

Smoke Taint Update Session

Adelaide Hills smoke update session

Tuesday 20 January 2015

Bird in Hand Winery, Woodside

Mark Krstic, Matt Holdstock & Randell Taylor

Australian Wine Research Institute



FIRST - Instructions – live polling



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❖ **Option 1 - SMS participation**

- ❖ Text the word 'awrismoke' (lowercase with no space) to **0427 541 357**
- ❖ You will receive a confirmation text once you have joined the session
- ❖ When a new question is asked, text your response to the same number (0427 541 357) (keep it under 25 words)
- ❖ Text 'LEAVE' at the end of the session
- ❖ You will not be charged to participate in this service - though normal texting and data fees from your carrier will apply.
- ❖ The AWRI and Poll Everywhere will never ever spam and will not share your information with any organisation.

FIRST - Instructions – live polling



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❖ Option 2 & 3 - Web participation

- ❖ Go to the website pollev.com/awrismoke. You can do this by scanning the QR code below in Option 3.
- ❖ You can choose to download the app or select 'not now'
- ❖ When a new question is asked it will display on your screen. Enter your response in the space and tap on the 'submit response' button



First Reports of Smoke Taint



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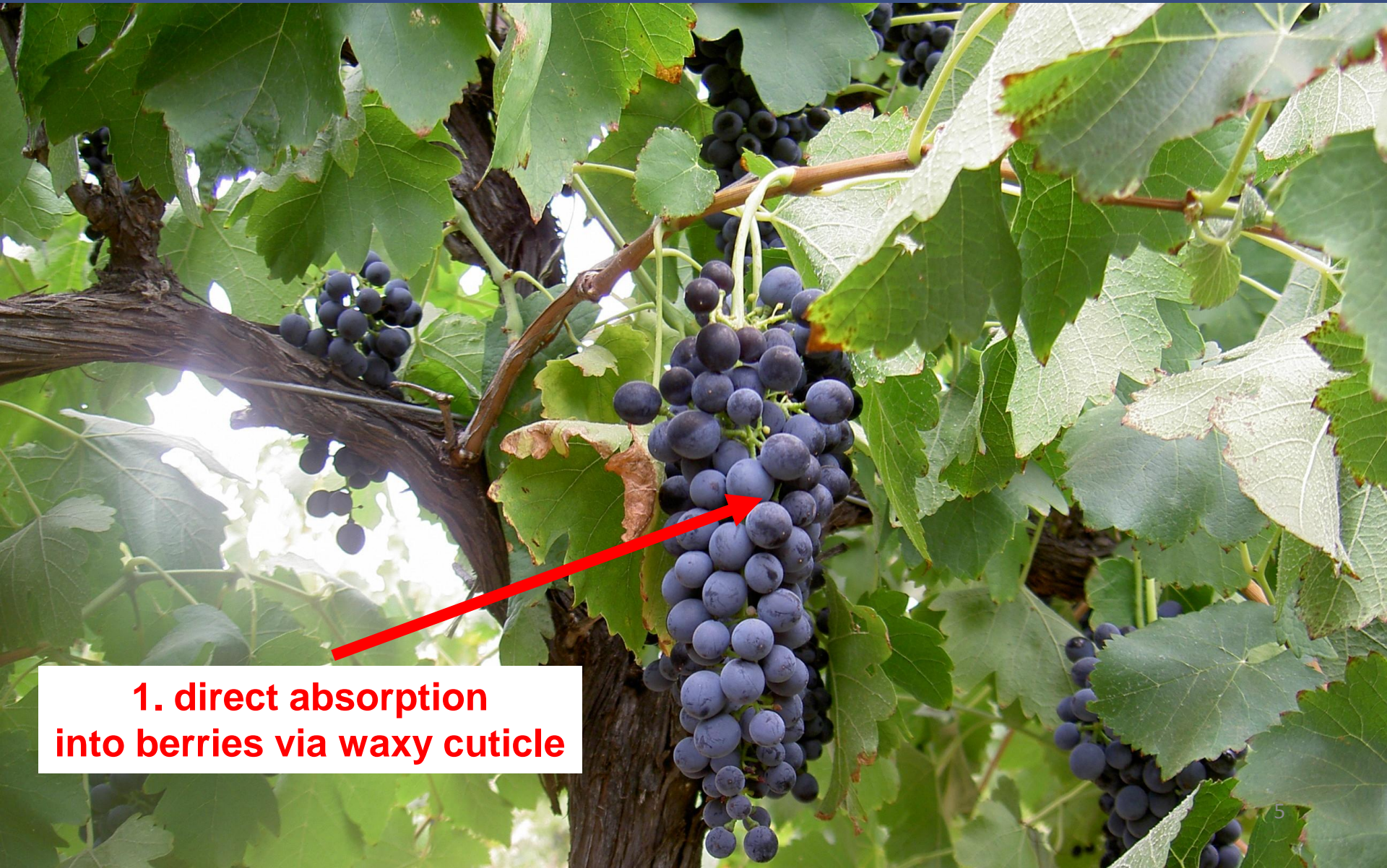
- ❖ 2003: Eastern Victorian (Alpine) Fires (March)
 - burnt over 1.3 million hectares
 - first official recognition of smoke causing taint in wine



Mode of Entry into Grapevines



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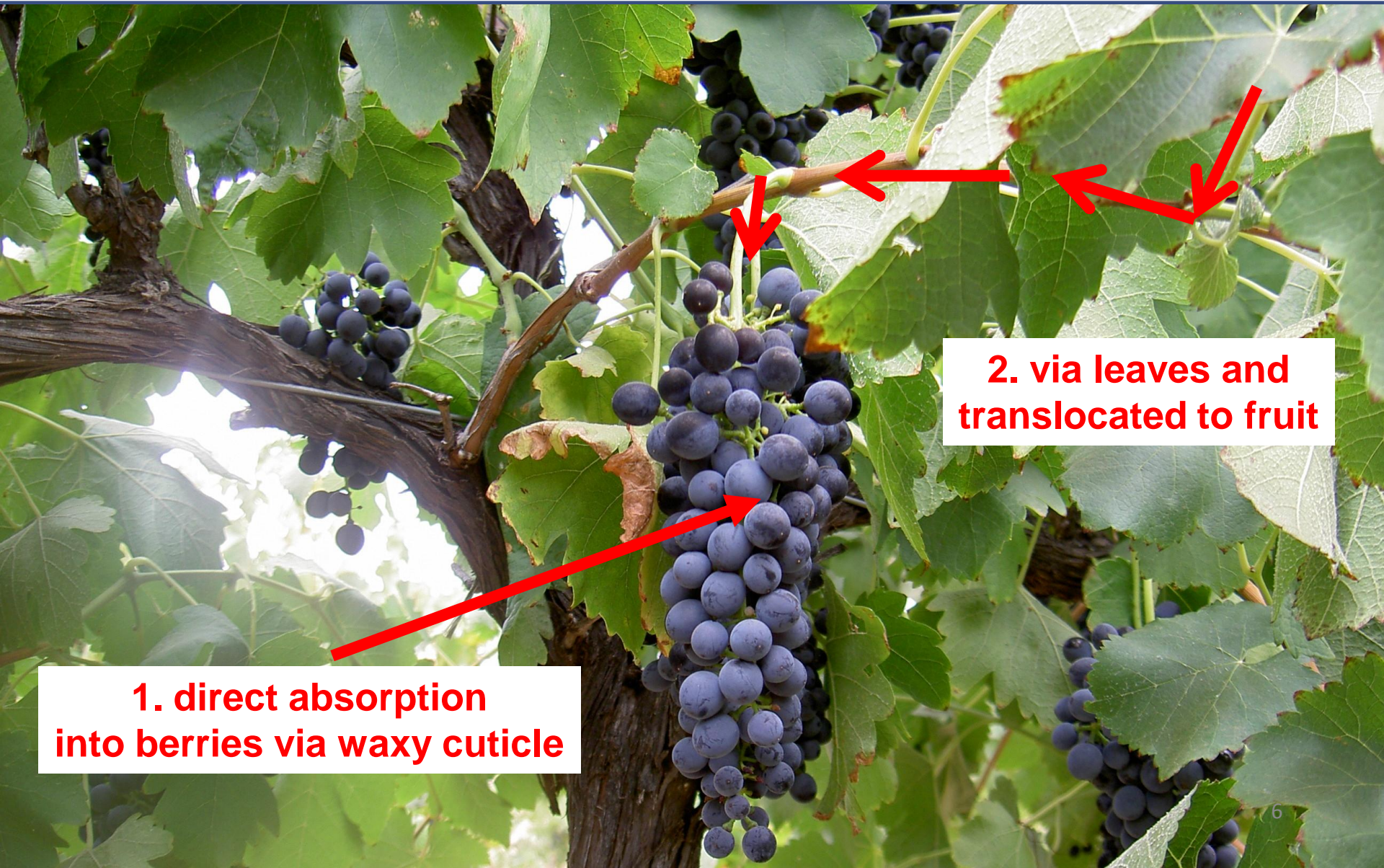


