Australian Government

Grape and Wine Research and Development Corporation

SMOKE TAINT WORKSHOP

FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **GWR 07/07**

Principal Investigator: **Dr Mark Krstic**

Research Organisation: GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Date: **29 July 2008**

GWRDC Technical Workshop – Smoke Taint

Tuesday, 29th July 2008
9:00am – 4:00pm
Venue – Melbourne Airport Motel and Convention Centre, Airdle Street, Attwood, VIC

9:00 **Welcome, introductions and aims for the day** - *Mark Krstic, GWRDC*

9:05 **Setting the Scene – Overview of Impacts from 2006/07 Bushfires –** *Joanne Butterworth-Gray, CEO VWIA*

9:15 **Setting the Scene – Climate Change and Bushfires in Australia: Recent trends and future projections –** *Dr Chris Lucas, Bureau of Meteorology, Melbourne*

9:45 **Technical research update #1 – Winemaking implications for the management of smoke and bush fire taints -** *Con Simos, AWRI (30minute presentation & 10minutes questions)*

10:25 **Technical research update # 2 – Western Australian Smoke Taint Research Focuses on Enhancing Decision Making Capacity for the Wine Industry and Landscape Managers -** *Kristen Kennison, Department of Agriculture and Food Western Australia, Bunbury; Mark Gibberd, Curtin University, Margaret River; (30minute presentation & 10minutes questions)*

11:05 *Morning Tea*

11:20 **Technical research update #3 – Update on R&D activities undertaken in Victoria** *Dr Mark Downey, Vic DPI, Mildura; John Whiting Vic DPI, Bendigo; Mr Steve Lowe, King Valley Vignerons Association (30minute presentation & 10minutes questions)*

12:00 **Technical research update #4 – New approaches to smoke taint analysis -** *Kerry Wilkinson, University of Adelaide; (30minute presentation & 10minutes questions)*

12:40 *Lunch (Provided) – includes informal tasting of smoke affected wines*

1:30 **Technical research update #5 – Smoke from bushfires and prescribed burning: health and environmental issues -** *Tina Bell, University of Melbourne, Parkville Campus; (20minute presentation & 10minutes questions)*

2:00 **Building relationships between Natural Resource management Agencies and the Wine Industry**
a) Glynn Ward & Drew Haswell – Experiences in Western Australia *(15 minutes)*
b) Liam Fogarty & Joanne Butterworth-Gray – Experiences in Victoria *(15 minutes)*

2:30 **Reports of other industry activities and regional trials** *(open forum discussion)*

3:00 **Identifying opportunities for partnering and collaboration** *(facilitated by Mark Krstic)*

3:20 **Identifying future wine industry R&D gaps, needs and opportunities** *(facilitated by Mark Krstic)*

3:50 **Summing up and feedback**

4:00 **Meeting Close**

Victorian Wine Industry Association

GWRDC Technical Workshop
SMOKE AFFECT ON WINEGRAPES

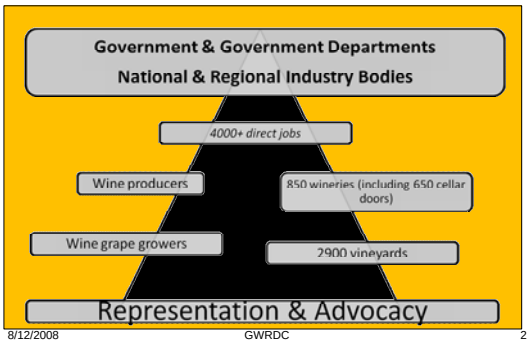
presented by

Chief Executive – Joanne Butterworth-Gray

find your wine

www.winesofvictoria.com.au

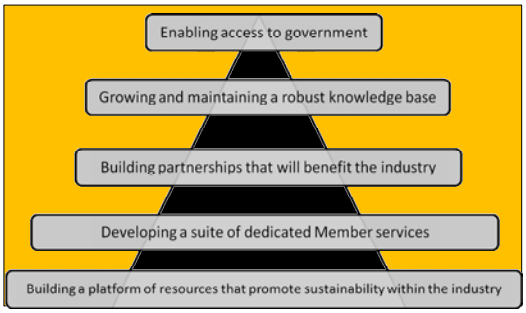
Role of VWIA



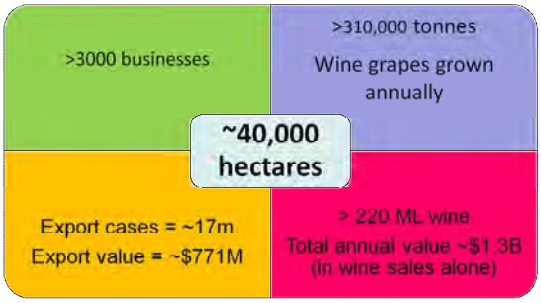
How do we fulfil that role?



VWIA Business Priorities



The scale of the Victorian wine industry



2006 /2007 D-DAYS

Summary

- October 2006 – **FROST** decimates 12 of Victoria's 21 wine regions – estimated 59% winegrape crop damaged
- November 2006 – **WATER allocations** at record lows due to drought
- January 16 2007 – **SMOKE haze** reduces visibility in Bendigo to <100m

IMPACT

Summary

- Vineyards in Pyrenees region (200-300km from source of fire) report smoke affect in wine
- Similar reports in Goulburn, Gippsland, Mornington, etc.
- Alpine & King Valleys face total crop loss
- Murray Valley vintage down 20%+
- Rest of Victoria down 40%+

VWIA RESPONSE

Summary

- Focal point for data collection and horror stories
- Plan government awareness campaign
- Minimise media scare campaign
- Commence dialogue with DSE department (Liam Fogarty)
- Coordinate communication pathways between regional associations, DSE, and DPI

OUTCOMES

Summary

- DSE purchased licence to use vineyard register & Vic wine regions to mapping across fire regions
- VWIA provided key regional associations contacts to DSE
- Facilitation of research trials on prescibed burn smoke affect on grapes
- Facilitation of regional stakeholder meetings to discuss planning for prescribed burns

NEXT STEPS

Summary

- Facilitation of regional meetings to discuss DSE Fire Operations Plans – August 2008
- Planning of good news stories for media to be jointly disseminated from DSE and VWIA

www.winesofvictoria.com.au

Our website
is your resource
visit and check it out for yourself.

Thankyou

Joanne Butterworth-Gray

Climate Change and Bushfires in Australia



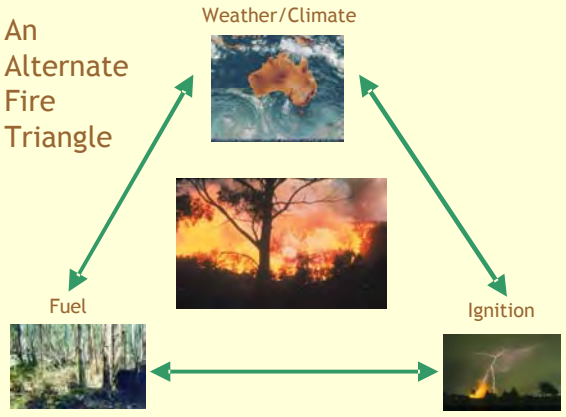
Chris Lucas
Centre for Australian Weather and Climate Research/Bushfire CRC

bushfire CRC

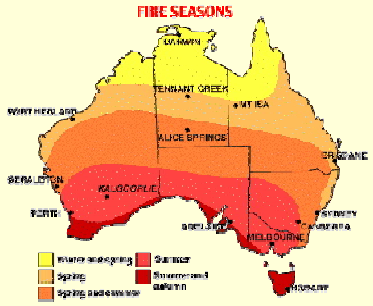
Overview

- Brief overview of Australian fire
- Projected effects of climate change on fire weather
- Current trends and observations

An Alternate Fire Triangle



Australian Fire Seasons



Quantifying Fire Danger

- Use McArthur Forest Fire Danger Index (FFDI)
  - 3 pm wind speed and relative humidity
  - Maximum temperature
  - Daily rainfall
  - KBDI-based for drought factor computation



- Built-in fuel-load assumptions not met in all places, but we are interested in the variations of the weather and climate, not necessarily the fire behaviour.

Fire Danger Rating

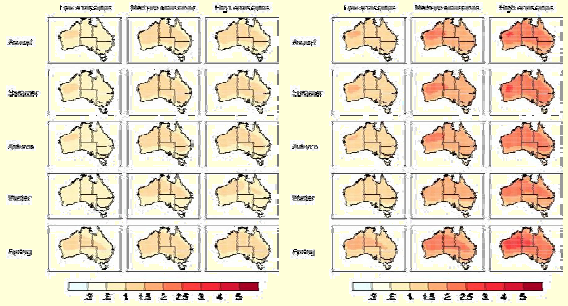
- Fire agencies give fire weather warnings in terms of the Fire Danger Rating, based on FFDI
  - 0-5 Low
  - 5-12 Moderate
  - 12-25 High
  - 25-50 Very High
  - >50 Extreme



Effects of Climate Change on Fire Danger

- Modelling study with Kevin Hennessy of CSIRO
- Two forcing scenarios on two climate models (CCAM2 and CCAM3)
- Apply changes in model distributions of temperature, humidity, wind and rain to observed data
- Recompute FFDI using new distributions
- SE Australia (NSW, VIC, TAS, ACT, SA, S. QLD) only
- Report commissioned by Climate Institute of Australia

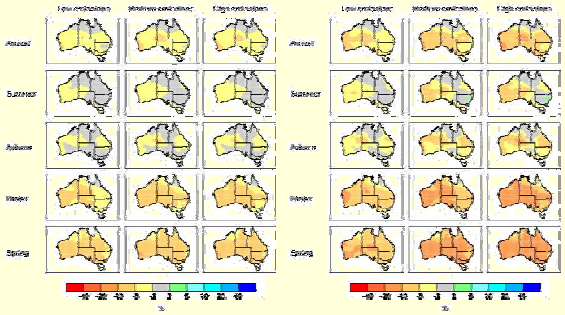
Projected Temperature Changes



2030 2050

http://climatechangeinaustralia.gov.au

Projected Precipitation Changes



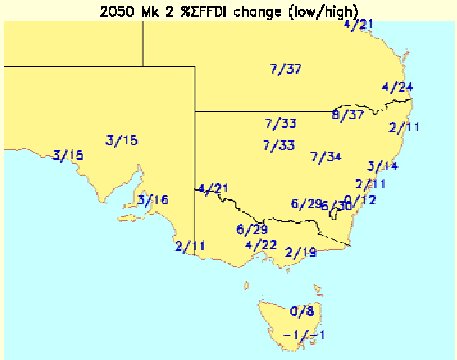
2030 2050

http://climatechangeinaustralia.gov.au

Analysis Variables

- Annual Cumulative FFDI
  - Sum of daily FFDI over a whole year
  - Year = July thru June
  - Good general indicator of fire season strength
  - Errors – worse case ~400 pts, or about 10-20%
- Seasonal Median/90% FFDI

Cumulative FFDI Changes

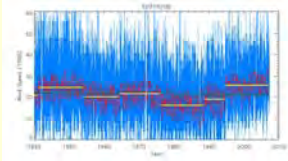


Other Effects

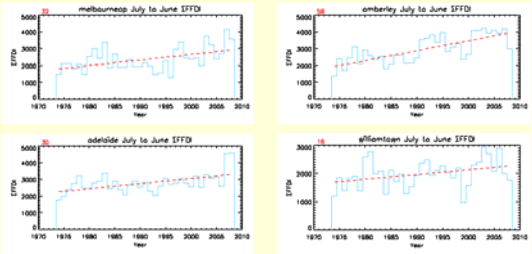
- Increase in number of very high and extreme days
  - Roughly 10-20% increase in number of VHE days by 2020 at most locales
  - Roughly 50-300% increase in VHE days by 2050
- Earlier start to fire season
  - Largest changes to model data occur in season before the peak fire season (e.g. SON in VIC, where DJF is peak…)
- Longer fire seasons
  - Earlier start and slightly later end mean a longer active fire season
  - Less time for prescribed burning (?)

