

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

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Mark Solomon

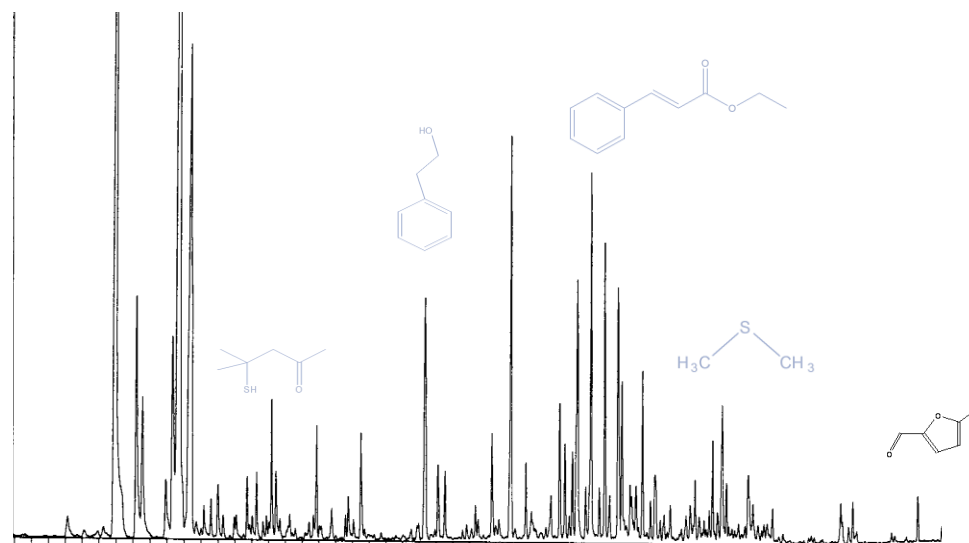
Gerard Logan (University of Auckland)



# Gas chromatography-mass spectrometry



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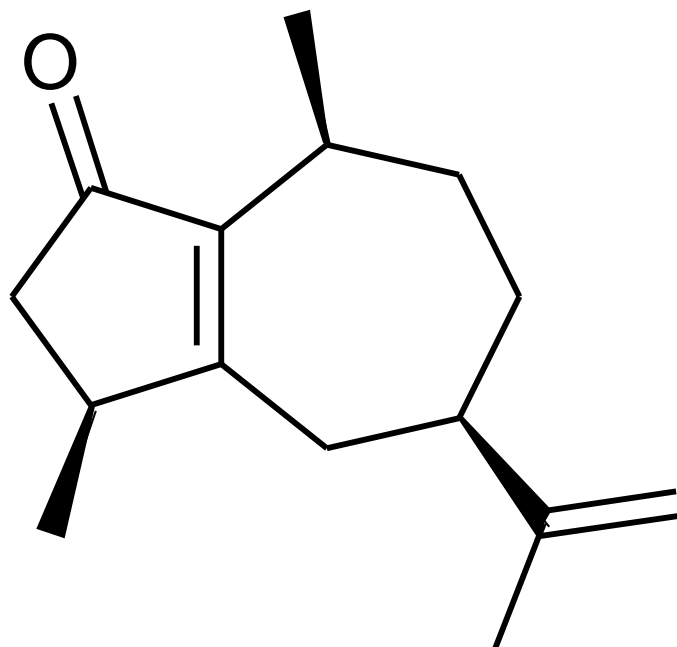




# (-)-Rotundone



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- Identity confirmed with reference compound (Symrise)  
*Cyperus rotundus*, nut grass weed
- $^1\text{H}$  and  $^{13}\text{C}$  NMR, ORD
- GC-MS-O. co-injections
- Qualitative DA