**1. direct absorption
into berries via waxy cuticle**

Mode of Entry into Grapevines



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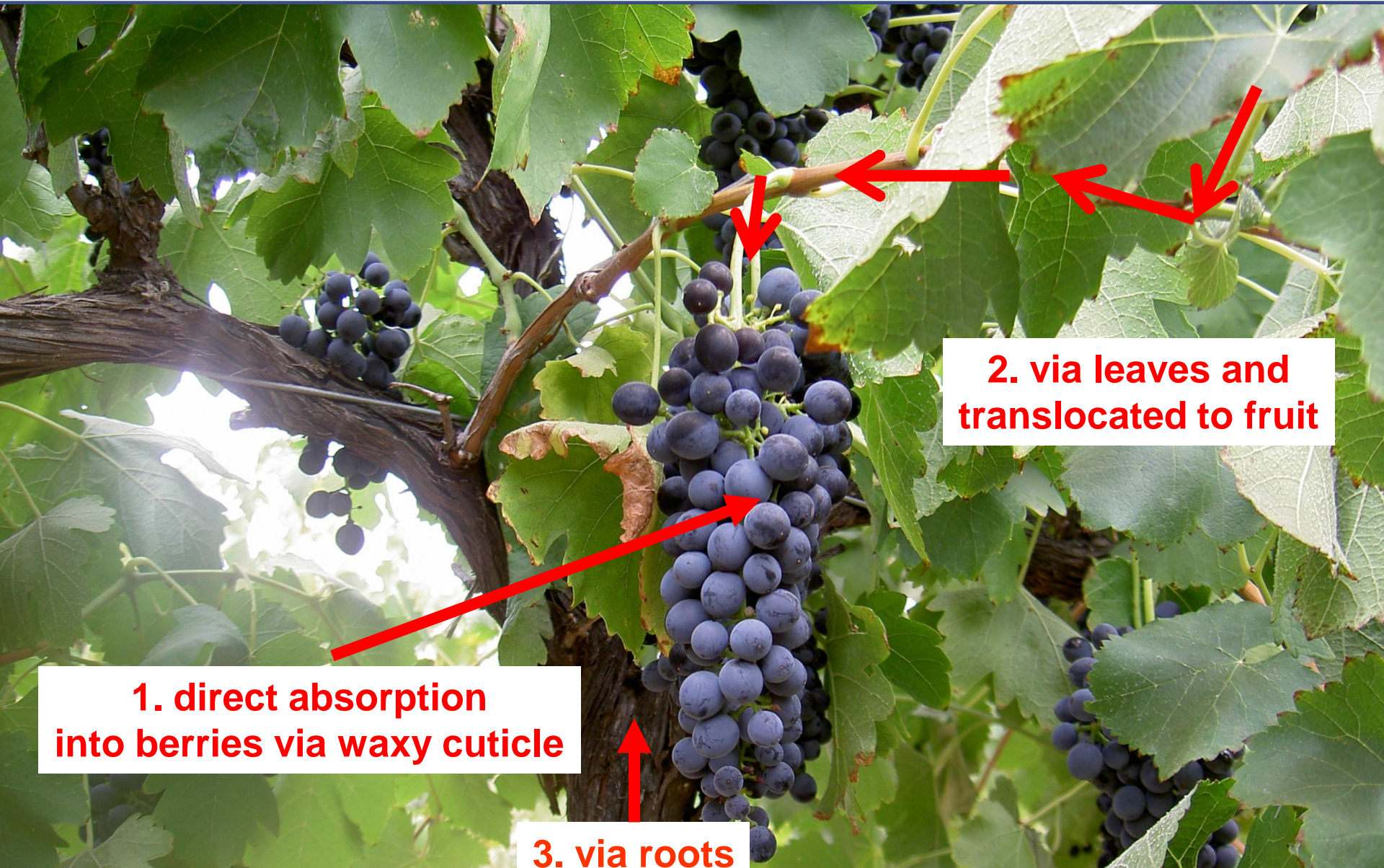
**1. direct absorption
into berries via waxy cuticle**

**2. via leaves and
translocated to fruit**

Mode of Entry into Grapevines



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**1. direct absorption
into berries via waxy cuticle**

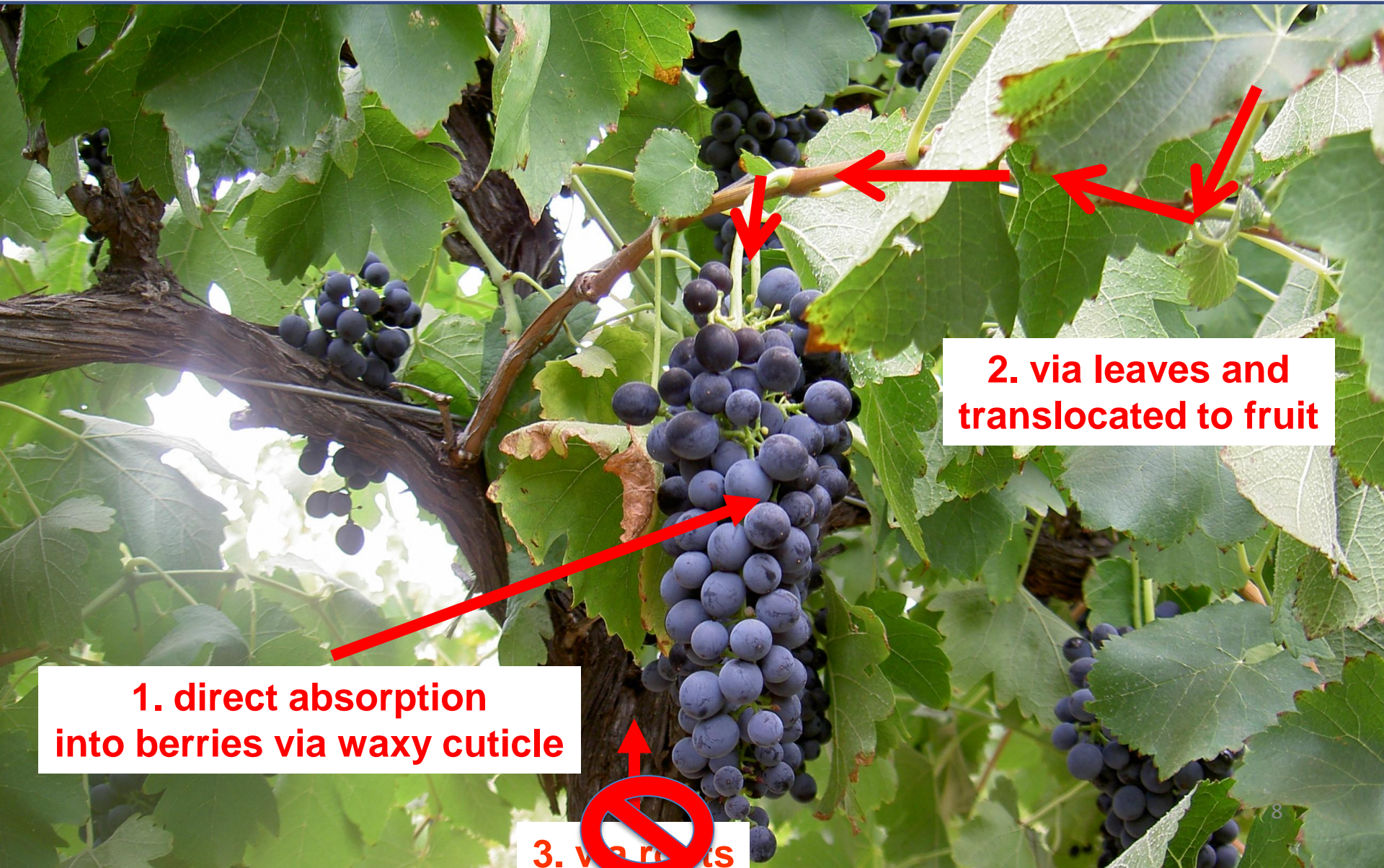
**2. via leaves and
translocated to fruit**

3. via roots

Mode of Entry into Grapevines



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**1. direct absorption
into berries via waxy cuticle**

**2. via leaves and
translocated to fruit**



3. via roots

Sensitivity to Smoke Uptake



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Timing of grapevine sensitivity to smoke uptake




	Grapevine growth stage	Potential for smoke uptake
P1	 Shoots 10 cm in length	Low
	 Flowering	Low

Sensitivity to Smoke Uptake



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Timing of grapevine sensitivity to smoke uptake

P2		Berries pea size	Variable (low to medium)
		Beginning of bunch closure	Variable (low to medium)
		Onset of veraison to 3 days post veraison	Variable ** (low to medium)

Sensitivity to Smoke Uptake



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Timing of grapevine sensitivity to smoke uptake

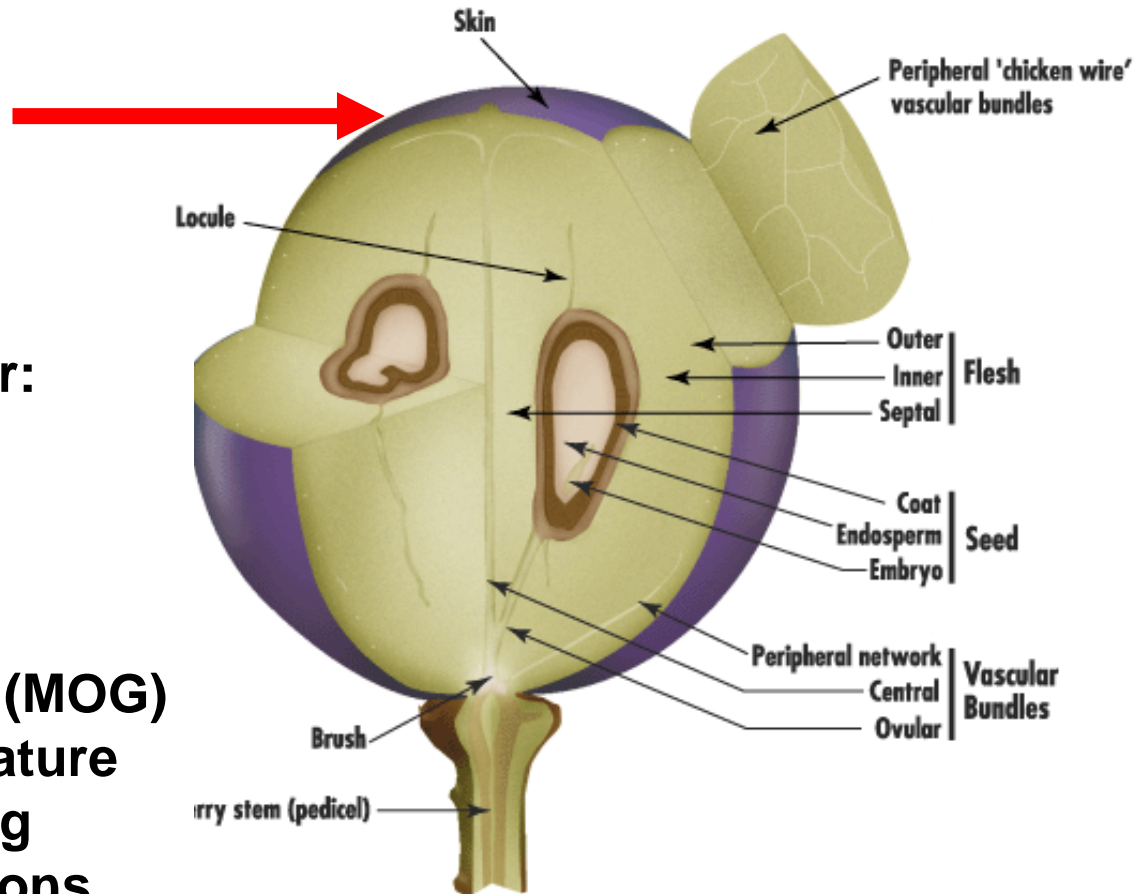


Localisation of smoke taint compounds



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**Concentration highest
around berry skins**