Observations

- Most observations here from 1973 to present
- Station-based national coverage
- Real data have quality issues
  - Non-homogeneity of data, particularly wind
  - Remote stations affected more strongly
  - Issues more prevalent earlier in record – modern AWSs help reduce/eliminate many of these issues

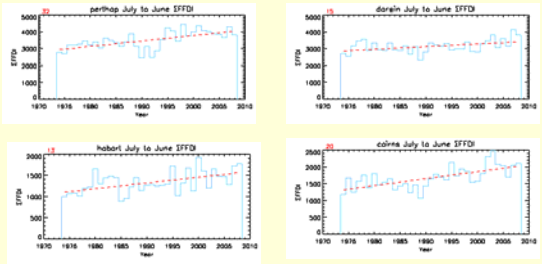


Trends in ∑FFDI - 1

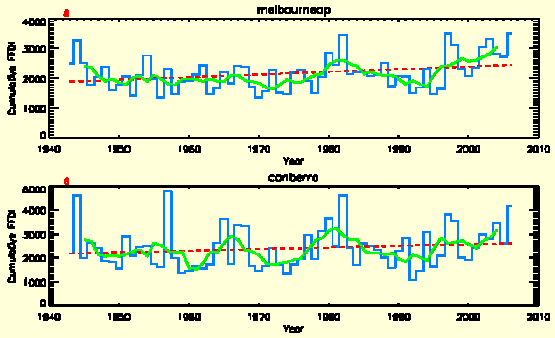


Many stations have witnessed a "jump" in ∑FFDI since ~2000. Compared to the 1980-2000 average, this jump **exceeds** the predictions made for the 2050 high scenario.

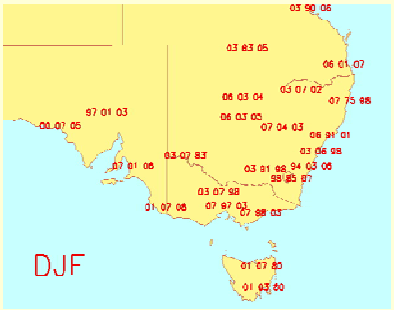
Trends in ∑FFDI - 2

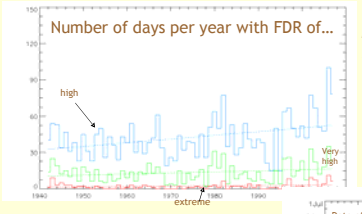


Long ∑FFDI Series



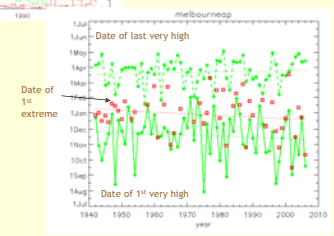
Worst Median Years



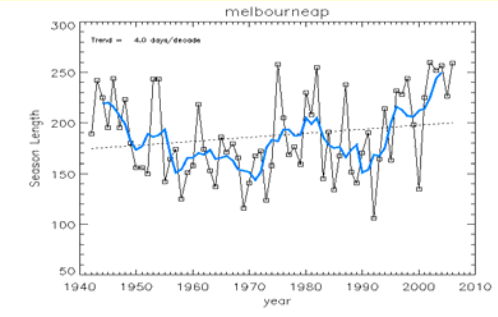


More dangerous fire weather days

Earlier season starts?



Fire Season Length



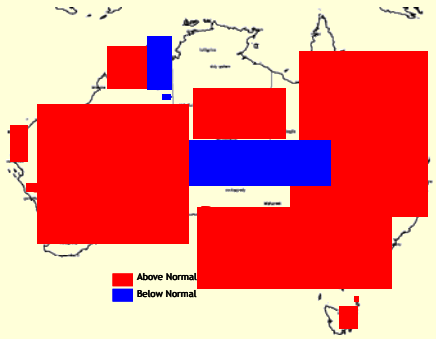
Hypothesis

- Current behaviour in ∑FFDI is a combination of **interdecadal variability** and **climate change.**
- But how much of each factor? The next few years of observations will tell the tale.
  - If interdecadal variability playing a large role, then we should see a return to conditions more in line with model projections
  - If no return, conclusion must be that climate model projections are too conservative (or our methodology is poor).

Other Factors

- This study only considers the weather-related factors
  - Assumes weather variability will be the same in the future
  - Is ENSO changing?
- What is impact of changing climate on vegetation (i.e. fuel)?
  - Enhanced CO2 changes the vegetation types which grow in an area.
  - More woody species on grasslands
  - More weeds and invasive species, especially in disturbed areas
- Changes to ignition
  - Most ignition by humans
  - Changes to 'dry lightning'?

Seasonal Bushfire Assessment 2007-8

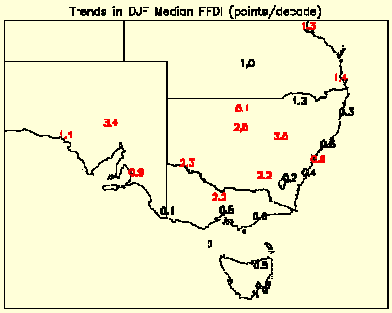


Some possible strategies

- While we can't unequivocally say 'This is climate change' at this point, the last decade or so provides a model for what climate change will be like. Use this as a basis for longer-term planning.
- Development of dynamic vegetation modules for use in coupled climate models
- Utilize and contribute to the Seasonal Bushfire Assessment Workshop

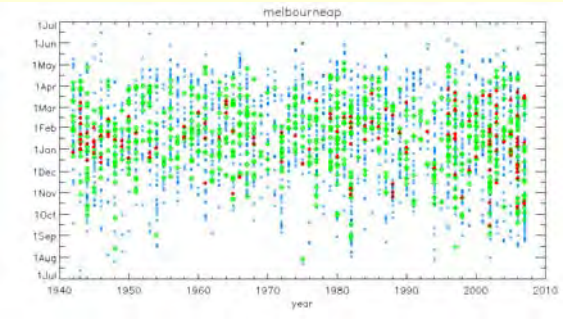
"If you look at the scientific knowledge things do seem to be getting progressively worse. Maybe before we were in a state of ignorance, but also we've seen much stronger trends in climate change. So you'd better start with the interventions even earlier. Now." -- Rajendra Pachauri, chair of the IPCC

Median DJF Trends 1973-2007



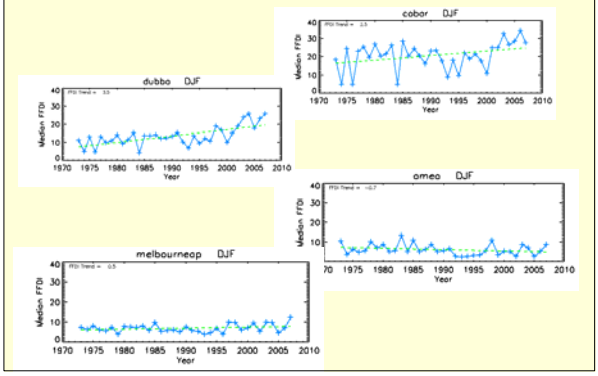
Red numbers indicate significance at 95% level

An alternate time series

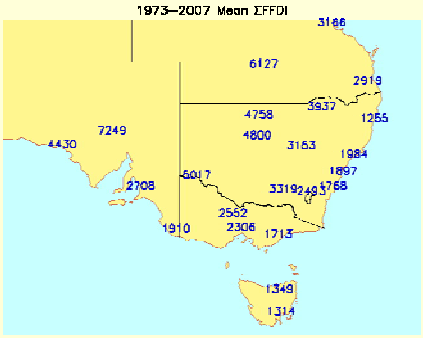


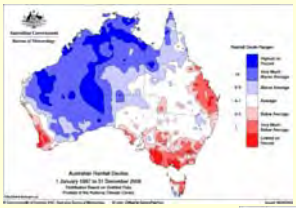
blue= high, green=very high, red=extreme

Some DJF Median Time series



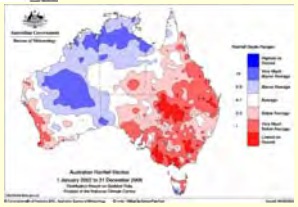
Average Annual ∑FFDI

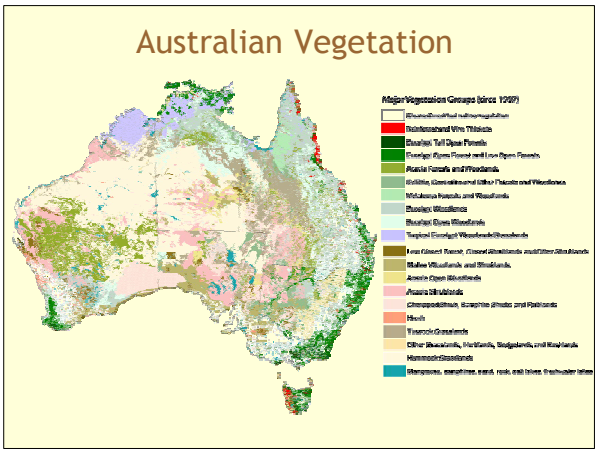




10 year rainfall deciles

5 year rainfall deciles




Australian Vegetation
Major Vegetation Groups (since 1750)

Winemaking implications for the management of smoke and bush fire taints

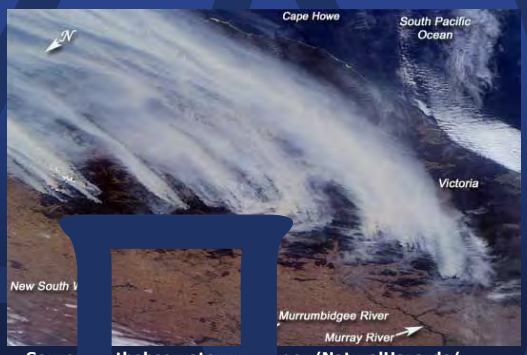
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Smoke taint – implications for the grape and wine sector:

- Smoke taint from fires:
  - NE Victoria, 2003 & 2007.
  - Ash Wednesday, 1983.
- Climate change: *"if we don't cut greenhouse pollution significantly we will see an almost tripling of fire weather (in Australia) conditions by 2*
  mate Change Institute].
- Pre bed burning
  ations:

Victorian bush fires – 2003:



Source
rthobservatory.
.gov/NaturalHazards/

Smoke taint:

- Guaiacol and 4-methylguaiacol are considered important markers which contribute to the smoky characters from bush fire taints.
- Guaiacol can be formed naturally, e.g. from the hydrolysis of fruit-derived precursors: Up to 20 ug/L has been observed, but levels of < 5 ug/L are much more typical.
- Gu
  barrel toasting, which is
  con
  ered a highly
  itive attribute (with oak
  lact
  , vanilla and
  lroxymethylfurfural, etc.)
  - G
    iacol 10 - 80
    L
  - 4
    ethylguaiacol
    30 ug/L.

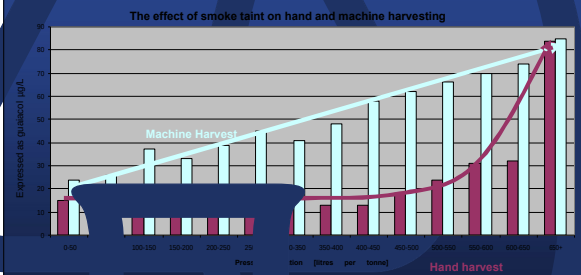
Sensory effects:

- Descriptors: smoky, ash burnt, ashtray, salami, smoked salmon etc.
- Two effects:
  - Aroma: smoky, burnt, cigarette.
  - Palate: hard metallic, ashtray like.

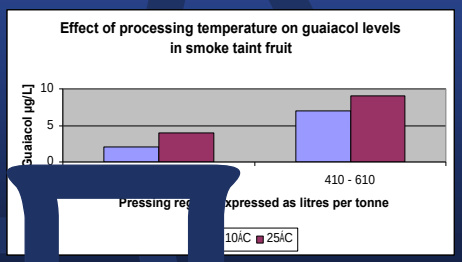
Sensory levels in juice and wine:

- White juices:
  - 6 ï 10 µg/L guaiacol
- Red wines:
  - 15 ï 25 µg/L guaiacol
- The lighter the juice / wine style the more obvious the level of taint.

