayanus has high N demand in red macerated ferments on skins fermentation kinetics are similar to *S. cerevisiae* strains at different YANs

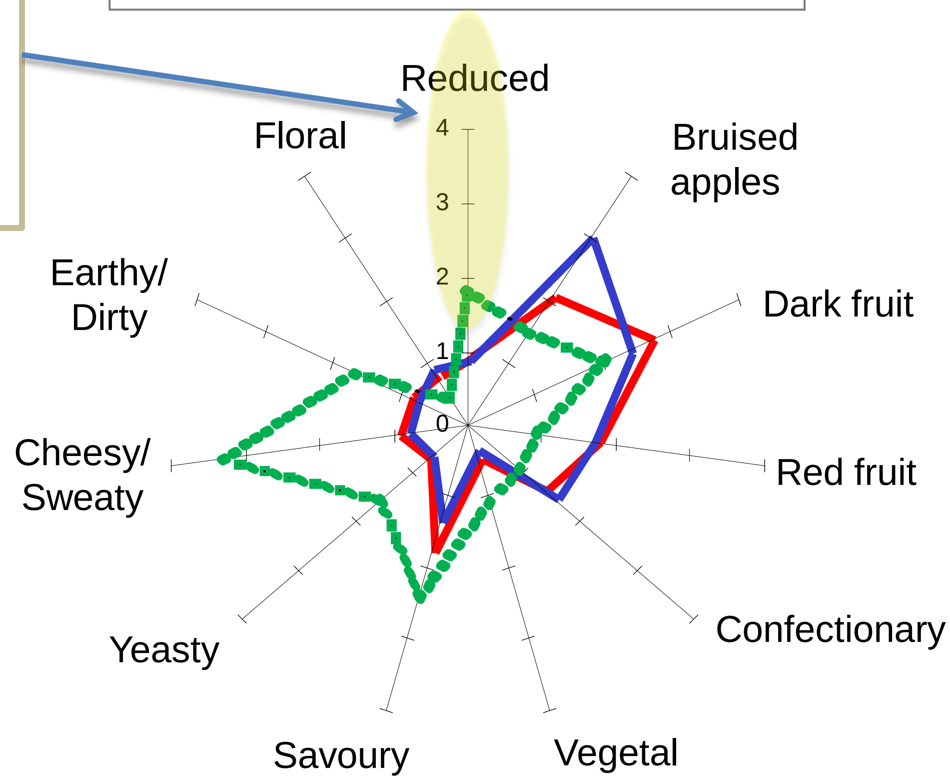
S. bayanus wine flavour response to DAP in Shiraz

The Australian Wine Research Institute

Classical H_2S response to N

Higher DAP = lower H_2S

Saccharomyces bayanus
AWRI 1176



YAN

- **100** (nil DAP)
- **250** (+ 0.75 g/L DAP)
- **400** (+1.5 g/L DAP)

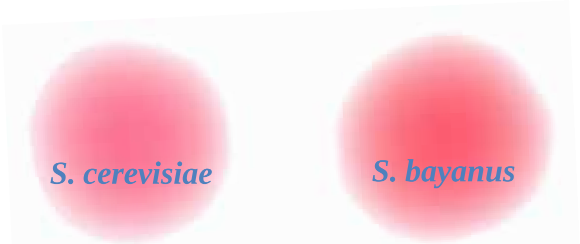
Shiraz
- on skins, 22°C
Source: Ugliano et al. (2010) JAgFdChem

- **Low YAN** – complex savoury, earthy, cheesy, H_2S 'reduction'
- **Moderate DAP-YAN** – enhanced dark and red fruit
- **High DAP-YAN** – dark and red fruit with bruised apple

Red winemaking properties of *S. bayanus*

The Australian Wine
Research Institute

- Moderate fermentation vigour
  - Improved ethanol tolerance from grape lipids
  - Good extraction of phenolics
- Higher acetaldehyde formation
  - Improved colour stabilisation



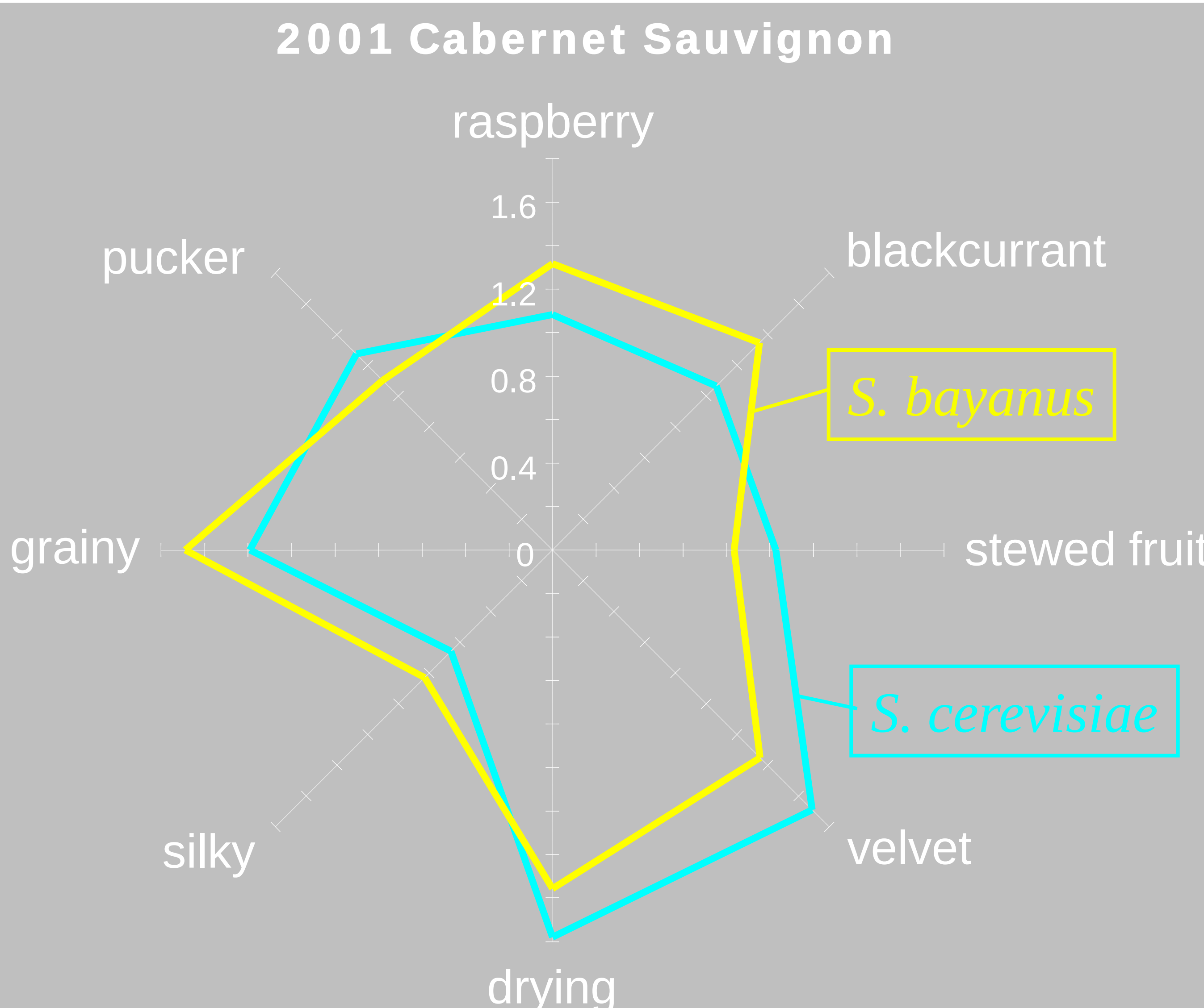
Cabernet Sauvignon – 2 mths old

- Reduces ‘green’ character?
  - Chardonnay, Cabernet Sauvignon, Merlot, etc

‘Micro-ox’ yeast?

Mouth-feel of *S. bayanus* wines

The Australian Wine Research Institute



Eglinton, Francis et al. AWRI Ann Report (2003)

Summary – AWRI *S. bayanus* strains

The Australian Wine Research Institute

- *S. bayanus* – contributes novel composition, aromas, flavours and mouth-feel properties under-pinning varietal and regional character
  - ‘savoury’ aroma notes, can reduce ‘green’ notes
  - increases mouth-feel; suited to extended lees stirring
  - *modifies* wine colour density and hue, and increases stability
- Building wine flavour complexity, principally as a blending component
- Novel yeasts require greater attention and management to achieve the benefits
- Experience suggests AWRI *S. bayanus* is more suited to non-floral varieties

Nutrient requirements of *S. bayanus* AWRI 1375 and AWRI 1176

The Australian Wine Research Institute

- **High Nitrogen (YAN) requirements**
- **Increased risk of H_2S formation in low YAN musts due to early consumption of N**
- **Robust fermentation in red (high solids) musts but increased risk of slow/stuck fermentation in highly clarified, low YAN, high Brix/Be musts**

1. Reactivate yeast with proprietary products, eg Goferm Protect®
2. YAN measurement and DAP use important

>>> Behaves similar to high N requiring S. cerevisiae strains

Commercial potential

The Australian Wine Research Institute

- Winemakers need to determine commercial potential

Successful in Chardonnay, Semillon & Sauvignon Blanc
Cabernet Sauvignon, Merlot, Pinot (generally non-florals)

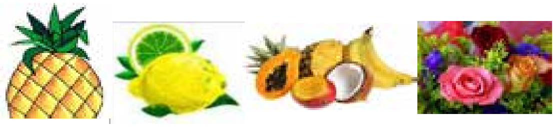
S bayanus – AWRI 1375/1176 dried yeast in development by Lallemand; contact AWRI for availability

- St Hallett winery – first released wine (Limited release 2004 Semillon, $40 bottle) made with AWRI *S. bayanus*
- Others: Balnaves / Punters Corner Chardonnay / Arrivo Nebbiolo....

Chardonnay

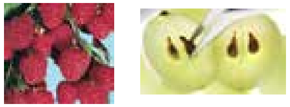
AWRI 838 *(S. cerevisiae)*
Simple and….

AWRI 1505 (*S. cerevisiae* X *S. bayanus*)
•Complex, savoury, creamy and….



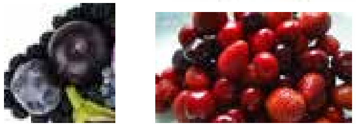
Merlot

AWRI 838 *(S. cerevisiae)*
Simple and….



AWRI 1176 (*S. bayanus)*
Complex, aromatic, nutty, dill and …

AWRI 1505 (*S. cerevisiae* X *S. bayanus*)
Complex, savoury, fine grained tannins, rich and….



(Trials performed by Yalumba 2007)

(For more trial results see Bellon et al. 2008 ANZ GG&WM)

Impact of yeast type on red wine flavour

(AWITC workshop 2007 – Bellon et al. ANZ GG&WM 2008)

Winery	Variety	Yeast	Aroma	Palate
Yalumba Wines	Merlot	AWRI 838	Simple, light red fruit	Green tannins, simple
Yalumba Wines	Merlot	AWRI 1176	Aromatic, red current, green/dill, aldehydic, nutty	More complex, spicey fruit, aldehydic
Yalumba Wines	Merlot	AWRI 1505	Riper, richer fruit, dark plum, savoury, complexity	Fruit tannins, sweet fruit, rich texture, fine grained tannins
Provisor/ Lallemand	Cabernet Sauvignon	BM 45	Green/raw, capsicum, herbal, peppery	Green/raw, hard tannins
Provisor/ Lallemand	Cabernet Sauvignon	AWRI 1375	Blackcurrent, oystershell, meaty	Complex, soft, lanolin, complex tannins
Provisor/ Lallemand	Cabernet Sauvignon	S6U	Green, blueberry, old rose	Good texture, rounded tannins, ripe, sweetness

Acknowledgements

GWRDC — Grape and Wine Research and Development Corporation

The Australian Wine Research Institute

Jeff Eglinton, Scott McWilliam, Holger Gockowiak – *S bayanus* project
Mike Fogarty – Honours project 1999 (AWRI-UA)
Jenny Bellon, Miguel de Barros Lopes, Paul Chambers – hybrids project, genetic analysis
Leigh Francis – sensory analysis; T. Siebert, D. Capone – volatiles analysis
Paul Henschke, Paul Chambers, Peter Hoj – project supervisors

Collaborating wineries

Yalumba, Hardys, Orlando-Wyndham, Fosters Est., St Hallett, Houghtons, H-R Wine Science Lab. (S. Clarke)

Lallemand – development of *S. bayanus* active dried yeast
AB Mauri Yeast – development of hybrid active dried yeast

Research at The AWRI is supported by Australia's Grapegrowers and winemakers through their investment agency the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

Further reading:

Bellon J, Rose L, Currie B, Ottawa J, Bell S, Mclean H, Rayment C, Treacher C, Henschke P. Summary from the winemaking with non-conventional yeasts workshops, 13th AWITC. Aust. N.Z. Grapegrower Winemaker 528, 72–77; 2008.

Eglinton J, Francis L, Henschke PA. Selection and potential of Australian Saccharomyces bayanus yeast for increasing the diversity of red and white wine sensory properties. Yeast's contribution to the sensory profile of wine: maintaining typicity and biodiversity in the context of globalization: proceedings of Les XVIIes Entretiens Scientifiques Lallemand; 27–28 April 2005; La Rioja. Blagnac Cedex, France: Lallemand; 2005: 5–12.

A W R I

The Australian Wine Research Institute

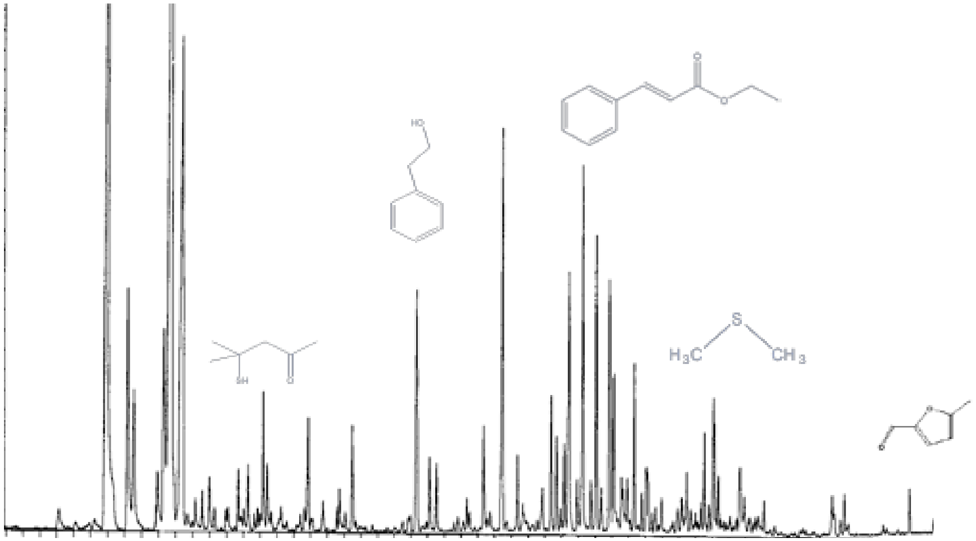
Pepper and spice in Shiraz: what influences rotundone levels in wines?

Leigh Francis
Tracey Siebert
Mark Solomon
Gerard Logan (University of Auckland)

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

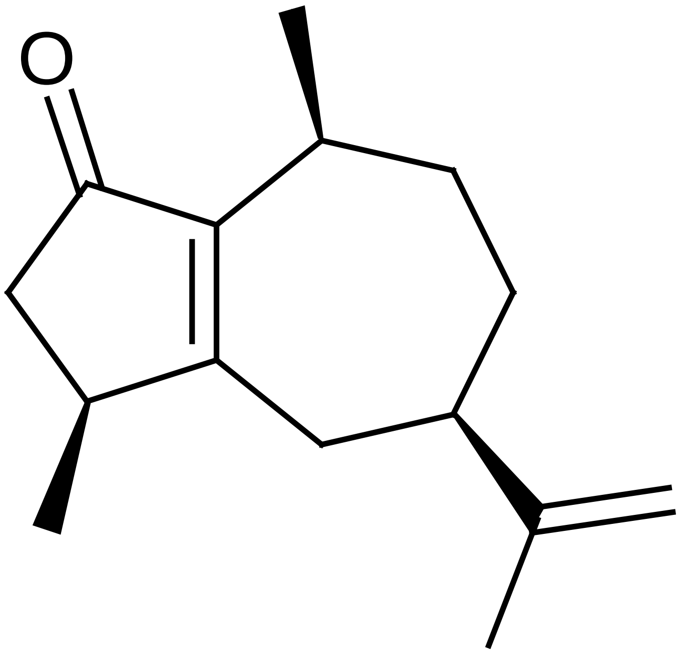
Gas chromatography-mass spectrometry

The Australian Wine Research Institute



(-)-Rotundone

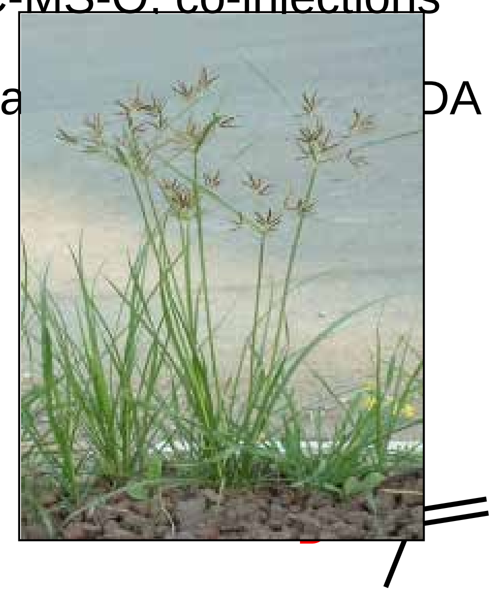
The Australian Wine Research Institute



- Identity confirmed with reference compound (Symrise)

Cyperus rotundus, nut grass weed

- ^{1}H and ^{13}C NMR, ORD
- GC-MS-O, co-injections
- Qua DA



By GC-MS-O, rotundone was established as the principal aroma impact compound for pepper aroma in grapes and wine.

Wood, C.; Siebert, T. E.; Parker, M. et al. *J. Agric. Food Chem.* **2008**, 56, 3738-3744
Siebert, T. E. et al. *J. Agric. Food Chem.* **2008**, 56, 3745-3748

How potent is rotundone?

The Australian Wine
Research Institute

aroma detection threshold

8 ng/L in water

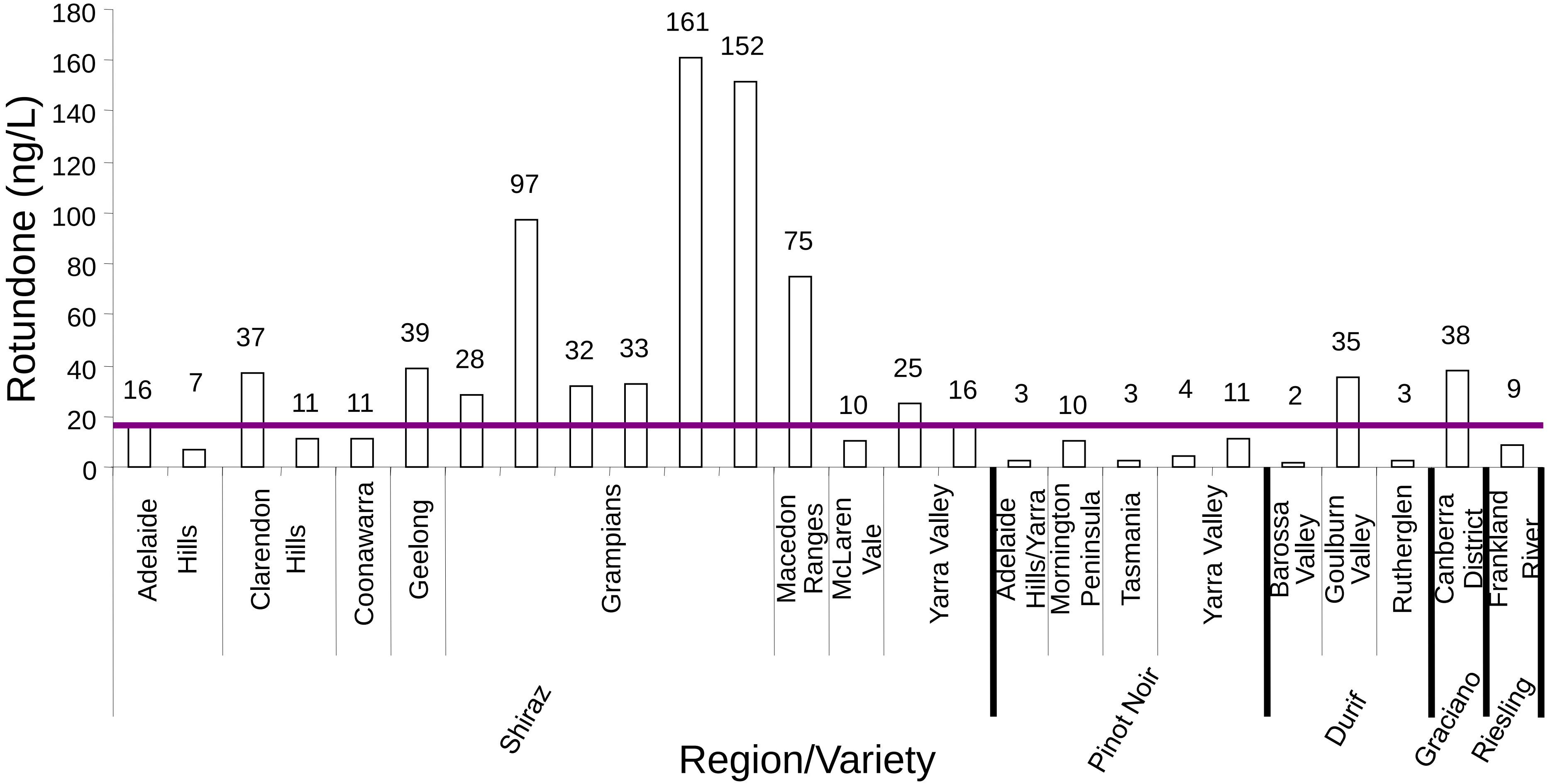
16 ng/L in red wine

20 to 25% of the panellists were anosmic to rotundone

Wood, C.; Siebert, T. E.; Parker, M. et al. *J. Agric. Food Chem.* **2008**, 56, 3738-3744

Rotundone in Australian wines

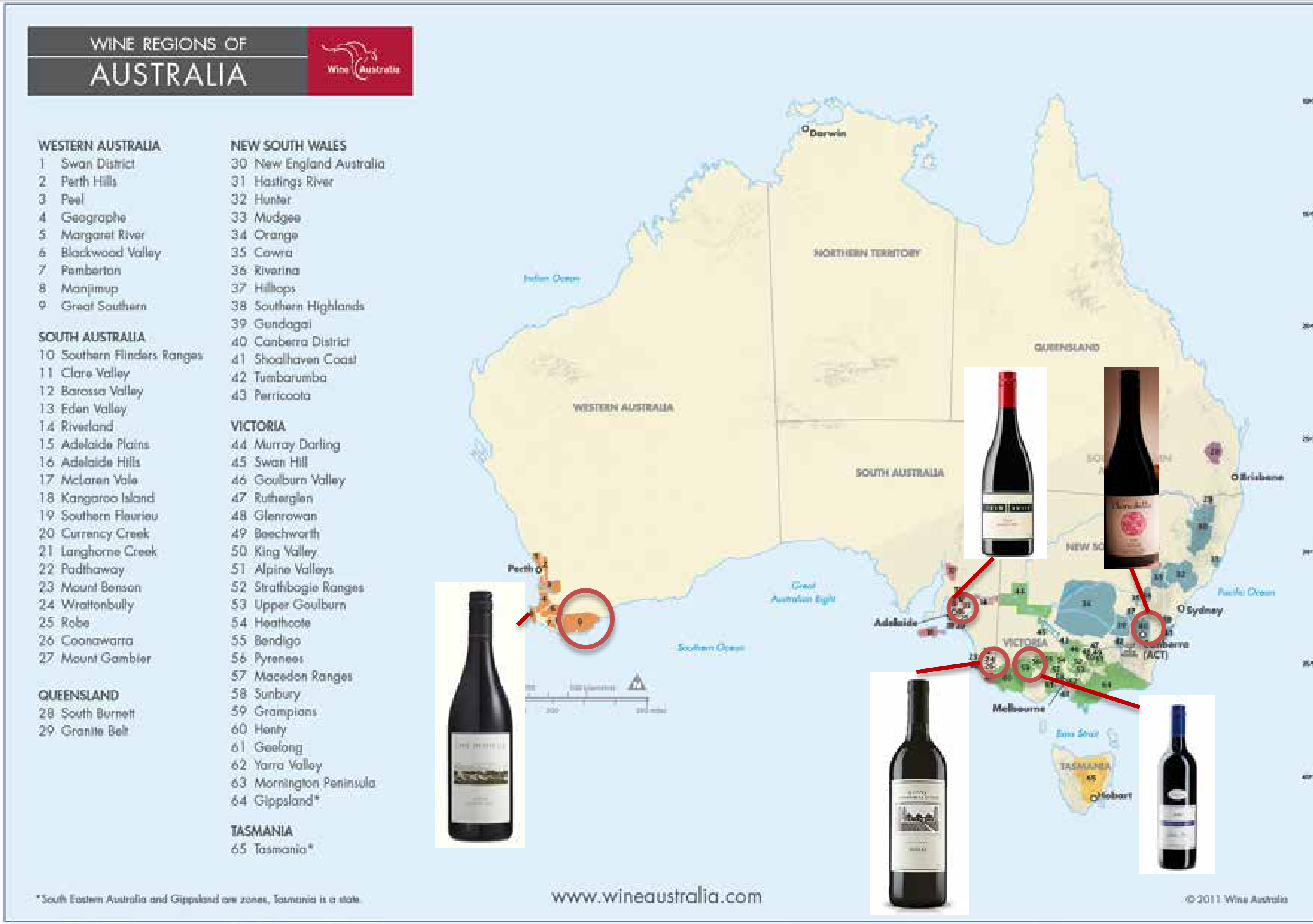
The Australian Wine Research Institute



AWRI TR #180 (June 2009)