This has implications for:

- hand vs mechanical harvesting
- fruit handling
- removing leaf material (MOG)
- managing fruit temperature
- red vs white processing
- separating press fractions
- etc

Figure 1: Structure of a ripe grape berry partially sectioned on the long and central axis to show internal parts. Illustration by Jordan Koutroumanidis, Winetitles.

No Carry Over Between Seasons



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Year 1
Severe Smoke Affected



Year 2
No detectable smoke taint



Gets Worse As Wine Ages



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Sensitivity Differs Between Varieties



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Sangiovese



Shiraz



Cabernet Sauvignon



- **Number of studies – but inconsistent results between varieties**
- **Recent paper suggested no differences when exposed to controlled and similar levels of smoke (Kelly *et al.* 2014)**

Smoke Taint Independent of Fuel Source



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Karri



Jarraah



Marri



Pine



Oat Straw



The lignin composition of vegetation fuels burnt during bushfires does not appear to affect the types of smoke taint compounds that accumulate in grapes and wine (Kelly *et al.* 2012)

Assessing Smoke Taint Risk



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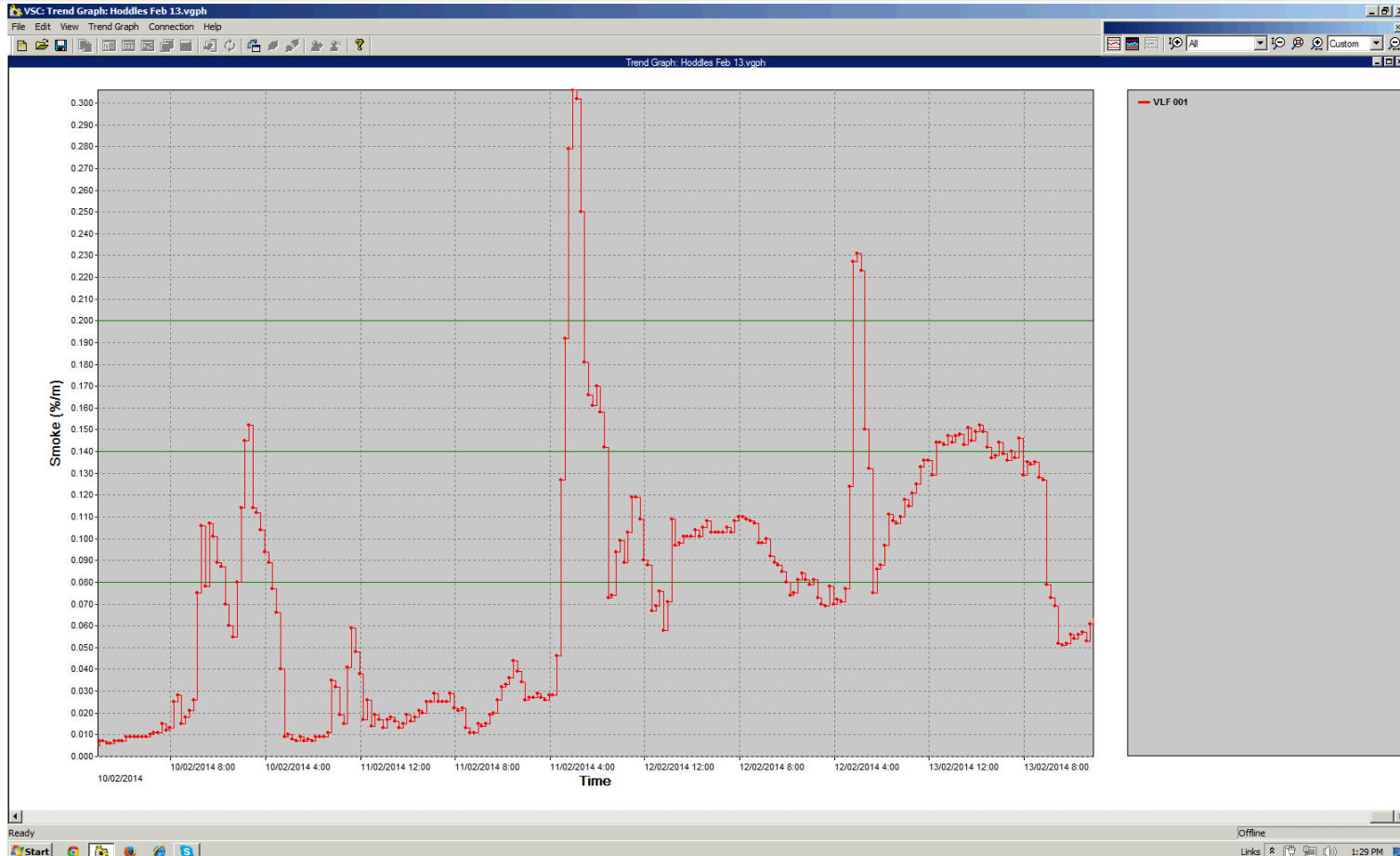


- **Function of concentration and duration of smoke exposure**
- **Historically assessed via ‘visibility’ assessments**

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- Measured more quantitatively with nephelometers (particulate matter)
- Important as they measure day & night (important diurnal fluctuations)

Slide courtesy: Ricky James (DEDJTR)

Assessing Smoke Taint Risk



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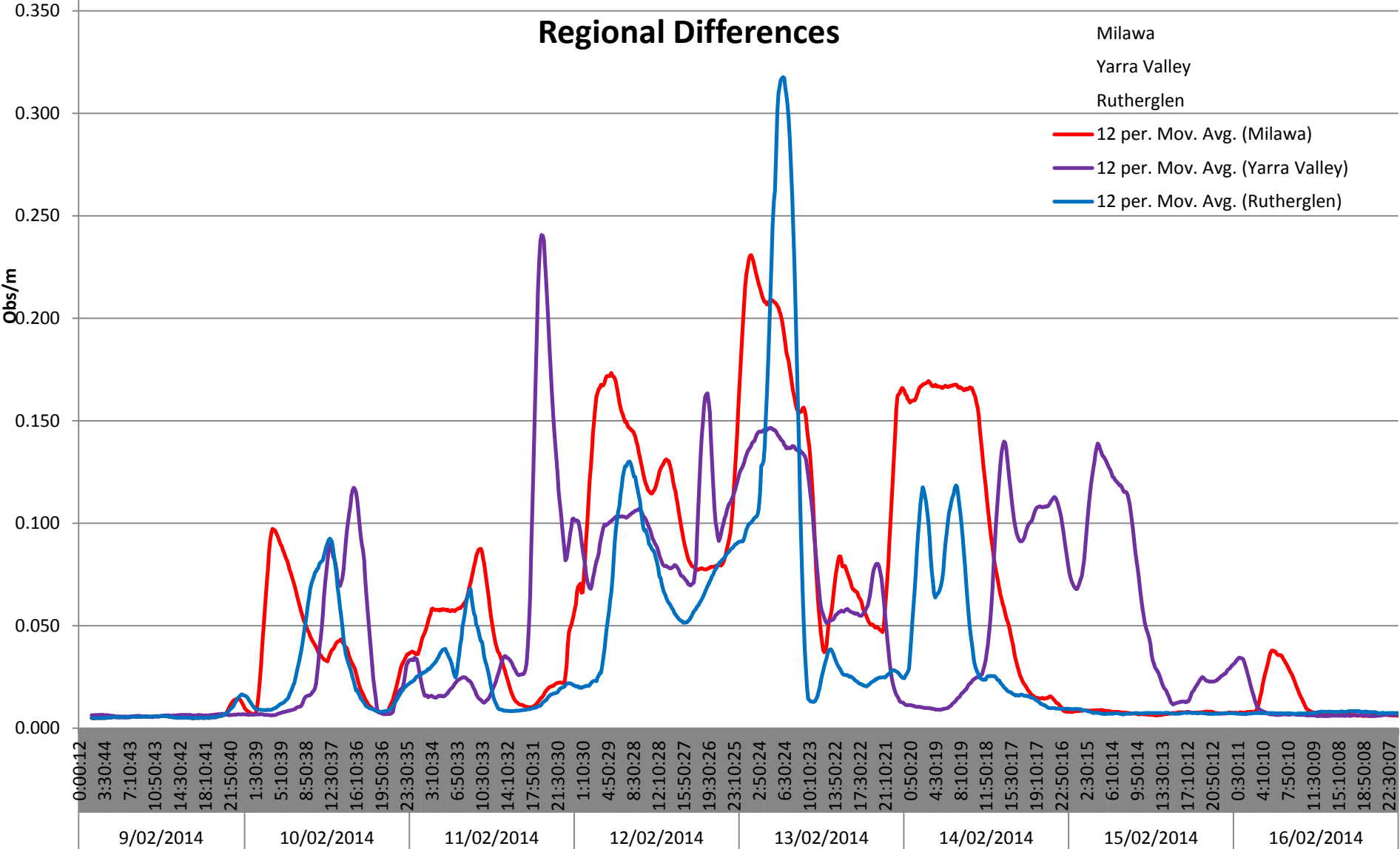