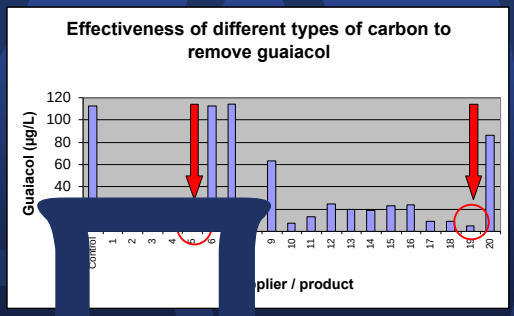
Winemaking implications – white:



Winemaking implications – white:



Winemaking implications – carbon:



Tria rried out on a 2(smoke tainted Sangiovese juice, rate addition +3g/L

Winemaking implications – white:

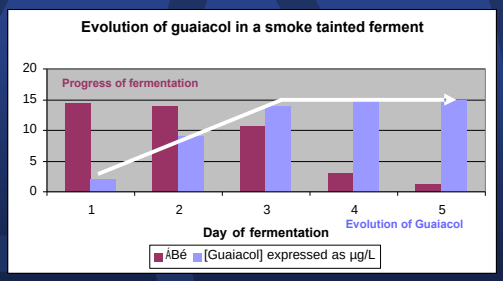
- Hand harvest not machine. No leaves.
- Chill fruit in cool-room overnight to as cold as possible.
- Pressings cut at å400 L/tonne.
- Perform carbon trials, treat at the juice stage.
- Trea nd settle with b nite, rack and earth filter.
- Add ids back to fern , otherwise stuck fermentation issu

Smoke taint in the vineyard:

Å Vineyard trial ï 2007 Dry Red

Vine #	Total harvested fruit weight (kgs.)	Ripeness (ÁBrix)	Leaves (Guaiacol µg/kg)	Grapes (Guaiacol µg/kg)
1	2.84	23.5	64	0
2	1.13	22.4	45	1
3	4.73	26.6	49	1
4	1.41	21.7	71	2

Winemaking implications – red:



Winemaking implications – red:

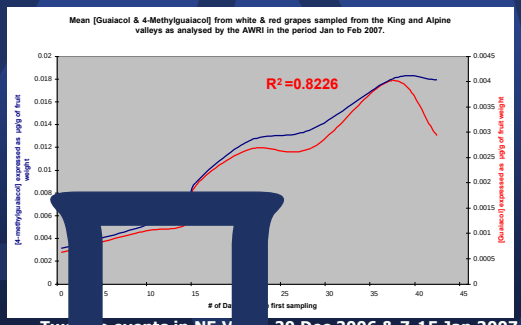
Effect of different winemaking treatments on smoke taint

Treatment	Start (guaiacol µg/L)	Dryness (guaiacol µg/L)	% change
20ÁC ferment 4 Days	22	37	68%
28ÁC ferment 4 Days	18	41	128%
3 day cold mac. +28Á ferment	17	50	194%
No enzyme addition	21	43	105%
+ colou	18	39	117%
+ 300 m seed tannin	20	45	125%
+ 300 m white tannin	18	41	128%
+ 300 m Quebracho tann	22	40	82%

Winemaking implications – red:

- Hand harvest (no leaves).
- The longer the maceration, the greater the level of smoke taint.
- Yeast and tannin combinations could offset some of the taint characters.
- Re se Osmosis.
- Ble ng.

Evolution of smoke taint during ripening:



Two e events in NE V -20 Dec 2006 & 7-15 Jan 2007

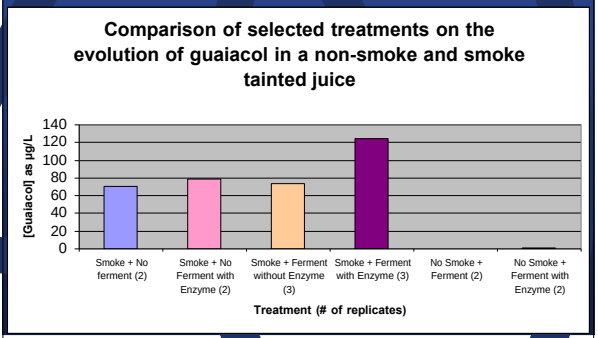
Evolution of smoke taint during ripening:

- Theory:
  - ñReservoir of smoke particles entrapped on the leaf surface, following a smoke event. Smoke particles are absorbed through the leaves and bound to é é é..(sugars?), transported via the phloem into the developing berryò.
- Accumulates within the inner layers of the skin, no.
- Cur ative, the late e harvest date, the higher the el of smoke t .

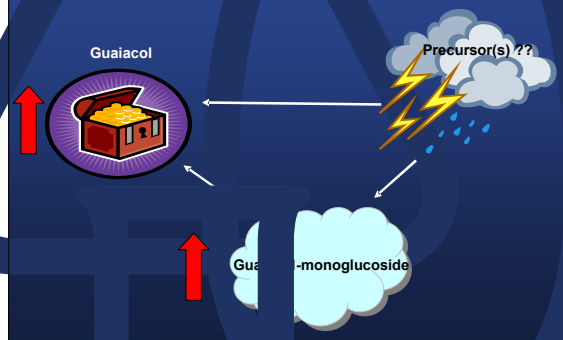
Winemaking implications - the role of β-glucosidase:

- So why doesnôt the analysis of fruit in the vineyard correlate with juice or resultant wine analysis?
- Significant variability within the vineyard.
  - Non statistical sampling indicates 4 to 6-fold difference among vines in the same vineyard.
- Possible enzymatic action leading to the liberation of free guaiacol, from bound precursors at the juice stage, primary fermentation and MLF.

Winemaking implications - the role of β-glucosidase:



Precursor X: Possible formation of Guaiacol



Carry over to the following vintage:

Vineyard trial ï vines sampled Nov 2007.

Vine #	Leaves (Guaiacol µg/kg)
1	nd
2	nd
3	nd
4	nd

In this case, there was no carry-over from a ómoderatelyô smoke-tainted vintage to the following growing season.

Acknowledgements:

The author would like to thank Dr. Alan Pollnitz, Dr. Yoji Hayasaka, Sarah Ballantine, The Australian Wine Research Institute; Dr. Kerry Wilkinson, Adelaide University; Audrey Lim, The Hardy Wine Company; Wendy Cameron, Brown Brothers; Lindsay Corby, La Trobe University and Stephen Lowe, King Valley Vignerons for their valuable contributions.

The AWRIôs research is financially supported by Australia's grapegrowers and winemakers through their investment body the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

WA Smoke Taint Program: Delivering outcomes for industry



Australian Government
Grape and Wine Research and Development Corporation

Curtin University of Technology

Multi-agency program

Department of Agriculture and Food
- Kristen Kennison
- Glynn Ward
- Bob Frayne
- Eric Wootton

Curtin University of Technology
- Mark Gibberd
- Kerry Wilkinson (Adelaide University)
- Hannah Williams

Contributions from
- Australian Wine Research Institute
- WIAWA Technical Committee
- Regional WIA's
- DEC

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Smoke taint in WA

Incidences of smoke taint recorded since mid 1990's in Perth Hills, Swan Districts, Blackwood Valley, Great Southern, Manjimup and Pemberton Regions

2004	Major incidence of smoke taint in Pemberton Region
Late 2005	R&D commenced (DAFWA, CUT, WIAWA, GWRDC)
2006	WIAWA 'Smoke Taint Working Group' formed

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WA wine regions are co-located with forest resources

South West is a fire prone area

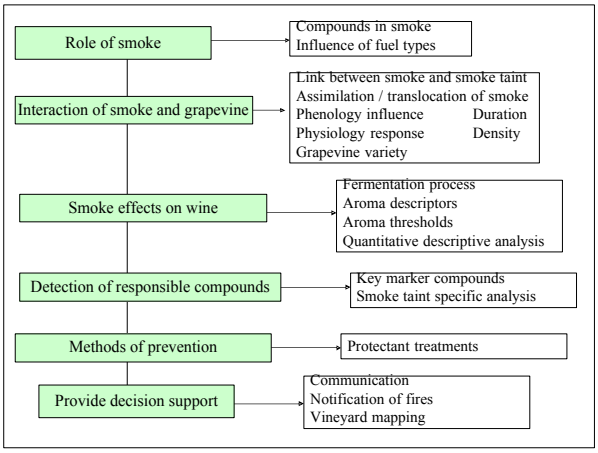
Approx. 4 m ha of forest

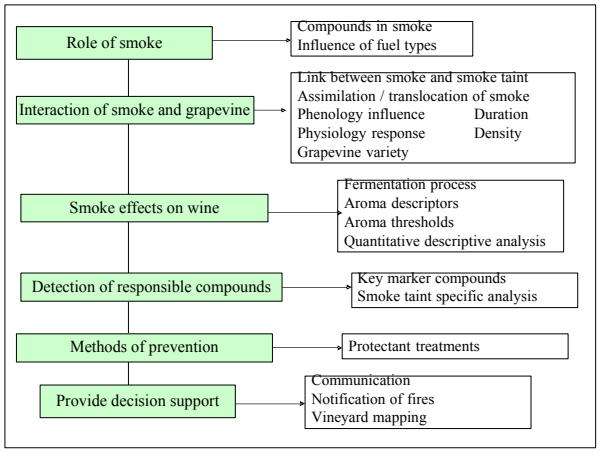
Up to 200 lightening caused fires per year

Forest management agency fuel reduction program in place



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Foundation research: Proof of smoke taint

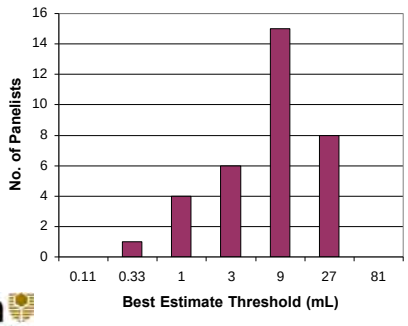


High levels of smoke compounds prove cause and effect

	Concentration (μg/L)	
	smoked	unsmoked
guaiacol	1470	n.d.
4-methylguaiacol	326	n.d.
4-ethylguaiacol	128.7	n.d.
4-ethylphenol	59.3	n.d.
furfural	16.7	n.d.

n.d. = not detected

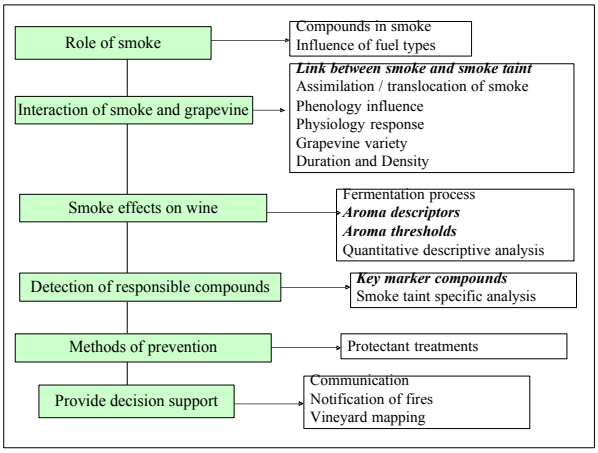
Aroma threshold of smoke taint in wine - 3.88 mL



Key outcome for industry Aroma threshold below published levels

	Aroma detection threshold (μg/L) (Boidron, 1988)			
	water	model wine	white wine	red wine
guaiacol	5.5	20	95	75
4-methylguaiacol	10	30	65	65

Wine aroma described as 'smoky', 'dirty', 'earthy', 'smoked meat' and 'burnt'