Australian cool climate Shiraz

The Australian Wine Research Institute



New Zealand

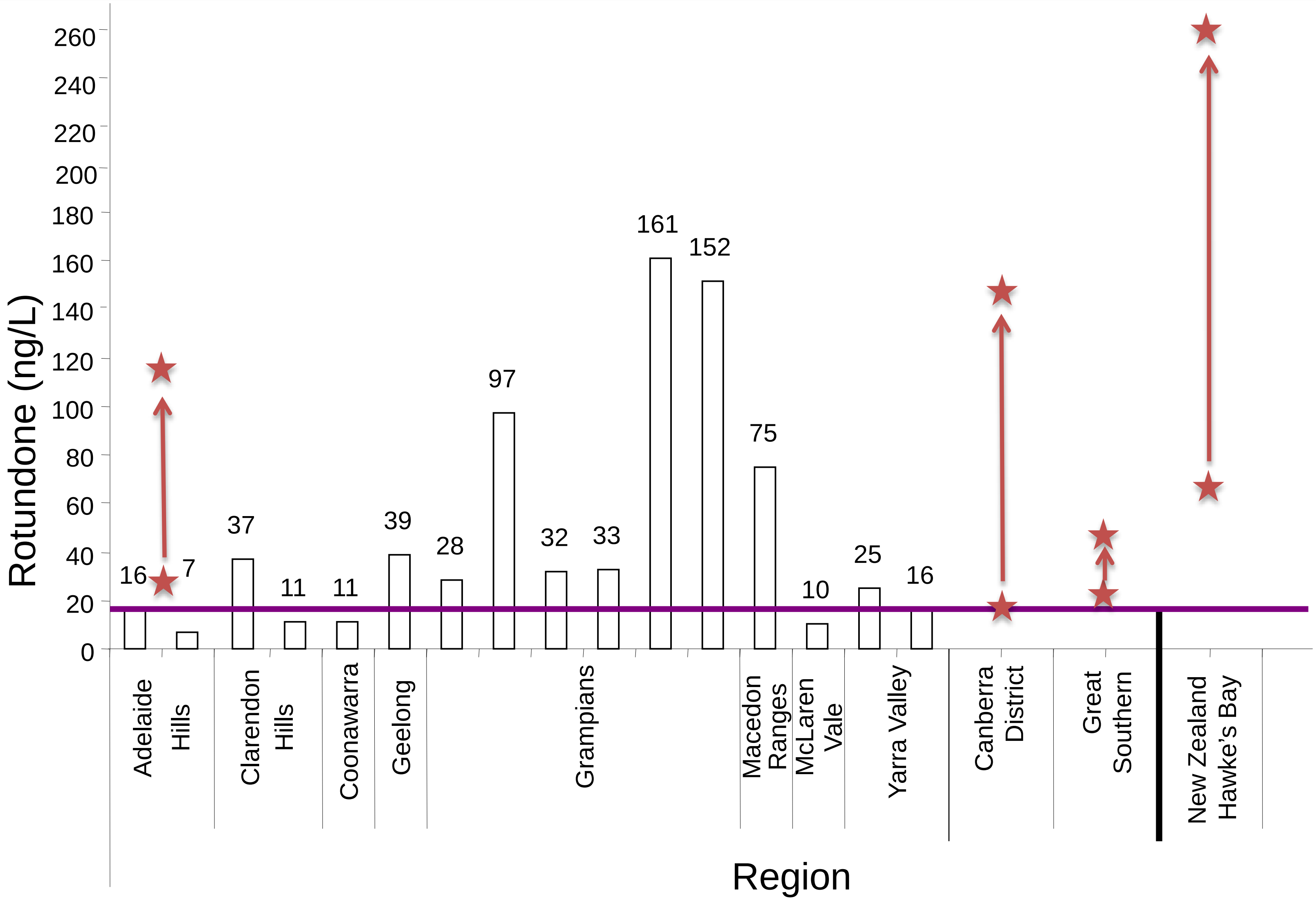
The Australian Wine Research Institute

Gimblett Gravels (400 Ha), Hawke's Bay, New Zealand

- 39°37' S, 176°44' E
- 1435 GDD (Base 10°C) (17 year average)
- 803mm rainfall (21 year average)
- 2188 hours of sunshine/year
- 14.5°C mean temperature all year
- Omahu Gravel Soil
- Maritime with a little continentality

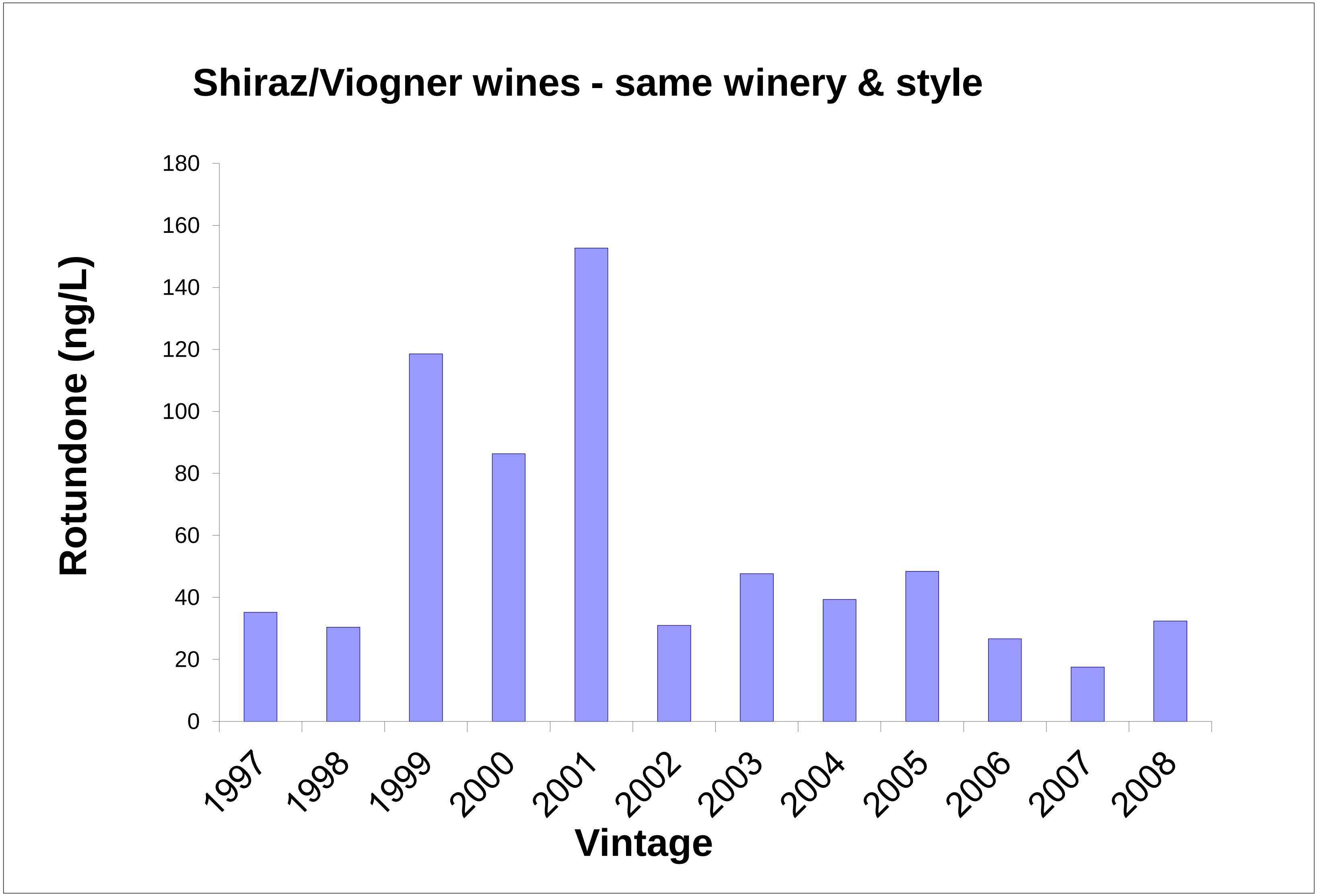
Rotundone in other commercially available Shiraz wines

The Australian Wine Research Institute



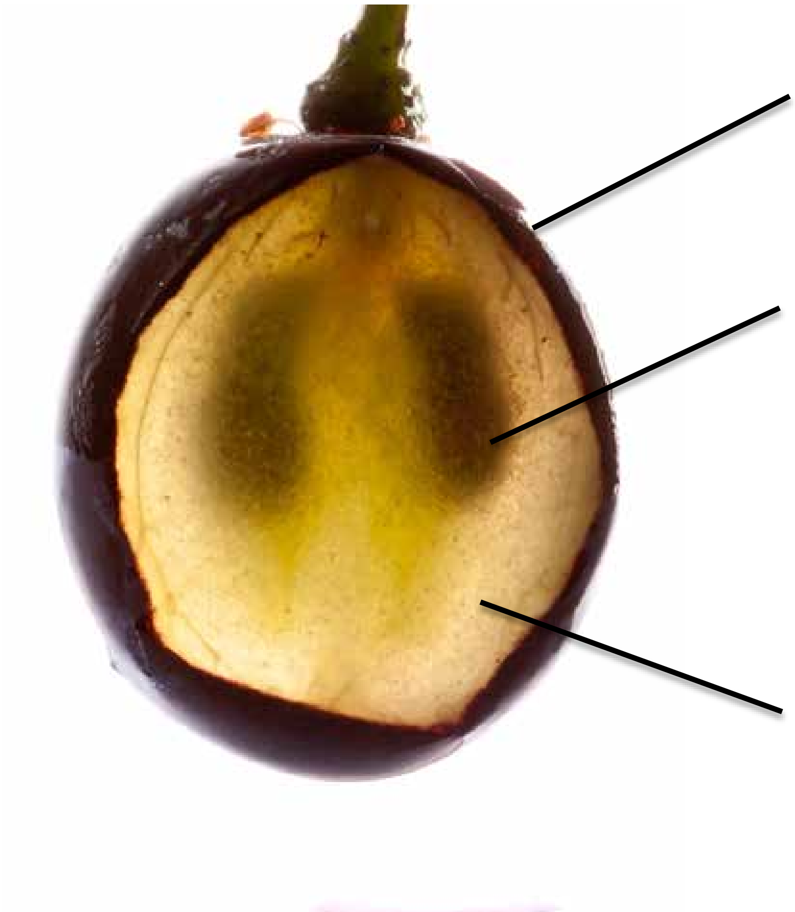
Variability across vintages: Canberra District

The Australian Wine Research Institute



Rotundone is only present in the skin

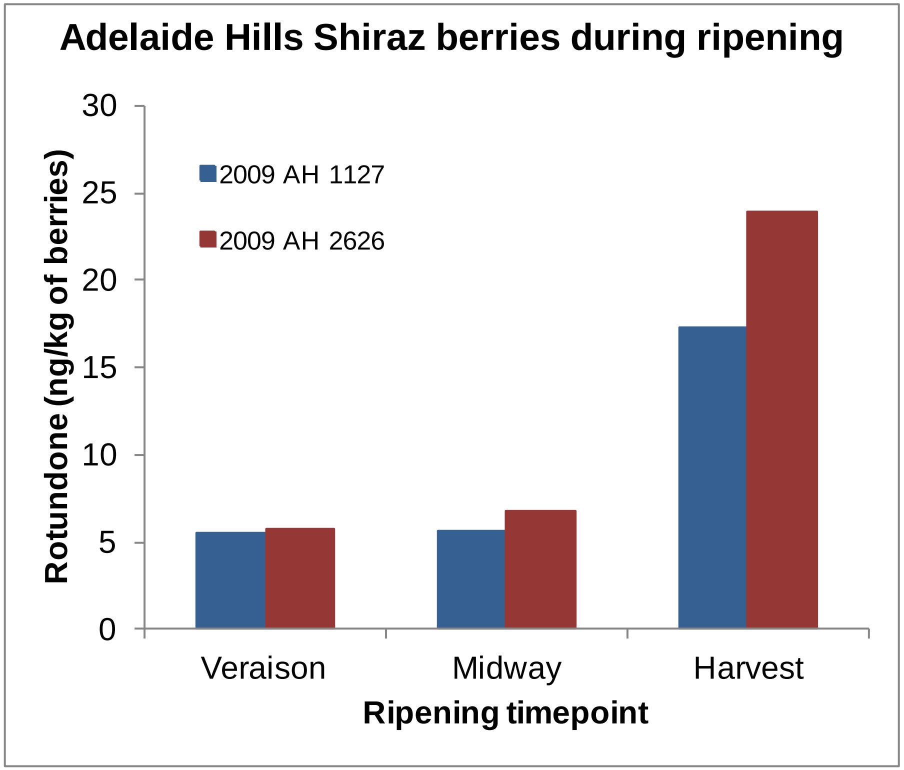
The Australian Wine Research Institute



Photograph by Eric Wilkes

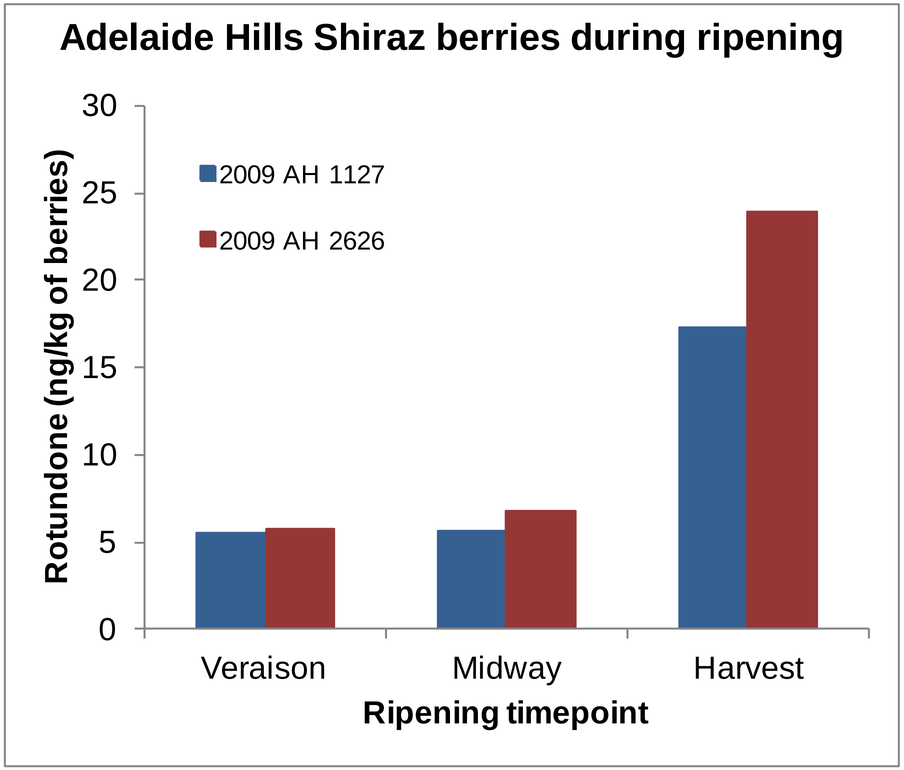
Rotundone increases during late stage ripening

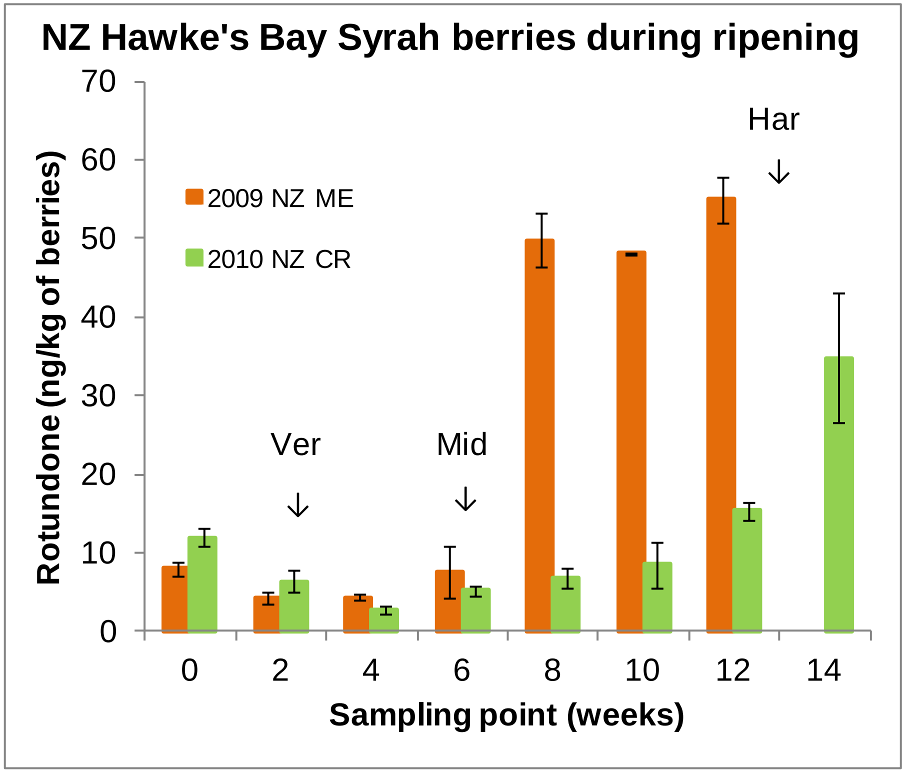
The Australian Wine Research Institute



Rotundone increases during late stage ripening

The Australian Wine Research Institute





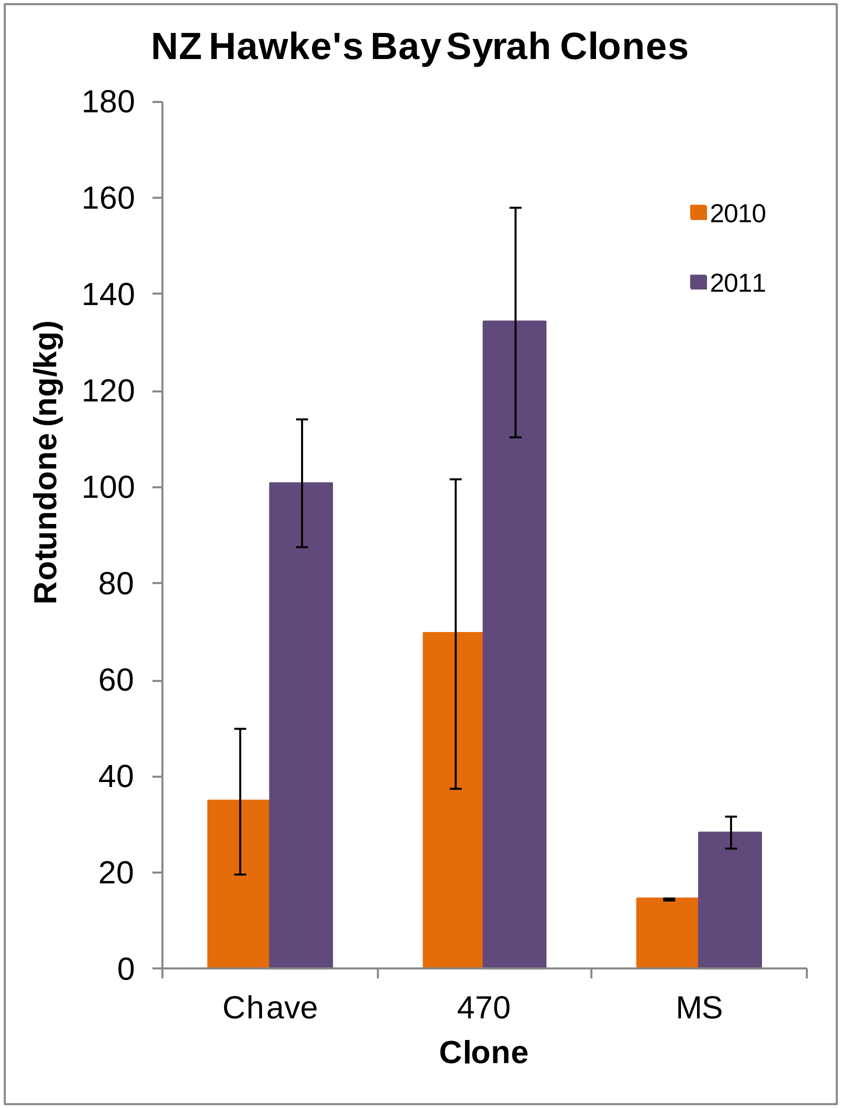
Does vine management affect rotundone levels?

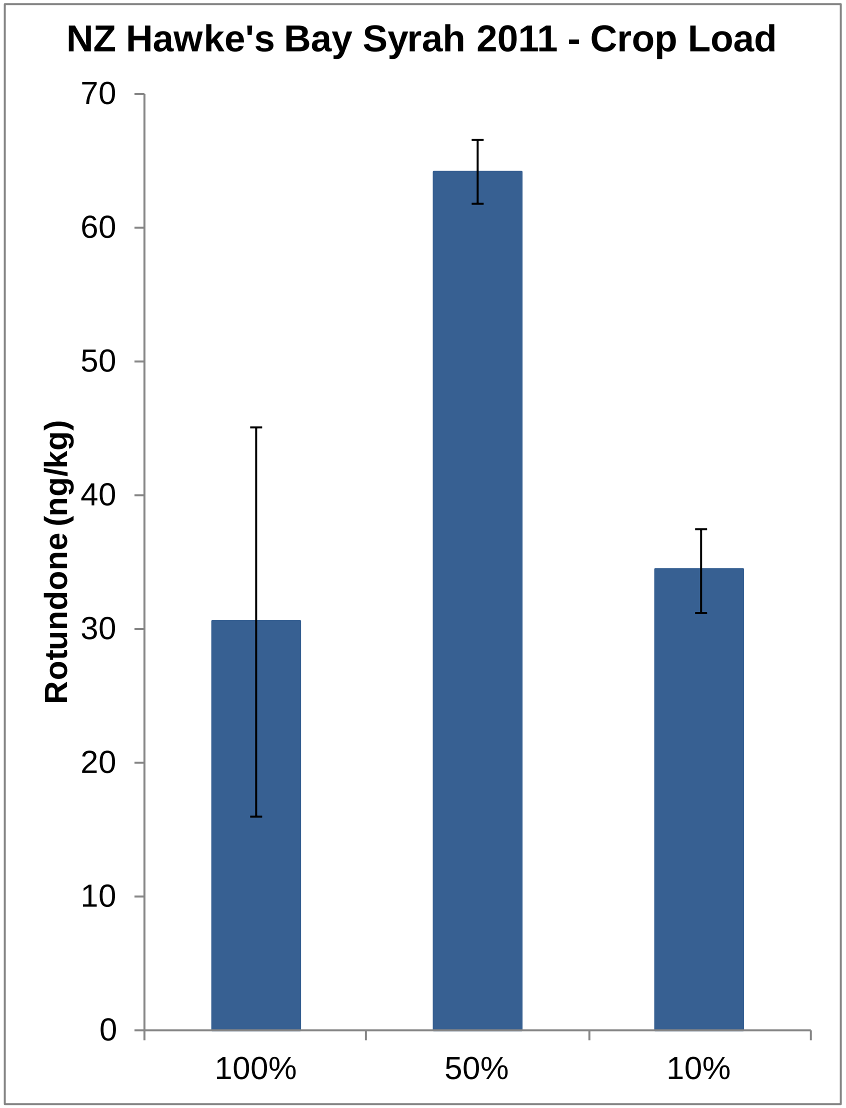
The Australian Wine Research Institute

- Fruit exposure
- Leaf removal time
- Crop load
- Vine vegetative vigour
- Clones