Slide courtesy: Ricky James (DEDJTR)

Assessing Smoke Taint Risk



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Slide courtesy: Ricky James (DEDJTR)

Assessing Smoke Taint Risk



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**However it is more complicated than
just concentration and duration**



- **Manjimup fire in mid-February 2012 confused our understanding**
- **Indicated that ‘Smoke Composition’ is important risk factor**

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Smoke consists of 1000s of different compounds



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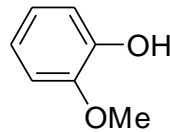


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Volatile phenols – lignin pyrolysis by-products

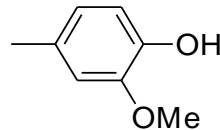
Guaiacol

'smoky', 'sweet
smoke', 'smoky bacon'



4-Methylguaiacol

'smoky', 'spicy'



**Identified in 2003 by the AWRI
as indicator compounds
from prior oak research
- affected by toasting levels**



**Presents problems when
assessing wine that has
been treated with oak**

Assessing Smoke Taint Risk

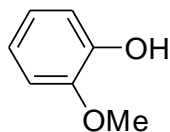


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Volatile phenols – lignin by-pyrolysis products

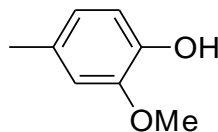
Guaiacol

‘smoky’, ‘sweet
smoke’, ‘smoky bacon’



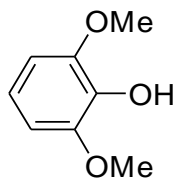
4-Methylguaiacol

‘smoky’, ‘spicy’



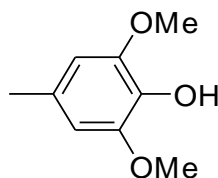
Syringol

‘smoky’, ‘charry’
(Weaker odorant)



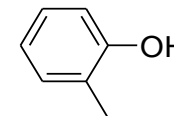
4-Methylsyringol

‘smoky’, ‘charry’
(Weaker odorant)



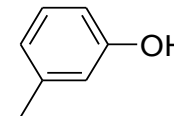
o-Cresol

‘phenol’, ‘plastic’



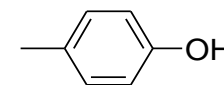
m-Cresol

‘smoky, phenolic’, ‘smoky
bandaid’, ‘faecal, plastic’



p-Cresol

‘faecal, horse stable-
like’, ‘medicinal’



Assessing Smoke Taint Risk



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Sensory thresholds of selected volatile phenols in neutral Merlot wine

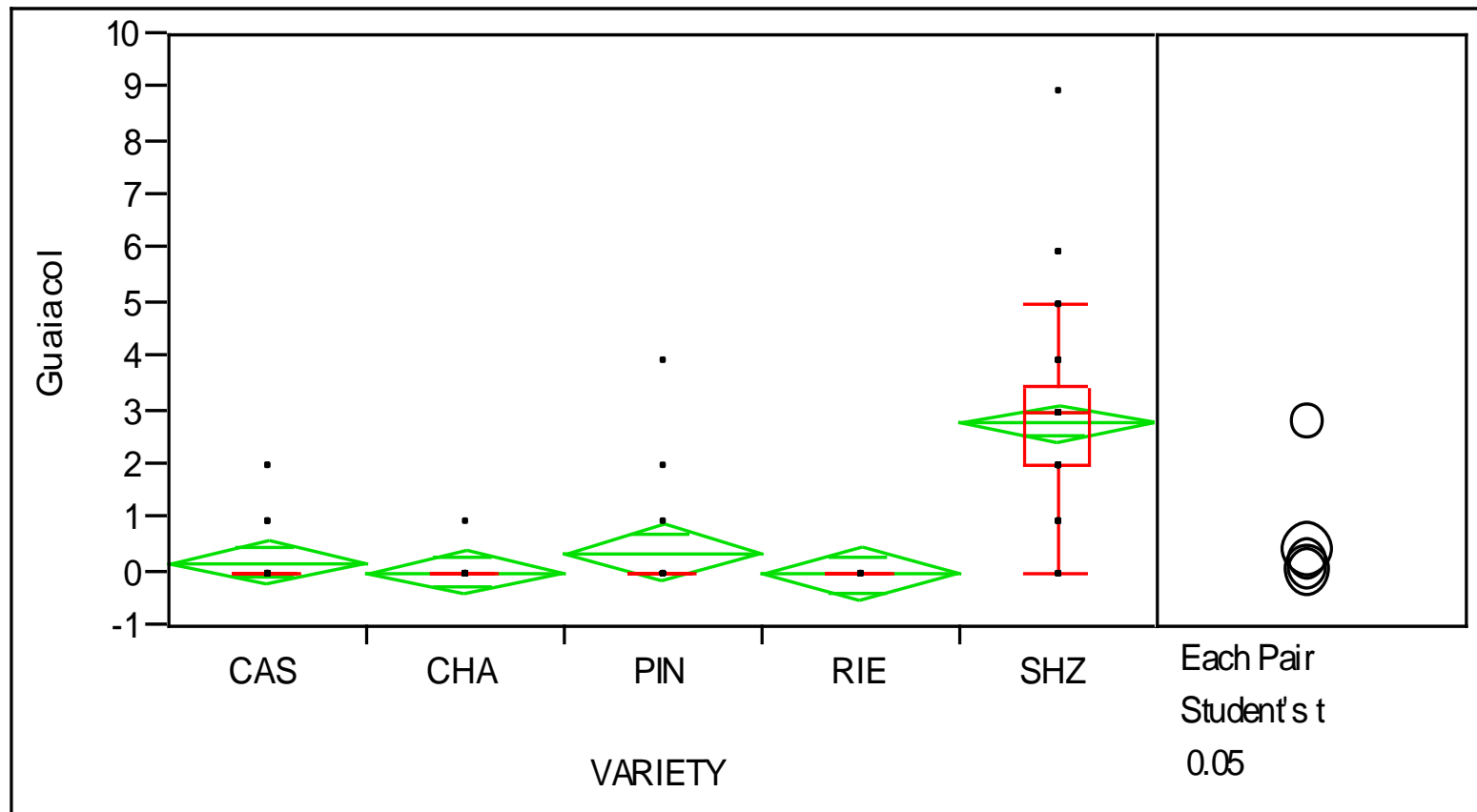
Compound	Threshold
Guaiacol aroma	23 $\mu\text{g/L}$
Guaiacol taste	27 $\mu\text{g/L}$
<i>m</i> -Cresol aroma	20 $\mu\text{g/L}$
<i>o</i> -Cresol aroma	62 $\mu\text{g/L}$
<i>p</i> -Cresol aroma	64 $\mu\text{g/L}$

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**These compounds may exist in grapes in non-smoke years
Understanding background levels – e.g. guaiacol**



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Background levels - Interpreting your results
Contact AWRI Winemaking and Extension Services



(08) 8313 6600





The 2009 'Black Saturday' Experience

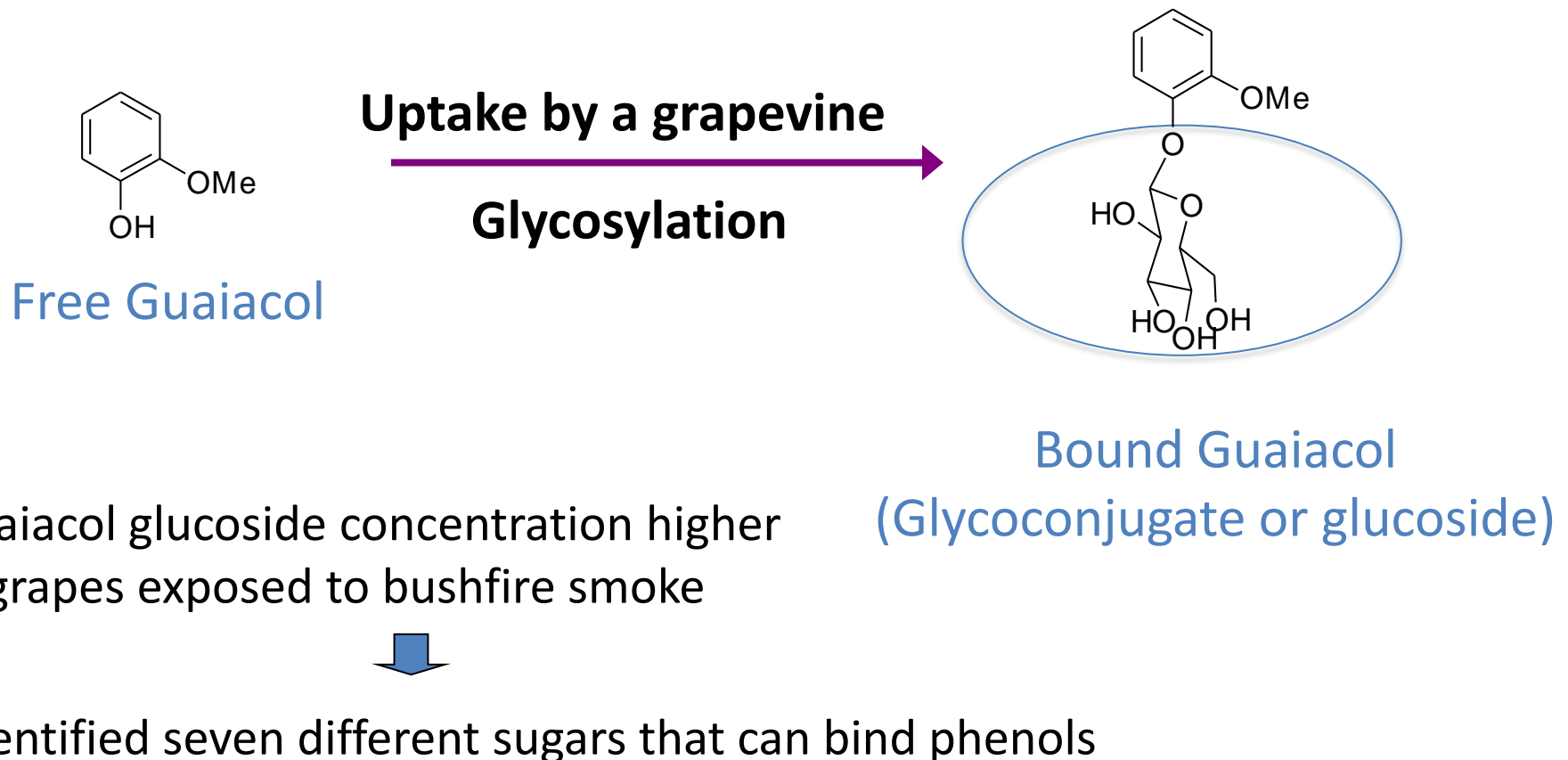
- ❖ In grapes from Victoria, guaiacol levels were often low
 - *“My grapes had no guaiacol but after alcoholic fermentation I could smell smoke in the wine”*
 - *“My wine seemed ok at first, until it finished MLF then it tasted like I licked an ashtray”*