Direct application of smoke

Key point of difference with smoke taint research

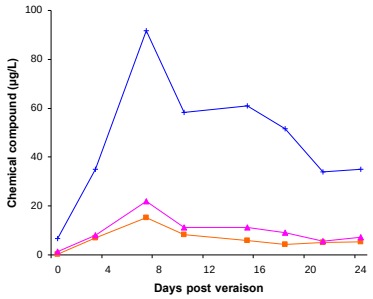
Smoke applied in field for past 3 years

Proven methodology

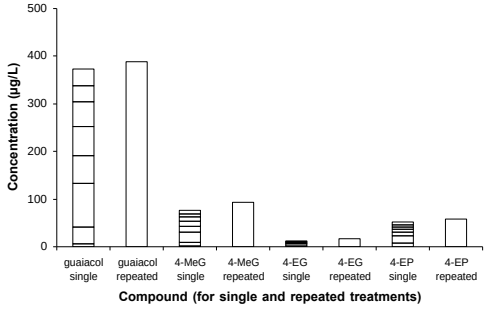




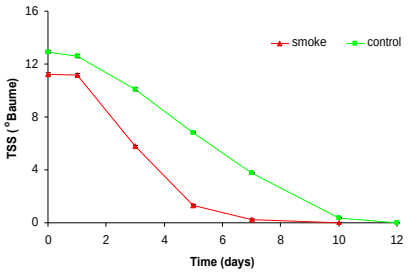
Field evidence of impact of smoke exposure on wine quality



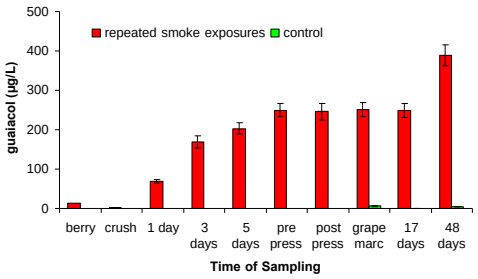
Repeated exposure increases smoke taint



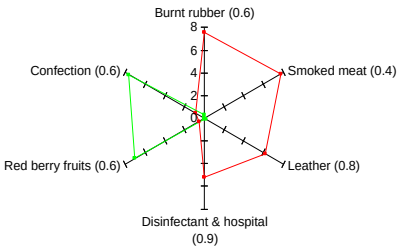
Wine production implication
Smoking of grapes increases fermentation rate



Increase in compound concentration throughout fermentation



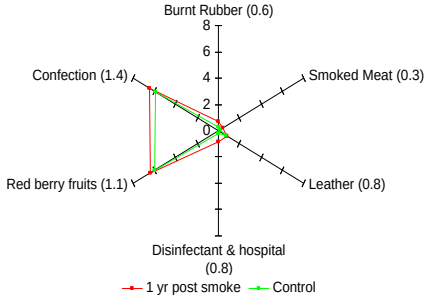
Wine sensory analysis demonstrates effect of smoke taint



Smoke carryover from year to year?

Treatment	Compound concentration (µg/L) in wine			
	guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
Repeated smoke application 2006	388 a	93 a	16.33 a	58.3 a
1 year post repeated smoke application 2007	2 b	0 b	0 b	0 b
Control	0 b	0 b	0 b	0 b

Smoke carryover wine sensory



Main carryover effect of smoke is in reduction in yield

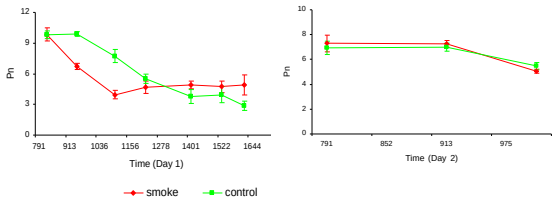
	Yield (kg)	Bunch number
Control	19.98 a	115.3 a
1 yr post repeated smoke application	6.41 b	73.7 b

Repeated smoke exposures lead to visible damage on leaves





Leaf physiology response



- Role of smoke
  - Compounds in smoke
  - Influence of fuel types
- Interaction of smoke and grapevine
  - ***Link between smoke and smoke taint***
  - Assimilation / translocation of smoke
  - ***Phenology influence***
  - Physiology response
  - Grapevine variety
  - Duration and Density
- Smoke effects on wine
  - ***Fermentation process***
  - ***Aroma descriptors***
  - ***Aroma thresholds***
  - ***Quantitative descriptive analysis***
- Detection of responsible compounds
  - ***Key marker compounds***
  - Smoke taint specific analysis
- Methods of prevention
  - Protectant treatments
- Provide decision support
  - Communication
  - Notification of fires
  - Vineyard mapping

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Smoke assimilation / translocation

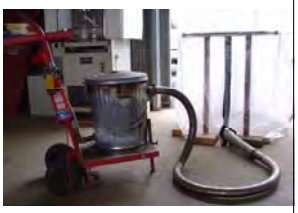




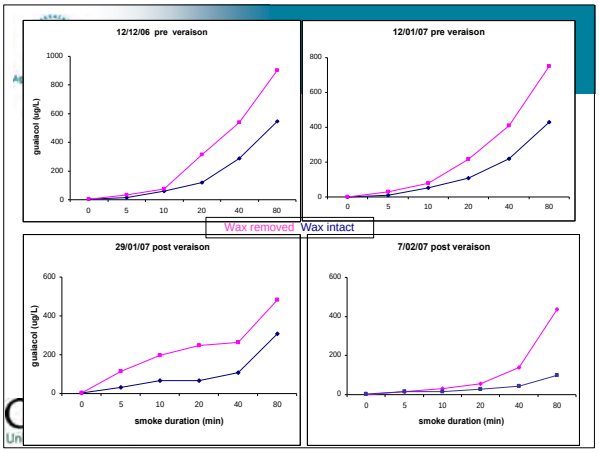
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Smoke assimilation / translocation

- Development of a model small scale system
  - Detached berries (waxed and unwaxed)
  - Allows high through-put of treatments



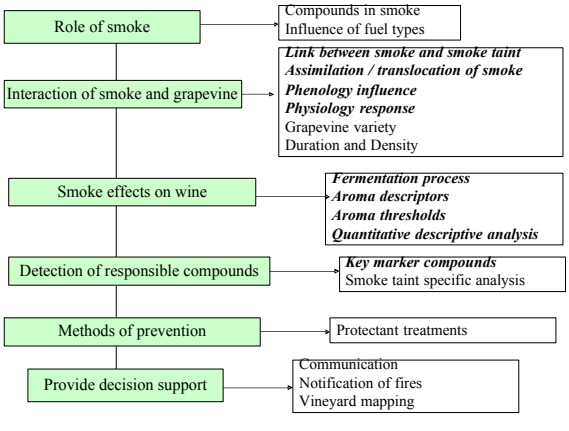
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Future program

- Deliver outcomes for industry
- Pathway of developing tools for industry and forest managers

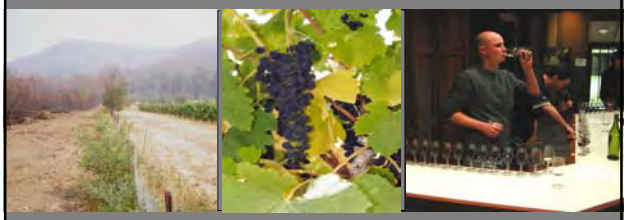
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Thank you

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Update on research activities in Victoria

John Whiting
Department of Primary Industries, Victoria

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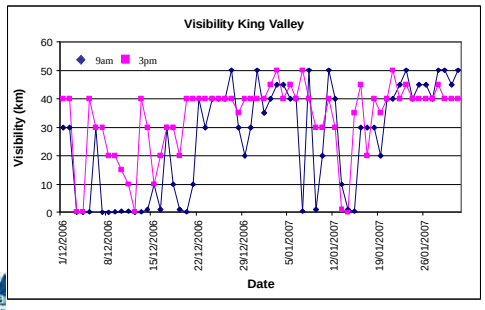
2006-07 Season

- Seminars and workshop
- Spatial variability
- Timing of uptake in the field
- Varietal sensitivity
- Grapes to wine
- Small scale wine assessment
- Leaf and cane analysis
- Translocation
- Winemaking treatments
- Laboratory comparison



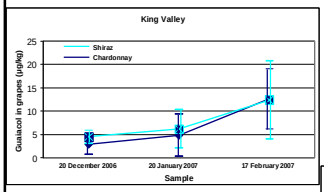
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2006-07 fire periods

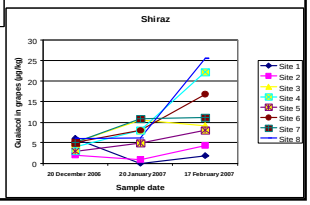


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Progressive sampling



- Mean of 8 vineyards
- Whole berries
- 20 Dec. – green, pea size, fires
- 20 Jan. – veraison, fires ended
- 17 Feb. – mid ripening

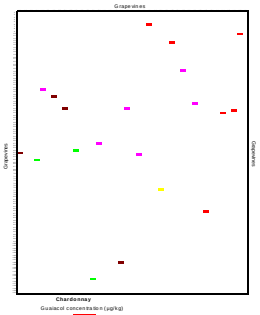


- Sites 1 & 2 – out of valleys
- Sites 3, 5 & 7 – in valleys, smoke drifted across them
- Sites 4, 6 & 8 – fires burned up close to vineyards

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Spatial sampling

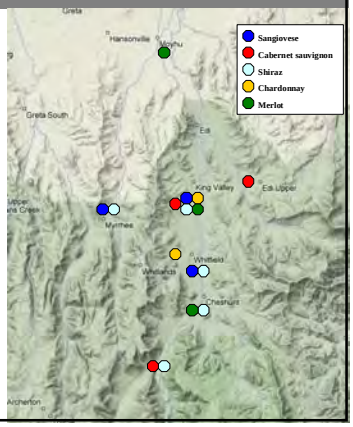
- Mean 7 ug/kg, CV 62%, optimum sample size 74 (15% doubt)
- Guaiacol concentrations decrease away from the fire front
- Potential for selective harvesting



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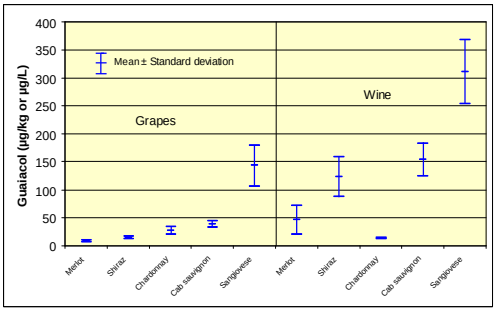
Grape samples for wine

- Harvested late Feb.– mid Mar.
- Approx. 20kg samples
- Frozen and processed by Provisor at Merbein



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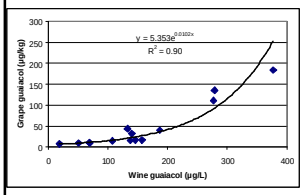
Varietal differences

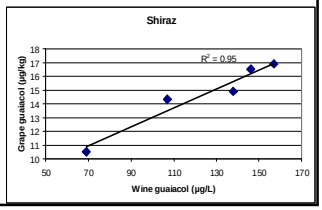


7

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Grape and wine guaiacol





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Varietal differences

	Guaiacol concn. wine:berry	Total guaiacol wine:berry @ 650L/t
Chardonnay	0.5	0.3
Sangiovese	2.2	1.4
Cab. Sauvignon	4.1	2.6
Merlot	5.2	3.4
Shiraz	8.3	5.4

9

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Wine scores

Wine smoke aroma			Wine smoke taste		
Wine	**Score**	**Difference**	**Wine**	**Score**	**Difference**
Sangiovese	5.8	a	Sangiovese	5.8	a
Cab. Sauvignon	5.2	a	Cab. Sauvignon	4.8	b
Shiraz	3.6	b	Shiraz	3.9	bc
Merlot	2.9	b	Merlot	3.1	c
Chardonnay	1.1	c	Chardonnay	1.9	d

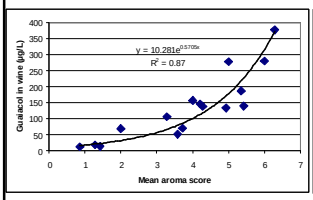
- Max. 7 points
- Lower the score, the less smoke character

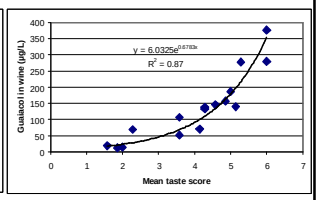


Descriptors: ash, drying, bitter, smoky, bacon, campfire, ashtray

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Detection thresholds





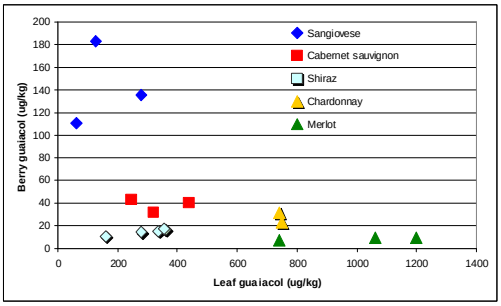
Apparent threshold aroma of 10.3 µg/L

Apparent threshold taste of 6.0 µg/L

Estimated thresholds in grapes of 5.7 µg/kg for taste and 5.9 µg/kg for aroma.