Clone and crop load

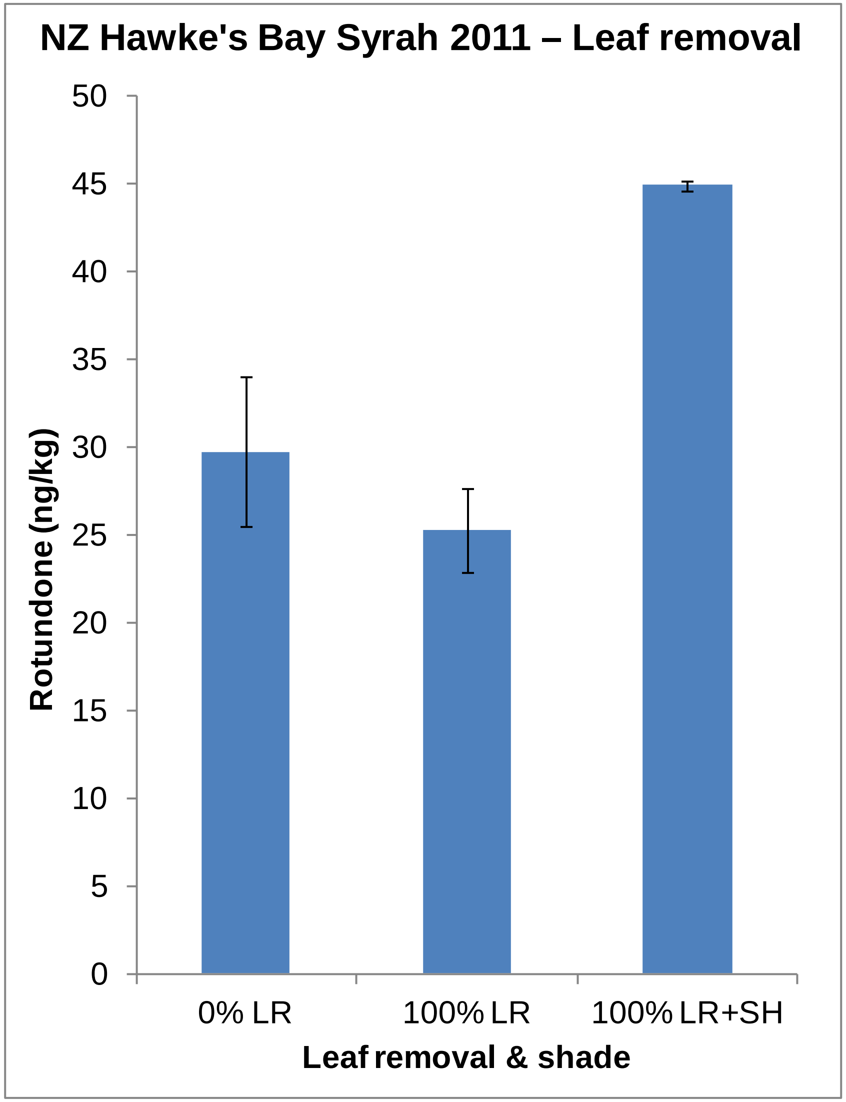
The Australian Wine Research Institute

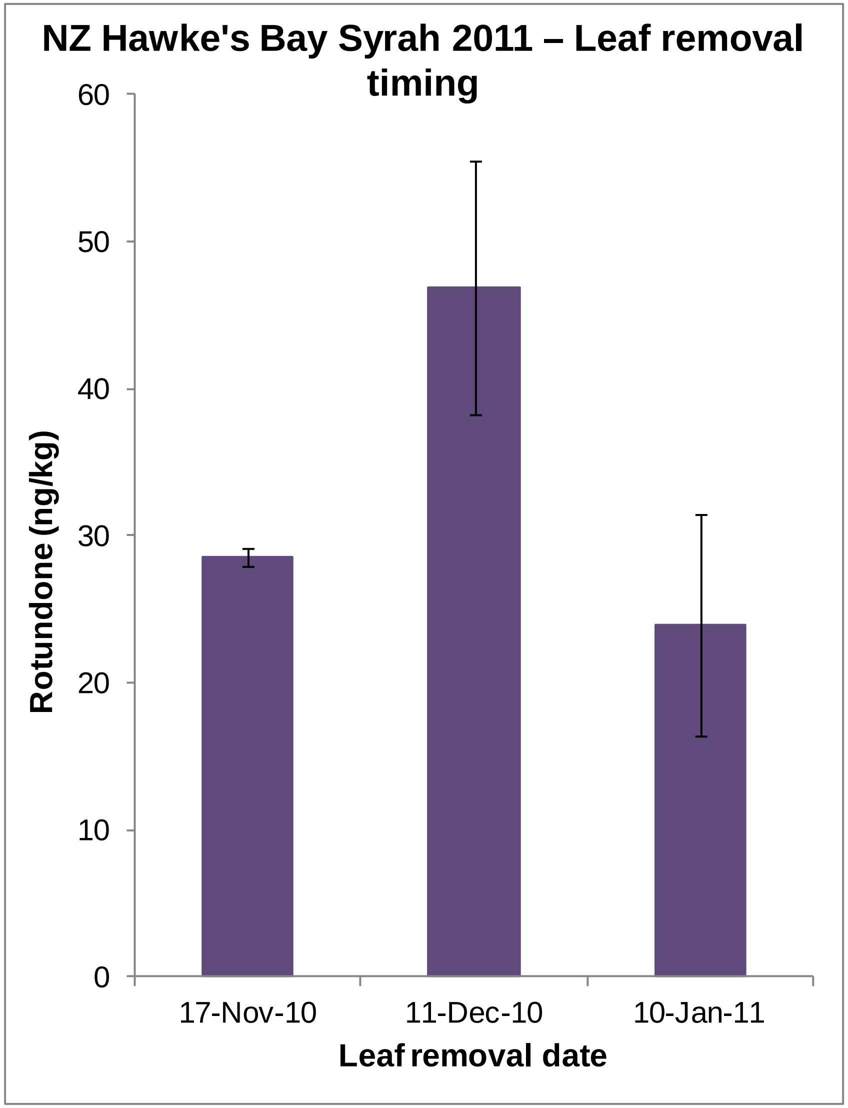




Leaf removal

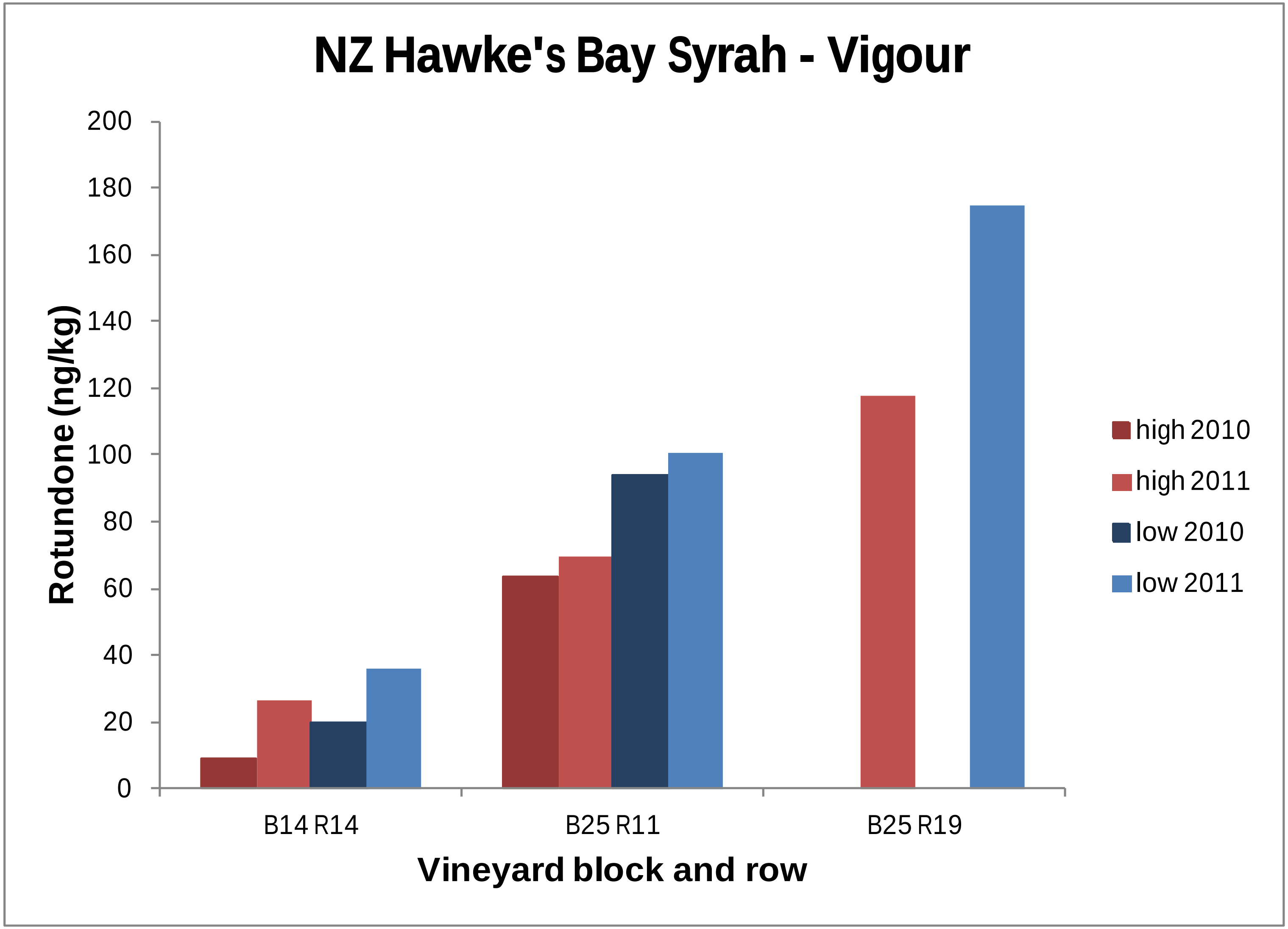
The Australian Wine Research Institute





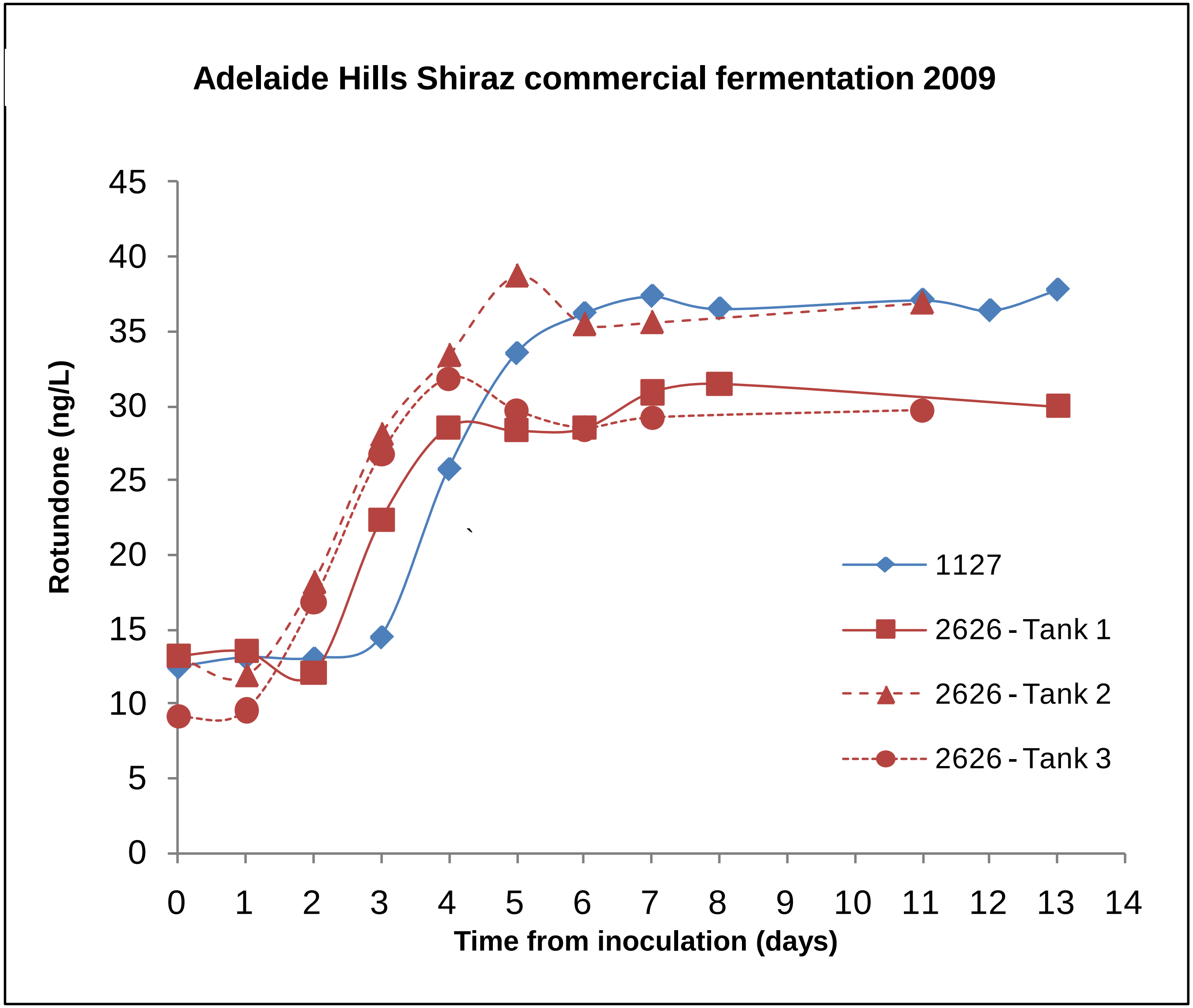
Vigour

The Australian Wine Research Institute



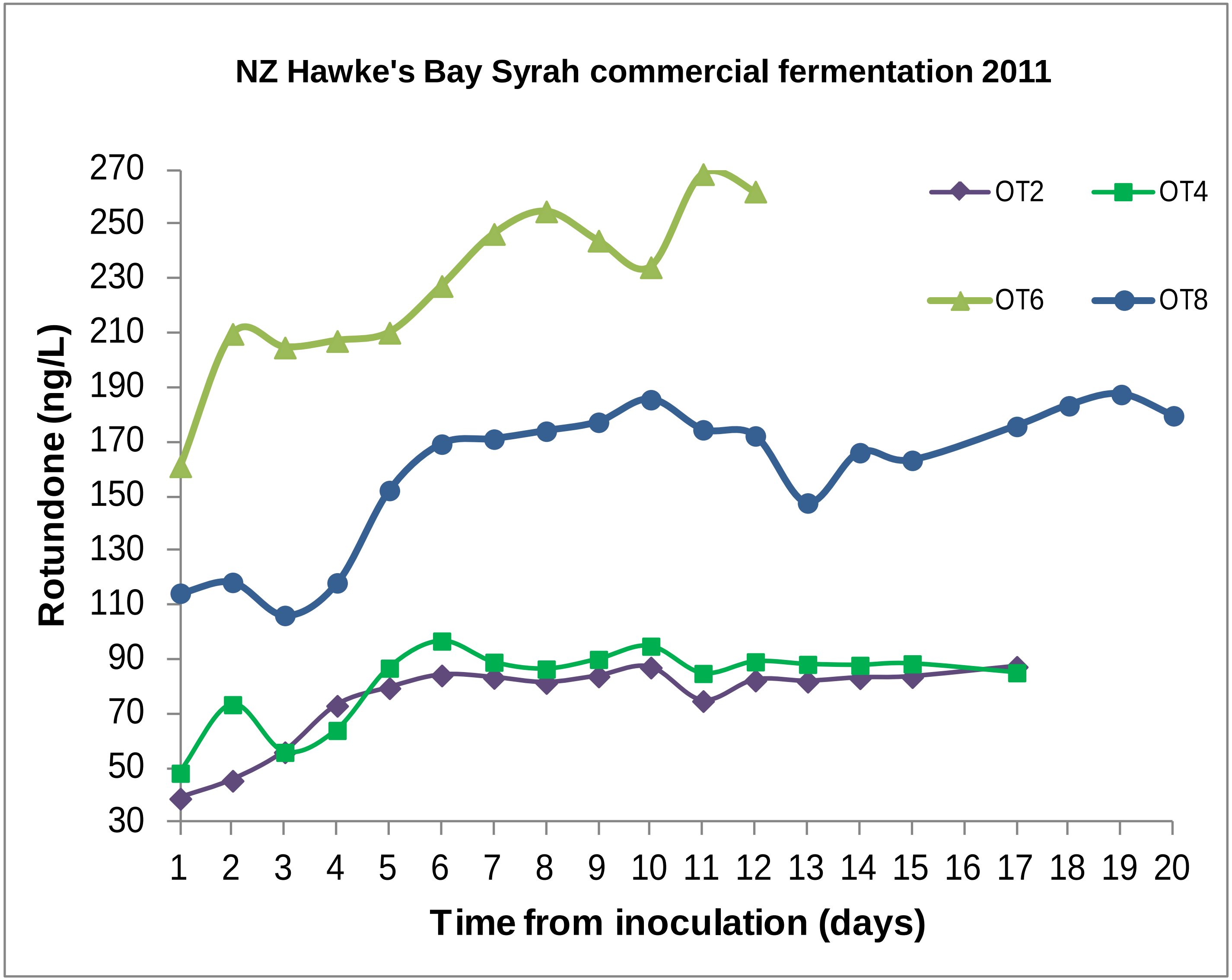
Rotundone extraction during winemaking

The Australian Wine Research Institute



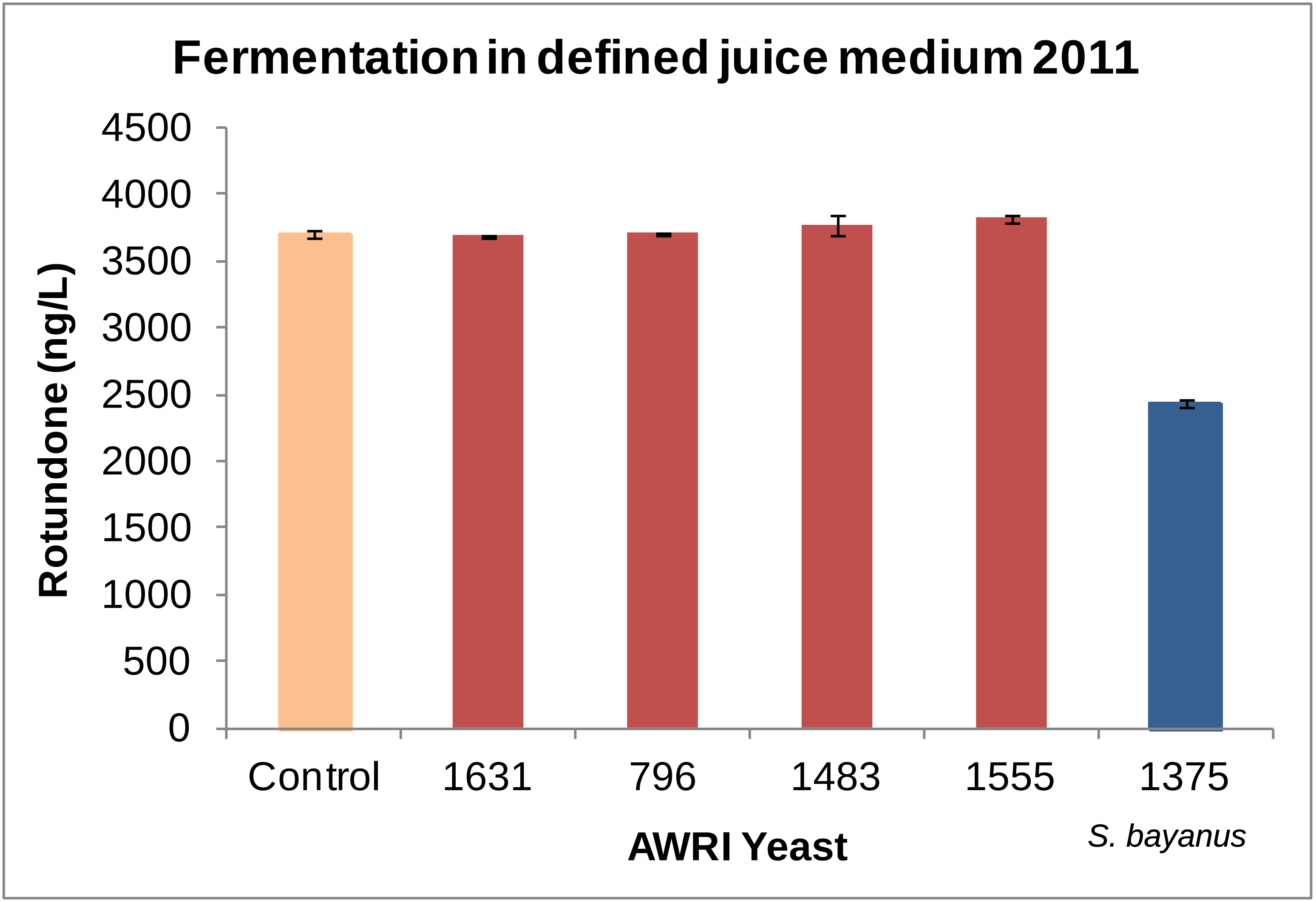
Rotundone extraction from berries during winemaking

The Australian Wine Research Institute



Can yeast affect rotundone levels during fermentation?

The Australian Wine Research Institute



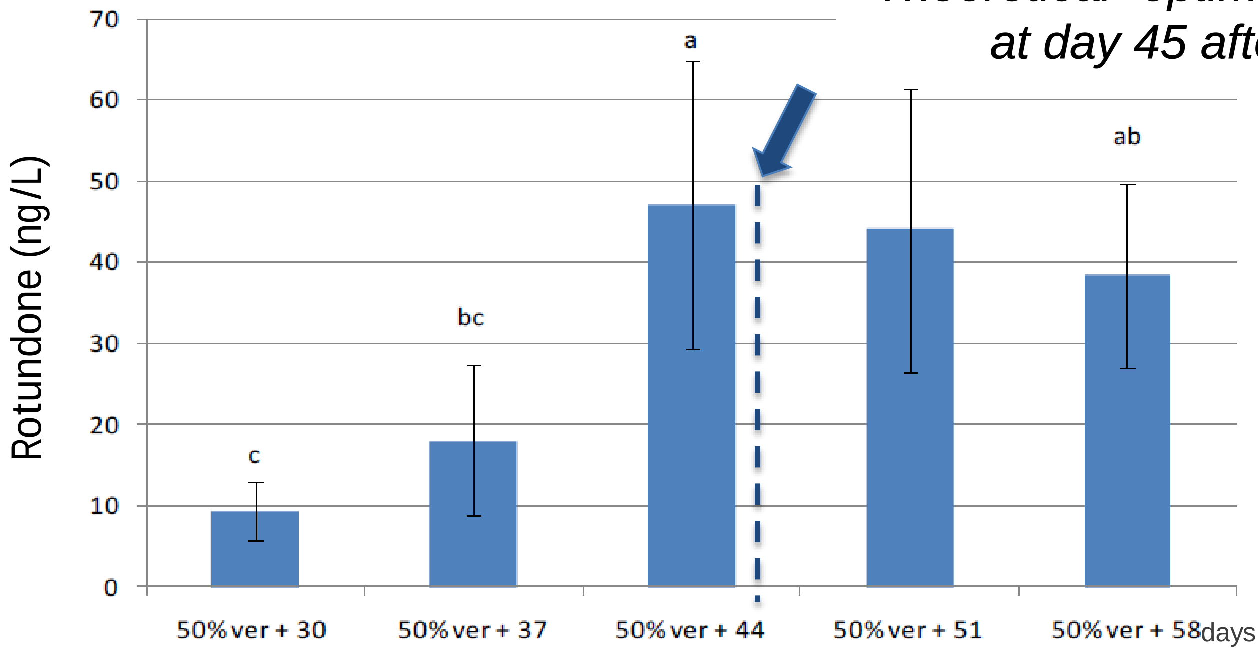
Rotundone in French Pyrenees wines

Olivier Geffroy, IFV Sud-Ouest

The Australian Wine Research Institute

2011 Duras microvinification at 5 levels of maturity

"Theoretical" optimum picking date at day 45 after veraison



INSTITUT FRANÇAIS DE LA VIGNE ET DU VIN

IFV viticulture trials:	***2011***	***2012***
Irrigation / Elicitor / crop load	43-48 ng/L	29-36 ng/L
Control	37 ng/L	27 ng/L
Leaf removal	12 ng/L	12 ng/L

Conclusions and future directions

The Australian Wine Research Institute

- Viticulture parameters affected rotundone levels: Picking date, clone, vigour, leaf removal & crop load
- Why does rotundone occur in Shiraz more often than other cultivars?
- Can rotundone be modulated during winemaking?

Acknowledgements

The Australian Wine Research Institute

- Darryl Catlin, Winemaker, and the winery and laboratory staff of Shaw and Smith Wines
- Frank van de Loo, Mt Majura Vineyard
- Jim Lumbers, Lerida Estate and Lumbers Consulting
- Dr Ayalsew Zerihun, Curtin University of Technology
- Nathan Scarlett, Dan Buckle, Damien Sheehan (Mt Langi Ghiran), Allen and Andrea Hart (Treasury), Inca Pearce, Martin Wirper (Orlando), Sue Hodder (Wynns Coonawarra Estate)
- Symrise, Germany

AWRI

- Mango Parker, Claudia Wood
- Flavour & Sensory Teams
- Radka Kolouchova

- The University of Auckland & EIT Hawke's Bay
- Mission Estate Wines
- Craggy Range Vineyards

THE UNIVERSITY OF AUCKLAND NEW ZEALAND

gwrdc GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

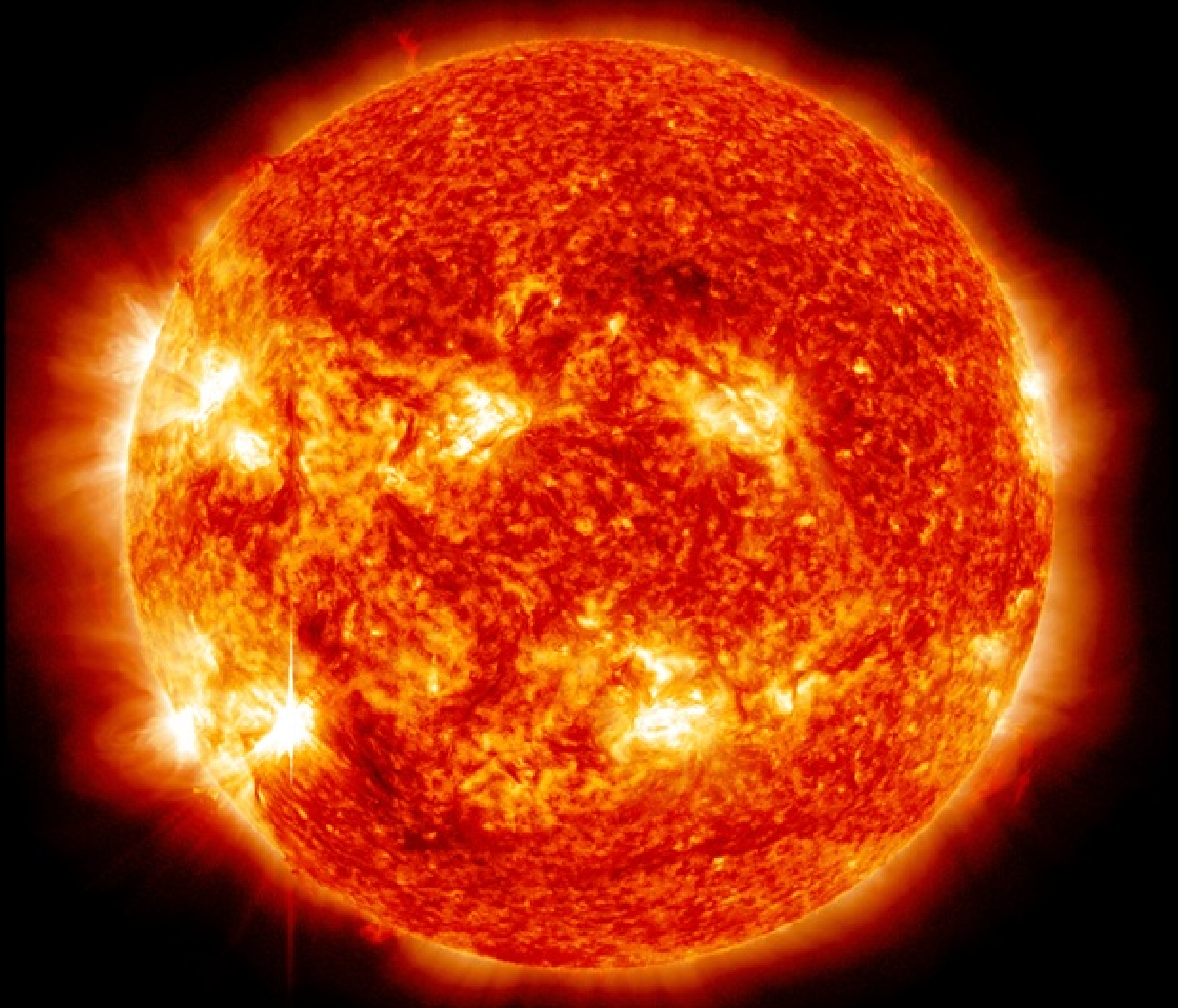
The AWRI, a member of the Wine Innovation Cluster in Adelaide, research is financially supported by Australia's grape growers and winemakers through their investment body the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

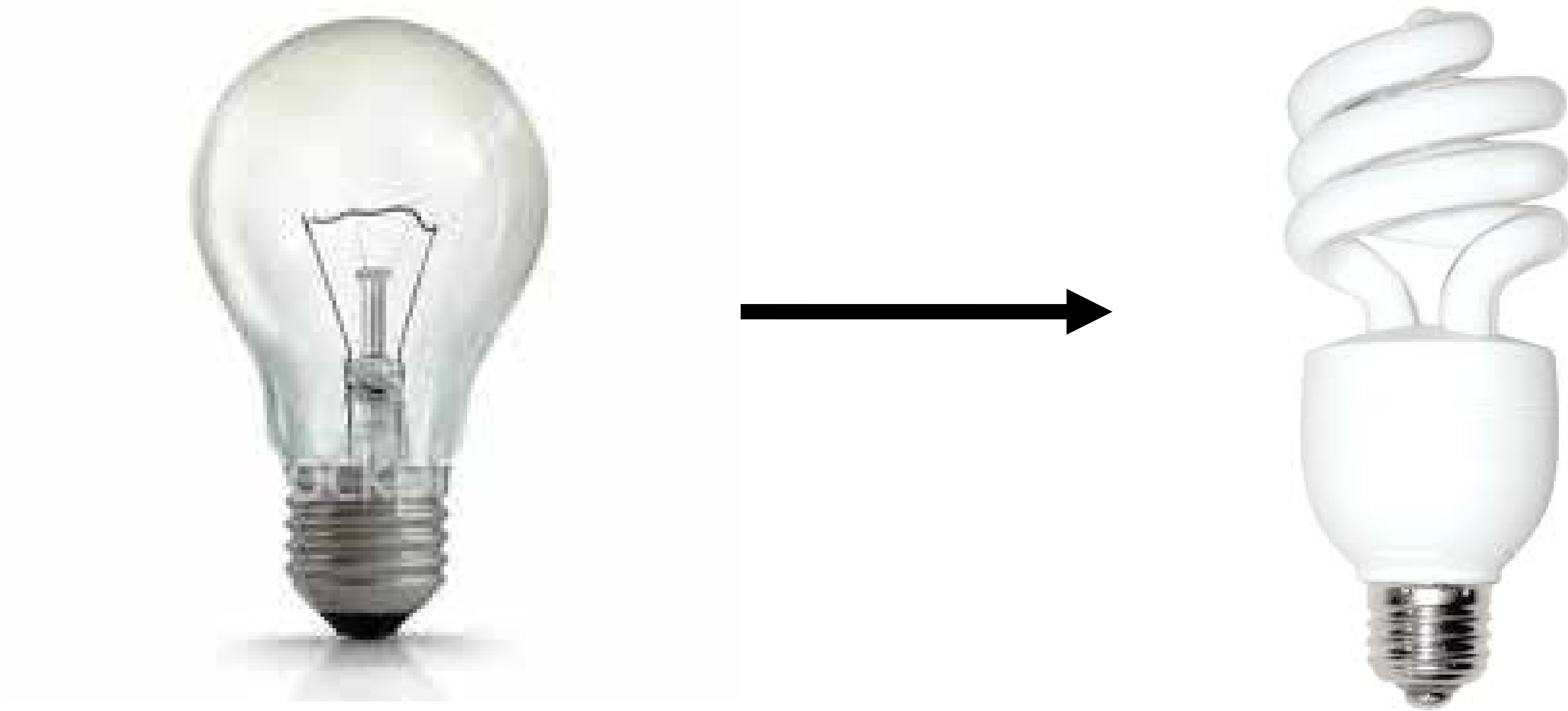
The Australian Wine Research Institute

Energy for the future: moving towards on site renewable biomass and solar technology