Assessing Smoke Taint Risk



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The discovery of the 'bound' (glycoconjugates) forms



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The volatile phenols are taken up by the grapevine and glycosylated to give the corresponding glycosides

Volatile phenols

Glycosides

1. Guaiacol

2. Methylguaiacol

3. *o*-Cresol

4. *p*-Cresol

5. *m*-Cresol

6. Syringol

7. Methylsyringol

Guaiacol glycosides

Methylguaiacol glycosides

o-Cresol glycosides

p-Cresol glycosides

m-Cresol glycosides

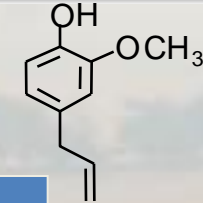
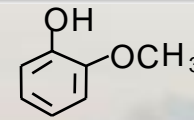
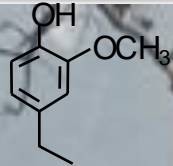
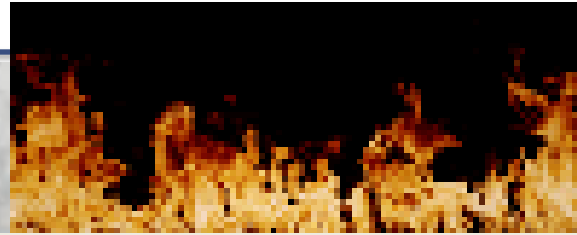
Syringol glycosides

Methylsyringol glycosides

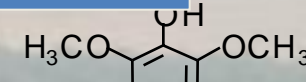
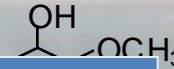
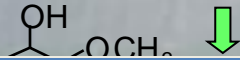
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Smoke consists of thousands of compounds



Smoke in air around vineyard



Smoke exposure to grapevines



Uptake of volatiles by grapes



Biotransformation of to glycoconjugates
(glycosylation)

Analysis of free volatiles in
grapes, juice or wine

Analysis of bound forms
(glycoconjugates)

Grapes and the resulting wine may contain

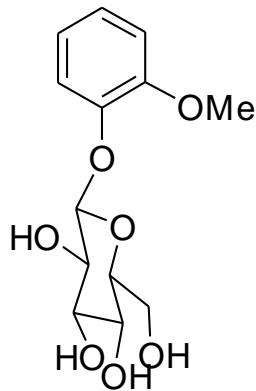
- ▶ volatiles (guaiacol etc)
- ▶ bound forms (glycoconjugates)

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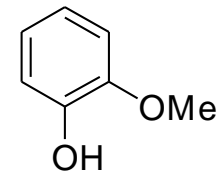
- ❖ Glycosides hydrolyse back to volatile forms
 - During fermentation (enzyme hydrolysis) – PARTIALLY
 - During storage (acid hydrolysis) - SLOWLY



Bound Guaiacol

(Glycoconjugate or glucoside)

Fermentation/wine storage
→
Hydrolysis



Free Guaiacol

Assessing Smoke Taint Risk



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Development of AWRI mini-ferment protocol (see handout)



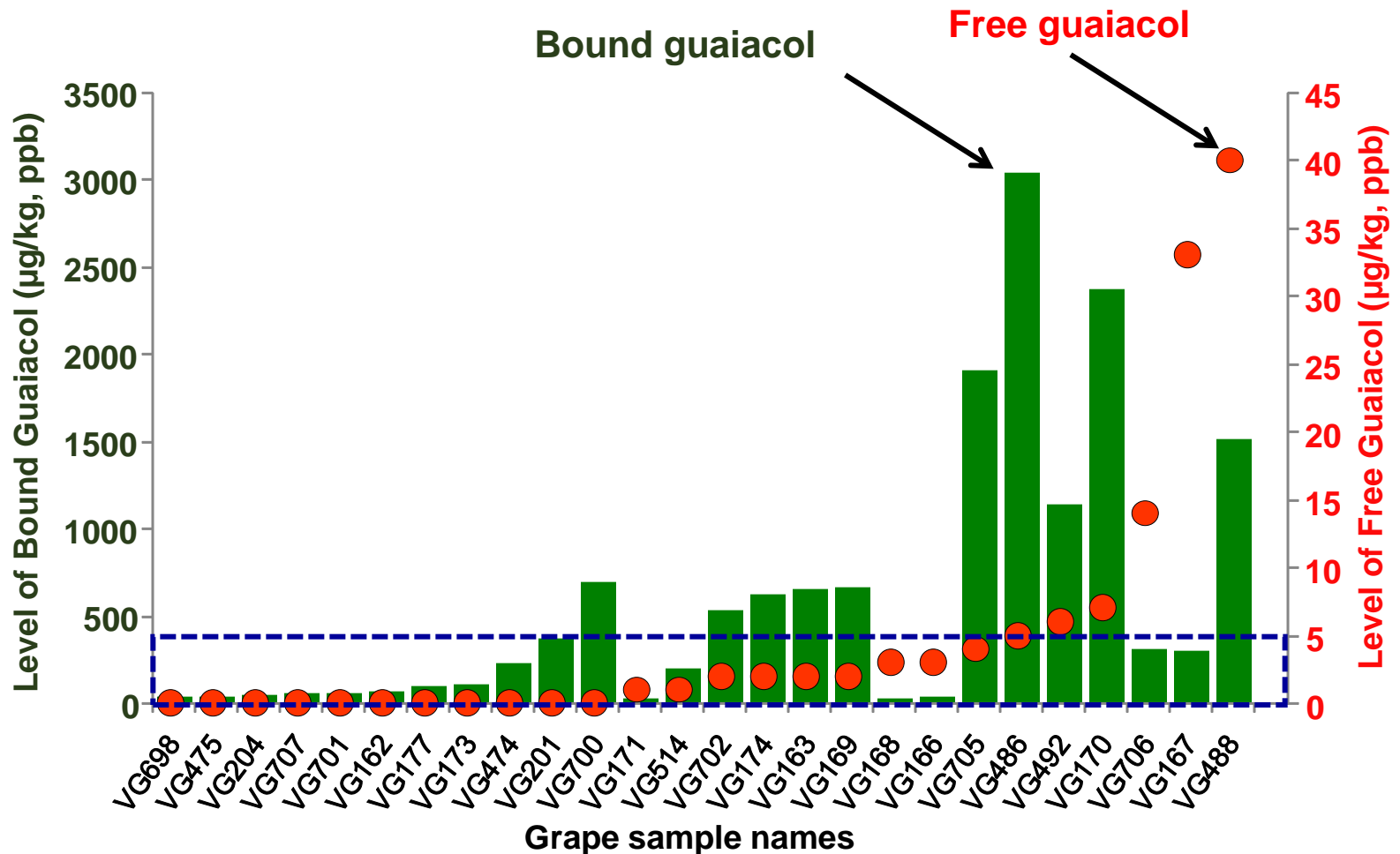
Can be conducted when fruit is at 8-9 Baume (14.4-16.2 Brix)