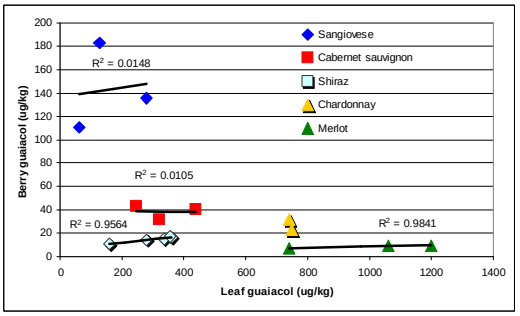
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Leaf and berry guaiacol



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Leaf and berry guaiacol





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Strategies to manage the impact of smoke taint in Australian vineyards

2008 Season Field Trials

AIMS

- To determine whether there is any carryover of smoke taint from 2007 season.
- To monitor the smoke produced from prescribed burns.
- To determine whether prescribed burn smoke from Victorian native vegetation causes smoke taint in grapes and wine.

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Good News Story

			2007 season harvest berry sample			2008 season pea sized berry sample		
Region	Locality	Variety	Sample date	4-MG ug/kg	Guaiacol ug/kg	Sample date	4-MG ug/kg	Guaiacol ug/kg
King Valley	Cheshunt South	Cabernet Sauvignon	14/03/2007	10.2	43.0	13/12/2007	nd	nd
King Valley	King Valley	Cabernet Sauvignon	19/03/2007	9.8	31.7	13/12/2007	nd	nd
King Valley	Edi Upper	Cabernet Sauvignon	19/03/2007	12.0	40.2	13/12/2007	nd	nd
King Valley	Whitfield	Chardonnay	1/03/2007	7.5	22.6	13/12/2007	nd	nd
King Valley	King Valley	Chardonnay	1/03/2007	10.2	31.7	13/12/2007	nd	nd
King Valley	Moyhu	Merlot	28/02/2007	1.9	6.9	13/12/2007	nd	nd
King Valley	King Valley	Merlot	28/02/2007	2.0	9.6	13/12/2007	nd	nd
King Valley	Cheshunt	Merlot	2/03/2007	3.2	9.1	13/12/2007	nd	nd
King Valley	King Valley	Sangiovese	7/03/2007	21.9	135.7	13/12/2007	nd	nd
King Valley	Myrrhee	Sangiovese	15/03/2007	20.3	110.5	13/12/2007	nd	nd
King Valley	Whitfield	Sangiovese	15/03/2007	28.7	183.0	13/12/2007	nd	nd
King Valley	Myrrhee 2	Shiraz	1/03/2007	1.3	10.5	13/12/2007	nd	nd
King Valley	Cheshunt	Shiraz	6/03/2007	2.0	14.3	13/12/2007	nd	nd
King Valley	King Valley	Shiraz	7/03/2007	2.2	16.5	13/12/2007	nd	1.0
King Valley	Cheshunt South	Shiraz	14/03/2007	1.9	14.9	13/12/2007	nd	nd
King Valley	Whitfield	Shiraz	15/03/2007	2.3	16.9	13/12/2007	nd	nd
nd = not detected								

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2008 season overview

- No significant bushfires were recorded in North East Victoria despite heatwaves in December, January and March
- Above average rainfall in November, December and January.
- Below average lightning strikes in December ï January period. Very few dry thunderstorms.
- Grape harvest was two ï three weeks earlier than normal.
- Prescribed burning was conducted throughout North East Fire Zone.

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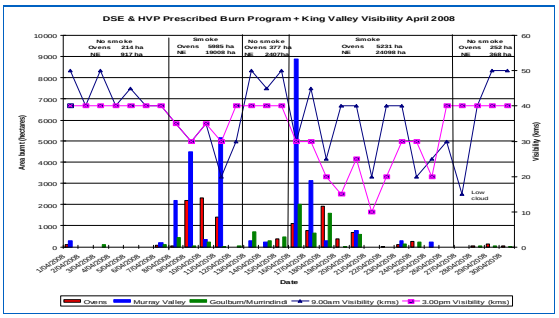
DSE 2008 Prescribed Burn Program Area Burnt (Hectares)

Ignition	Fire District				Fire Zone
Date	Ovens	Murray Valley	Goulburn	Murrindindi	North East Zone
September	120	0	0	23	143
October	0	0	33	69	102
November	0	0	0	5	5
March	0	0	30	0	30
April	11431	26856	3844	3617	45748
May	0	23	3	106	132
Totals	11551	26879	3910	3820	46160

Hancock Plantations Victoria 2008 Prescribed Burn Program Area Burnt (Hectares)

Ignition Date	Fire District				Fire Zone
	Ovens	Murray Valley	Goulburn	Murrindindi	North East Zone
September	0	0	0	0	0
October	0	0	0	0	0
November	0	0	0	0	0
March	145	0	36	0	181
April	628	0	421	0	1050
May	305	0	293	0	598
Totals	1078	0	750	0	1829

Smoke periods King Valley April 2008



BOM Edi Upper Weather Station

20th April 9.00am 3.00pm 5.30pm
21st April 9.00am 3.00pm 5.30pm



Wind Direction and Speed Surrounding Areas

	19th April 2008				20th April 2008				21st April 2008			
	9.00am		3.00pm		9.00am		3.00pm		9.00am		3.00pm	
Location	Wind Direction	Wind Speed (kmh)	Wind Direction	Wind Speed (kmh)	Wind Direction	Wind Speed (kmh)	Wind Direction	Wind Speed (kmh)	Wind Direction	Wind Speed (kmh)	Wind Direction	Wind Speed (kmh)
Edi Upper	Calm	0	N	4	E	4	W	9	NW	4	N	4
King Valley												
Hunters Hill	ENE	7	ESE	6	ESE	6	ENE	6	WNW	2	SE	4
Upper Murray												
(NE)												
Bairnsdale	ENE	11	E	35	NNE	6	ESE	22	NW	11	SE	13
Gippsland												
(SE)												
Shepparton	E	7	NE	9	ESE	7	SE	13	ESE	7	SSW	11
Goulburn Valley												
(NW)												
Kilmore	N	26	E	11	N	28	SSW	17	S	19	SSE	28
(SW)												

Prescribed Burn Impact on Grape and Wine Industries

King Valley & Alpine Valleys Wine Regions

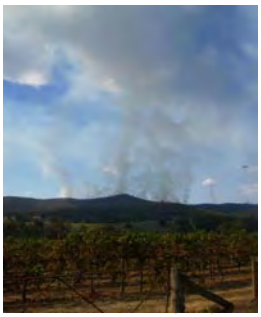
- Winemakers report no evidence of smoke taint in 2008 vintage wines.
- 90% of grapes harvested before prescribed burning commenced (only 6 vineyards with unharvested grapes).
- Hot weather in March delayed the start of burning (planned start date 15th March).
- Some burns were postponed until grapes were harvested.
- DSE communicated with Regional Assocaitions on a regular basis resulting in growers being fully aware of plannned burns location, ignition date and size.

King Valley Vignerons sampling

Region	Locality	Variety	Sample date	Sample type	4-MG ug/kg	Guaiacol ug/kg
Alpine Valleys	Myrtleford	Merlot	18-Apr	Grapes	nd	nd
Alpine Valleys	Myrtleford	Merlot	18-Apr	Leaves	22	62
Alpine Valleys	Myrtleford	Merlot	18-Apr	Canes	nd	nd
King Valley	Myrrhee	Sangiovese	22-Apr	Grapes	nd	nd
King Valley	Myrrhee	Sangiovese	22-Apr	Leaves	nd	nd
King Valley	Myrrhee	Sangiovese	22-Apr	Canes	nd	nd
King Valley	King Valley	Sangiovese	24-Apr	Grapes	nd	nd
King Valley	King Valley	Sangiovese	24-Apr	Leaves	nd	13
King Valley	King Valley	Sangiovese	24-Apr	Canes	nd	nd
nd = not dtected						

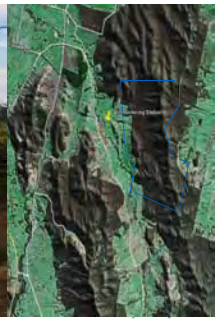
DPI King Valley Prescribed Burn Study

Location: Meadow Creek
DSE Burn name: Leviny
DSE Burn Number: W146
Area burnt: 528 ha
Ignition date: 10th April



EPA Victoira
Air Quality Monitoring Details





EPA Victoira
Air Quality Monitoring Details

Monitoring Start Date: Wed 9/04/08 (16:00)
Decommission Date: Tue 13/05/2008 (16:00)

Parameters measured

Particles:	Particulate Matter - PM10 in µg/m³
Gases:	Carbon Monoxide - CO in ppm
	Ozone - O3 in ppb
	Nitrogen oxides - NOx in ppb
Meteorology:	Wind speed and direction
	Dry bulb (ambient) temperature
	Visibility (as airborne particle index)
Time averages:	Data is provided as 1-hour averages

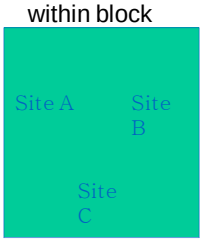
Leviny Vineyard 9.00am 12th April



Vineyard details

Variety: Cabernet Sauvignon
Clone: G9V3
Rootstock: Schwarzmann
Trellis: Smart Dyson
Block size: 4.0 ha

Sample sites within block





Field sampling

- Grape, cane and leaf samples were taken from each sample site on:
  - 27th March ï rest of block harvest date
  - 8th April ï prior to prescribed burn
  - 17th April - + 1 week after ignition
  - 25th April - + 2 weeks after ignition
  - 2nd May - + 3 weeks after ignition

Small lot winemaking

- 20kg grape samples were taken from each sample site on:
  - 27th March - prior to prescribed burn
  - 2nd May - post prescribed burn
- Samples were frozen before dispatching by overnight courier to Provisor Merbein for small lot winemaking.

Acknowledgements

Australian Wine Research Institute (AWRI) - Con Simos & Randell Taylor for grape and wine analysis
Provisor Merbein ï Peter Rogers & his team for small lot winemaking
Dept. Of Sustainability & Environment (DSE) ï Liam Fogarty & his team and Shaun Lawlor for providing DSE prescribed burn data
Hancock Plantations Victoria (HVP) ï Ron Harper for providing HVP prescribed burn data
Emvironmental Protection Authority, Victoria (EPA) ï Lyn Dennison, Dave Gooding and Dietmar Dinges for their valuable assistance and providing EPA data
King and Alpine Valleys grapegrowers / winemakers, especially John Leviny for volunteering his vineyard (and grapes) for the prescribed burn study



The Way Forward

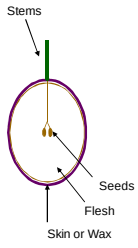
Dr. Mark Downey
Department of Primary Industries, Victoria
mark.downey@dpi.vic.gov.au

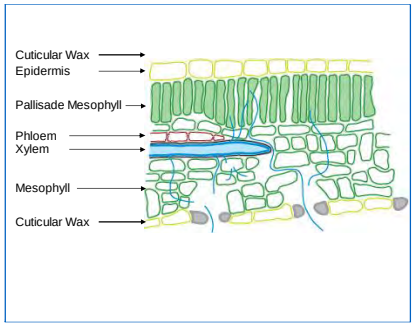
Knowledge Gaps

- localisation
- mode of entry
- translocation
- timing sensitivity
- intensity & duration
- varietal sensitivity
- possible prevention

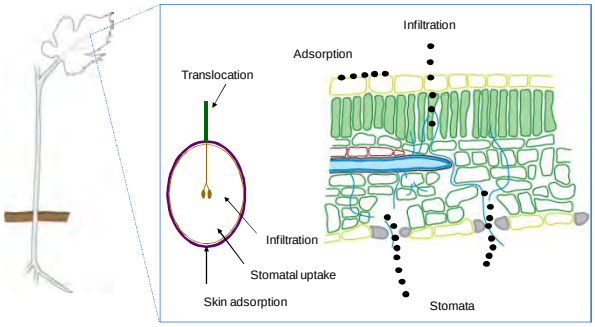


Localisation





Mode of Entry



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Translocation

Can smoke taint compounds move?