Dr Richard Muhlack

AWRI Riverina Node

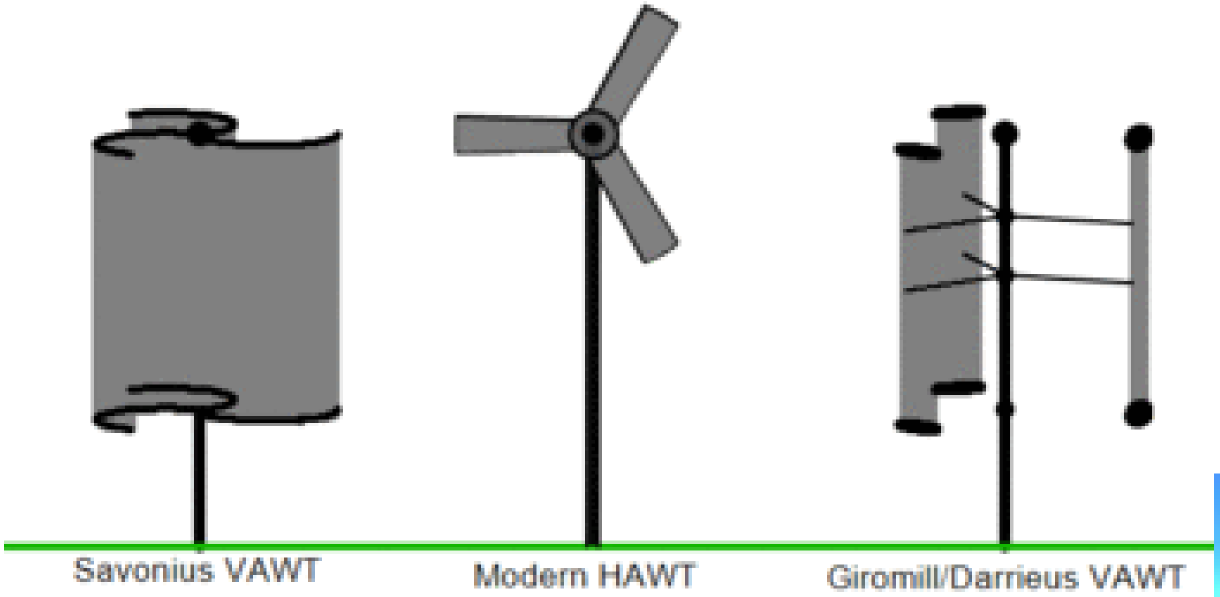





Australia
100

Self sufficiency

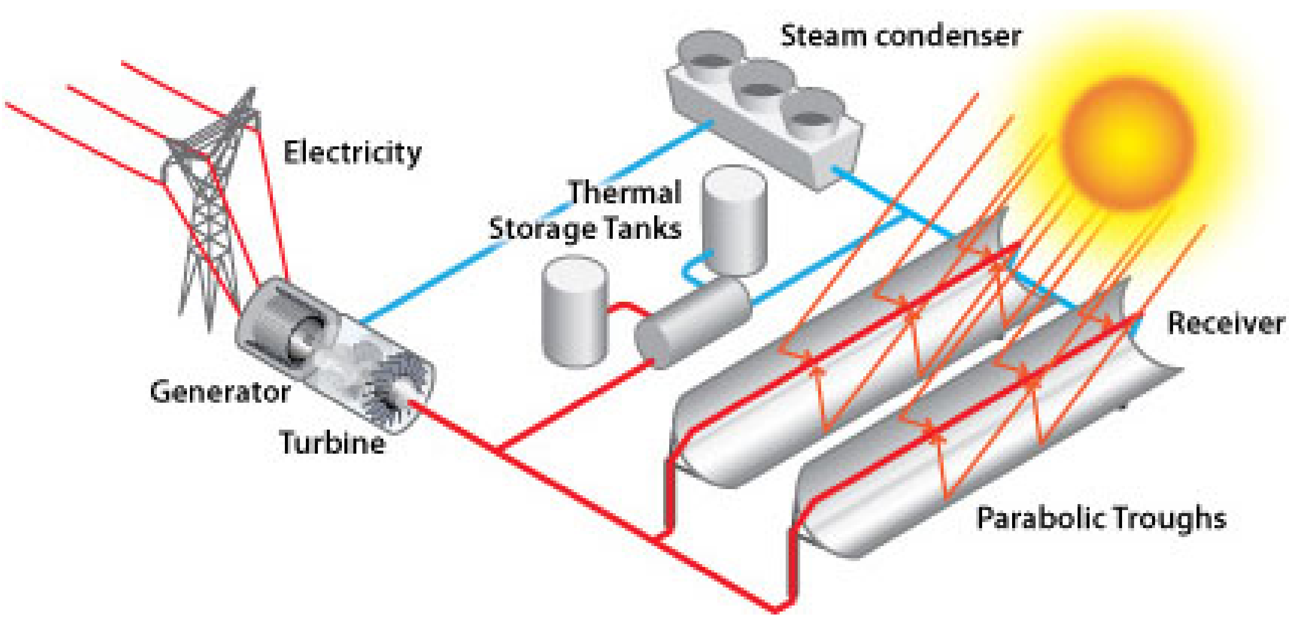
“Old School”



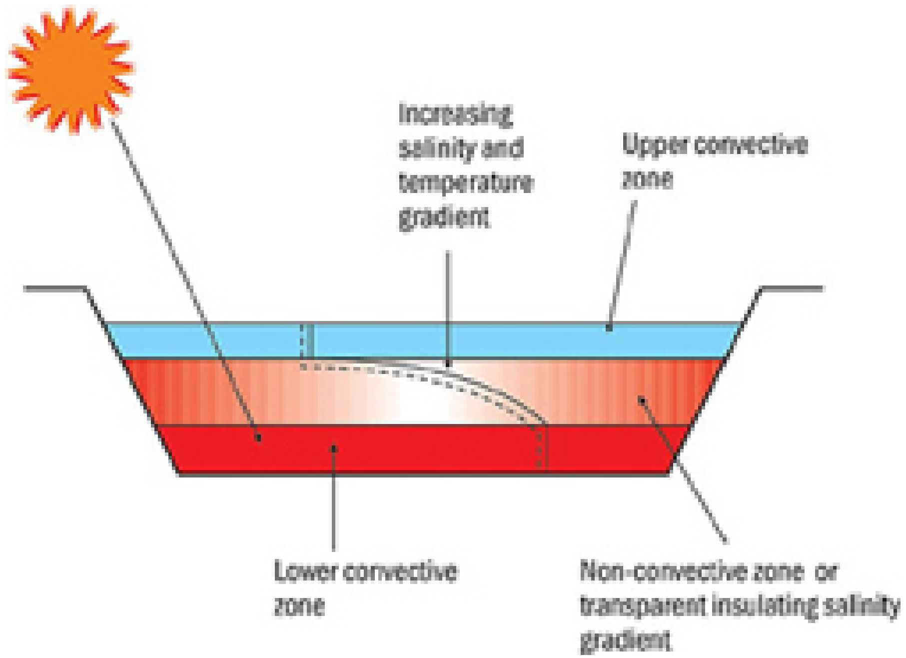
Solar Thermal – CSP

Source: Keith Lovegrove, Solar Thermal Group, ANU

Solar Thermal – how it works



Solar Thermal – Solar Ponds



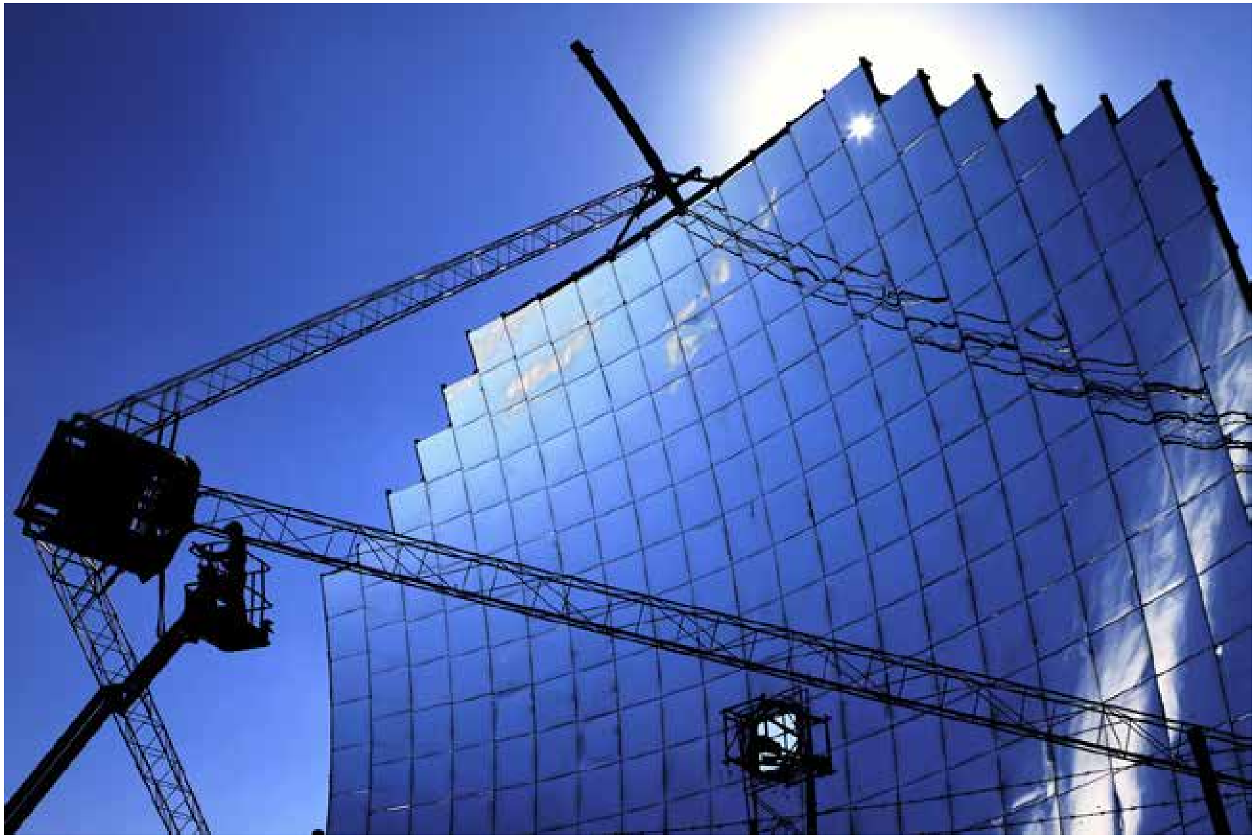
60kW Solar Pond, Kerang Vic

Source: www.enersalt.com.au

Organic Rankine Cycle Engine to convert low grade heat to electricity

Solar Thermal Outputs

- Electricity Generation
- Process Heating and Cooling (Absorption Refrigeration)



SG4 Big Dish, ANU

(Photo: Robert Corkery)

BIOMASS ENERGY

$$??? = \int_{\text{Costs}}^{\text{Value}} \text{Waste}$$

Rocky Point Sugar Mill, Qld   30MW Cogen


Visy Clean Energy Plant, Melbourne
30MWth 3MWe Combustion System
Processing 120,000 tpa reclaimed paper

AGL Biogas Plant: Melbourne WW Treatment Werribee Vic

Biogas generated by **Anaerobic Digestion** is used to power this V16 gas engine

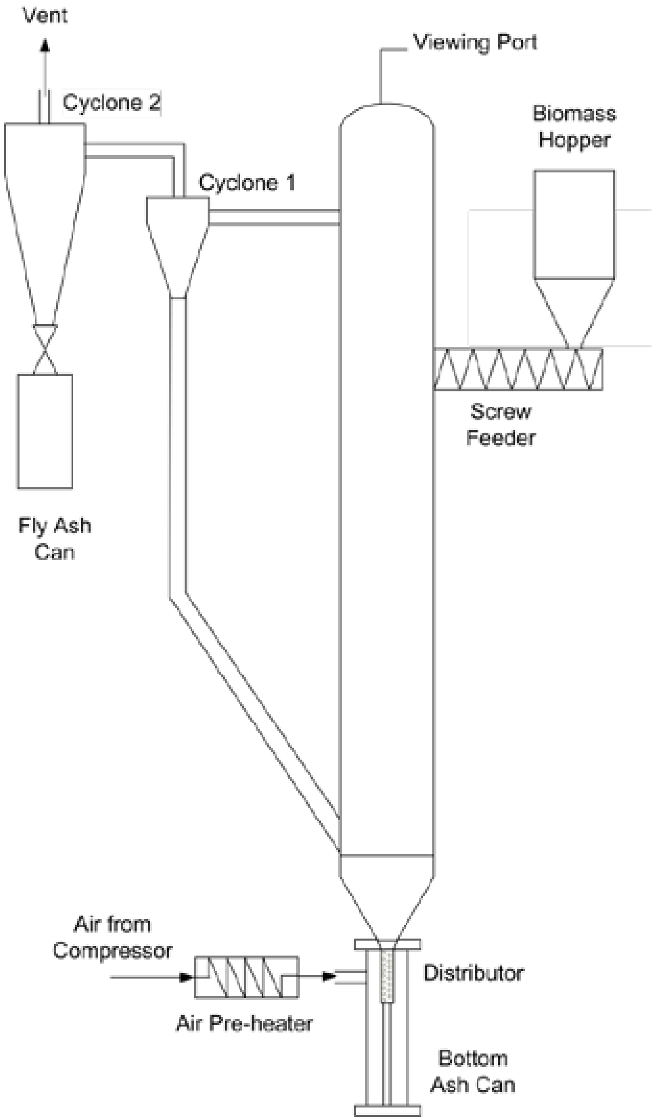
Power output:
1.225 MWe


Livestock rendering plant
600kW Anaerobic Digestion system
Supplying all site electricity needs
METHANE


Piggery treatment pond in Queensland
Retro-fitted for Anaerobic Digestion
gas production

- 10 kW downdraft fixed grate gasifier (peach stones)
  - Earth Systems Pty Ltd (www.earthsystems.com.au)
  - Demonstration at the Bioenergy Australia Conference 2009

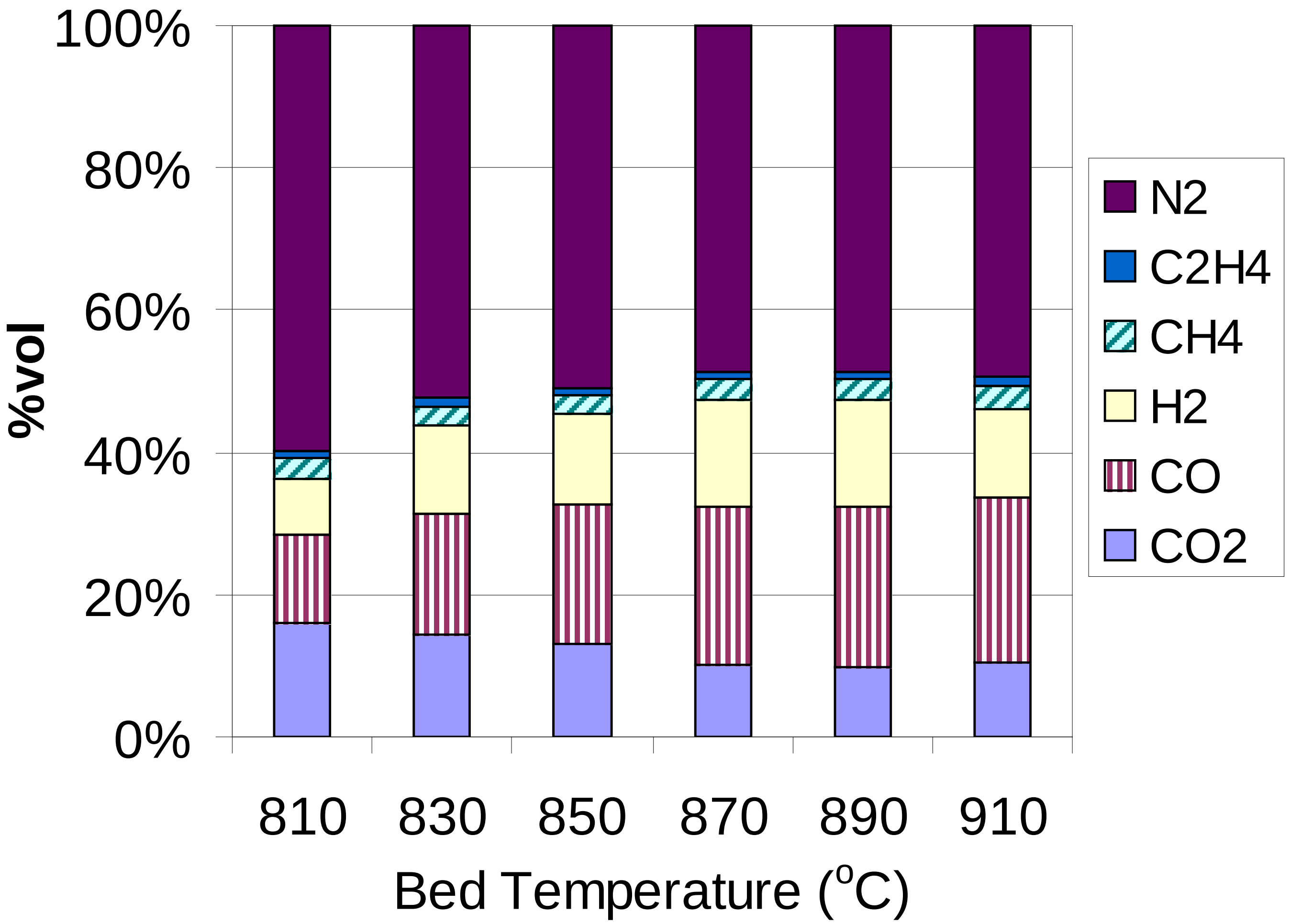
Gasification test rig



Lab-scale Circulating Fluidized Bed Gasifier

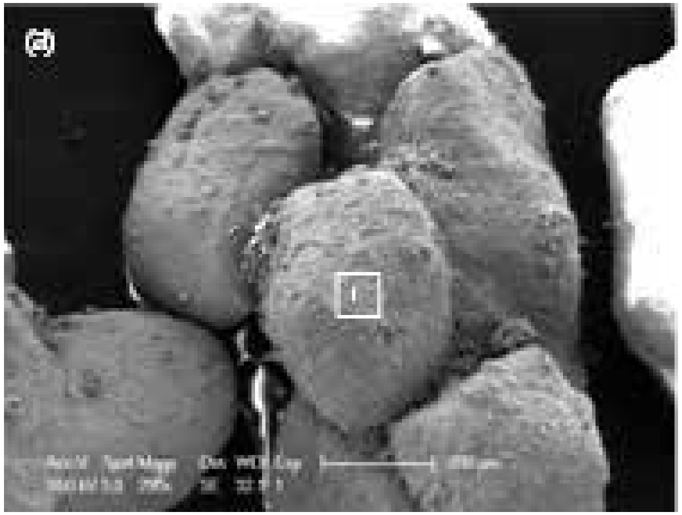
University of Adelaide
Centre for Energy Technology

Gas composition versus Gasification Bed Temperature

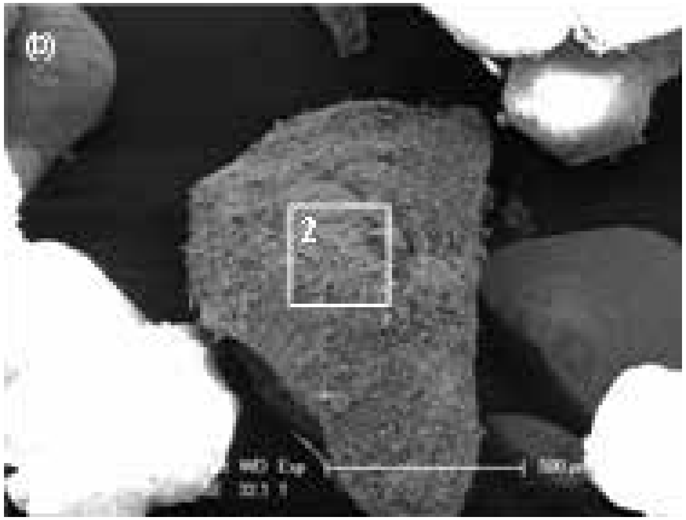


Ash analysis by SEM and XRD

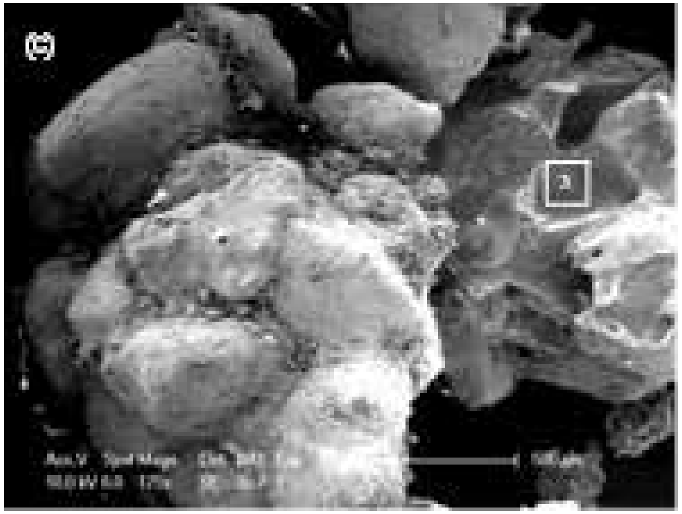
1.

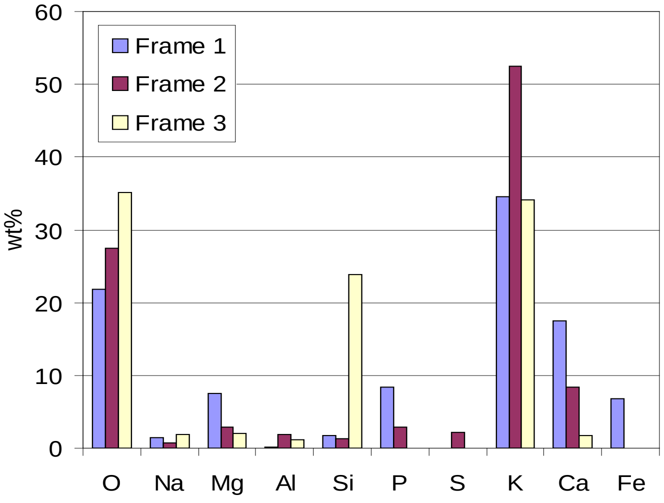


2.



3.





Let’s illustrate with an example

10,000 tonne crush winery

	Tonnes	Calorific Value (MJ/kg)	kWh Electricity	Equivalent Electricity Value
Grape Marc	750	21	787,500	$ 165,375
Stalks	56	19	53,438	$ 11,222
Pruning wood	917	20	916,511	$ 192,467
TOTAL			1,757,449	$ 369,064

Typical winery demand:
1,300,000 kWh (130 kWh/t)

An Energy Example

10,000 tonne crush winery

	Tonnes	Calorific Value (MJ/kg)	kWh Electricity	Equivalent Electricity Value
Grape Marc	750	21	787,500	$ 165,375
Stalks	56	19	53,438	$ 11,222
Pruning wood	917	20	916,511	$ 192,467
TOTAL			1,757,449	$ 369,064

>100%

Typical winery demand:
1,300,000 kWh (130 kWh/t)

Three promising technologies

Scenario	Description	Simple payback (years)	Projected Grid Energy Savings (%)
6	Site electricity supplemented by biomass energy (using gasification technology)	5.6	49%
12	Supplementary refrigeration supplied by AD powered refrigeration compressor	4.5	25%
13	Site electricity (except vintage refrigeration) supplemented by biomass (using ORC technology)	5.2	49%

Self sufficiency for a 300t winery ??

COST $45,000

30-70%

Bioenergy Australia

- Established in 1997 as a government-industry forum to foster and facilitate the development of biomass for energy, liquid fuels, and other value added bio-based products.

  http://www.bioenergyaustralia.org

Acknowledgements

- Colleagues in the AWRI Industry Applications, Research, IDS and Commercial Services Teams
- University of Adelaide School of Chemical Engineering / Centre for Energy Technology –
  Dr Peter Ashman, Dr Philip van Eyk
- Bioenergy Australia

RM acknowledges the receipt of a DAFF Australian Agricultural Industries Young Innovators and Scientists Award, which partly funded this work.