Assessing Smoke Taint Risk



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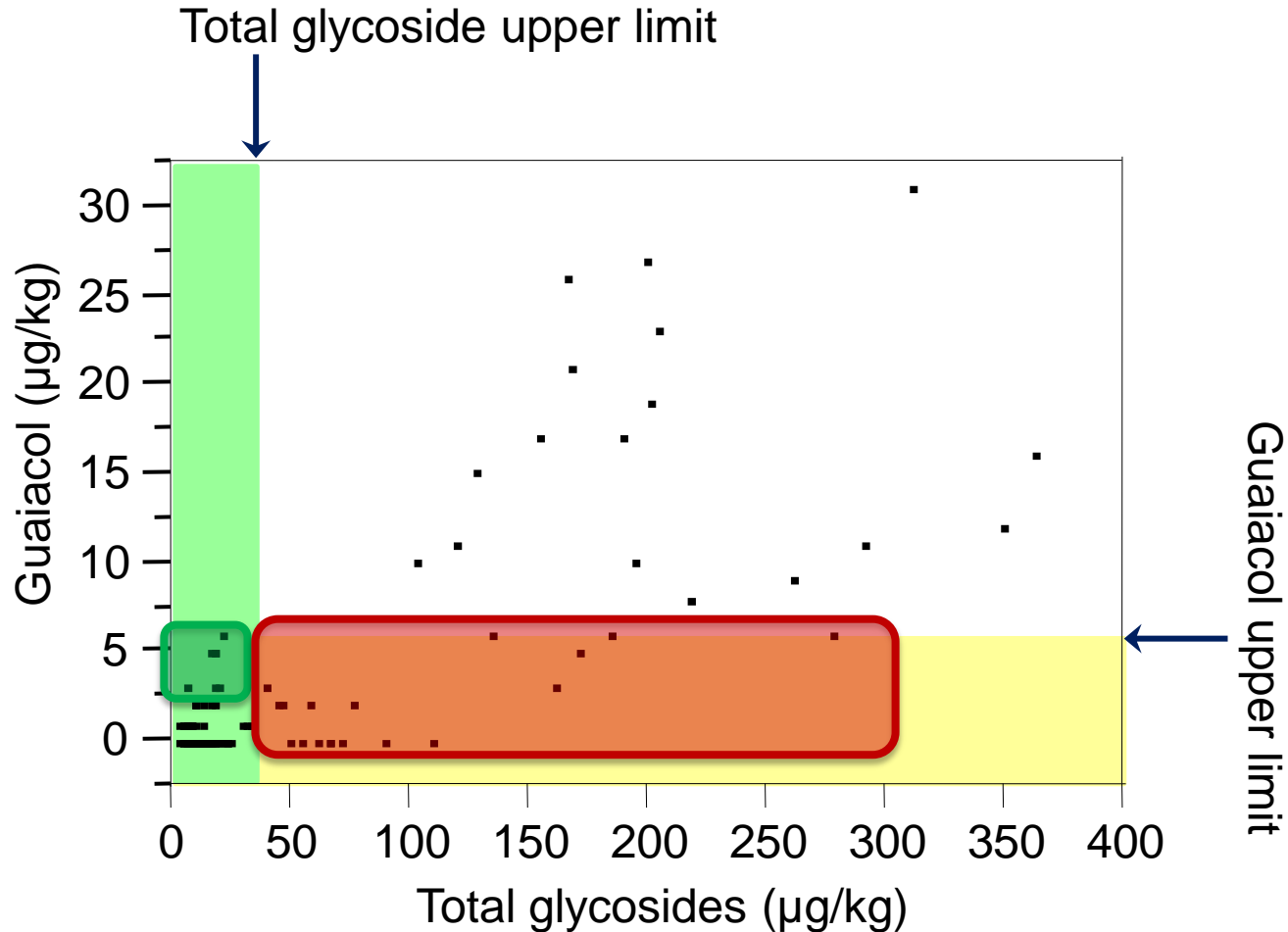
- Snapshot of smoke affected grapes from Victoria 2009



Assessing Smoke Taint Risk



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Managing the Impacts of Smoke Taint



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Technique	Details
Hand harvest fruit	Minimise breaking or rupturing of the skins as long as possible ^{1,2}
Exclude leaf material	Grapevine leaf material can contribute smoke related characteristics when in contact with fruit and juice ^{1,2}
Keep fruit cool	Fruit processed at 10°C had less extraction of smoke-related compounds compared to fruit processed at 25°C ^{1,2}
Whole bunch press	Has been shown to reduce the extraction of smoke derived compounds in whites ^{1,3}

Refs: ¹Simos 2008, ²Whiting and Krstic 2007, ³Ulrich 2009

Managing the Impacts of Smoke Taint



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Technique	Details
Separate press fractions	Smoke characters could be minimised in the first 400L/t when combined with fruit cooling; free-run juice can contain less smoke characters ^{1,2,3}
Consider addition of oak chips and tannin	Have been found to reduce intensity of smoke effect through increased wine complexity ⁴
Reverse osmosis of wine	Has been found to be effective in smoke effect reduction however smoke-related characteristics found to return in the wine over time ⁵
Market wine for immediate consumption	Evolution of smoke related characteristics can occur in bottle over time as wine ages therefore early consumption is recommended ^{1,3,5}

Refs: ¹Simos 2008, ²Whiting and Krstic 2007, ³Ulrich 2009, ⁴Ristic 2011, ⁵Fudge et al 2011.

Further information on AWRI website



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Annual reports

AWRI publications

▾ Current topics

Smoke Taint

eBulletins

eNews

Factsheets

Grape & wine search portal

▾ Library services to levy payers

Online image collection

▾ Technical Review*

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[Information Services](#) > [Current topics](#) > Smoke Taint

Smoke Taint

Smoke taint (last updated February 2012)

The following information is provided to assist Australian grape and wine producers who might have concerns with smoke contamination.

- Q&A regarding the AWRI's Commercial Service's smoke taint analysis ([click here to access \(pdf\)](#))
- Small-Lot fermentation method for assessing impact of smoke exposure ([click here to access \(pdf\)](#))
- What can be done to identify and reduce smoke effect in grape and wine production? ([click here to access \(pdf\)](#)). Also see articles by Fudge et al (2011) and Ristic et al (2011) in the link to publications below.
- Information on managing burnt vines can be found ([here \(pdf\)](#)) and information on grapevine recovery can be found ([here \(pdf\)](#))
- Assessing vineyard viability after bushfire ([click here to access \(pdf\)](#))
- Publications and other resources regarding smoke taint in grapes and wine ([click here to access](#))
- Email bulletin issued by the Department of Primary Industry Victoria, The Australian Wine Research Institute, Grape and Wine Research and Development Corporation and the Victorian Wine Industry Association on 20 February 2009 regarding the assessment of smoke taint in grape and wine samples (PDF, [click here to access](#))
- [Webcast presentation on smoke taint by Con Simos](#)

Other external links:

- [The Grape and Wine Research and Development Corporation](#)
- [Wines of Victoria](#)

General Recommendations



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- ❖ How do I assess if my grapes smoke tainted? What should I do?
- ❖ Step 1 – conduct a mini-ferment and sensory analysis (see handout)
- ❖ Call AWRI Commercial Services, send in samples according to quarantine protocols
- ❖ Analyse for ‘free’ volatile phenols and ‘bound’ forms (glycoconjugates)
- ❖ Winemaking and Extension Services can help interpret the data
 - In terms of sensory thresholds
 - Comparing similar batches of fruit/wine for streaming
 - In terms of baseline levels in the future (work in progress)
- ❖ Help you to make better informed decisions about your grapes/wine

End Session 1 – Questions ?



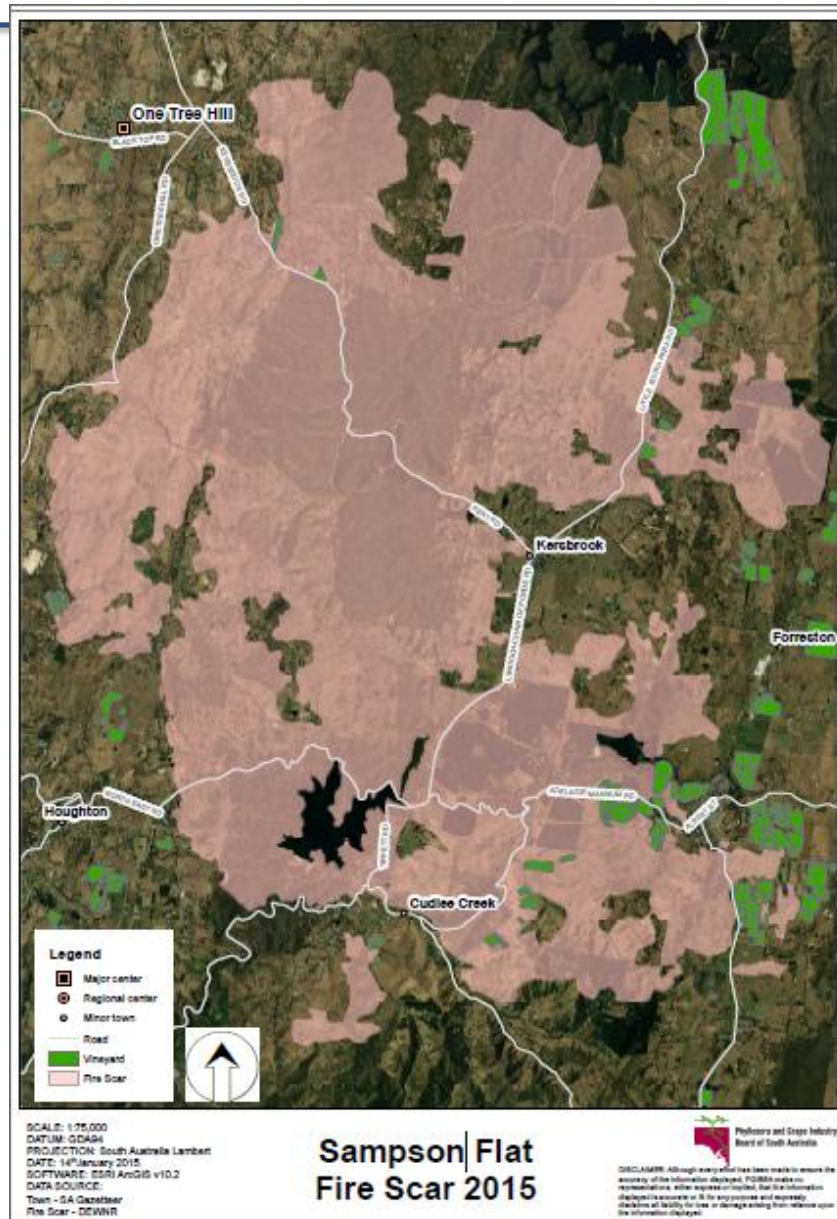
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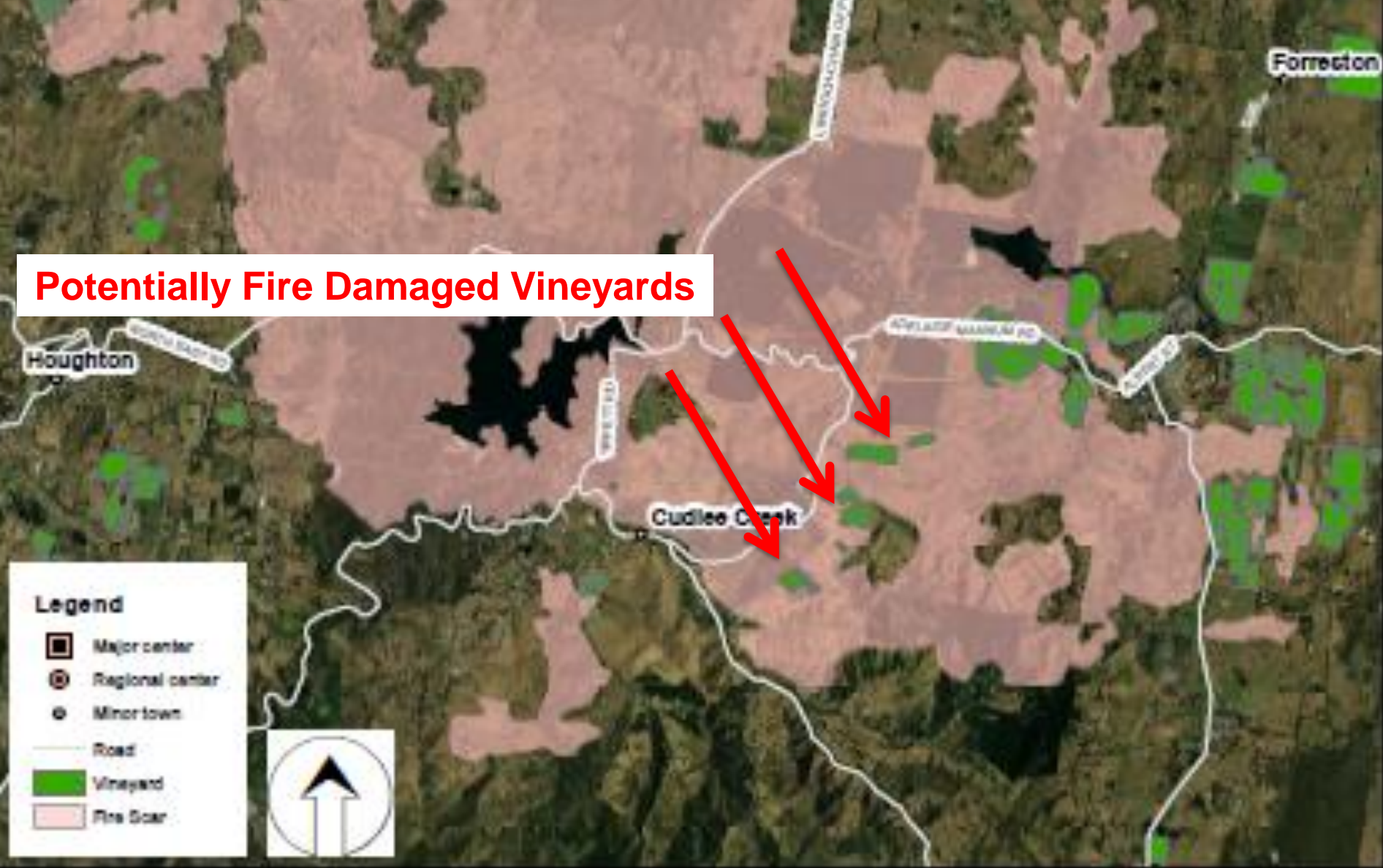
Assessing viability in damaged vineyards