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

# How potent is rotundone?



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aroma detection threshold



8 ng/L in water



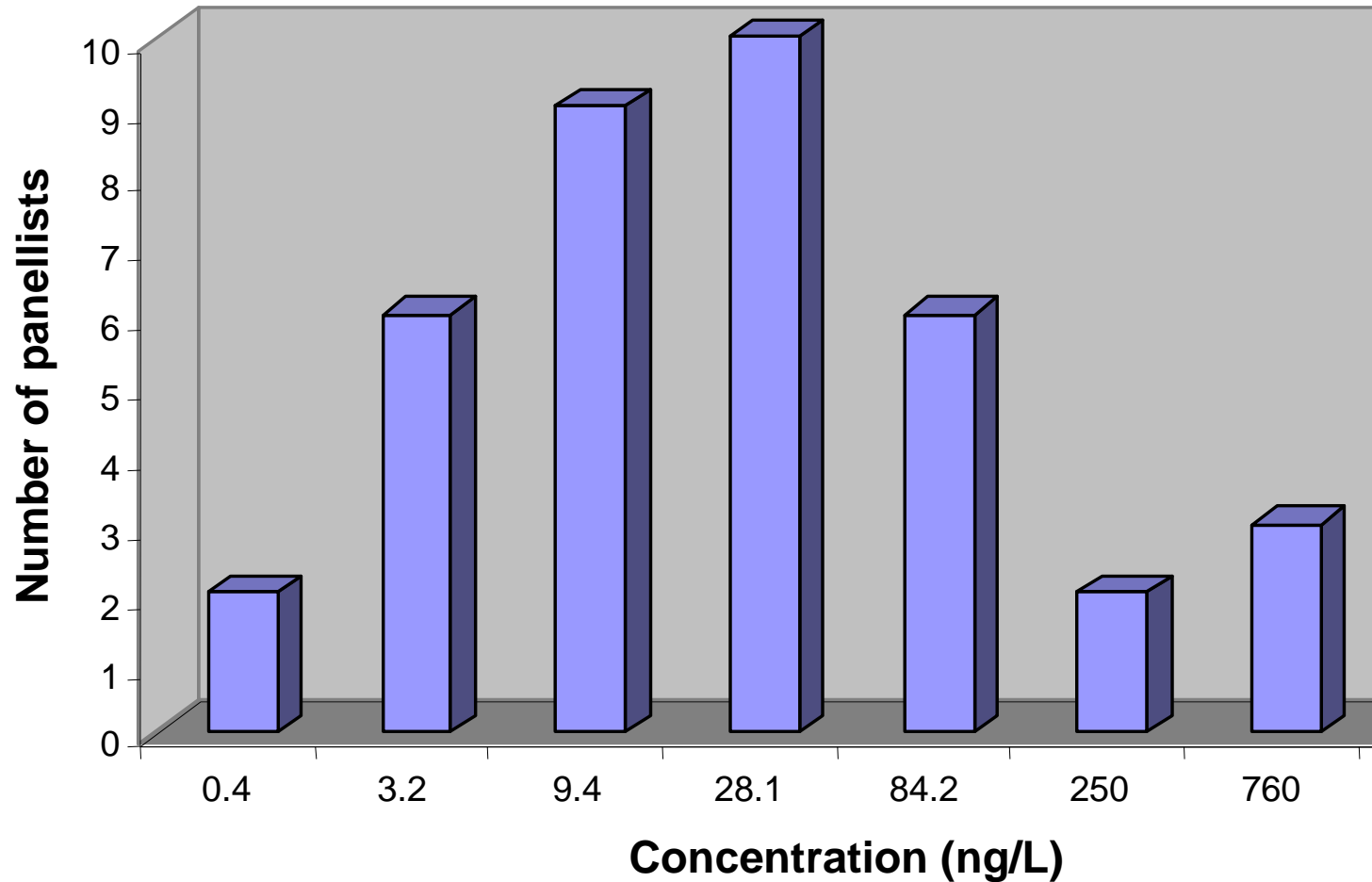
16 ng/L in red wine