The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australian grapegrowers and winemakers through their investment body, the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

AWRI

The Australian Wine Research Institute

Choose the right yeast to achieve the red wine style you want

Chris Curtin

Senior Research Scientist

Eveline Bartowsky

Senior Research Scientist

Robert Dambergs

Senior Research Scientist

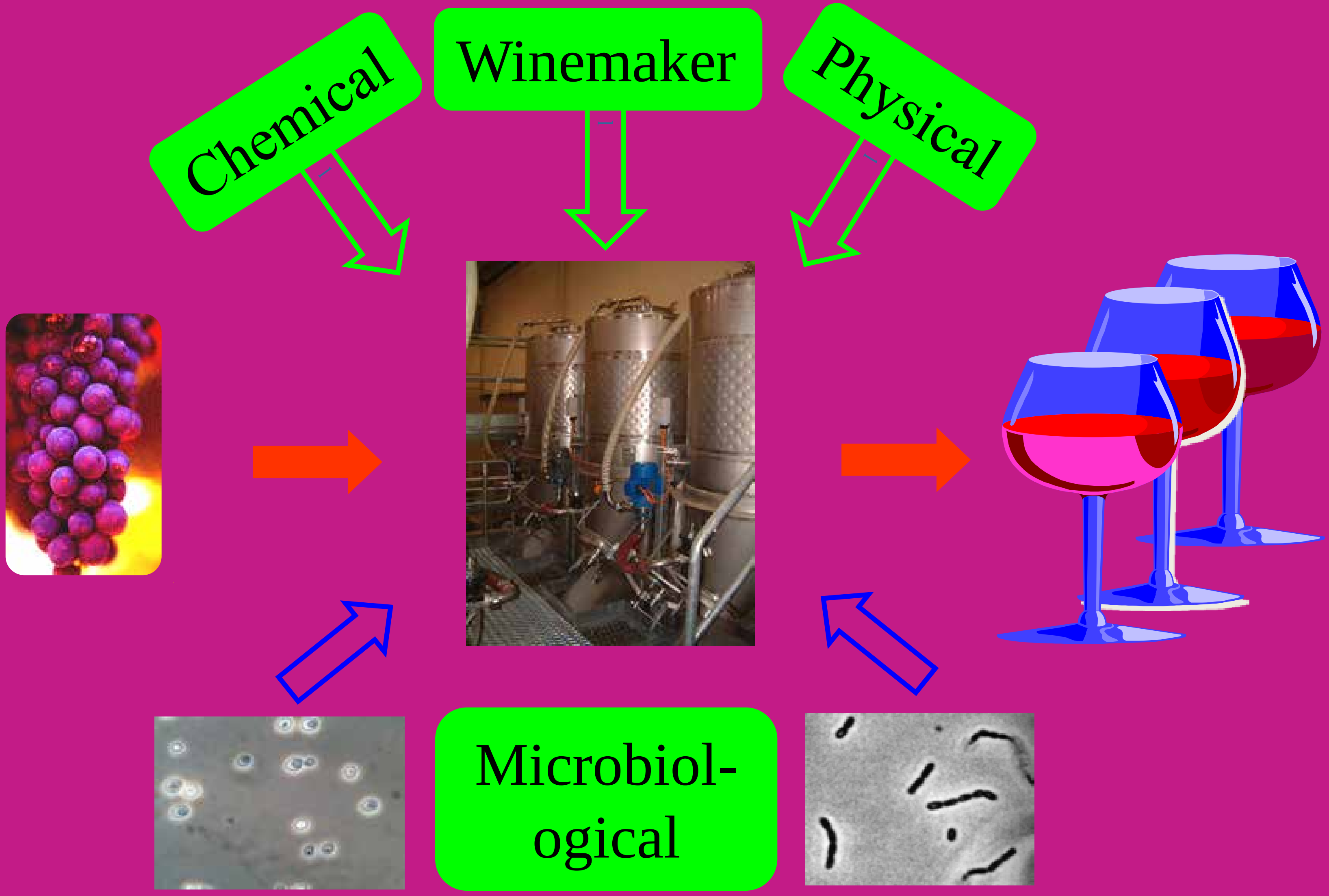
Paul Henschke

Principal Research Scientist

Red Wine Fermentation Technology

Complex Interactions: must, microbes & fermentation conditions

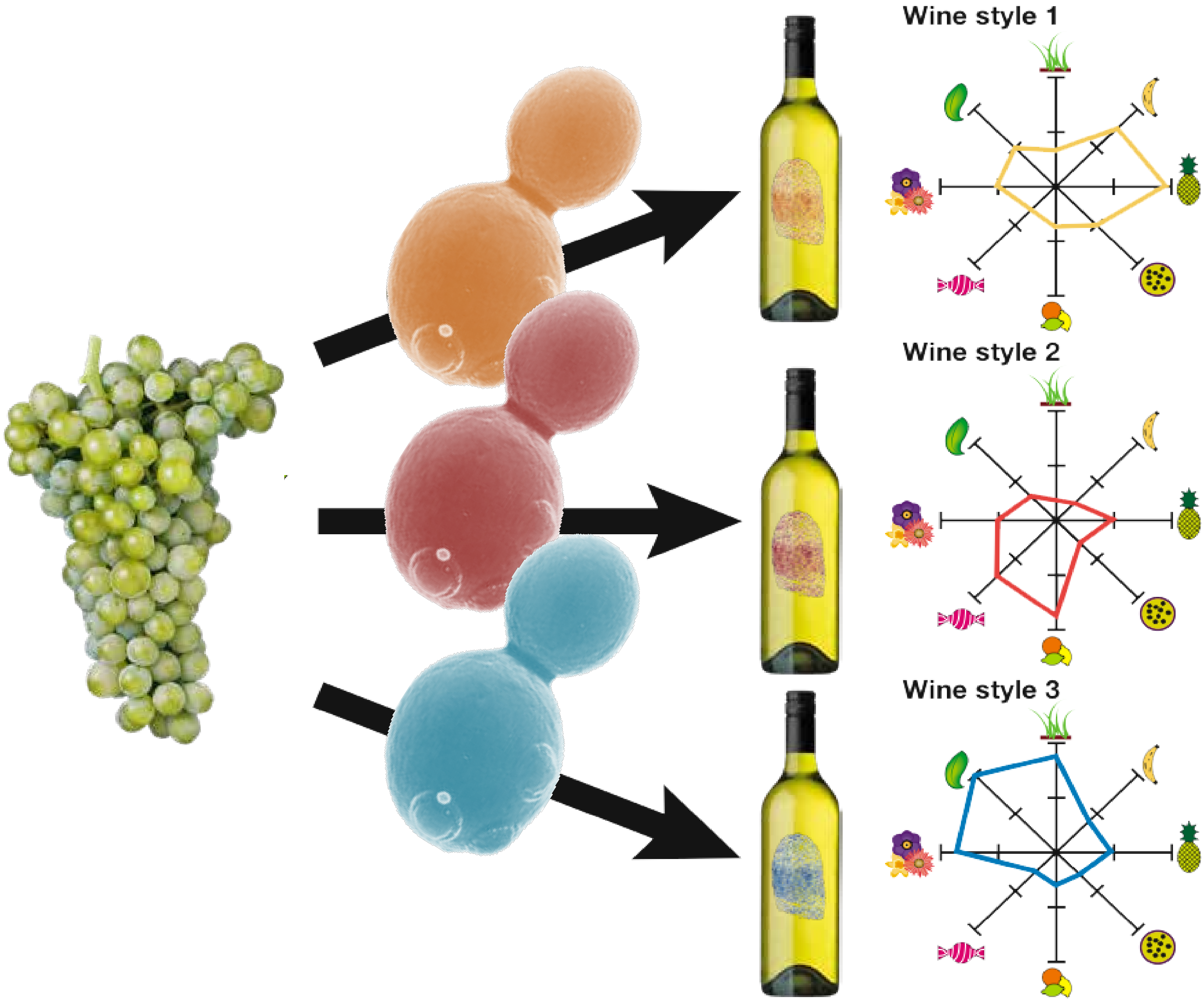
The Australian Wine Research Institute



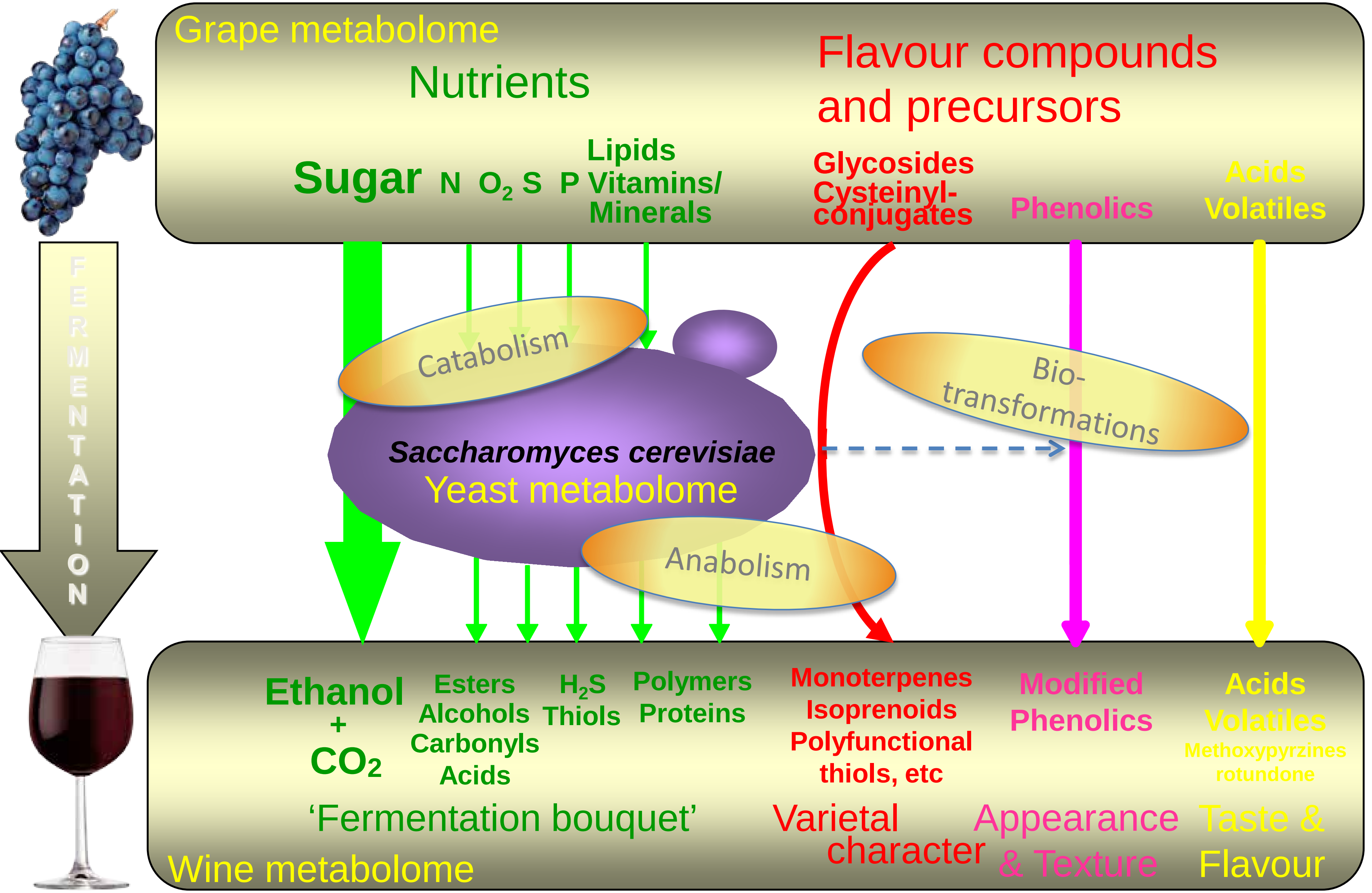
What impact do yeasts have on red wine properties?

Yeast modulation of white wine style is well established

The Australian Wine Research Institute



Yeast – Grape must interactions
Flavour formation / modulation

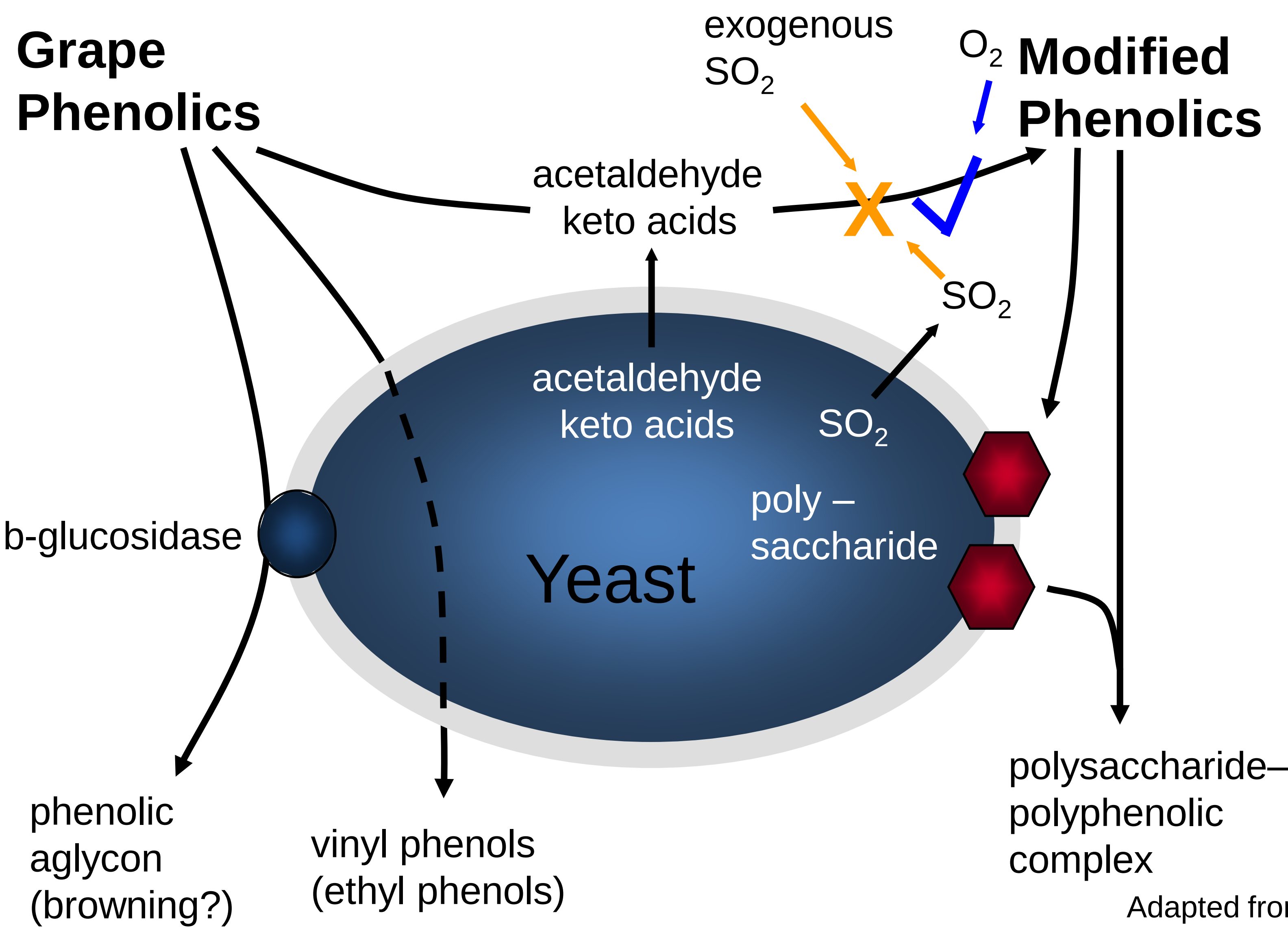


Can yeast affect colour, flavour, and texture of red wine?

The Australian Wine Research Institute

Interactions between yeast and phenolic compounds during red wine fermentation

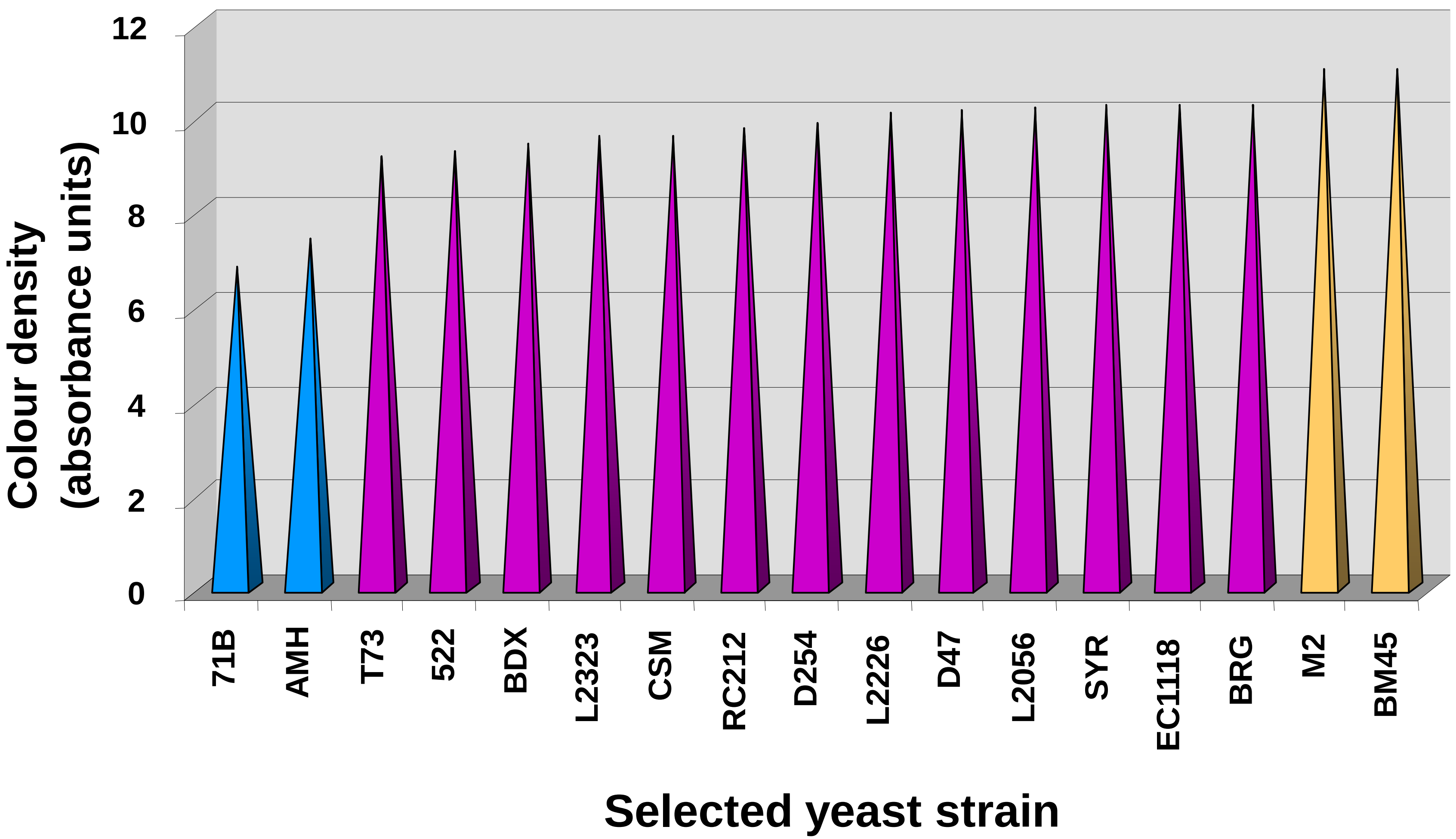
The Australian Wine Research Institute



Adapted from Ugliano & Henschke 2009

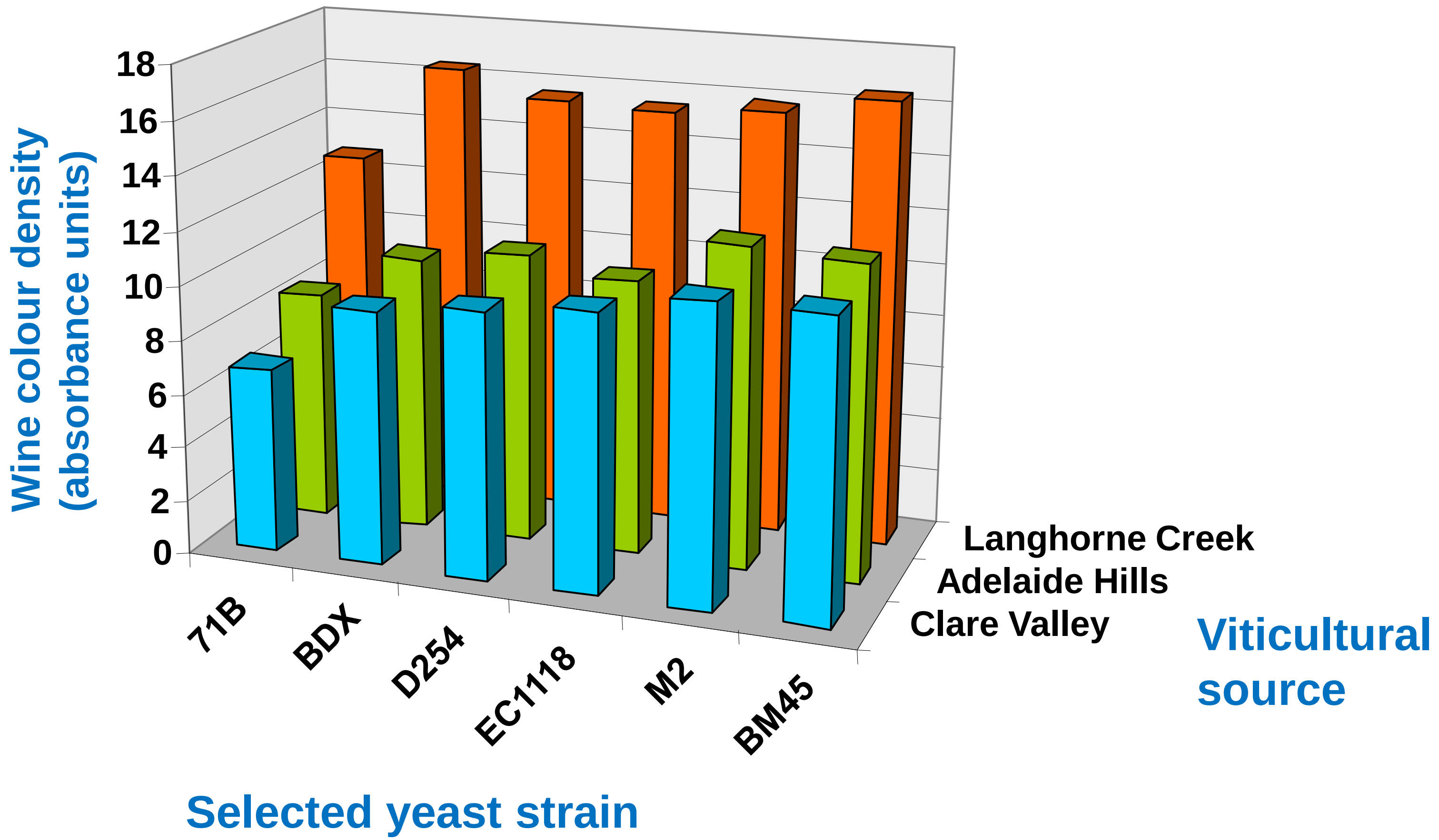
Effect of wine yeast strain on colour density of young red wine

The Australian Wine Research Institute



Interaction of Yeast X Region on colour density preservation of *terroir*

The Australian Wine Research Institute

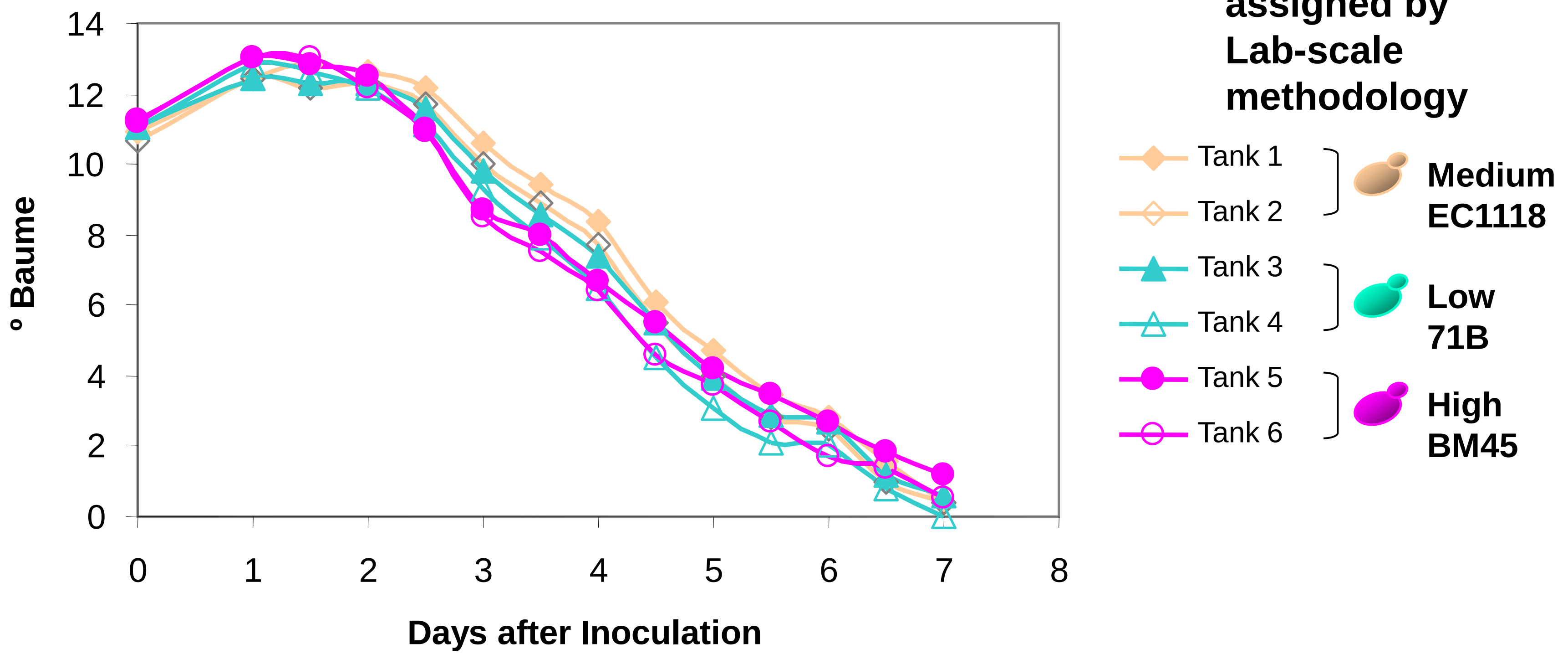


Pilot scale winery fermentation trial (1 tonne)

Confirmation of wine colour properties of yeast selected by the lab-scale methodology

The Australian Wine Research Institute

Wine colour density assigned by Lab-scale methodology



Dillon et al (2004) Procs 12AWITC pp. 316-317.

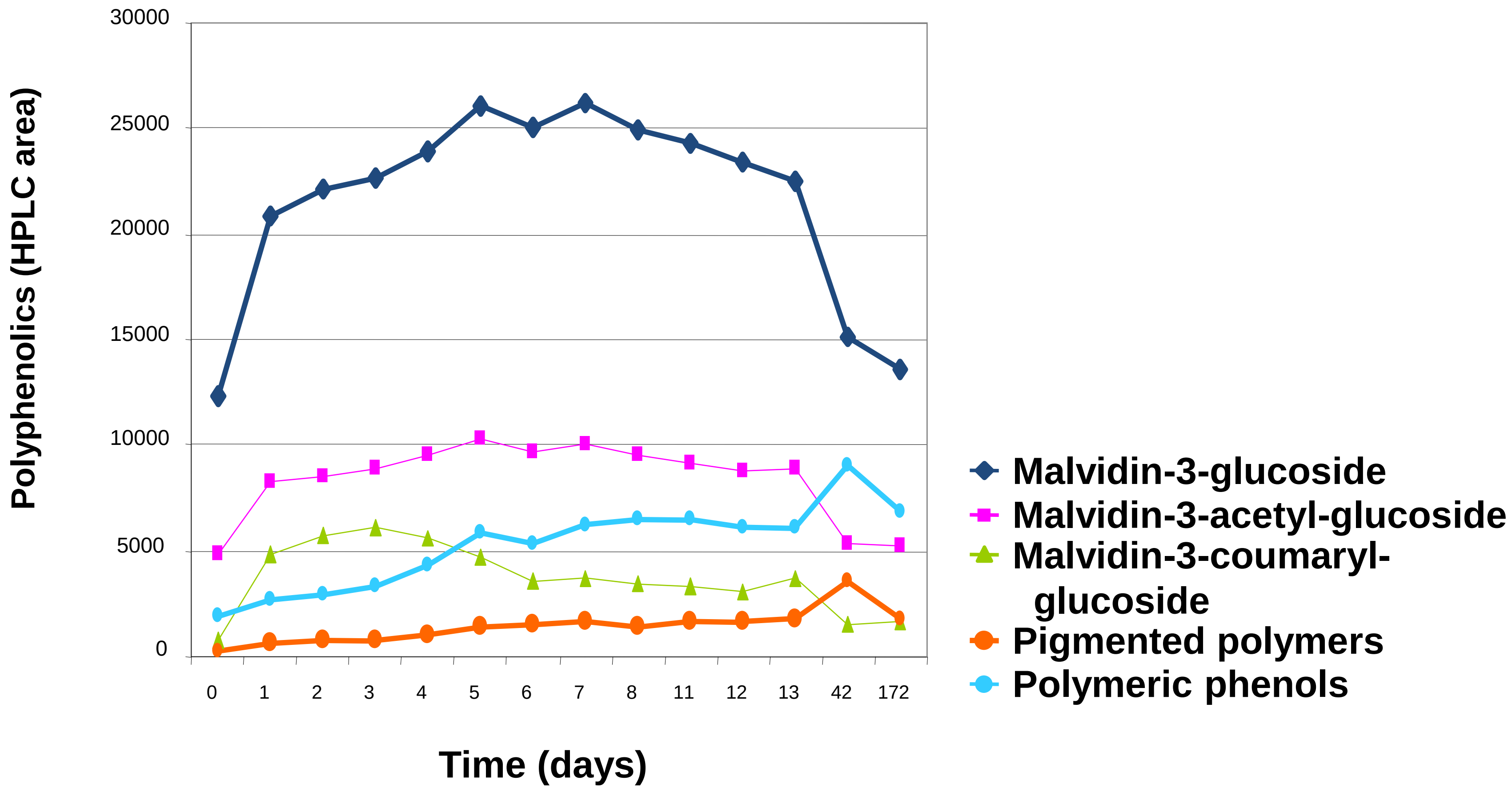
Shiraz grapes supplied by Hardy's Wines, 2003
Wines made by Stephen Clarke, WSL, Uni. Adelaide

HR Wine Science Laboratory
Waite Precinct – University of Adelaide

The Australian Wine Research Institute

Development of Polyphenolics over 8 months

The Australian Wine Research Institute

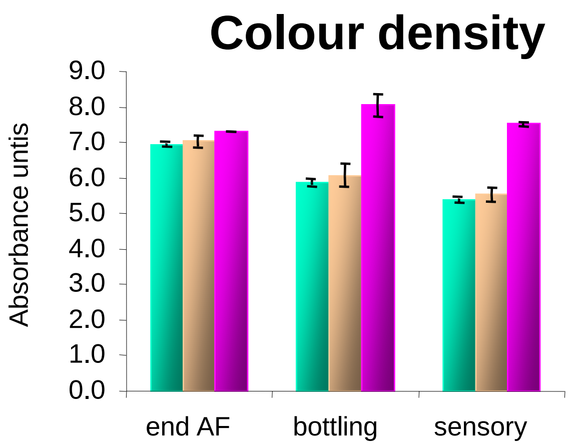


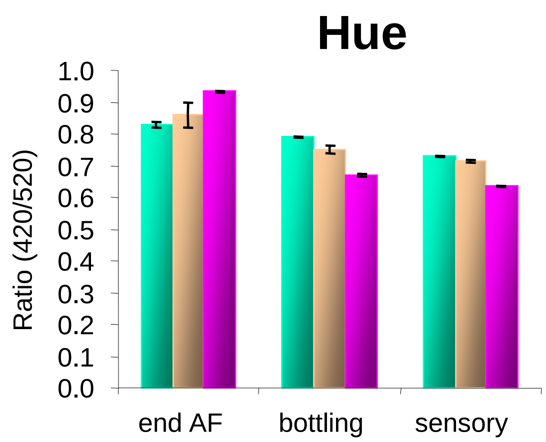
>>> continuous increase in pigmented polymers fraction and large decrease in anthocyanins post alcoholic fermentation

Dillon et al (2004) Procs 12AWITC pp. 316-317.