The Australian Wine Research Institute



Potentially Fire Damaged Vineyards



SCALE: 1:75,000
DATUM: GDA94
PROJECTION: South Australia Lambert
DATE: 14th January 2015
SOFTWARE: ESRI ArcGIS v10.2
DATA SOURCE:
Town - SA Gazetteer
Fire Scar - DEWNR

Sampson| Flat Fire Scar 2015



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Assessing viability in damaged vineyards



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Assessing viability in damaged vineyards



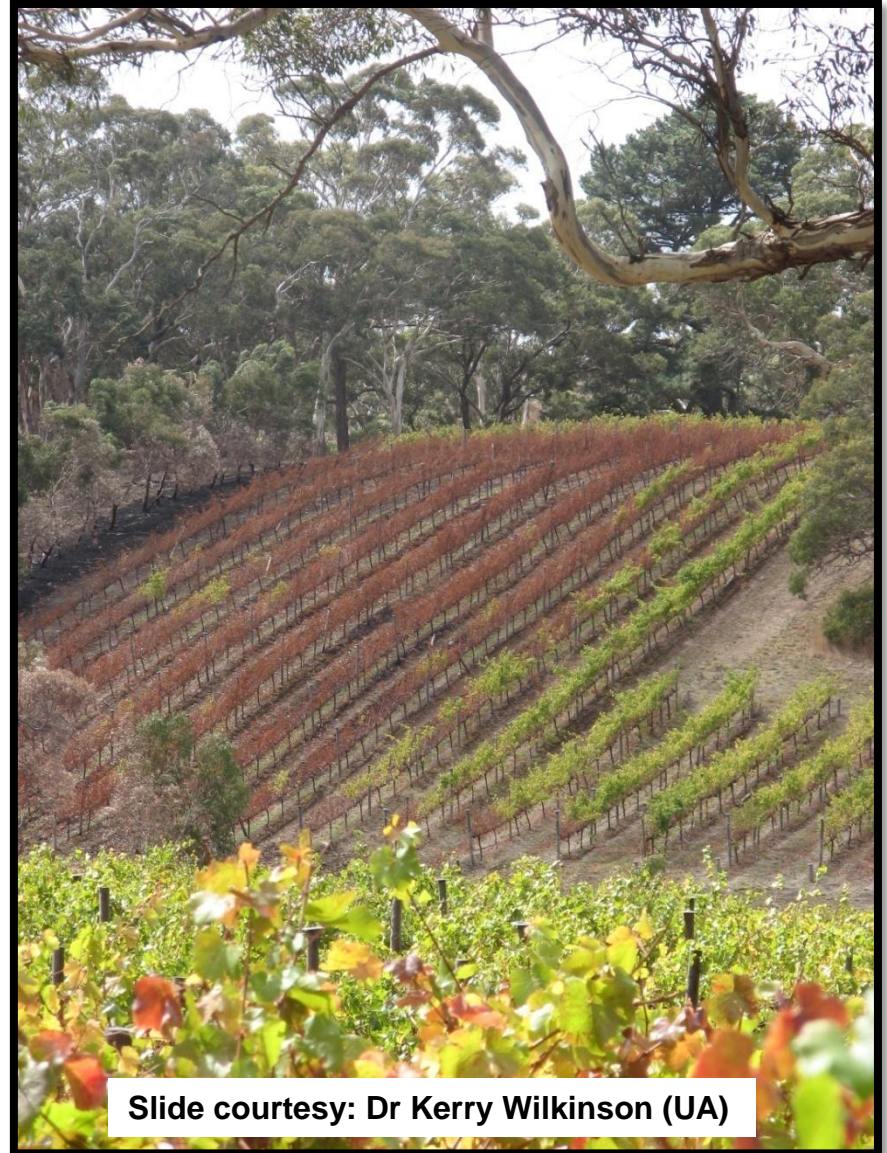
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Assessing viability in damaged vineyards



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Slide courtesy: Dr Kerry Wilkinson (UA)

Assessing viability in damaged vineyards



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Assessing viability in damaged vineyards



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Assessing viability in damaged vineyards



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Recommendation 1
Re-establish your irrigation infrastructure and irrigate

Assessing viability in damaged vineyards



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Recommendation 2
Assess visual damage soon after fire

Assessing viability in damaged vineyards



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Severely Damaged

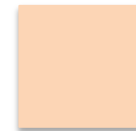
Complete defoliation

Vines have either been on fire or adjacent to extreme radiant heat loads sufficient to cause critical tissue damage/failure

Assessing viability in damaged vineyards



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Moderately Damaged

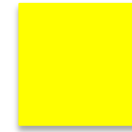
Some leaf retained but has suffered a degree of radiant heat load sufficient to cause damage to tissue.



Assessing viability in damaged vineyards



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Slightly Damaged

Minimal damage.

Vines show mild heat stress from fire radiance. Majority of leaves still present.