*20 to 25% of the panellists were anosmic to rotundone*

Aroma detection threshold of the black pepper compound Rotundone, in red wine, is 16 ng/L



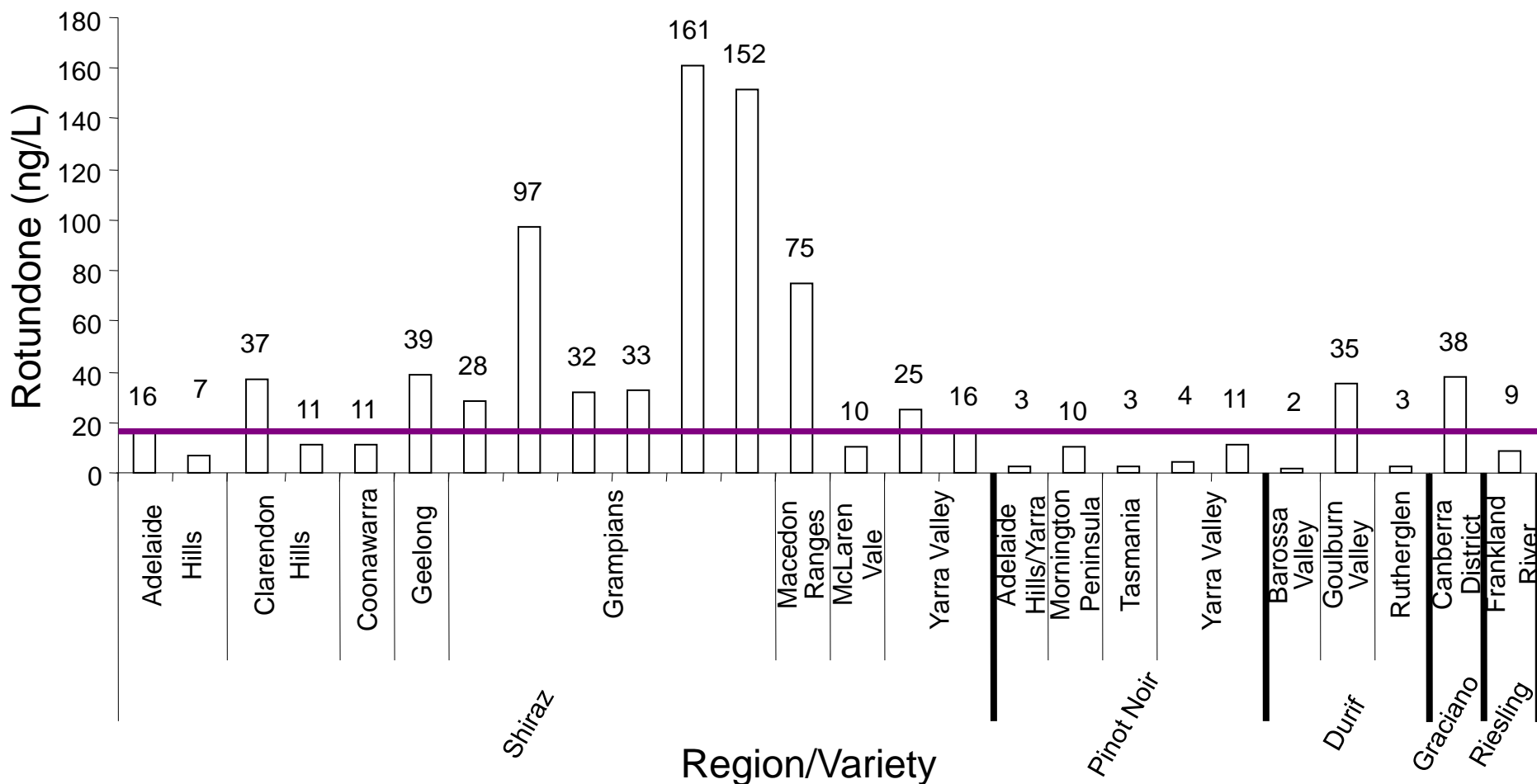
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# Rotundone in Australian wines