- e.g. from leaf to fruit
- from the roots

- previous work in cut shoots
- direct uptake

- *in vivo* ?



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Timing Sensitivity

Critical Periods & Windows of Opportunity

- when is it safe to burn?
- when are berries most sensitive?
- WA research suggests post-veraison
- can we confirm this?
- current CA experience



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Intensity & Duration

Quantification of Smoke Levels

- continuation of EPA data collection
- smoke levels and composition
- CSIRO Marine & Atmospheric
  - monitor levels of individual compounds
  - correlate composition with smoke taint compounds
  - changes in smoke composition over time
  - fuel relationship to smoke composition

Australian Government
Grape and Wine Research and Development Corporation

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Varietal Sensitivity

Tolerant vs. Sensitive

- can some cultivars exclude smoke?
- can some cultivars sequester smoke?
- differences in wax structure
- or are difference related to intensity & duration



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Prevention

é rather than cure

- windows of opportunity for burning
- effective industry dialogue with land and fire managers
- possible barrier strategies to exclude smoke taint compounds



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Collaborators

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DEPARTMENT OF SUSTAINABILITY AND ENVIRONMENT
FARM SERVICES VICTORIA

Australian Government
Grape and Wine Research and Development Corporation

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AUSTRALIA

King Valley Vignerons

E.&J. Gallo Winery

The Australian Wine Research Institute

bushfire CRC

New Approaches to Smoke Taint Analysis

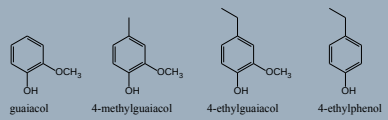


Dr Kerry Wilkinson
The University of Adelaide

Life Impact The University of Adelaide

Assessment of Smoke Taint

Smoke taint currently assessed by: 1) sensory evaluation of juice and wine
2) quantification of guaiacol by GC-MS



guaiacol 4-methylguaiacol 4-ethylguaiacol 4-ethylphenol

Volatile phenols identified in wine made from grapes exposed to smoke post-harvest[1]

Guaiacol and 4-methylguaiacol routinely identified in oak-aged wines
guaiacol: 10 to 100 μg/L 4-methylguaiacol: 1 to 20 μg/L

4-Ethylguaiacol and 4-ethylphenol associated with *Brettanomyces*/*Dekkera* spoilage

[1]Kennison et al., *J. Agric. Food Chem.* **2007**, *55*, 10897-10901

Assessment of Smoke Taint: Issues

Volatile phenols are useful indicator compounds, but not solely responsible for smoke taint
Identity of other volatile smoke components contributing to taint remains unknown

Smoke volatiles may accumulate in grapes as non-volatile, sensorially inactive conjugates
Therefore, cannot be detected by either sensory or GC-MS analysis

GC-MS analysis can be time-consuming (especially during high demand)
Results not always available in a time-frame that facilitates decision-making at vintage

In 2008, two PhD projects established at University of Adelaide to address these issues:
1) The analysis of smoke derived volatile compounds in wine (Anthea Fudge)
2) Accumulation of smoke derived volatile compounds in grapes (Kerry Dungey)

Analysis of smoke derived volatile compounds

Project Aims:

1) Identify other volatile compounds responsible for smoke taint
Develop new GC-MS based analytical methods for their quantification

Direct approach: Candidates identified from scientific literature
Indirect approach: Candidates identified by GC-olfactometry analysis

2) Evaluate UV/Vis/NIR/MIR spectroscopy as a rapid analytical technique

Source commercial wines exhibiting smoke taint (and control wines)
Analyse wines by: UV/Vis/NIR/MIR spectroscopy
GC-MS and sensory analysis
Correlate spectral, chemical and sensory data using multivariate analysis

Accumulation of smoke derived volatile phenols

Anecdotal evidence from industry that smoke taint intensifies during winemaking
Evolution of volatile phenols during fermentation investigated[2]

During fermentation of unsmoked (control) grapes:
only trace levels (< 5 μg/L) volatile phenols detected

	concentration (μg/L)			
	guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
free run juice	n.d.	n.d.	n.d.	n.d.
after alcoholic fermentation	1	tr.	n.d.	n.d.
after malo-lactic fermentation	4	n.d.	tr.	tr.

[2]Kennison et al., *J. Agric. Food Chem.* **2008** (in press)

Accumulation of smoke derived volatile phenols

During fermentation of smoked grapes:
progressive release of volatile phenols observed

	concentration (μg/L)			
	guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
free run juice	1	tr.	n.d.	n.d.
after 1 day maceration	68	11	10	5
after 3 days maceration	168	26	8	5
after 5 days maceration	203	32	9	15
after 7 days maceration	249	42	9	17
after alcoholic fermentation	249	43	8	23
after malo-lactic fermentation	388	93	16	58

Accumulation of smoke derived volatile phenols

Release during primary fermentation could be attributed to extraction from skins
Except, phenol levels increased during malo-lactic fermentation (i.e. after pressing)

Results suggests: 1) the presence of precursor forms of volatile phenols in grapes
2) and conjugation of volatile smoke components

Hydrolytic release of volatile phenols investigated[2]

mild acid hydrolysis: juice pH at 100°C for 1 hour
strong acid hydrolysis: pH 1.0 at 100°C for 1 hour
enzyme hydrolysis: β-glucosidase at 30°C for 24 hours

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[2]Kennison et al., *J. Agric. Food Chem.* **2008** (in press)

Accumulation of smoke derived volatile phenols

Phenols released from smoke affected juice under strong acid and enzyme hydrolysis

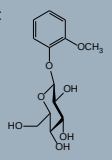
		concentration (μg/L)			
		guaiacol	4-methyl guaiacol	4-ethyl guaiacol	4-ethyl phenol
control	free run juice	n.d.	n.d.	n.d.	n.d.
	mild acid hydrolysate	tr.	tr.	tr.	tr.
	strong acid hydrolysate	tr.	tr.	tr.	tr.
	enzyme hydrolysate	tr.	tr.	tr.	tr.
smoked	free run juice	1	tr.	n.d.	n.d.
	mild acid hydrolysate	tr.	tr.	tr.	tr.
	strong acid hydrolysate	431	162	31	48
	enzyme hydrolysate	325	82	13	27

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Accumulation of smoke derived volatile phenols

Hydrolytic release of phenols further supports presence of precursors
Enzymatic release suggests precursors of a glycoconjugate nature

For example, β-D-glucopyranosides:



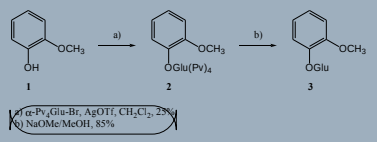
Many flavour compounds known to occur in glycoside form:
monoterpenoids and nor-isoprenoids in grapes
oak lactones in oak wood

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Accumulation of smoke derived volatile phenols

Project Aims:
1) Investigate provenance of glycoconjugate precursors of guaiacol

β-D-Glucopyranoside of guaiacol synthesised

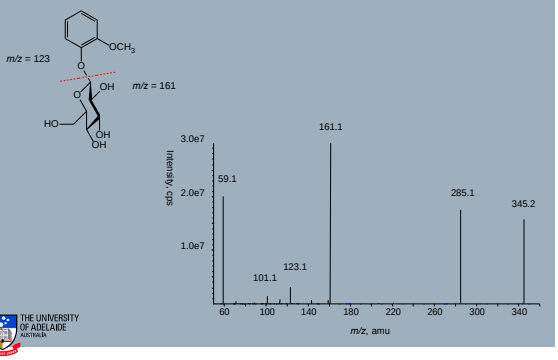


Guaiacol glucoside characterised by liquid chromatography-tandem mass spectrometry

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Characterisation of guaiacol glucoside

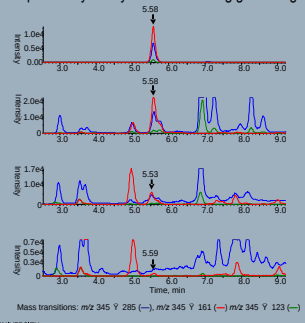
Fragmentation of guaiacol glucoside = chemical fingerprint



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Provenance of Guaiacol Glucoside

Juice samples analysed by LC-MS/MS using guaiacol glucoside as reference compound:

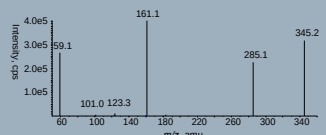


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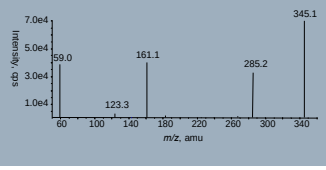
Provenance of Guaiacol Glucoside

Fragmentation pattern of juice components matches that of the reference compound

juice of Sangiovese grapes exposed to bushfire smoke



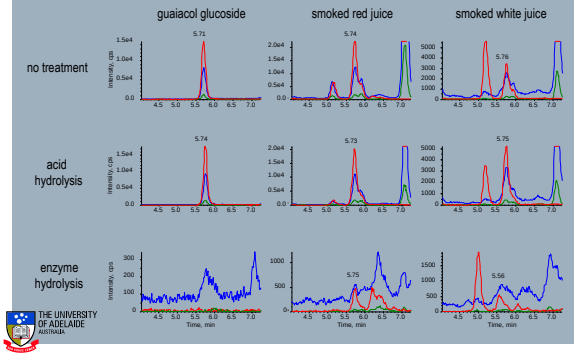
juice of Chardonnay grapes experimentally exposed to smoke



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Hydrolytic Behaviour of Guaiacol Glucoside

Glucoside and juice samples hydrolysed with strong acid or β-glucosidase enzyme



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Implications?

Provenance of β-D-glucopyranoside precursor in smoke affected grapes confirmed

Glucoside released guaiacol under enzymatic conditions
But glucoside survived strong acid hydrolysis conditions

Suggests multiple precursors…
- Guaiacol released in earlier hydrolytic experiments not glucoside derived

Sample preparation for assessment of smoke taint is crucial…
- Recommend enzyme hydrolysis of juice samples prior to analysis
- Strong acid conditions may not hydrolyse glucoside precursors
- But may catalyse phenol degradative side reactions

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Future Directions

Synthesis of glucoside derivatives of other smoke derived volatile phenols

Synthesis of isotopically labelled phenol glucosides (internal standard)
Development of a quantitative LC-MS/MS method
Monitor phenol and glucoside levels in grapevines to investigate glycosylation process

Isolation and identification of other precursors compounds

Investigate precursor degradation under alcoholic and malo-lactic fermentation conditions

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Acknowledgements

FERMENTATION EXPERIMENTS
Kristen Kennison (DAFWA, Curtin)
Assoc Prof Mark Gibberd (Curtin)

LC-MS/MS and GC-MS ANALYSIS
Dr Yoji Hayasaka, Dr Alan Pollnitz, Gayle Baldock (AWRI)

GUAIACOL GLUCOSIDE SYNTHESIS and HYDROLYSIS
Kerry Dungey (UA)

FUNDING
Grape and Wine Research and Development Corporation

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Project B2.2 - Smoke composition and impact on human health and ecosystems

Tina Bell, Simin Maleknia, Mark Adams

SFES, University of Melbourne
BEES, University on New South Wales

Aim of project

Developing a better understanding for land managers of the composition of smoke (identification and quantification) produced by prescribed fires and wildfires in relation to human health and environmental effects

Research questions

1. What are the major components of smoke produced (i) under laboratory conditions, (ii) during prescribed burning and (iii) during wildfires? In what quantities are these components produced? How do fuel type and condition and burning conditions affect composition of smoke?
2. Are there key indicator components of smoke from vegetation fires in Australia? How can certain components of smoke be used to predict emissions and improve forecasting models?
3. What contribution does prescribed burning and wildfires make to greenhouse gases in the atmosphere?