Colour & Polyphenolics Composition over 8 months

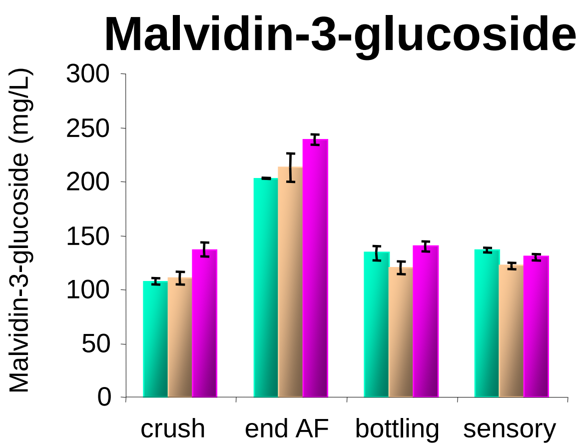
The Australian Wine Research Institute

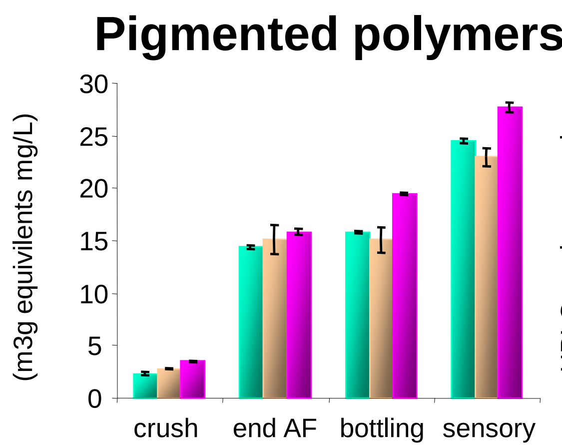


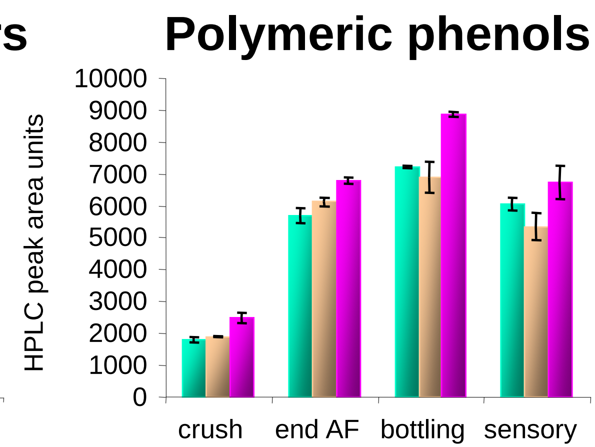


Low (71B)
Medium (EC1118)
High (BM45)

Wine age = 8 months at last analysis (sensory)





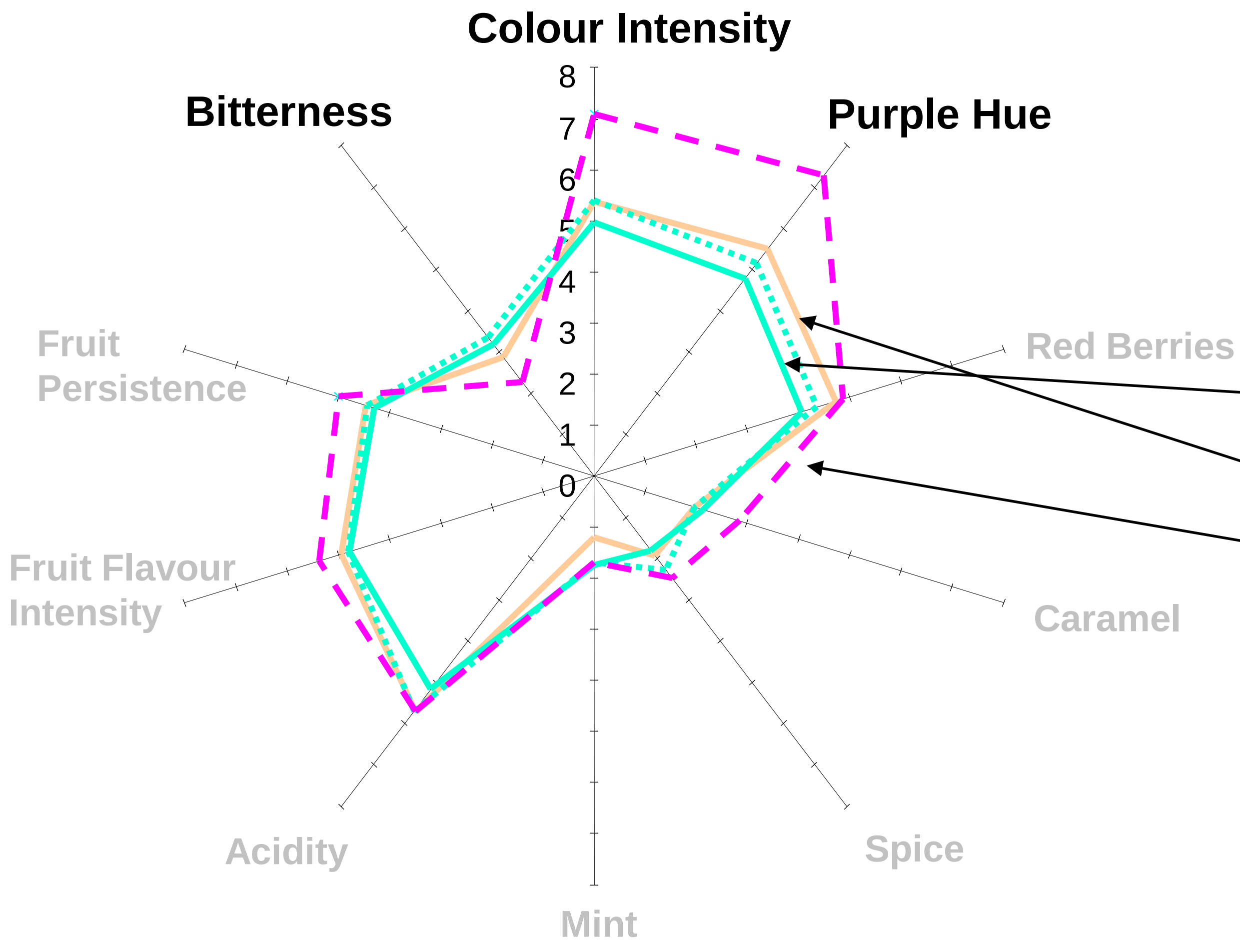


>>> Depending on strain of yeast, yeast effects can persist as wine ages

Dillon et al (2004) Procs 12AWITC pp. 316-317.

Sensory evaluation at 8 months

Attributes which are significantly different (P<0.1)



Wine colour density assigned by Lab-scale methodology

- Low (71B) (both replicates)
- Medium (EC1118)
- High (BM45)

>>> Yeast strain can affect colour and bitterness in ageing red wine

Dillon et al (2004) Procs 12AWITC pp. 316-317.

Effect of Chemical & Physical fermentation parameters on wine colour density

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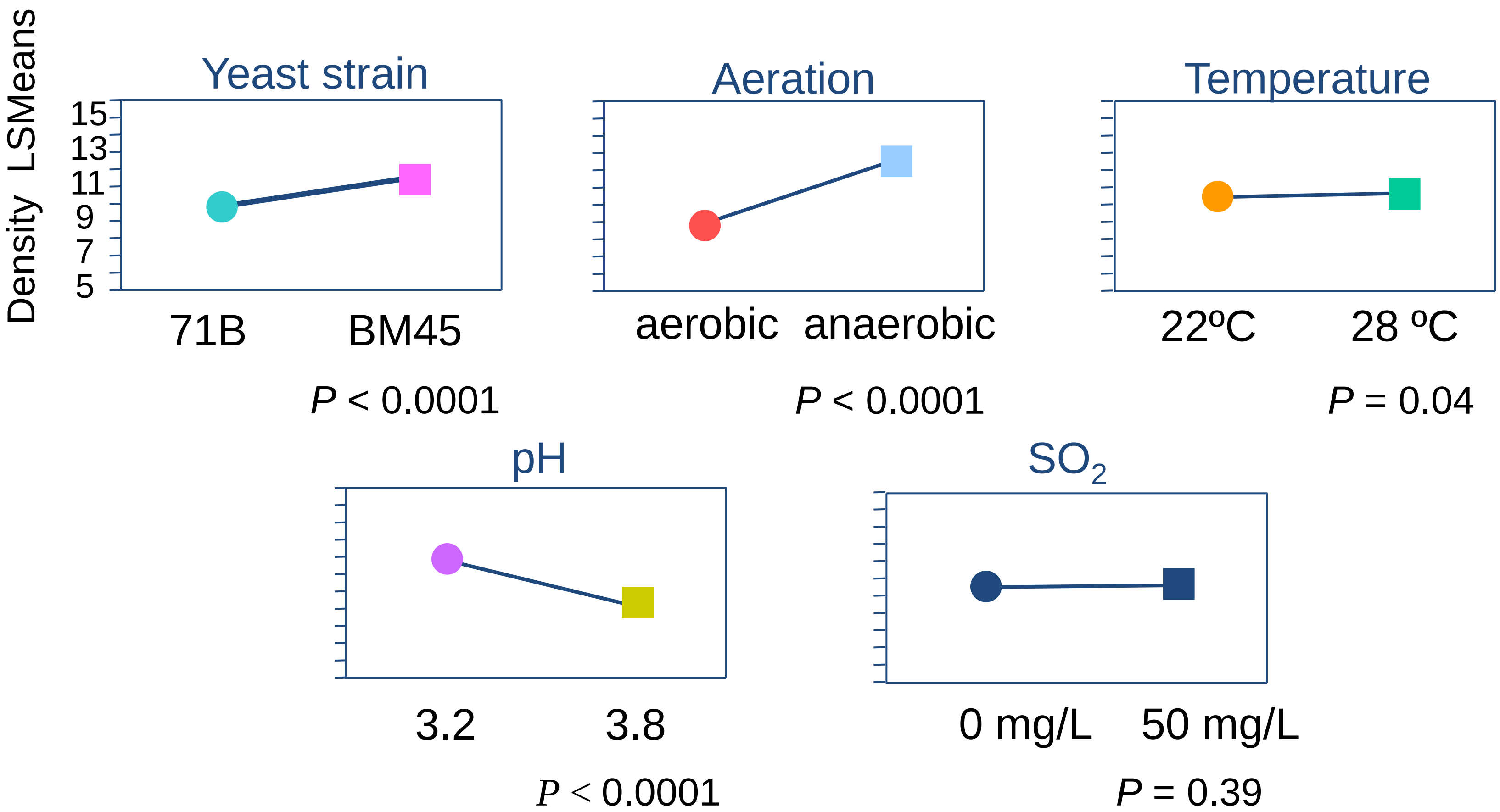
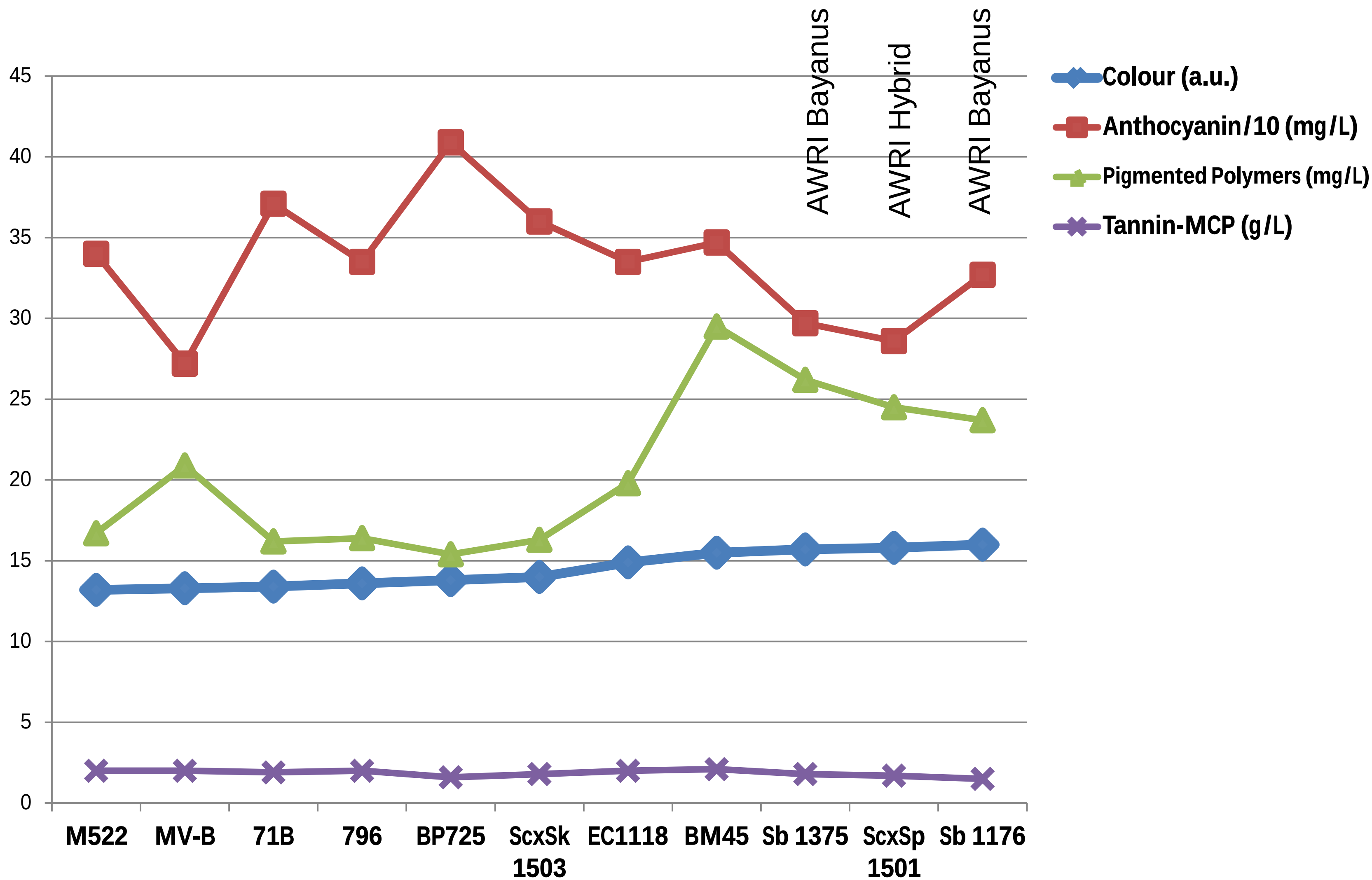


Yeast strain affects colour and tannins in young Cabernet Sauvignon wine

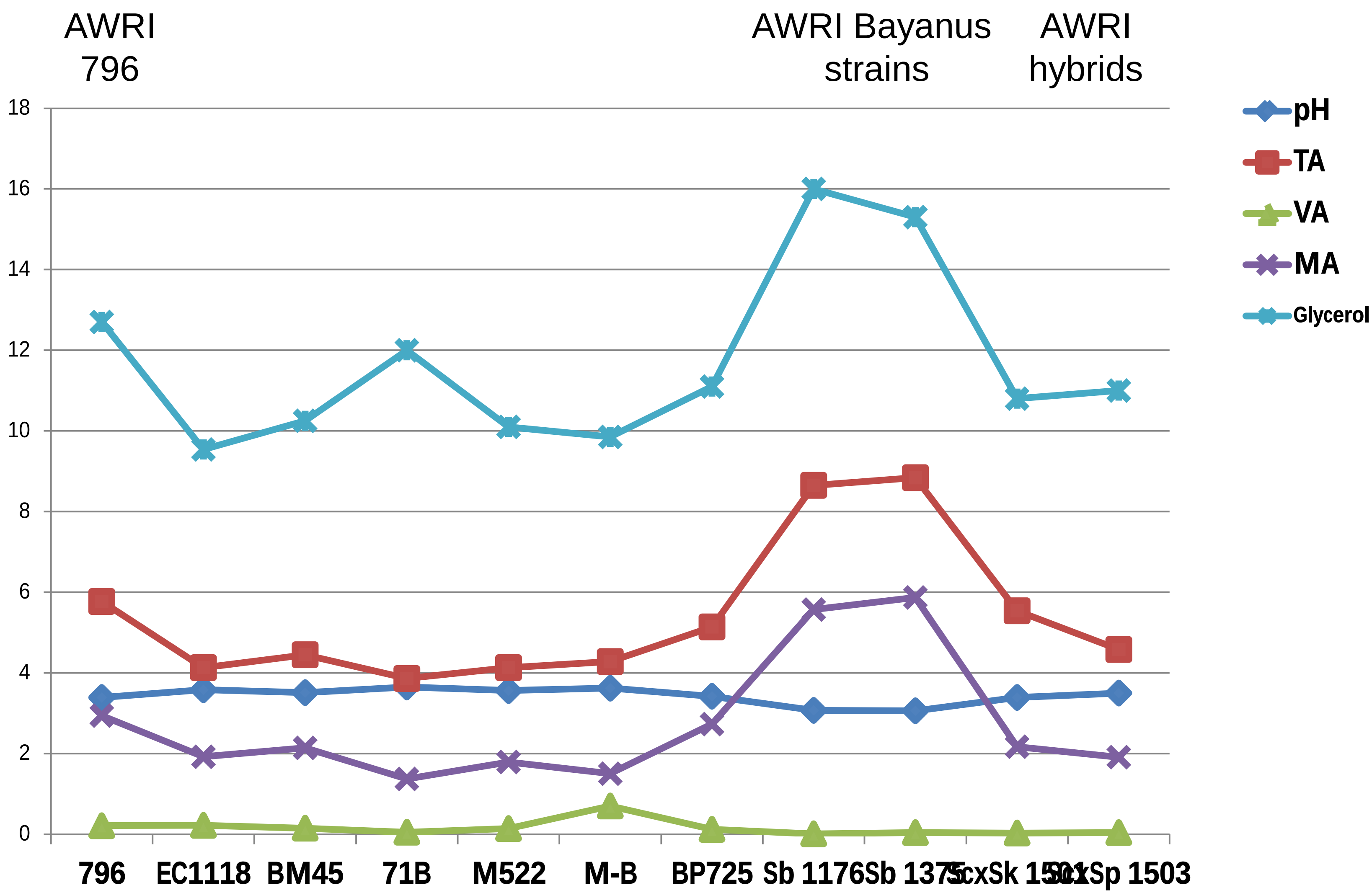
The Australian Wine Research Institute



Blazquez Rojas, Smith & Bartowsky WJMB 2012

Some strains can profoundly affect the basic composition of young Cabernet Sauvignon wine

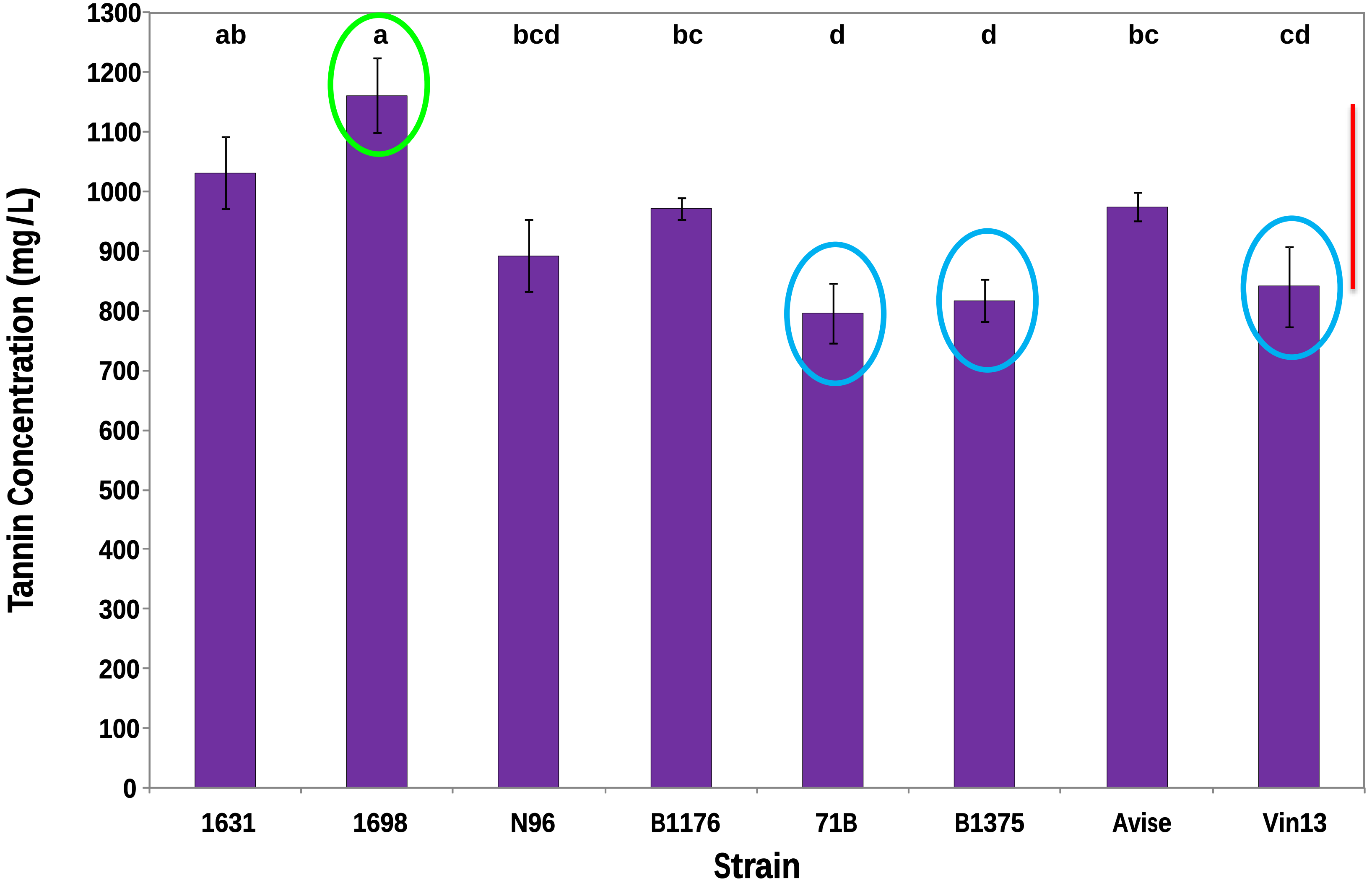
The Australian Wine Research Institute



Blazquez Rojas, Smith & Bartowsky WJMB 2012

Final tannin concentrations in Shiraz

The Australian Wine Research Institute



Holt et al. 2013 IJFM

Tannin size

A W R I
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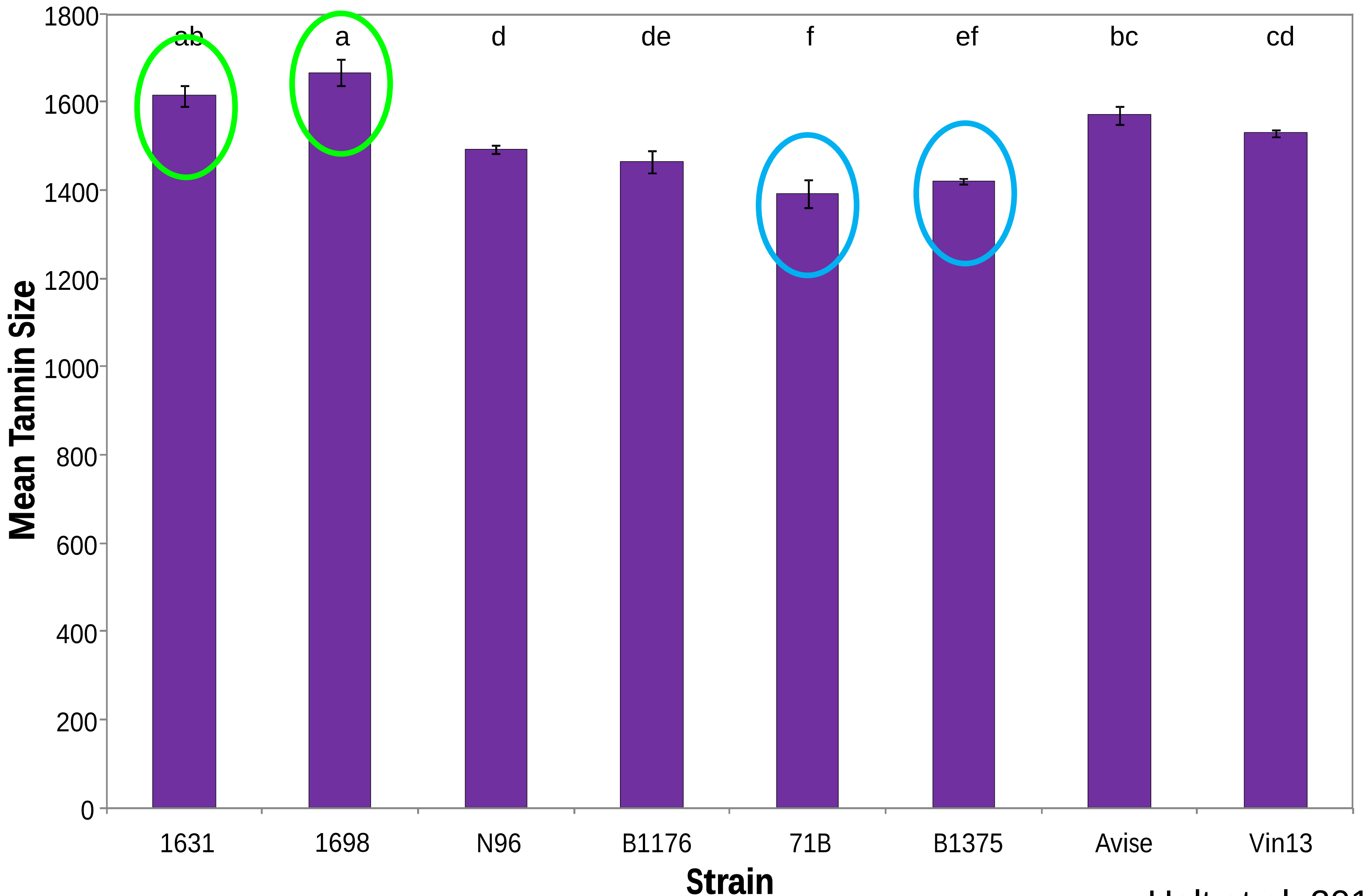


Holt et al. 2013 IJFM

Example of Pinot Noir:

The Australian Wine Research Institute

Why do Pinot noir producers use RC212 as an ‘industry standard’ yeast rather than EC1118?