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# Australian cool climate Shiraz



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## WINE REGIONS OF AUSTRALIA



### WESTERN AUSTRALIA

- 1 Swan District
- 2 Perth Hills
- 3 Peel
- 4 Geographe
- 5 Margaret River
- 6 Blackwood Valley
- 7 Pemberton
- 8 Manjimup
- 9 Great Southern

### SOUTH AUSTRALIA

- 10 Southern Flinders Ranges
- 11 Clare Valley
- 12 Barossa Valley
- 13 Eden Valley
- 14 Riverland
- 15 Adelaide Plains
- 16 Adelaide Hills
- 17 McLaren Vale
- 18 Kangaroo Island
- 19 Southern Fleurieu
- 20 Currency Creek
- 21 Langhorne Creek
- 22 Padthaway
- 23 Mount Benson
- 24 Wrattenbully
- 25 Robe
- 26 Coonawarra
- 27 Mount Gambier

### QUEENSLAND

- 28 South Burnett
- 29 Granite Belt

### NEW SOUTH WALES

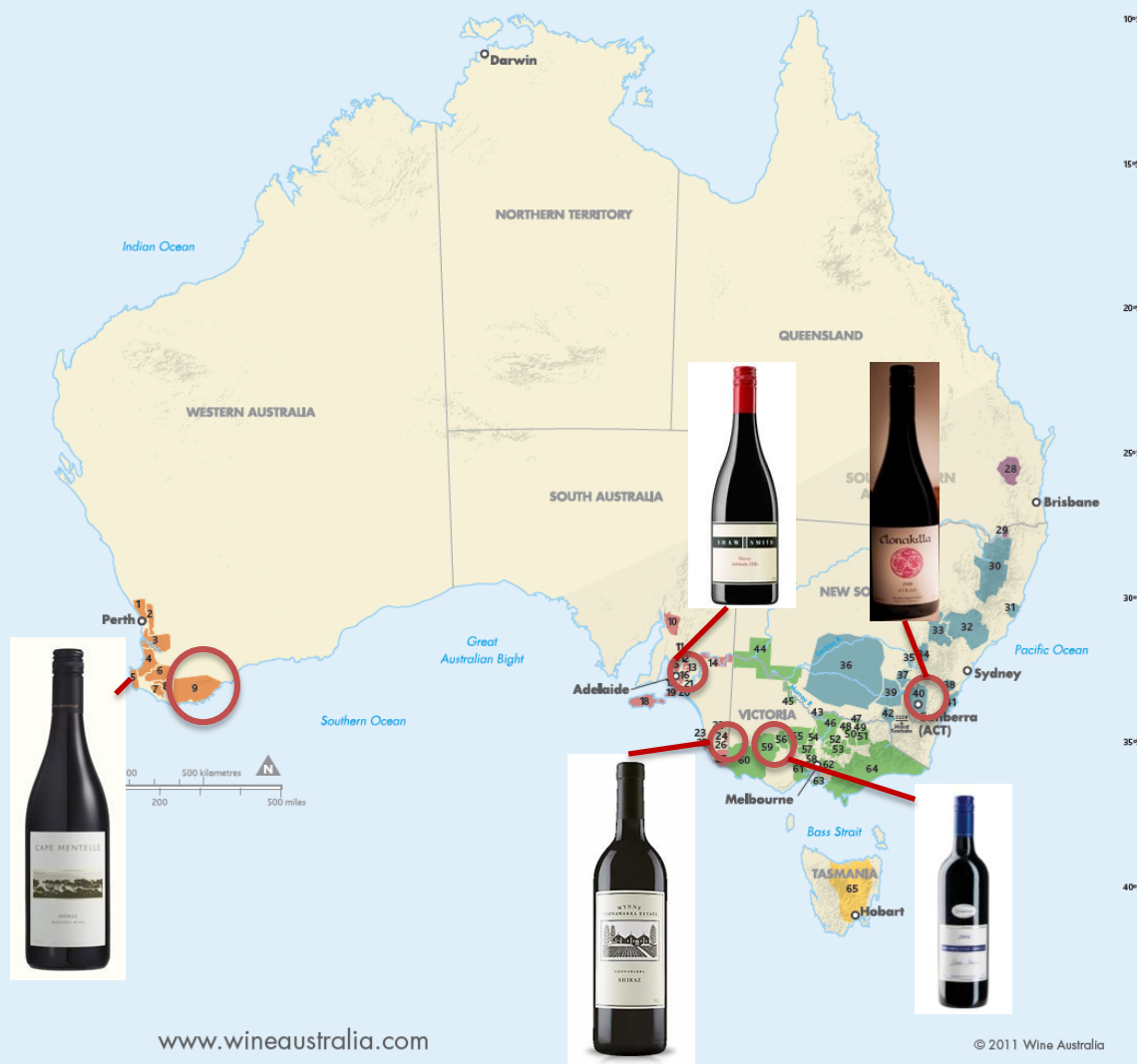
- 30 New England Australia
- 31 Hastings River
- 32 Hunter
- 33 Mudgee
- 34 Orange
- 35 Cowra
- 36 Riverina
- 37 Hilltops
- 38 Southern Highlands
- 39 Gundagai
- 40 Canberra District
- 41 Shoalhaven Coast
- 42 Tumbarumba
- 43 Perricoota

### VICTORIA

- 44 Murray Darling
- 45 Swan Hill
- 46 Goulburn Valley
- 47 Rutherglen
- 48 Glenrowan
- 49 Beechworth
- 50 King Valley
- 51 Alpine Valleys
- 52 Strathbogie Ranges
- 53 Upper Goulburn
- 54 Heathcote
- 55 Bendigo
- 56 Pyrenees
- 57 Macedon Ranges
- 58 Sunbury
- 59 Grampians
- 60 Henty
- 61 Geelong
- 62 Yarra Valley
- 63 Mornington Peninsula
- 64 Gippsland\*

### TASMANIA

- 65 Tasmania\*



\*South Eastern Australia and Gippsland are zones, Tasmania is a state.

