Smoke Taint Update Session

Adelaide Hills smoke update session
Tuesday 20 January 2015
Bird in Hand Winery, Woodside

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Australian Wine Research Institute
FIRST - Instructions – live polling

- 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.
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

- 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

1. direct absorption into berries via waxy cuticle
Mode of Entry into Grapevines

1. direct absorption into berries via waxy cuticle

2. via leaves and translocated to fruit
Mode of Entry into Grapevines

1. Direct absorption into berries via waxy cuticle
2. Via leaves and translocated to fruit
3. Via roots
Mode of Entry into Grapevines

1. direct absorption into berries via waxy cuticle
2. via leaves and translocated to fruit
## Sensitivity to Smoke Uptake

### Timing of grapevine sensitivity to smoke uptake

<table>
<thead>
<tr>
<th>Grapevine growth stage</th>
<th>Potential for smoke uptake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoots 10 cm in length</td>
<td>Low</td>
</tr>
<tr>
<td>Flowering</td>
<td>Low</td>
</tr>
</tbody>
</table>

**P1**
## Sensitivity to Smoke Uptake

### Timing of grapevine sensitivity to smoke uptake

<table>
<thead>
<tr>
<th>Stage</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berries pea size</td>
<td>Variable</td>
</tr>
<tr>
<td>Beginning of bunch closure</td>
<td>Variable</td>
</tr>
<tr>
<td>Onset of veraison to 3 days post veraison</td>
<td>Variable **</td>
</tr>
</tbody>
</table>

*Variable* (low to medium)
Timing of grapevine sensitivity to smoke uptake

From 7 days post veraison to High Harvest
Localisation of smoke taint compounds

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
No Carry Over Between Seasons

Year 1
Severe Smoke Affected

Year 2
No detectable smoke taint
Gets Worse As Wine Ages
Sensitivity Differs Between Varieties

- 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)
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

- Function of concentration and duration of smoke exposure
- Historically assessed via ‘visibility’ assessments
Assessing Smoke Taint Risk

- 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
Assessing Smoke Taint Risk

Regional Differences

- Milawa
- Yarra Valley
- Rutherglen

12 per. Mov. Avg. (Milawa)
12 per. Mov. Avg. (Yarra Valley)
12 per. Mov. Avg. (Rutherglen)
Assessing Smoke Taint Risk

• Manjimup fire in mid-February 2012 confused our understanding

• Indicated that ‘Smoke Composition’ is important risk factor
Assessing Smoke Taint Risk

Smoke consists of 1000s of different compounds
Assessing Smoke Taint Risk

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

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)

**α-Cresol**
‘phenol’, ‘plastic’

**m-Cresol**
‘smoky, phenolic’, ‘smoky bandaid’, ‘faecal, plastic’

**p-Cresol**
‘faecal, horse stable-like’, ‘medicinal’
## Sensory thresholds of selected volatile phenols in neutral Merlot wine

<table>
<thead>
<tr>
<th>Compound</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guaiacol aroma</td>
<td>23 µg/L</td>
</tr>
<tr>
<td>Guaiacol taste</td>
<td>27 µg/L</td>
</tr>
<tr>
<td><em>m</em>-Cresol aroma</td>
<td>20 µg/L</td>
</tr>
<tr>
<td><em>o</em>-Cresol aroma</td>
<td>62 µg/L</td>
</tr>
<tr>
<td><em>p</em>-Cresol aroma</td>
<td>64 µg/L</td>
</tr>
</tbody>
</table>
Assessing Smoke Taint Risk

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

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”
The discovery of the ‘bound’ (glycoconjugates) forms

Uptake by a grapevine

Glycosylation

Guaiacol glucoside concentration higher in grapes exposed to bushfire smoke

Identified seven different sugars that can bind phenols
The volatile phenols are taken up by the grapevine and glycosylated to give the corresponding glycosides.