TASMANIAN INSTITUTE OF AGRICULTURE

Anna L Carew (TIA), Robert Dambergs (AWRI/TIA), Dugald Close (UTAS) & Chris Curtin (AWRI)

UTAS

TIA is a joint venture of the University of Tasmania and the Tasmanian Government

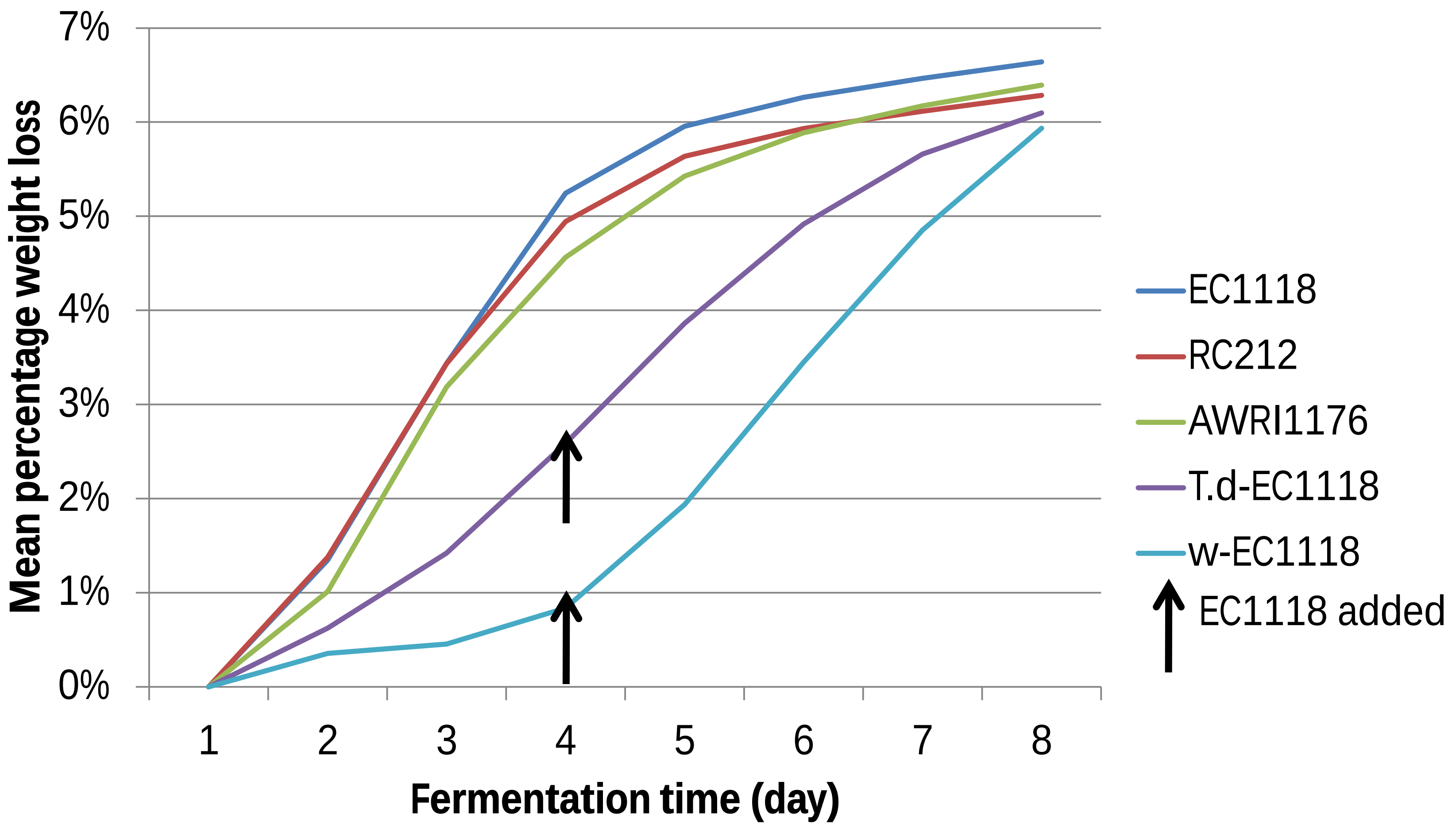
Tasmania
Explore the possibilities

Yeast trials

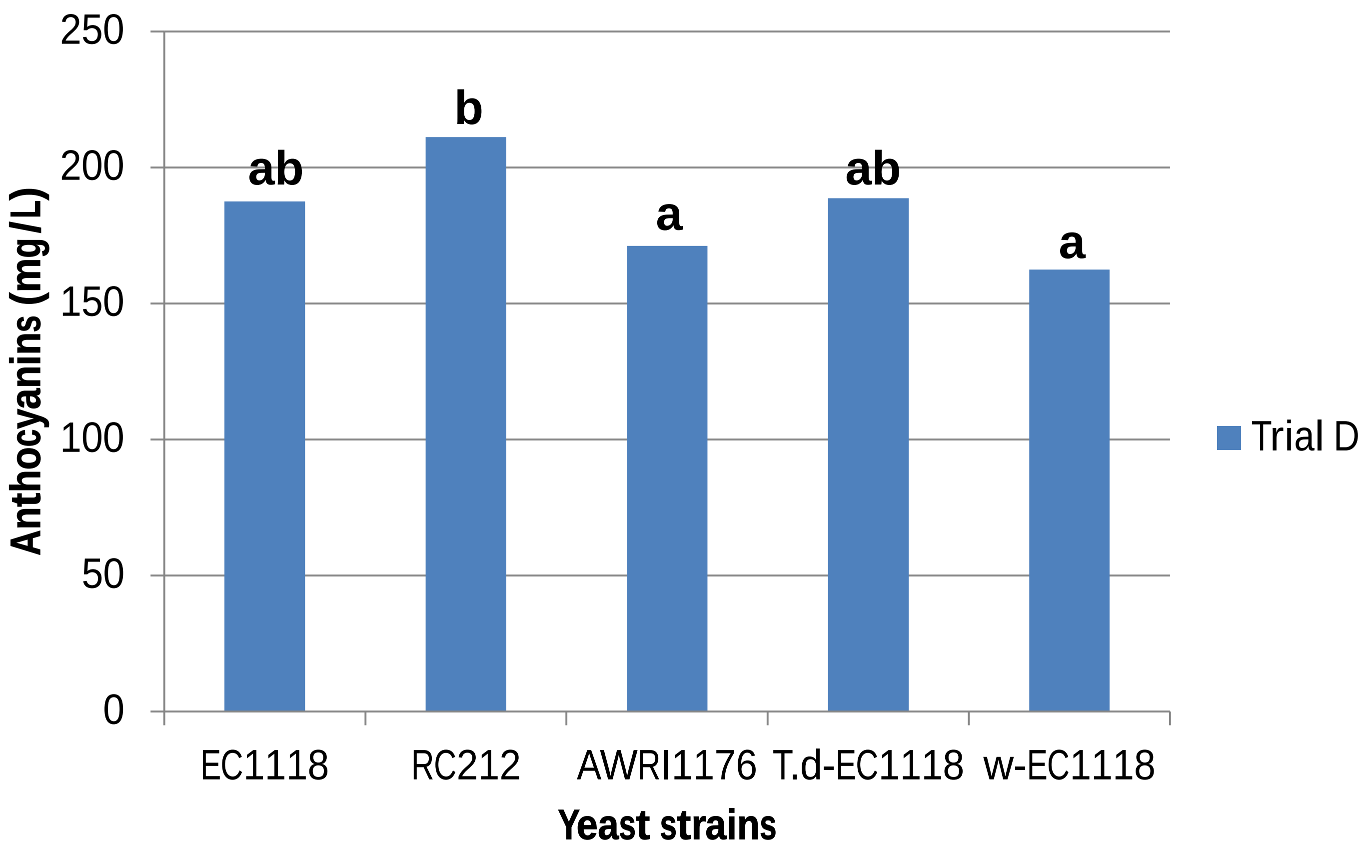
Q1: Are there yeast strain effects on phenolics in Pinot noir?

Strains:
- *Saccharomyces cerevisiae* EC1118, RC212
- *Saccharomyces bayanus* AWRI1176
- non-*Saccharomyces* sequential inoc (*Torulaspora delbruekii* + EC1118)
- ‘wild’ sequential inoculation (EC1118)

Fermentation kinetics (D)

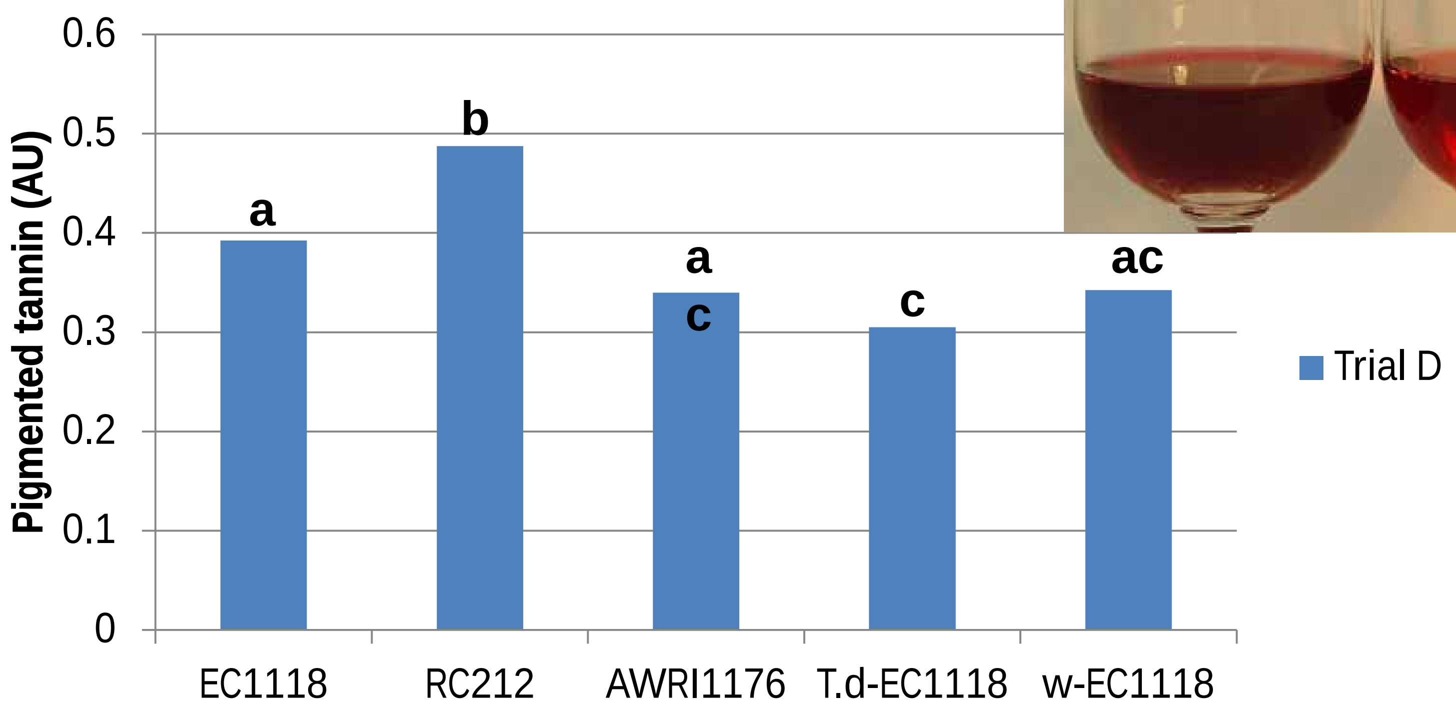


Anthocyanins - 6 mths



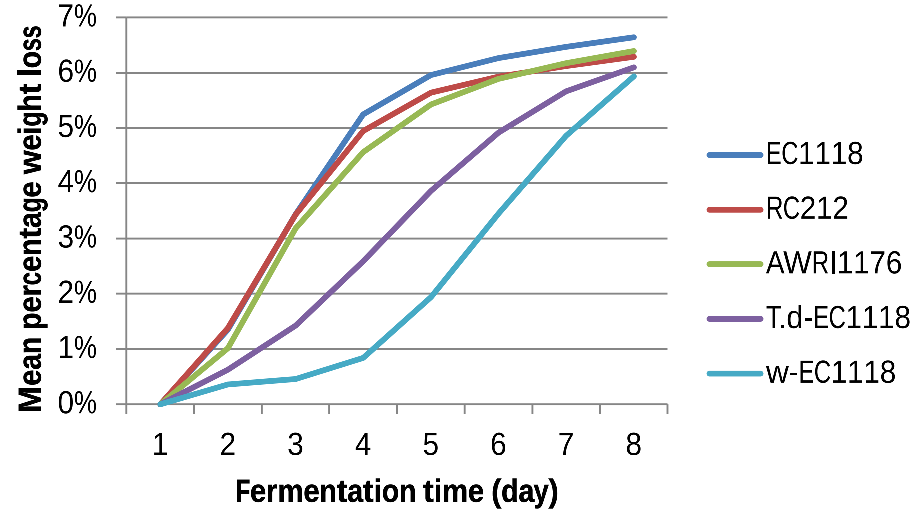
Different letter denotes significant difference between strains within trial (P<0.05)

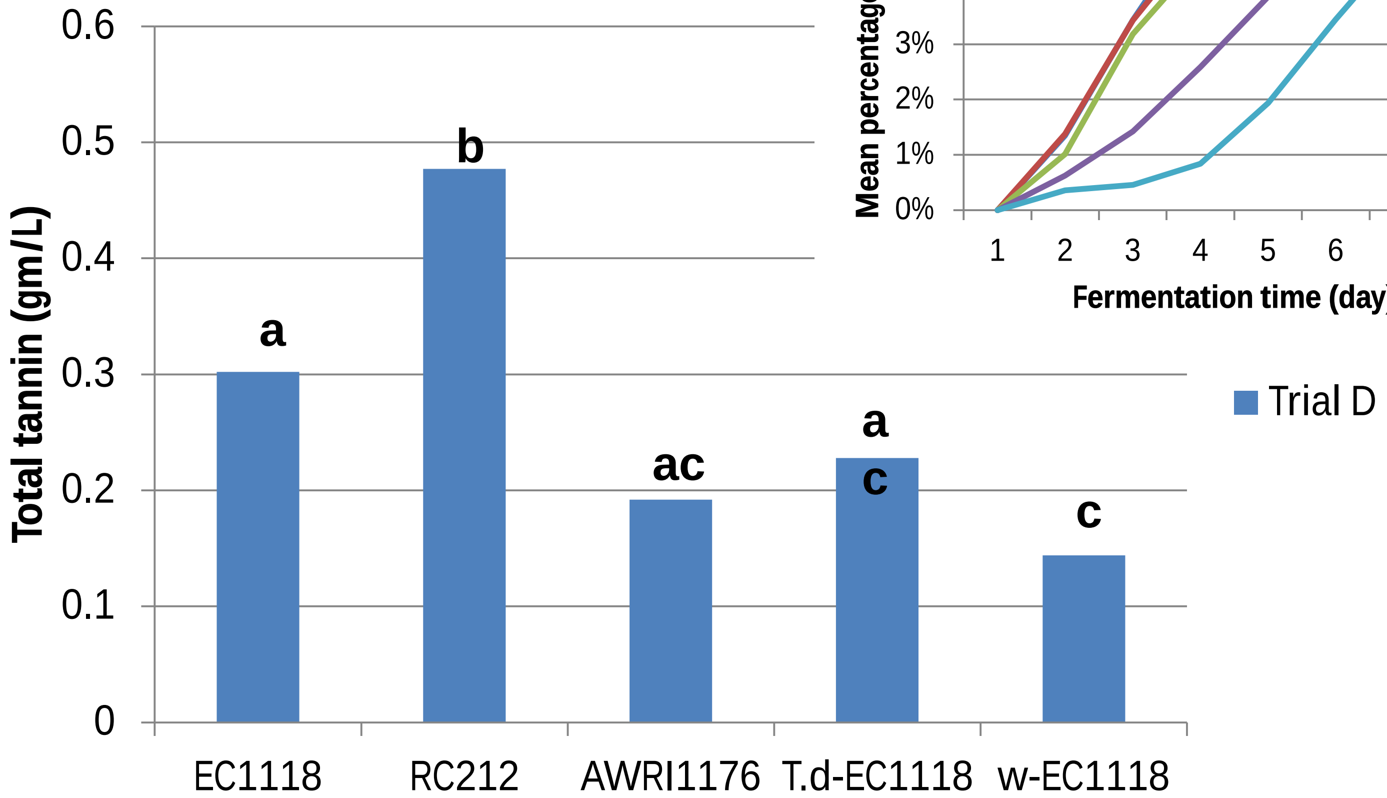
Pigmented tannins - 6 mths



Different letter denotes significant difference between strains within trial ($P<0.05$)

Total tannin - 6 mths





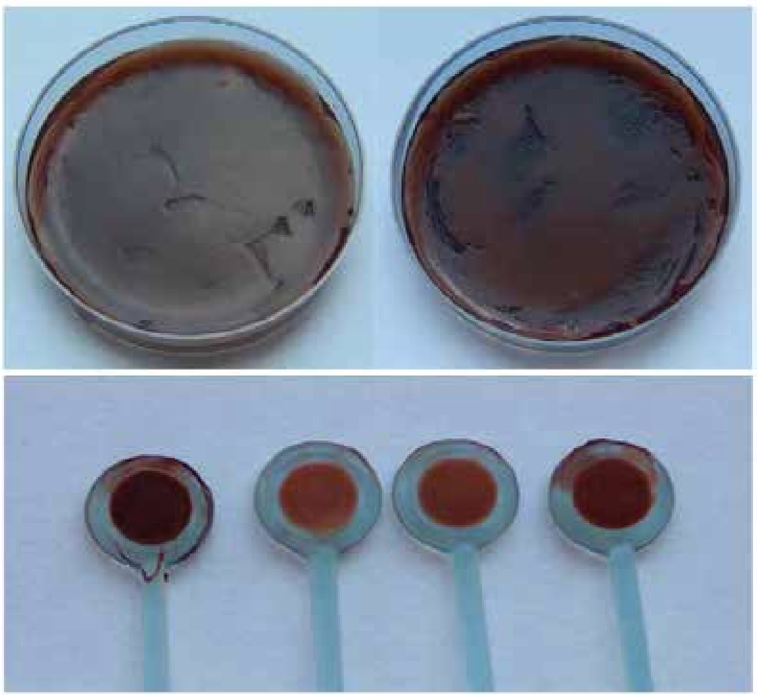
Different letter denotes significant difference between strains within trial (P<0.05)

Yeast effects on phenolics

The Australian Wine Research Institute

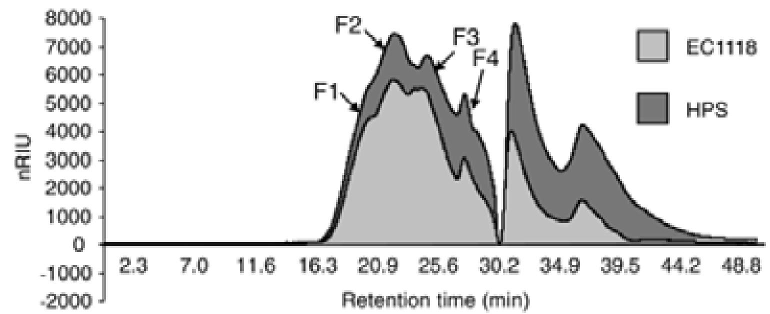
Improved Screening Method for the Selection of Wine Yeasts Based on Their Pigment Adsorption Activity

*Andrea Caridi**



Effect of Yeast Strain and Supplementation with Inactive Yeast during Alcoholic Fermentation on Wine Polysaccharides

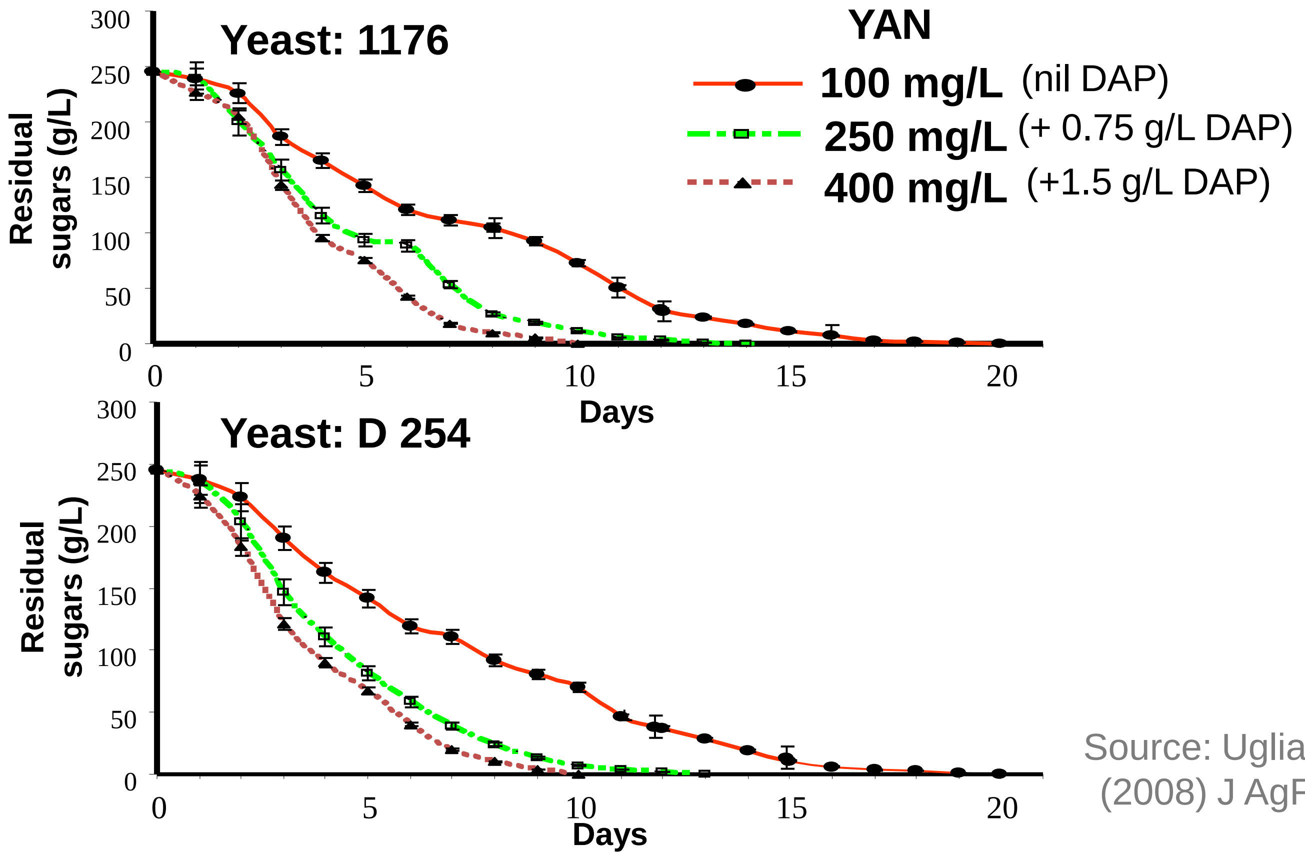
Elena González-Royo,[1] Andoni Urtasun,[1] Mariona Gil,[1] Nikolaos Kontoudakis,[1] Mireia Esteruelas,[1] Francesca Fort,[1] Joan Miquel Canals,[1] and Fernando Zamora[1]*



Parameter	EC1118 (control)	HPS
Ethanol (% v/v)	12.5 ± 0.2 a[a]	12.6 ± 0.2 a
Titratable acidity[b]	6.5 ± 0.22 a	6.20 ± 0.25 a
pH	3.45 ± 0.05 a	3.50 ± 0.03 a
Color intensity	19.14 ± 0.18 a	19.79 ± 0.31 b
Total phenolic index	57.8 ± 2.0 a	62.5 ± 1.9 b
Anthocyanidins (mg/L)	815 ± 24 a	851 ± 36 a
Proanthocyanidins (g/L)	1.94 ± 0.10 ac	2.43 ± 0.23 b

S. bayanus red fermentation properties

Shiraz must (macerated), 22°C



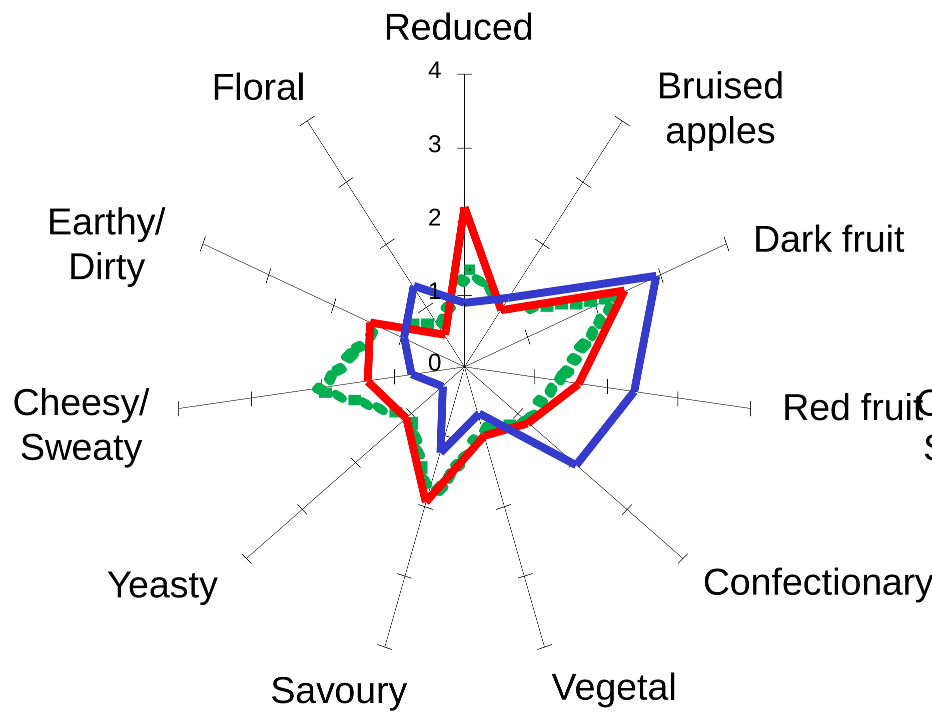
Source: Ugliano et al. (2008) J AgFdChem

Although S. bayanus has high N demand in red macerated ferments on skins fermentation kinetics are similar to *S. cerevisiae* strains at different YANs