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# New Zealand



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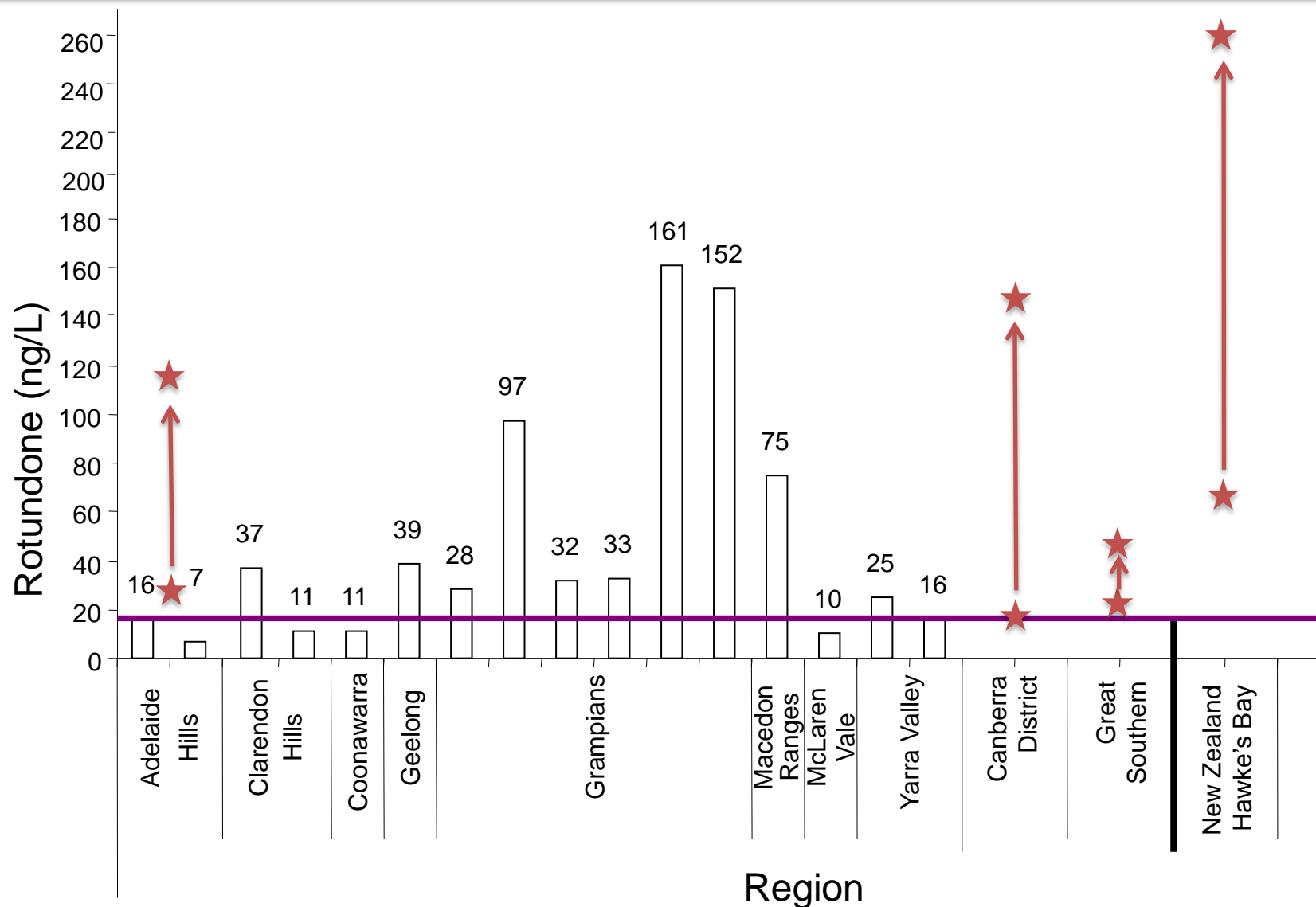
## Gimblett Gravels (400 Ha), Hawke's Bay, New Zealand

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

# Rotundone in other commercially available Shiraz wines



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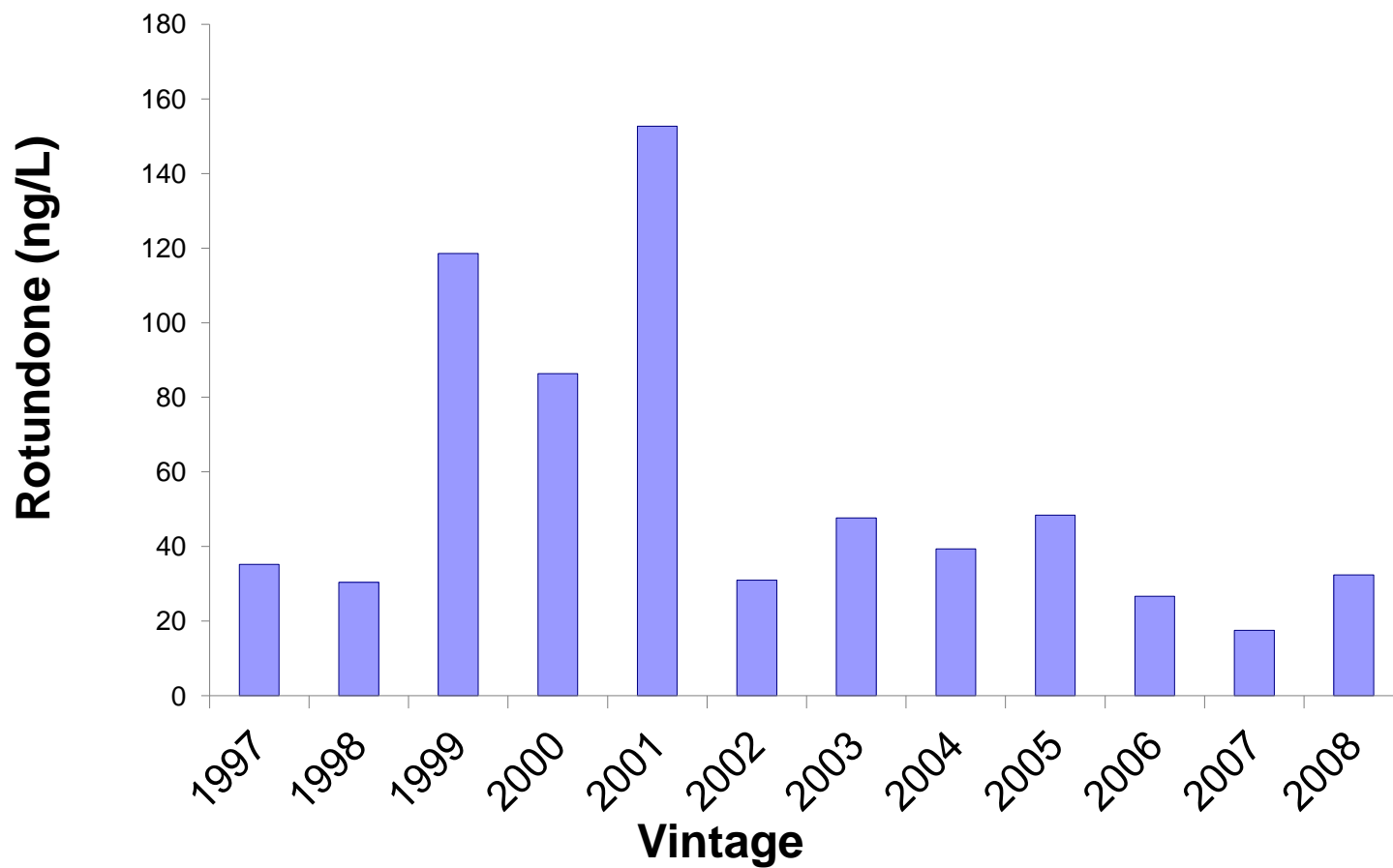