Smoke-related projects in the Bushfire CRC

1. B2.1 Behaviour of smoke plumes and hazes from rural or urban fires
   Graham Mills, Bureau of Meteorology
2. B2.2 Smoke composition and impact on human health and ecosystems
   Tina Bell, University of Melbourne
3. D2.2 Air toxics exposure and management
   Mick Myer, CSIRO Marine and Atmospheric Research
4. D4 Respiratory health of firefighters
   Phil Weinstein, University of Western Australia

http://www.bushfirecrc.com/research/

Composition of bushfire smoke

- Particulate matter
- Gases
  CO, CO_2, CH_4, NO_X, NH_3
- Volatile organic compounds (VOCs)
- Polycyclic aromatic hydrocarbons (PAHs)
- Water vapour



www.dse.vic.gov.au

'Smoke' review

Bell and Adams (2008) - in press

1. A clear need to focus on the role of volatile organic compounds (VOCs) in smoke - potential as markers and associated health risks
2. Forests and plantations in Australia dominated by *Eucalyptus* and *Acacia*
3. No specific facility available for generation and analysis of combustion products at the scale and accuracy needed for this and other projects on native plants

Volatile Organic Compounds (VOCs)

1. wide variety of organic compounds
   (e.g. benzene, naphthalene, toluene, methanol, formaldehyde, formic acid, acetic acid)
2. non-methane hydrocarbons
3. low molecular weight and boiling point
   many partitioned between gaseous and liquid or solid phase
4. produced abundantly from partial oxidation of fuels containing cellulose and lignin
5. little characterisation work has been done
   (Ward, WHO, 1999)

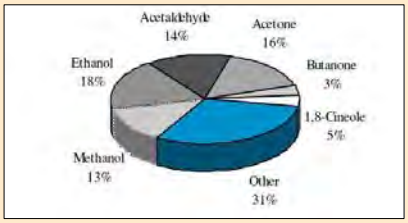


For example, the Blue Mountains in New South Wales are blue due to continual VOC emissions

Some plants can allocate up to 10% of their carbon to the production of volatile secondary metabolites



VOCs from cut pasture



Kirstine *et al.* (1998) Emissions of volatile organic compounds (primarily oxygenated species) from pasture. *J Geophys Res* 103, 10605-10620

Health effects

1. Several VOCs are major pollutants in smoke from biomass burning
   e.g. benzene, acrolein, formaldehyde
2. Many VOCs are strong irritants, others may be carcinogenic
   benzo(a)pyrene, benzo(e)pyrene, formic acid, acetic acid
3. Certain VOCs may act as markers for fire-related exposure but better characterisation is still needed (Mannino, WHO, 1999)

Epidemiological studies of bushfire smoke in Australia

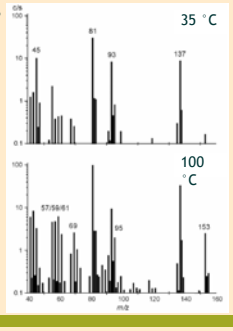
Study	Location	Findings
Smith *et al.* 1996	Sydney	No increase in hospital visits for asthma
Jalaludin *et al.* 2000	Sydney	No reduction in lung function in a cohort of asthmatic children
Johnston *et al.* 2002	Darwin	Increased hospital visits for asthma
Chen *et al.* 2006	Brisbane	Significant increased risk of hospital admissions
Johnston *et al.* 2006	Darwin	Elevated PM_{10} associated with onset of asthma and increased medication use
Lee *et al.* 2006*	Perth	Number of fires not significant for predicting asthma hospitalisations, vegetation/fuel type may be important
Tham *et al.* 2008*	Melbourne and Gippsland	Emergency department attendances strongly associated with PM_{10} emissions from Alpine fires in 2003 but hospital admissions only weakly associated

Analytical techniques

1. Proton-transfer reaction mass spectrometry (PTR-MS)
2. Gas chromatography mass spectrometry (GC-MS)
1. Mass-Loss Calorimeter for complete combustion of fuels
2. CO and CO_2 analysers for measurement of greenhouse gases

Effect of low temperatures on VOCs emitted from eucalyptus leaves

acetaldehyde (45)
acetic acid (61, 43)
isoprene, furan (69)
terpenes $C_{10}H_{16}$ (137, 81)
$C_{10}H_{16}O$ (153, 137, 81)



Maleknia *et al.* (2007) PTR-MS analysis of reference and plant-emitted volatile organic compounds. *Int J Mass Spectrometry* 262, 203-210

Temperature-dependent emissions of VOCs

Maleknia *et al.* (2008) - submitted

Group (1) Reactive organic compounds - acids, aldehydes, alcohols, ketones

Group (2) Plant-specific isoprenoids - isoprene (C_5H_8), monoterpenes ($C_{10}H_{16}$), sesquiterpenes ($C_{15}H_{24}$)

Group (3) Plant-specific polymers - cellulose and lignin

Group (1) and (2) compounds are emitted continuously by plants and have relatively low boiling points (60-200 °C)

Group (3) compounds release a range of compounds on pyrolysis (>250-300 °C)

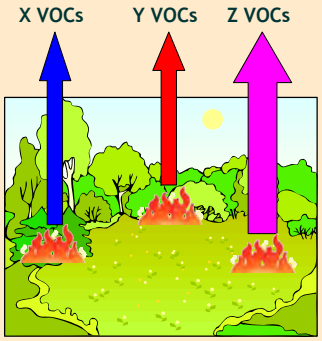
Current studies

1. Series of combustion analyses using a '4 × 4 sample matrix'
2. Two fuel types (a mix of leaves and branches)
3. Two fuel moistures (air dry at 25 °C and oven dry at 70 °C)
4. Four combustion conditions:
   60-80 °C for 'distillation' of VOCs
   <300 °C for pyrolysis before production of smoke
   450-500 °C for onset of smoke production
   600-650 °C for pyrolysis with rapid production of smoke

Species - End User driven

- NSW - *E. tereticornis* (Forest Red Gum), *E. sieberi* (Silvertop Ash)
- Victoria - *E. obliqua* (Messmate), *E. dives* (Broad-leaved Peppermint), *E. rubida* (Candlebark)
- WA - *E. marginata* (Jarrah)
- SA - *E. baxteri* (Stringybark)
- Queensland - *Eucalyptus pilularis* (Blackbutt)
- Tasmania - *E. amygdalina* (Black Peppermint)
- ACT - *E. macrorhyncha* (Red Stringybark), *E. rossii* (Scribbly Gum)

Modelling emissions



BUILDING RELATIONSHIPS IN WESTERN AUSTRALIA

Presentation at the GWRDC Smoke Effects Technical Workshop

Melbourne, 29th July 2008

Drew Haswell, Department of Environment and Conservation WA
Glynn Ward, Department of Agriculture and Food WA

OUTLINE OF PRESENTATION

- Smoke taint history (Drew Haswell)
- Strategic planning (Glynn Ward)
- Risk Management (Drew Haswell)

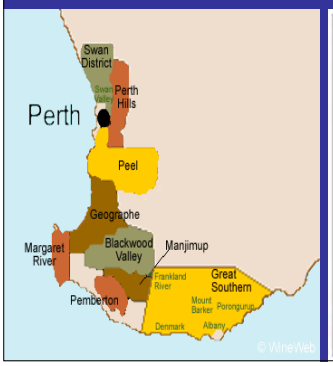
HISTORICAL CONTEXT

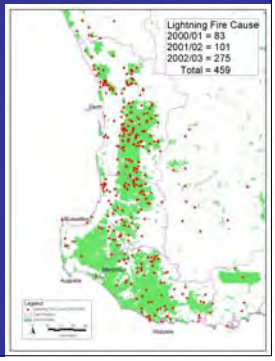
- First became aware in 2003/04
- Collaboration with DAFWA and Curtin UT
- Involvement with smoke taint research
- Two forums conducted
- Links with State and regional associations
- Established Smoke Effect Working Group
- Joint media protocols

OUTCOMES FOR INDUSTRY AND LAND MANAGERS

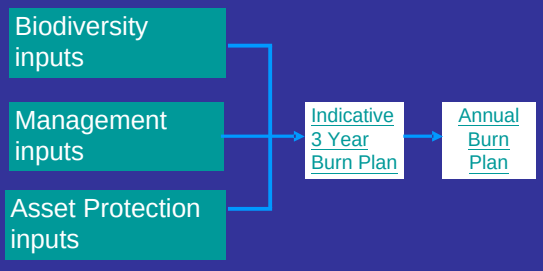
- Stakeholders
  - Wine industry
  - DEC
  - Researchers
- Shared goal
  - Decision support tools for industry and land managers
- Better outcomes
  - Minimise impact of smoke on grapes and wine

IMPROVE ALIGNMENT FOR BURNS AND WINE GRAPES





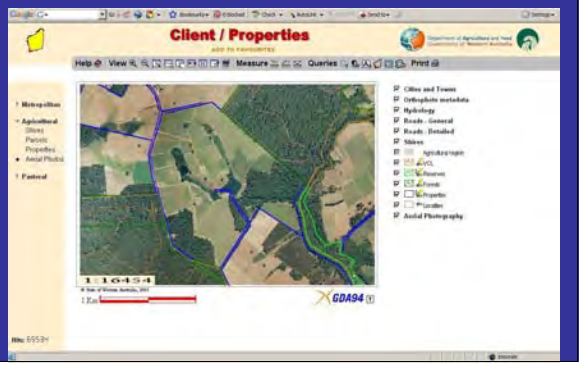
MASTER BURN PLANNING



VINEYARD MAPPING AND ATTRIBUTED DATA

- Vineyard locations, size and boundaries
- Property and contact details
- Grape varieties
- Phenological data
- Predictive seasonal harvest and phenological events

CLIENT AND RESOURCE INFORMATION SYSTEM (CRIS)





INDIVIDUAL VINEYARD DETAILS

NEXT STEPS

- Link vineyard mapping information (CRIS) with prescribed burn plans (DEC)
- Improve alignment of predictive systems for grape phenology and harvest with plans for prescribed burns
- Evaluate alignment of wine grape modelling with Soil Dryness Index
- Updating vineyard information

RISK MANAGEMENT

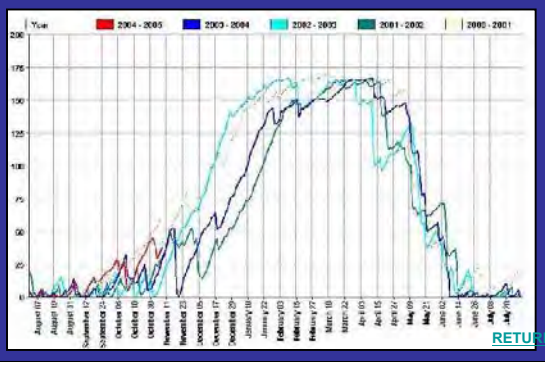
- Burn decision protocols
- Predictive approaches
- Consultation

KEY STRATEGIES

- Developing a vineyard registry and completing the ñvineyard mapping projectò.
- Improving the alignment of strategic planning systems used for grape production and for planning prescribed burns.
- Developing risk based approaches to minimise clashes between prescribed burning and grape harvesting.
- Supporting ongoing research into the effect of smoke on grapevines and wine.