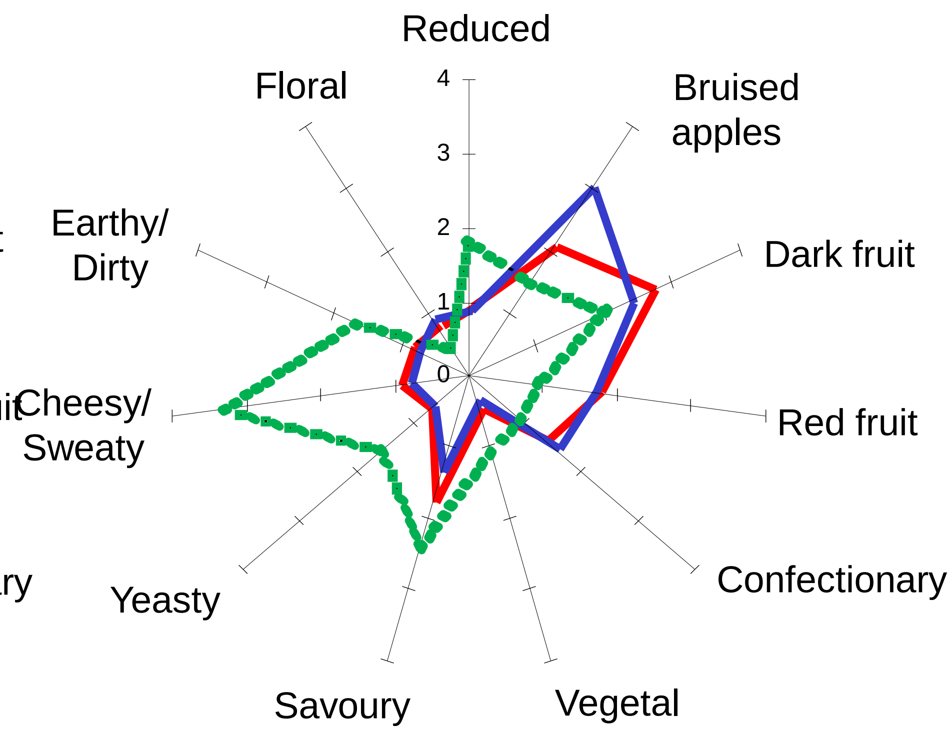
Effect of Yeast on Shiraz wine flavour

The Australian Wine Research Institute

Saccharomyces cerevisiae
D254



Saccharomyces bayanus
AWRI 1176

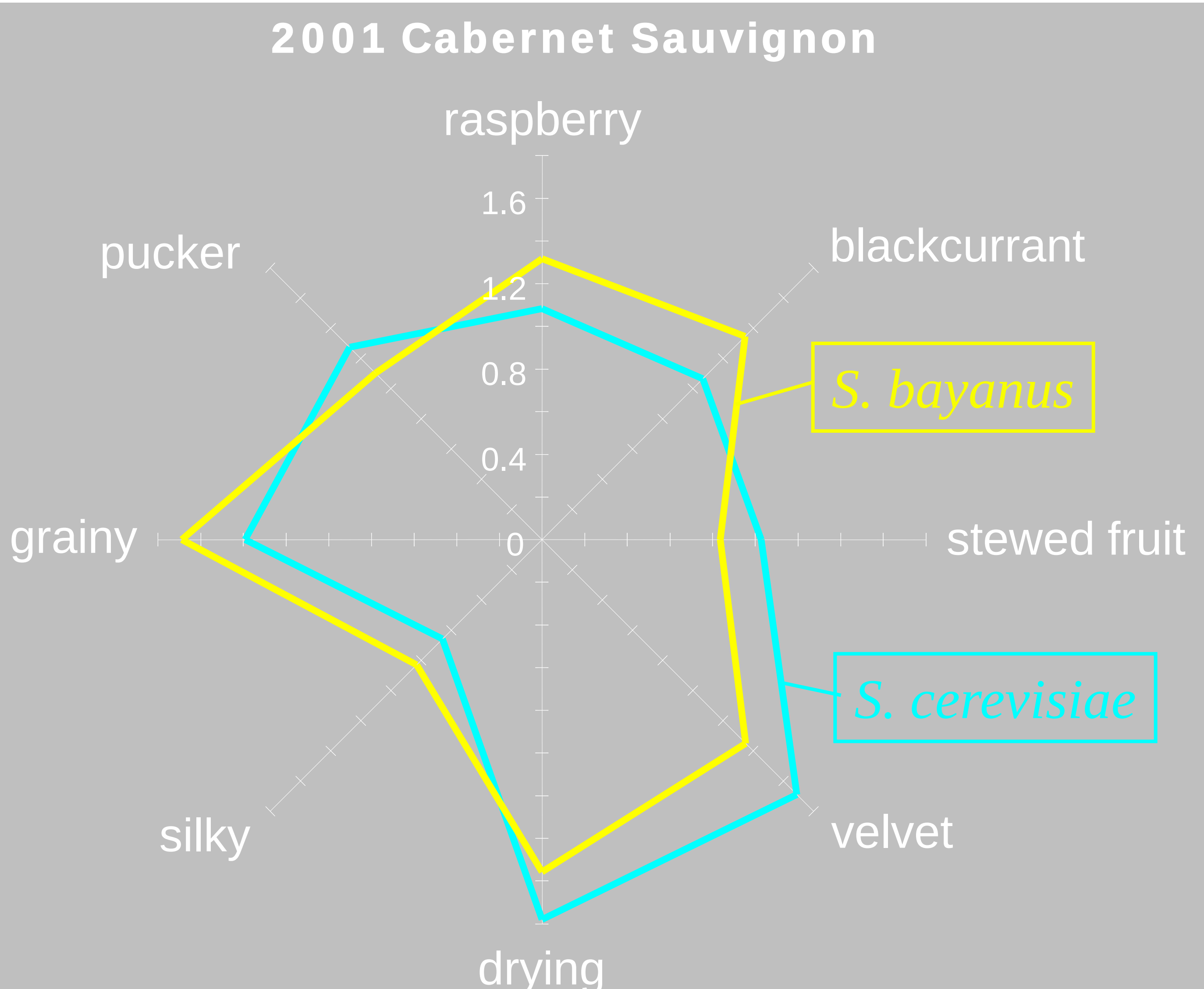


Shiraz
- on skins, 22 C

Source: Ugliano et al. (2010) JAgFdChem

YAN
- 100
- 250 (+ 0.75 g/L DAP)
- 400 (+1.5 g/L DAP)

Mouth-feel of *S. bayanus* wines



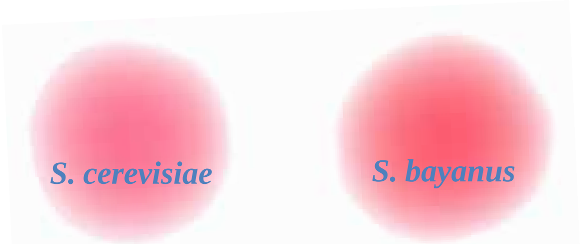
Eglinton, Francis et al. AWRI Ann Report (2003)

Red winemaking properties of *S. bayanus*

The Australian Wine Research Institute

- Moderate fermentation vigour
  - Improved ethanol tolerance from grape lipids
  - Good extraction of phenolics

- Higher acetaldehyde formation
  - Improved colour stabilisation



Cabernet Sauvignon – 2 mths old

- Reduces 'green' character?
  - Chardonnay, Cabernet Sauvignon, Merlot, etc

'Micro-ox' yeast?

Impact of yeast type on red wine flavour

(AWITC workshop 2007 – Bellon et al. ANZ GG&WM 2008)

The Australian Wine Research Institute

Winery	Variety	Yeast	Aroma	Palate
Yalumba Wines	Merlot	AWRI 838	Simple, light red fruit	Green tannins, simple
Yalumba Wines	Merlot	AWRI 1176	Aromatic, red current, green/dill, aldehydic, nutty	More complex, spicey fruit, aldehydic
Yalumba Wines	Merlot	AWRI 1505	Riper, richer fruit, dark plum, savoury, complexity	Fruit tannins, sweet fruit, rich texture, fine grained tannins
Provisor/ Lallemand	Cabernet Sauvignon	BM 45	Green/raw, capsicum, herbal, peppery	Green/raw, hard tannins
Provisor/ Lallemand	Cabernet Sauvignon	AWRI 1375	Blackcurrent, oystershell, meaty	Complex, soft, lanolin, complex tannins
Provisor/ Lallemand	Cabernet Sauvignon	S6U	Green, blueberry, old rose	Good texture, rounded tannins, ripe, sweetness

Acknowledgements

GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

The Australian Wine Research Institute

Simon Dillon, Laurent Dulau (Lallemand), Eveline Bartowsky, Paul Henschke – Lallemand Yeast-Red wine colour project

Immaculada Blazquez Rojas, Paul Smith, Eveline Bartowsky – Cabernet Sauvignon Yeast phenolics project

Helen Holt, Daniel Cozzolino, Jane McCarthy, Caroline Abrahamse, Sylvester Holt, Mark Solomon, Paul Smith, Paul Chambers, Chris Curtin – Shiraz yeast quality project

Anna L Carew (TIA), Robert Dambergs (AWRI/TIA), Dugald Close (UTAS) & Chris Curtin - TIA/AWRI Pinot yeast project

Jeff Eglinton, Scott McWilliam, Holger Gockowiak, Paul Henschke – *S bayanus* project

Leigh Francis – sensory analysis

Chris Curtin, Paul Henschke, Paul Chambers, Robert Dambergs, Eveline Bartowsky, Peter Hoj – projects supervisors

Collaborating wineries

Yalumba, Hardys, Orlando-Wyndham, Fosters Est., St Hallett, Houghtons, H-R Wine Science Lab. (S. Clarke)

Collaborating companies

Lallemand – development of *S. bayanus* active dried yeast

AB Mauri Yeast – development of hybrid active dried yeast

Research at The AWRI is supported by Australia’s Grapegrowers and winemakers through their investment agency the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

Information and online tools available on the AWRI website

www.awri.com.au

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Information on agrochemicals and related analytical services, advice and support, fact sheets and more.

Resources for wineries

Includes permitted additives, winemaking calculators, laboratory setup and method, Frequently Asked Questions, and products and suppliers.

Resources for wine exporters

Information for exporters such as factsheets and publications, analytical services and more.

Resources for consumers

Factsheets and publications, library resources, links to other websites, research projects and wine and health

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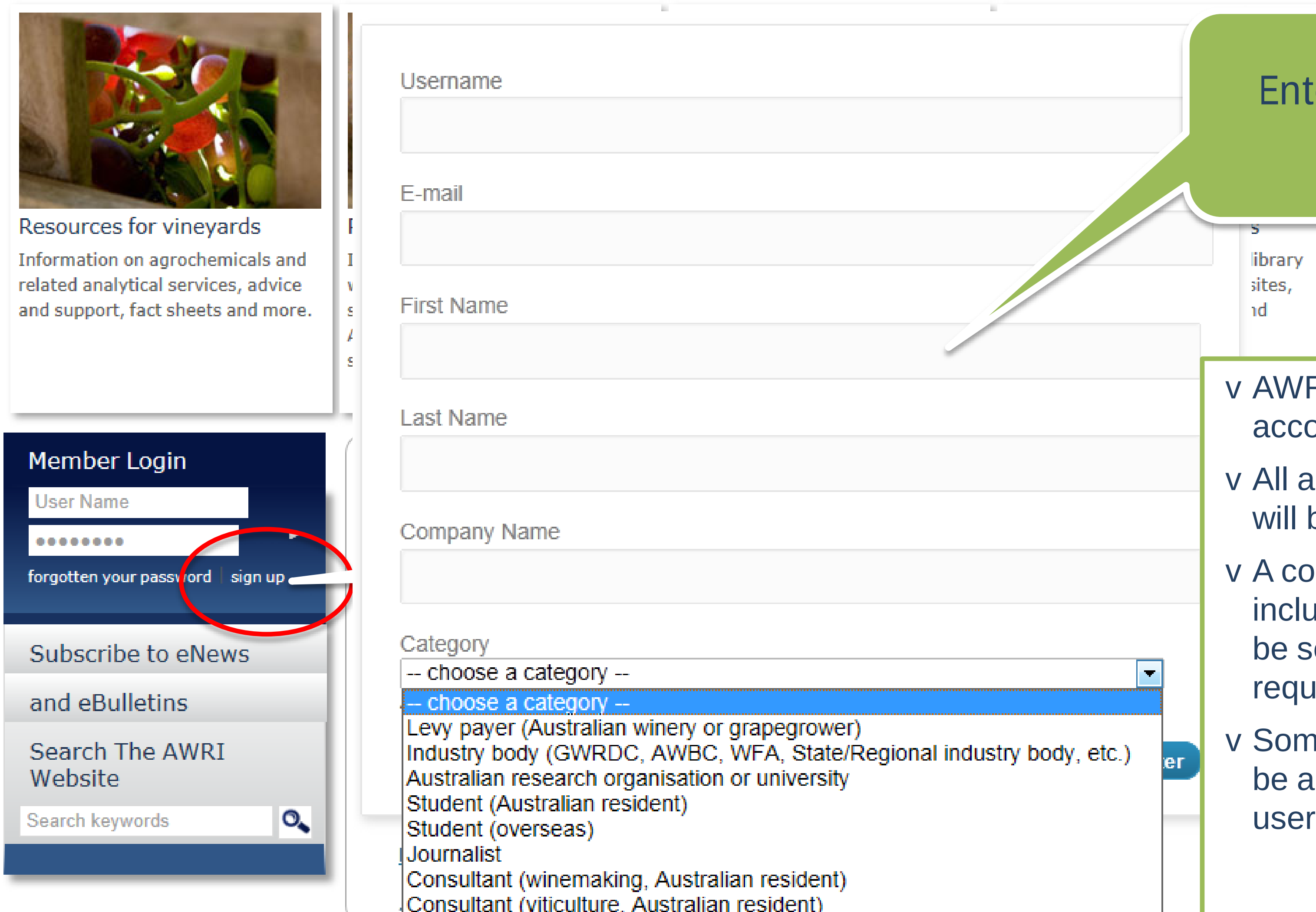

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Regulatory assistance

- Analytical requirements for the export of Australian wine
- Wine standards
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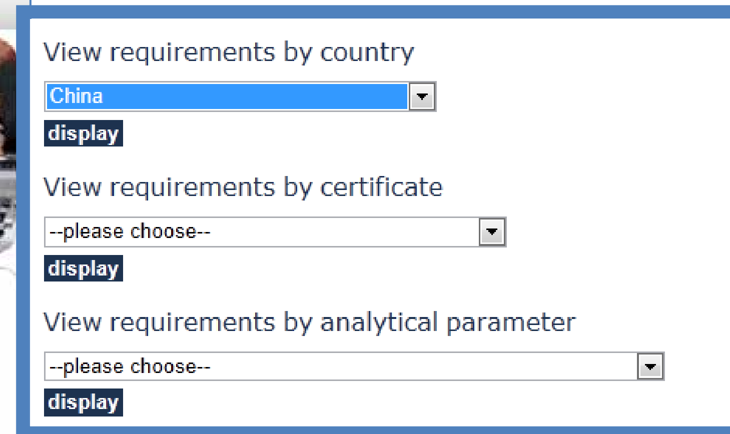
The AWRI provides regulatory and technical advice to the Australian grape and wine the Managing Director, the Health and Regulatory Information Manager and membe Industry Development and Support team. The AWRI handles approximately 150 ind information requests annually, on technical, scientific and regulatory issues from go producers and the general public. The AWRI also prepares numerous position papers submissions in relation to viticulture and oenological practices.

The AWRI is represented on the following committees of relevance to regulatory mat

- South Australian Wine Industry Council;
- The Winemaker's Federation of Australia Wine Industry Technical and Advisory Co
- The Winemaker's Federation of Australia Wine Industry National Environment Com
- Wine Committee of the Royal Agricultural and Horticultural Society of South Austra
- Organisation Internationale de la Vigne et du Vin (OIV)

The AWRI's Library (the John Fornachon Memorial Library) maintains the largest coll related literature in the southern hemisphere. It also houses an extensive print colle European Union wine and grape legislation (updated weekly) which is linked electron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China

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View requirements by certificate

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Industry Support and Education > Regulatory assistance > Analytical requirements for the export of Australian wine

Analytical requirements for the export of Australian wine

China

Quick Guide to Export Requirements

Export Region	Wine Standards	Minimum Specification	Maximum Specification	Continuing Approval Application	Certificate of Origin	Other Requirements
China	Y	Y	Y	Y	Y	Certificate of Free Sale

Standards

ANALYTICAL PARAMETER	SPECIFICATION MINIMUM	SPECIFICATION MAXIMUM
Alcohol strength at 20°C		
wines*	7.0 % v/v	–
Total sugar (glucose)*		
Still	–	–
Dry wines*	–	4.0 g/L
Semi-dry*	4.1 g/L	12.0 g/L
Semi-sweet	12.1 g/L	45.0 g/L
Sweet	45.1 g/L	–
Sparkling	–	–
Brut*	–	12.0 g/L
Extra-dry*	12.1 g/L	17.0 g/L
Dry	17.1 g/L	32.0 g/L
Semi-dry	32.1 g/L	50.0 g/L
Sweet	50.1 g/L	–
Dry extract		
White	16 g/L	–
Rosé	17 g/L	–

Searchable databases on permitted additives and processing aids, and export analytical requirements

Winemaking calculators

The Australian Wine Research Institute

- Acid addition
- Ascorbic acid addition
- Bentonite addition
- Carbon addition
- Copper sulfate addition
- Crème of Tartar addition
- Deacidification
- Diammonium phosphate additions
- Ferro Cyanide trial
- Fining trial
- Fortification
- Gelatine addition
- General conversion calculators
- Grape juice concentrate (GJC) addition using Pearson Square
- Hydrogen peroxide addition
- Interconversion of acidity units
  - Acetic acid
  - Citric acid
  - Lactic acid
  - Malic acid
  - Sulfuric acid
  - Tartaric acid
  - Tartaric acid (meq/L)
- Isinglass addition
- Laboratory stock solution
- Methanol expressed as proportion of ethanol calculator
- Micro-ox addition
- Molecular sulfur dioxide addition
- Number of standard drinks
- Paired preference
- PMS addition
- PVPP addition
- Same/Different
- Sensory difference test
  - Duo-trio
  - Paired comparison
  - Triangle
- Sorbic acid addition
- Sulfur dioxide addition
- Tannin addition
- Winery stock solution

Industry Support and Education > Winemaking resources > Winemaking calculators > Number of standard drinks

Number of standard drinks

Suggestions / questions / comments? email the calculator services staff

Approximate standard drinks

Container volume	750	mL
Alcohol content	14.5	% v/v
Calculate number of standard drinks	8.6	standard drinks

Clear

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- The rotten facts about laccase
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- ▸ AWRI Publications
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  - ▸ General
  - ▾ Juice and wine handling
    1. Relative efficacy of high-pressure hot water and high-power ultrasonics for wine oak barrel sanitization
    2. Characterisation of wine yeasts: Fermentation temperature in rosé wines: how far can you lower the temperature? Affect on flavour profile
    3. Grape juice: how to extract the full potential of the grape
    4. Australian producers make the most of the poor cousin of the red Bordeaux varieties
    5. Sulfur dioxide content of wines: role of winemaking and carbonyl compounds
    6. Transport and ripeness linked to top tropical flavours in Sauvignon Blanc
  - ▸ Microbiology
  - ▸ Analysis and composition
  - ▸ Marketing and packaging
  - ▸ Environment (however formerly Wine and Health)
  - ▸ Sensory (formerly Environmental Health)

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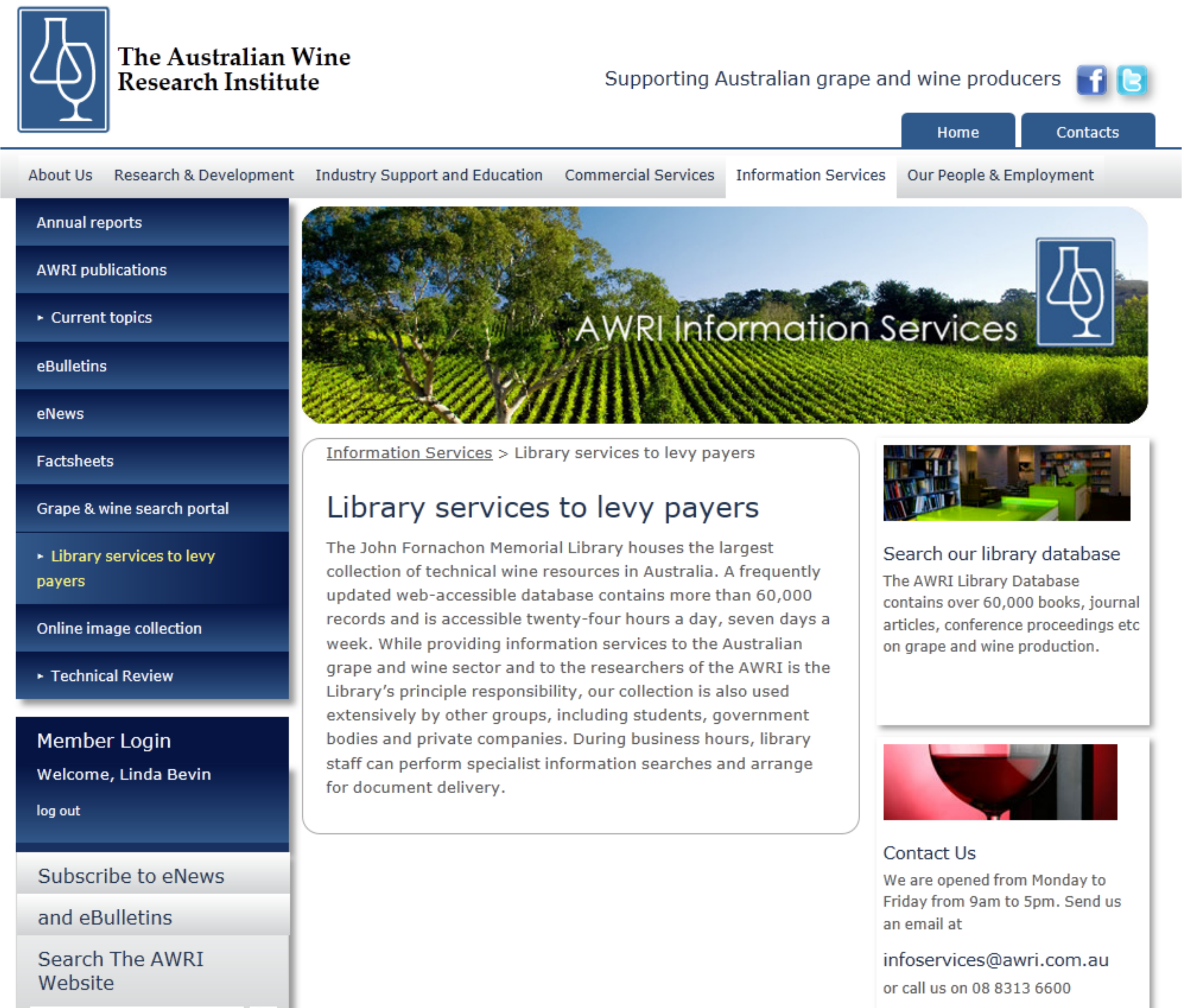

- Free library service to Australian grape and wine producers
- Over 65,000 books, journal articles, conference proceedings etc
- Online library database
- *Fast response time (1 to 3 days)*

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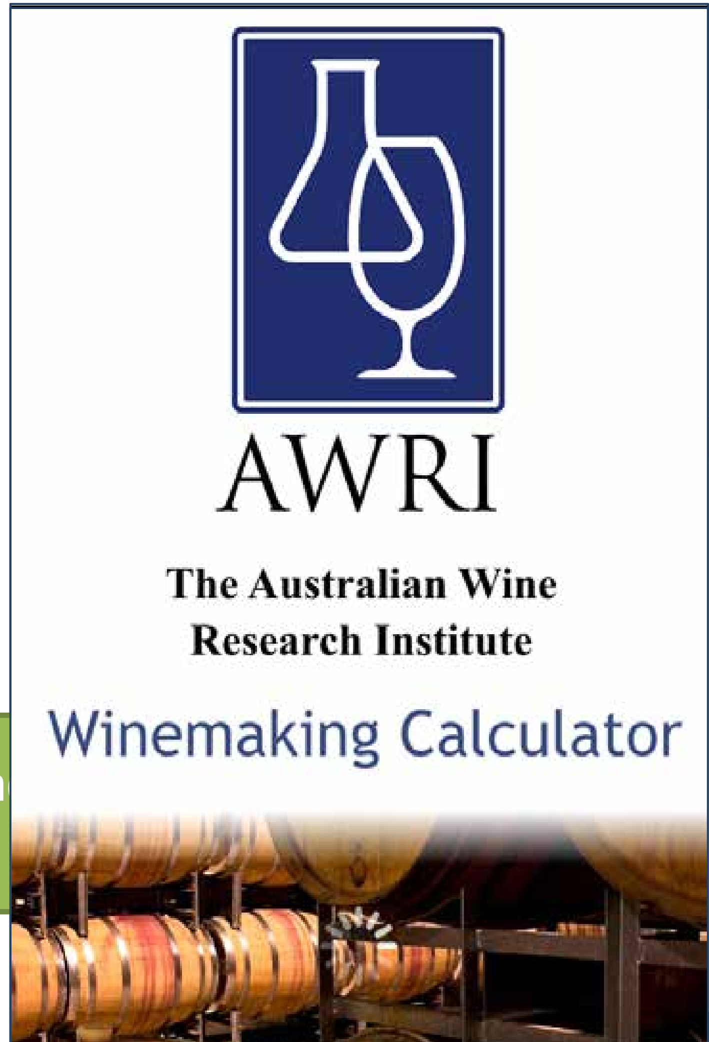
Provides content to key projects and services offered by the AWRI.

Linked to full website for detailed information.

Winemaking calculator app



Calculators grouped for easy access

Enter the search an
select ‘Calculate’

http://www.awri.com.au/industry_support/winemaking_resources/winemaking-calculators-app/

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2013 webinar program

Presentation	Description	Presenter	Date	Register
Optimising your laboratory for the best results	Laboratories are a critical, and often expensive, part of modern wine production. This webinar will highlight a number of areas that are important to not only ensure results are accurate, but to achieve them in an efficient and cost effective manner. Some of the topics that will be discussed include basic lab quality systems; LIMS; lab design; lean systems and troubleshooting common laboratory issues.	Eric Wilkes (The AWRI)	23/07/2013	Register
Strategies for reducing alcohol levels in wine	The AWRI has taken a holistic approach to the development of strategies for the reduction of alcohol concentration in wine. Several viticultural and fermentation practices show considerable promise for the production of good quality reduced-alcohol wines. This session will present our latest findings and point to the need to evaluate a combinatorial approach to reducing alcohol concentration in wine.	Cristian Varela (The AWRI)	30/07/2013	Register
The latest on CMCs	Carboxymethylcellulose is becoming an important part of the winemaker's tool box for white wine tartrate stabilisation. However, like all wine additives, there is more to the successful use of CMCs than sales brochures might suggest. This webinar will look at how CMC works; when it is appropriate to use; what precautions you need to take and the best ways to test the wine when using it.	Eric Wilkes (The AWRI)	6/08/2013	Register
Till death do us part: Cell death in the grape berry as a quality measure	TBA	Steve Tyerman (The University of Adelaide)	20/08/2013	Register
Climate influence and trends for the wine industry	TBA	Darren Ray (Bureau of Meteorology)	27/08/2013	Register

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Date	Event
14 May 2013	AWRI Hunter Valley Seminar *Mercure Resort Hunter Valley, Pokolbin NSW*
14 May 2013	New Technologies in Grapegrowing and Winemaking *Treasury Wine Estates vineyards, Padthaway SA*
15 May 2013	AWRI Barossa Adapting to difficult vintages workshop *Vine Inn, Nuriootpa SA*
21 May 2013	AWRI Clare Adapting to difficult vintages workshop *The Artisan Table, Clare SA*
21 May 2013	AWRI Langhorne Creek and Adelaide Hills Seminar *Langhorne Creek Football Clubrooms, Langhorne Creek SA*
22 May 2013	Regional Smoke Taint Update *Gum San Chinese Heritage Centre, Ararat VIC*
23 May 2013	GWRDC #INseries workshop - China Insights: McLaren Vale
23 May 2013	Regional Smoke Taint Update *Yarra Glen Memorial Hall, Yarra Glen VIC*
24 May 2013	GWRDC #INseries workshop - China Insights: Barossa
24 May 2013	Regional Smoke Taint Update *Oxley Shire Hall, Oxley VIC*
27 May 2013	GWRDC #INseries workshop - China Insights: Hunter Valley
28 May 2013	GWRDC #INseries workshop - China Insights: Yarra Valley
30 May 2013	GWRDC #INseries workshop - China Insights: Margaret River
30 May 2013	Margaret River Wine in Sydney *The Barnet Long Room, Customs House, Circular Quay NSW*

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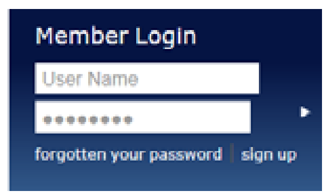

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