# Variability across vintages: Canberra District



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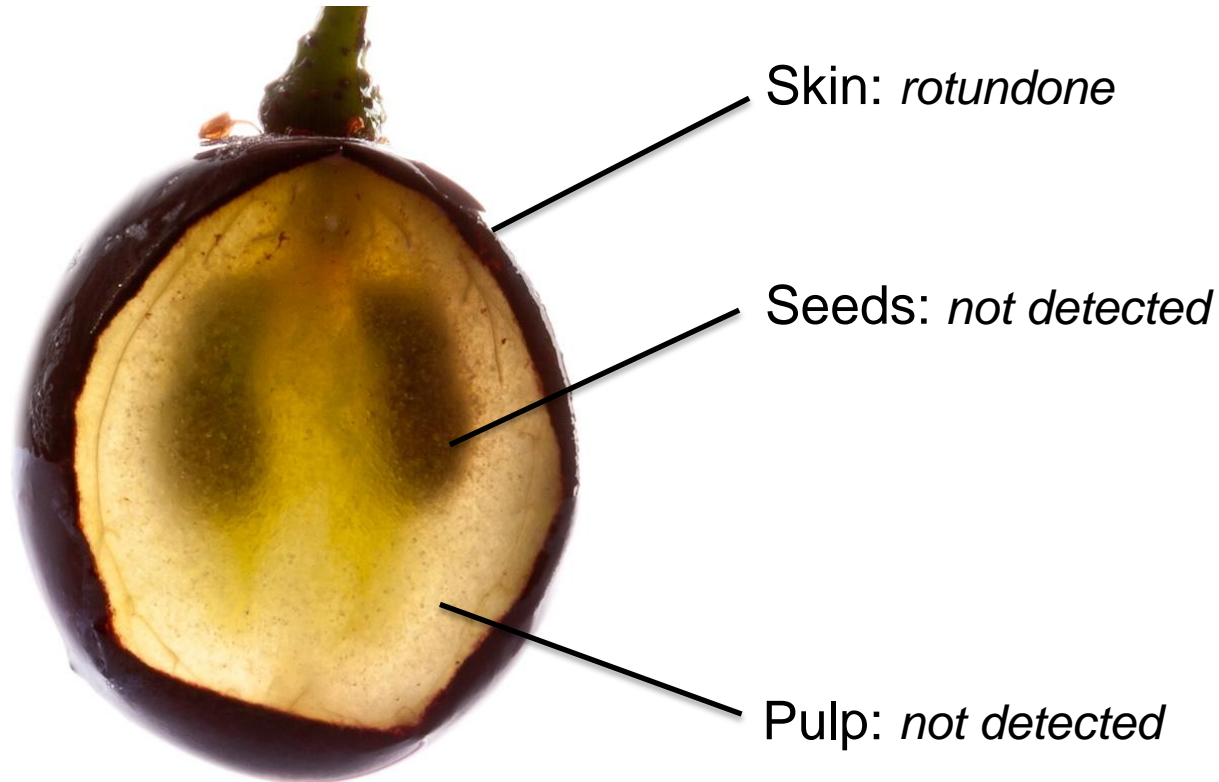
## Shiraz/Viognier wines - same winery & style