Assessing viability in damaged vineyards



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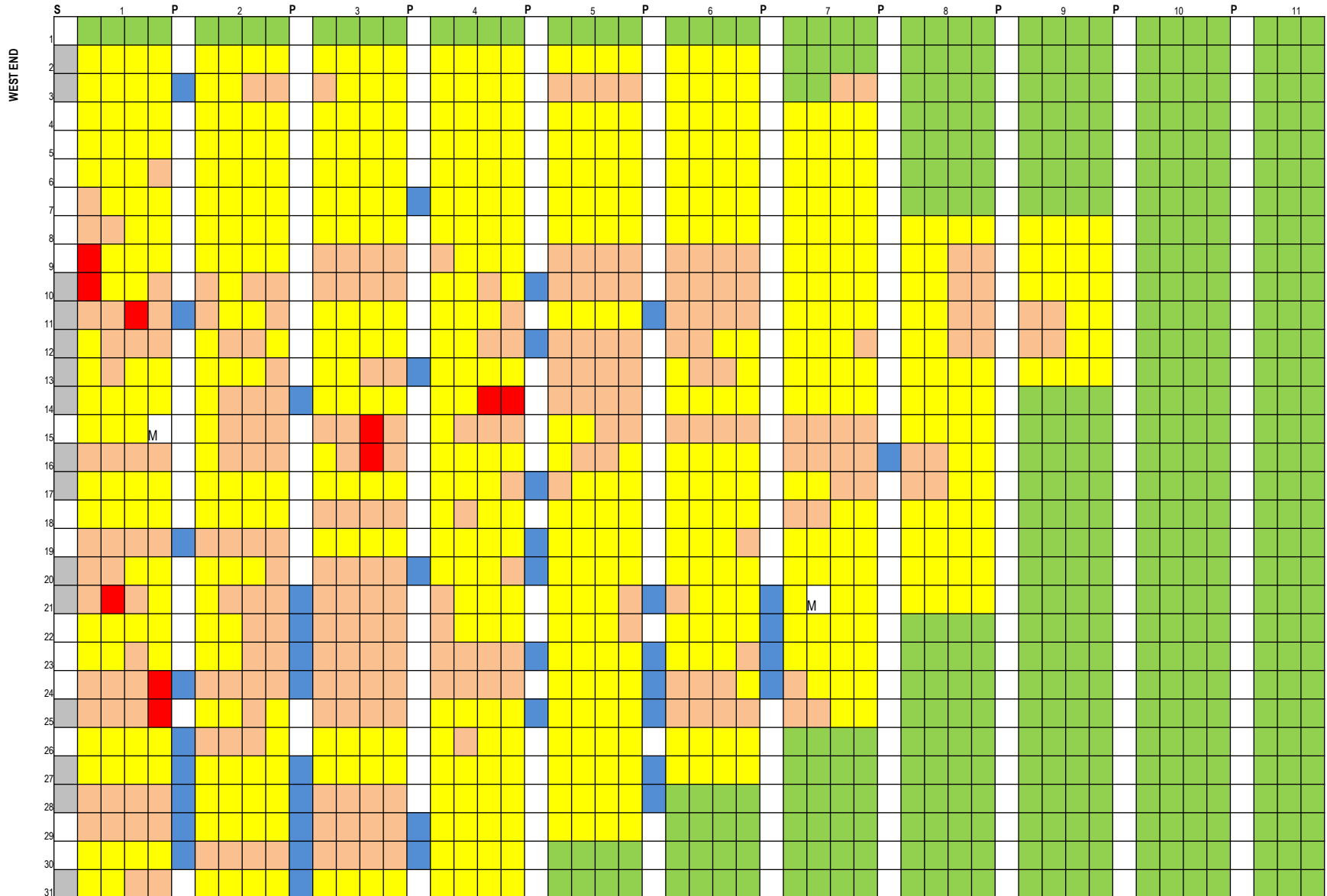
Alive

Unaffected by fire event

Assessing viability in damaged vineyards



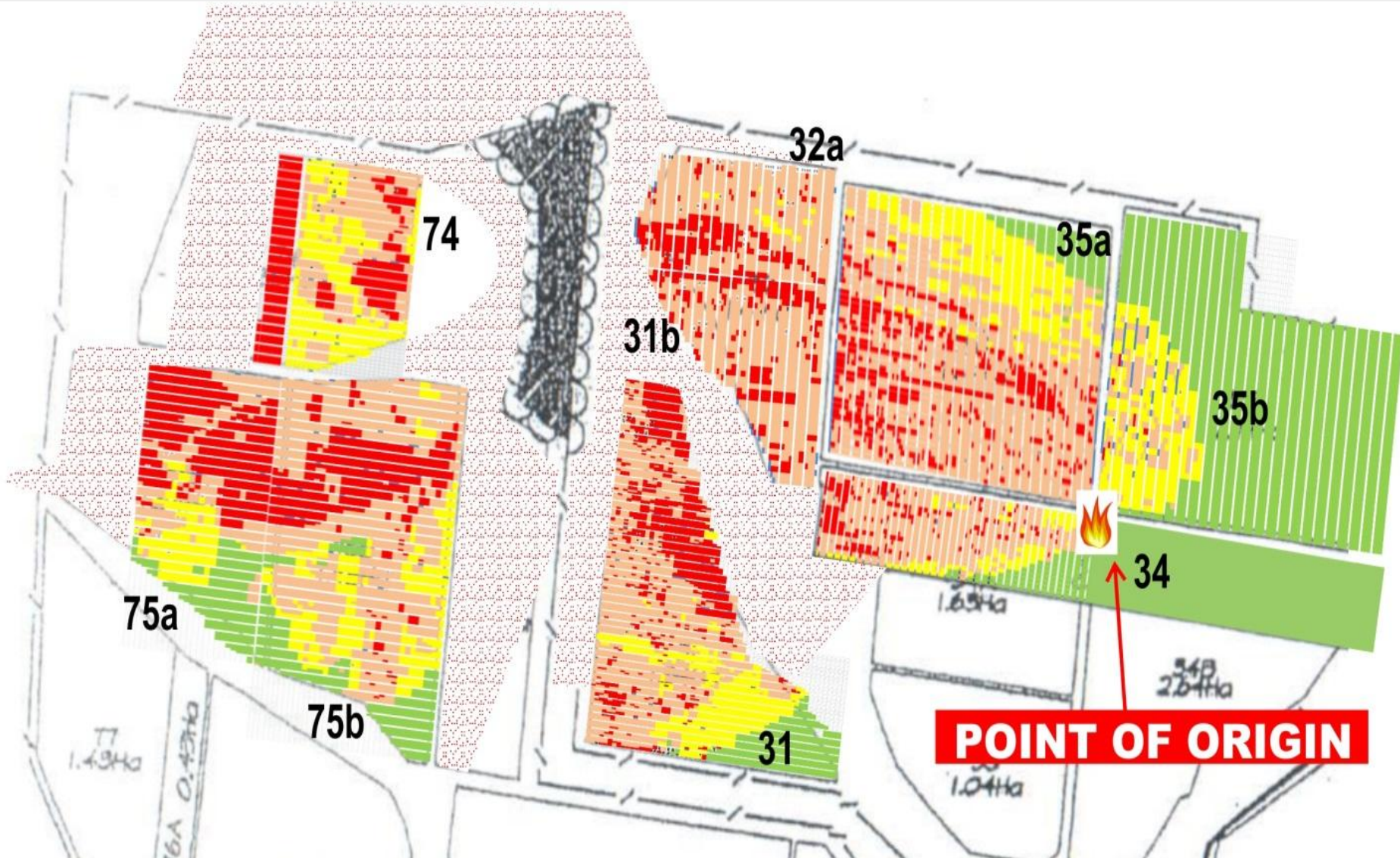
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Assessing viability in damaged vineyards



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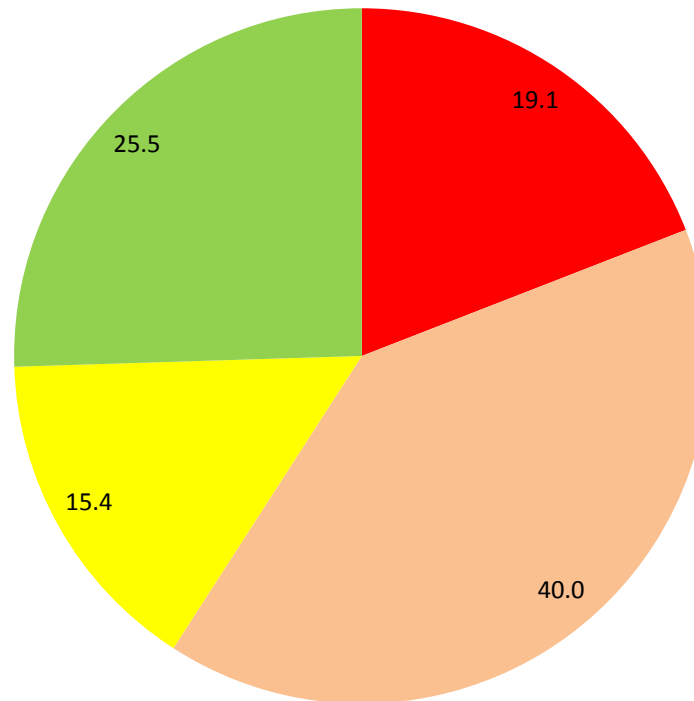


Assessing viability in damaged vineyards



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More quantitative assessments can be made



Extreme Moderate Slight Alive



Recommendation 3
Assess grapevine vascular tissue damage
Phloem and cambium tissues







Destructive sampling – assessing trunk cross-section vascular damage

Healthy Tissue

Damaged Tissue



Trunk transect after staining with 1% Methylene Blue Aq.
Healthy live tissue stained bright blue, damaged vascular tissue stained discoloured blue, black/brown.

Assessing viability in damaged vineyards



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Destructive sampling – assessing trunk cross-section vascular damage

Healthy Tissue

Damaged Tissue



Use prior map to strategically target where this destructive sampling can be undertaken (e.g. sample only 1 in 200-250 vines)

Summary and Take Home Messages



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- Actual vine damage/death based on heat experienced by individual vine. This can be highly variable and depend on tree lines and fuel (dry grass/mulch) in vineyard;
- Vines with leaves that are partially or totally scorched should have the crop removed to eliminate competition for water, carbohydrates and nutrients.
- Grapes may well have picked up a smoke taint and rendered unsuitable for winemaking anyway.

.

Summary and Take Home Messages



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- Research by Whiting (2012) suggested no advantage in pruning back scorched shoots – just allow to regrow and see what damage has occurred.
- Experience has shown that vines can take 2 to 3 years to get back into full production and some vines can still collapse after showing initial signs of recovery.
- The amount of work required to rejuvenate a mix of dead and sick vines needs to be weighed up against a total replant of a block.
- Area requiring more R&D

Acknowledgments



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❖ AWRI

- Smoke team

Dr Yoji Hayasaka, Gayle Baldock, Mango Parker, Dr Jason Geue, Patricia Osidacz, Dr David Jeffery, Dr James Kennedy, Adrian Coulter, Con Simos, Dr Cory Black, Kevin Pardon, Dr Leigh Francis, Dr Markus Herderich

❖ Australian wine sector partners

- Constellation Wines Australia
- Treasury Wine Estates
- Wine Victoria – formerly VWIA
- Taltarni Wines – Matthew Bailey

❖ University of Adelaide

- Dr Kerry Wilkinson & team

❖ DEPI Victoria – Centre for Expertise in Smoke Taint Research

- Dr Ian Porter, John Whiting and Ricky James

The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australia's grapegrowers and winemakers through their investment body, the Australian Grape and Wine Authority, with matching funds from the Australian government.



Australian Government
Australian Grape and
Wine Authority

End Session 2 – Questions ?



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