**Volatile phenols**

1. Guaiacol
2. Methylguaiacol
3. \( o \)-Cresol
4. \( p \)-Cresol
5. \( m \)-Cresol
6. Syringol
7. Methylsyringol

**Glycosides**

- Guaiacol glycosides
- Methylguaiacol glycosides
- \( o \)-Cresol glycosides
- \( p \)-Cresol glycosides
- \( m \)-Cresol glycosides
- Syringol glycosides
- Methylsyringol glycosides
Smoke consists of thousands of compounds

Smoke in air around vineyard
- Smoke exposure to grapevines
- Uptake of volatiles by grapes
- Biotransformation of volatiles 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)
Assessing Smoke Taint Risk

- 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

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

- Snapshot of smoke affected grapes from Victoria 2009
Assessing Smoke Taint Risk

![Graph showing guaiacol and total glycosides](image)

- **Guaiacol (µg/kg)**
  - Lower limit: 0
  - Upper limit: 30

- **Total glycosides (µg/kg)**
  - Lower limit: 0
  - Upper limit: 400

**Total glycoside upper limit**

**Guaiacol upper limit**
# Managing the Impacts of Smoke Taint

<table>
<thead>
<tr>
<th>Technique</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand harvest fruit</td>
<td>Minimise breaking or rupturing of the skins as long as possible&lt;sup&gt;1,2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Exclude leaf material</td>
<td>Grapevine leaf material can contribute smoke related characteristics when in contact with fruit and juice&lt;sup&gt;1,2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Keep fruit cool</td>
<td>Fruit processed at 10&lt;sup&gt;°&lt;/sup&gt;C had less extraction of smoke-related compounds compared to fruit processed at 25&lt;sup&gt;°&lt;/sup&gt;C&lt;sup&gt;1,2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Whole bunch press</td>
<td>Has been shown to reduce the extraction of smoke derived compounds in whites&lt;sup&gt;1,3&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Refs:** 1Simos 2008, 2Whiting and Krstic 2007, 3Ulrich 2009
## Managing the Impacts of Smoke Taint

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<tbody>
<tr>
<td>Separate press fractions</td>
<td>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)</td>
</tr>
<tr>
<td>Consider addition of oak chips and tannin</td>
<td>Have been found to reduce intensity of smoke effect through increased wine complexity(^4)</td>
</tr>
<tr>
<td>Reverse osmosis of wine</td>
<td>Has been found to be effective in smoke effect reduction however smoke-related characteristics found to return in the wine over time(^5)</td>
</tr>
<tr>
<td>Market wine for immediate consumption</td>
<td>Evolution of smoke related characteristics can occur in bottle over time as wine ages therefore early consumption is recommended(^1,3,5)</td>
</tr>
</tbody>
</table>

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

- 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?
Assessing viability in damaged vineyards
Assessing viability in damaged vineyards
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Assessing viability in damaged vineyards

Slide courtesy: Dr Kerry Wilkinson (UA)
Assessing viability in damaged vineyards
Assessing viability in damaged vineyards
Recommendation 1
Re-establish your irrigation infrastructure and irrigate
Assessing viability in damaged vineyards

Recommendation 2
Assess visual damage soon after fire
Assessing viability in damaged vineyards

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

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

Slightly Damaged

Minimal damage. Vines show mild heat stress from fire radiance. Majority of leaves still present.
Assessing viability in damaged vineyards

Alive

Unaffected by fire event
Assessing viability in damaged vineyards

[Image of a grid with various symbols and colors indicating different conditions and viability assessments in damaged vineyards.]
Assessing viability in damaged vineyards
Assessing viability in damaged vineyards

More quantitative assessments can be made

- Extreme: 19.1%
- Moderate: 40.0%
- Slight: 25.5%
- Alive: 15.4%
Recommendation 3
Assess grapevine vascular tissue damage
Phloem and cambium tissues
Assessing viability in damaged vineyards
Assessing viability in damaged vineyards

Destructive sampling – assessing trunk cross-section vascular damage

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

Destructive sampling – assessing trunk cross-section vascular damage

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

• 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

• 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

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

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