# Rotundone is only present in the skin



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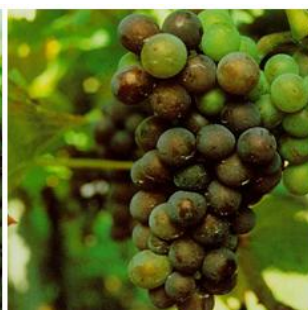
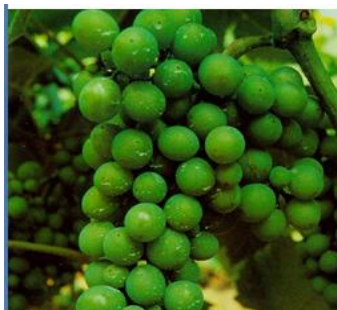
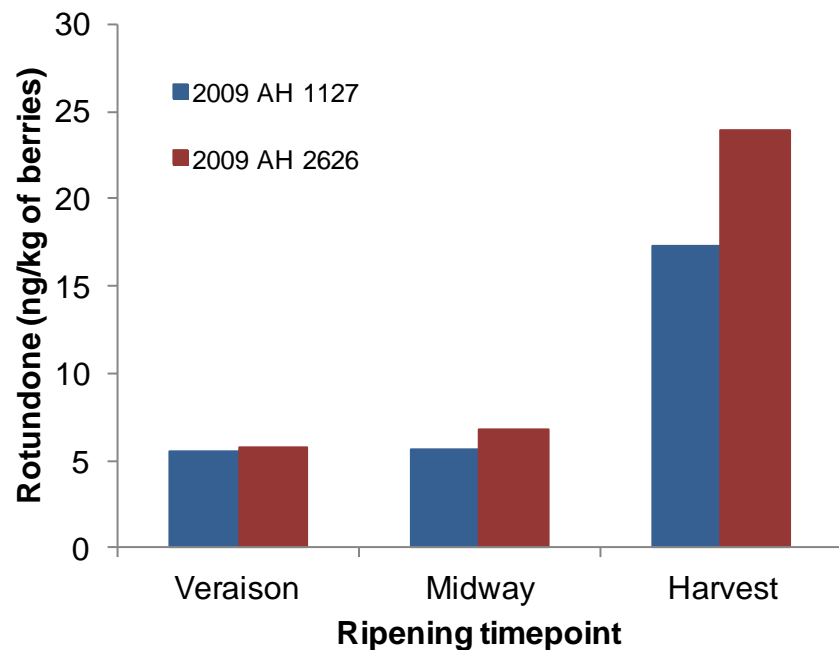
Photograph by Eric Wilkes

# Rotundone increases during late stage ripening



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**Adelaide Hills Shiraz berries during ripening**