RETURN

SOIL DRYNESS INDEX



RETURN

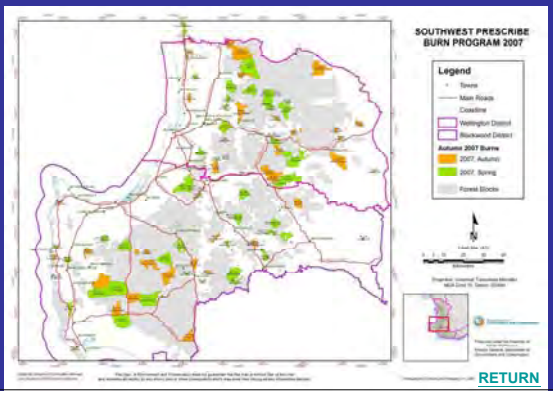
SIX-SEASON INDICATIVE BURN PLAN



- PINK: Biodiversity
- PURPLE: Community and strategic protection
- BLUE: Forest regeneration
- RED: Visitor and tourism protection

RETURN

ANNUAL BURN PLAN



RETURN

CONSULTATION

- Community consultative meetings
- One-on-one meetings
- Notices of Intention to Burn
- Operations Lists
- Day of burn liaison

SUMMARY

Formalise relationship

Smoke Effect Working Group

Communication and consultative process

Improve contacts, content and flow of information

Develop information

Smoke effects, data base, predictive models for grapes and prescribed burns

Link information and strategic plans

Highlight risks, enhance communication and decision making

ACKNOWLEDGEMENTS

Wine Industry Association WA

Regional Wine Associations

Smoke Effect Working Group

Curtin University of Technology

Department of Environment and Conservation

Department of Agriculture and Food



DSE
Fire Management

Agenda

- The Fire Protection Plan
- Prescribed burning
- Fire Management Zones
- The Fire Operations Plan
- Questions and discussion

Shaun Lawlor,
Senior Fire Management Officer,
DSE Ovens.

Fire Management on public land

The Department of Sustainability and Environment (DSE) is responsible for the management of fire on public land within Victoria.

Fire Management on public land

What is public land?

National Park

State Forest

State Park

Protected public land

The Fire Protection Plan

Section 62 (2) of the Forests Act (1958)

- Ensure proper and sufficient works for the prevention and suppression of fire in every State Forest and national park and on all protected public land in Victoria é

Fire Management Plans will be developed as outlined in the revised Code of Practice for Fire Management on Public Land (2006)



The Fire Protection Plan

Outlines four main strategies:

- Prevention (Education/enforcement)
- Suppression (Firefighting)
- Preparedness (Prescribed burning)
- Recovery (Rehabilitation)

Suppression

Controlling bushfires



Northeast fires 2006



Preparedness

Prescribed Burning



Use of fire in land management

Prescribed burning:

ñThe use of fire to achieve planned Land Management Objectives and Burn Operation Objectives ò

Generally 3 categories in Victoria:

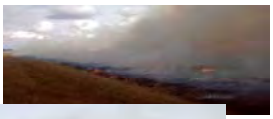
- Fuel management
- Ecological/biodiversity management
- Silvicultural management

Fuel reduction burning



Ecological burning







Silvicultural burning



Consequences



FRB smoke in Marysville

Consequences

Fuel reduction burning can be hazardous.
A set of very specific prescriptions must be met in order for a burn to be both effective and safe.

Prescriptions relating to weather and fuel moisture mean DSE must make the most of EVERY opportunity to carry out safe and effective burns.

Outside of these prescriptions, fuel reduction burning can pose a serious risk to:

- Firefighter safety and;
- Assets (due to the risk of escape)

However, not completing scheduled fuel reduction works may also pose a potential risk to lives and assets in the event of a wildfire.



Fire Management Zones

The revised ñCode of Practice For Fire Management on Public Landò(2006) defines public land into 4 Fire Management Zones.

Zones are determined in conjunction with park and forest managers and the public following consideration of various factors (ie proximity to assets, ecological values etc.)

The extent and frequency of any burning program is based on the priorities set by the zones and fuel hazard triggers.

Zone 1

Asset Protection Zone

- To provide the highest level of strategic protection to human life, property and highly valued assets
- Fuel management will be intensive
- Fuel management will take precedence, however measures taken to maximise the protection of ecological and cultural values.
- Will represent a small portion of public land.

Zone 1

Asset Protection Zone

Typically abuts or surrounds areas where there is a bushfire threat to human life and property





Zone 2

Strategic Wildfire Moderation Zone.

- Be of sufficient width and continuity to provide a substantial barrier to the spread of wildfire.
- Fuel characteristics will be maintained at a nominated range, within defined limits.
- Ecological outcomes to be maximised, provided fire protection objectives can be met.
- The treatment of fuels within this Zone may assist the Asset Protection Zone

In Zones 1 and 2, methods other than fuel reduction burning may be used to reduce fuel hazards



Brushcutting



Grooming/slashing

Zone 3

Ecological Management Zone.

- Prescribed burning for specific land management objectives, including:
- ecologically appropriate fire regimes
- management of areas and values including forest regeneration and protection of water catchments at a landscape scale.
- fire ecology strategies will determine prescribed burning frequency, intensity, seasonality and patchiness.

Zone 3

Ecological Management Zone.



Zone 4

Prescribed Burning Exclusion Zone.

- Exclusion of prescribed burning for the period of the Fire Protection Plan/Fire Management Plan.
- High potential for economic, ecological or cultural loss from prescribed burning.
- Additional prescribed burning undertaken in nearby areas to reduce the probability of damage by wildfire.

Zone 4

Prescribed Burning Exclusion Zone.



Fuel Hazard Assessment

Fuel hazards are identified as:

- Surface fine fuels
- Bark hazard
- Elevated fuel

Overall Fuel Hazard= (the sum of the influence of) Bark Hazard + Elevated Fuel Hazard + Surface Fine Fuel Hazard.

Fuel hazard - SURFACE



Moderate Surface Fine Fuel



Extreme Surface Fine Fuel

Fuel hazard - BARK



Moderate Bark Hazard



Extreme Bark Hazard

Fuel hazard - ELEVATED



Moderate elevated fuel



Extreme elevated fuel

The Fire Operations Plan (FOP) - What is it?

It is a rolling 3 year plan of fire prevention and preparedness works.

It is reviewed and updated annually and details:

- The timing and location of proposed prescribed burns and track works for the following 3 years.
- New prevention & preparedness programs planned for the next 3 years.

FOP Process and Timetable

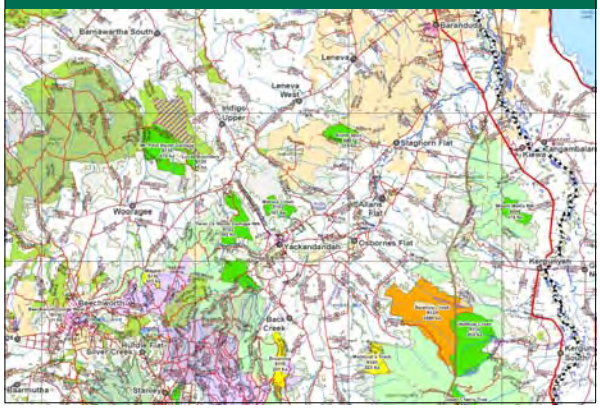
Burn nominations by Land Managers	April to July
Consultation with AAV and DSE	July to August
Community consultation	August
FOP amendments	August to Sept
FOP finalisation	October

FOP Targets

- Statewide 130,000 hectares
- ENRC recommendations are for an increase to 385,000 hectares, including landscape scale burns.

FOP Format

FINANCIAL YEAR	BURN NUMBER	BURN TYPE	BURN STATUS	FMZ	LOCATION DESCRIPTION	Ha	GRID REFERENCE
2011	S146	FUEL REDUCTION	PROPOSED	3	800m E of BARNAWARTHA	131	DA724043
2010	T122	FUEL REDUCTION	PROPOSED	2	1.8KM ENE of MT BEAUTY	967	EV200350
2011	T124	FUEL REDUCTION	PROPOSED	2	500m S of MT BEAUTY	970	EV145313
2010	W153	FUEL REDUCTION	PROPOSED	3	1Km N of ROSEWHITE	1896	DV875545
2011	W158	FUEL REDUCTION	PROPOSED	3	1km N of Kancoona	2146	EV015565
2010	S134	FUEL REDUCTION	PROPOSED	3	7.5KM NE of Eldorado	76	DV610885
2011	S141	FUEL REDUCTION	PROPOSED	3	9km N of Yackandandah	157	DV854866
2010	S135	FUEL REDUCTION	PROPOSED	2	2KM W of TWIST CREEK	69	DV790807



The Fire Operations Plan

After wide internal review and the public consultation process, the types of changes generally made to the Fire Operations Plan are:

- Boundary change
- Season change
- Prescription change
- Consideration of additional burns/works

Any comment received will be responded to by appropriate Fire Management personnel.

Questions and discussion

- What do you think about the current process?
- What do you expect?
- How would you like to contribute/
  comment on the FOPs?



DEPARTMENT OF
SUSTAINABILITY AND ENVIRONMENT

Contact information

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www.dse.vic.gov.au/fires

What we know

- Smoke taint/effect carryover from one season to another is not a problem.
- Guaiacol indicator compound involved – but not necessarily responsible for smoke taint (it is also found in oaked wine products).
- Safe to burn after grape harvest (the date varies depending on growing region and grape variety).
- Taint compounds durable in wine (that is compounds only get worse with age of wine).
- Guaiacol and 4-methylguaiacol increases during fermentation as it is extracted into solution.
- Problems in current guaiacol and 4-methylguaiacol analytical methods (some grape samples can come back with not detected levels of indicator compounds, but still show taint in wine).

- Highly variable between varieties (some grape varieties more sensitive than others).
- Cumulative affect of smoke (increased smoke exposure = increased risk of being affected).
- Smoke affects grape vine physiology (i.e. yield and photosynthesis).
- Peak in sensitivity at 7 days post-veraison from WA research trials.
- The are burning plans in both WA and Vic.
- Wildfire and smoke and vineyard = loss (grapes, wine and $)
- Wines from white grapes is less affected than wine from red grapes (this is due to skin contact during fermentation in red winemaking)
- Hand harvesting better than machine harvesting in regards to expression of taint compounds in wine.
- Positive relationships between wine industry and DSE/DEC = good outcomes for all.
- Reverse osmosis does work – more from a filtration perspective, but we don't know all the taint compounds.

What we don't know	**Current work**	**Current funding priority**
•Impact of carbon offset plantings (plantations)	None	?
•Mode of smoke entry into vine and fruit	AWRI, Vic DPI	N
•Sensitivity and timing of vines to smoke exposure	Vic DPI, KK	N
•Burning plan in SA and NSW	None	?
• Effect of distance, composition, concentration and duration and entry into the vine (models)	DAFWA, Vic DPI, CSIRO	Y-Maybe Still Gaps (1)
•Fire source (fuel types), smoke composition and affect on vines	Vic DPI, TB	N
•Impact of prescribed burns on smoke taint – lower intensity fires (discussions with DSE)	JB-G	N
•Localisation of "smoke" taint compounds in grape berries	Vic DPI, AWRI	N
•Pre-cursor and conjugates in grapes (what are they?)	KW, AWRI	N
•Ground truthing model systems to real world – related to distance, composition, concentration etc	SL	N –at present

issue above		
•What are the smoke taint compounds?	KW (PhD students)	N
•Quick, reliable and accurate methods for analysis this includes a rethink about sample extraction.	None	Y (2)
•Model to predict vine phenological (stage of development) events to aid prescribed burning	Some prior work with VineLogic	Y (3)
•Early detection systems/risk analysis	None	Y (3)
•Isotope ratios of where fire comes from	None	N – needs more thought
•Viticultural and winemaking treatments to protect &/or ameliorate	Vic DPI, KW, LC, AWRI	N
•Varietal variation and sensitivity •Yeast influence on expression (MLF?)	MD, David Kelly(WA)	N
•Grower databases (WA&Vic)	None	Y (3)
•Publications	Occurring – but lagging	X