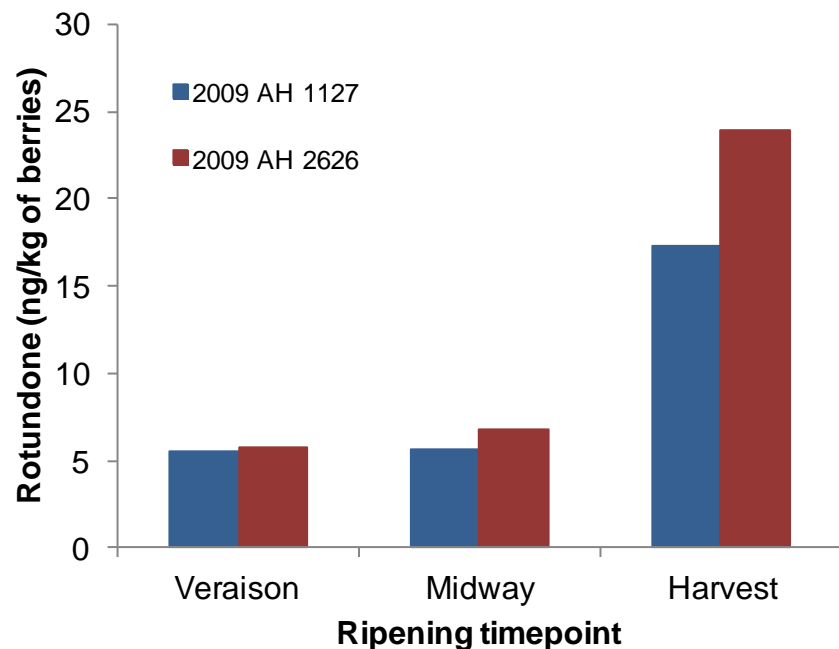


# Rotundone increases during late stage ripening

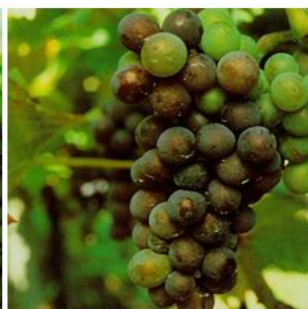
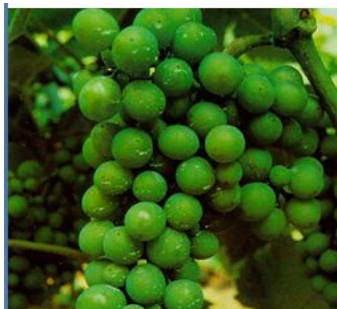
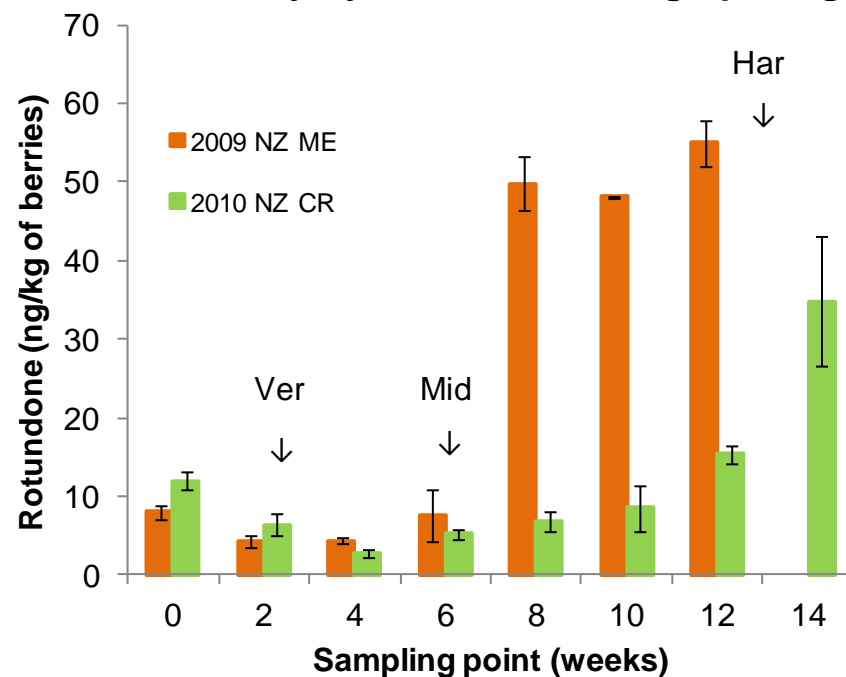


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## Adelaide Hills Shiraz berries during ripening



## NZ Hawke's Bay Syrah berries during ripening



# Does vine management affect rotundone levels?



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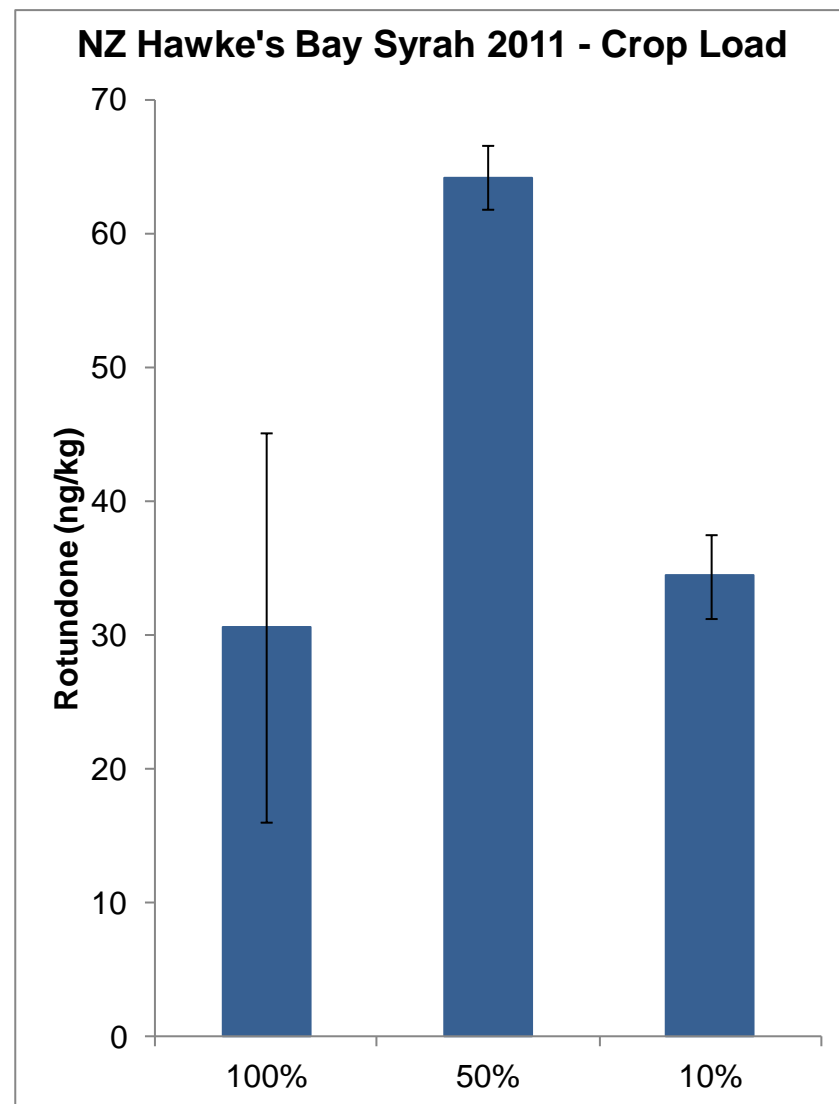
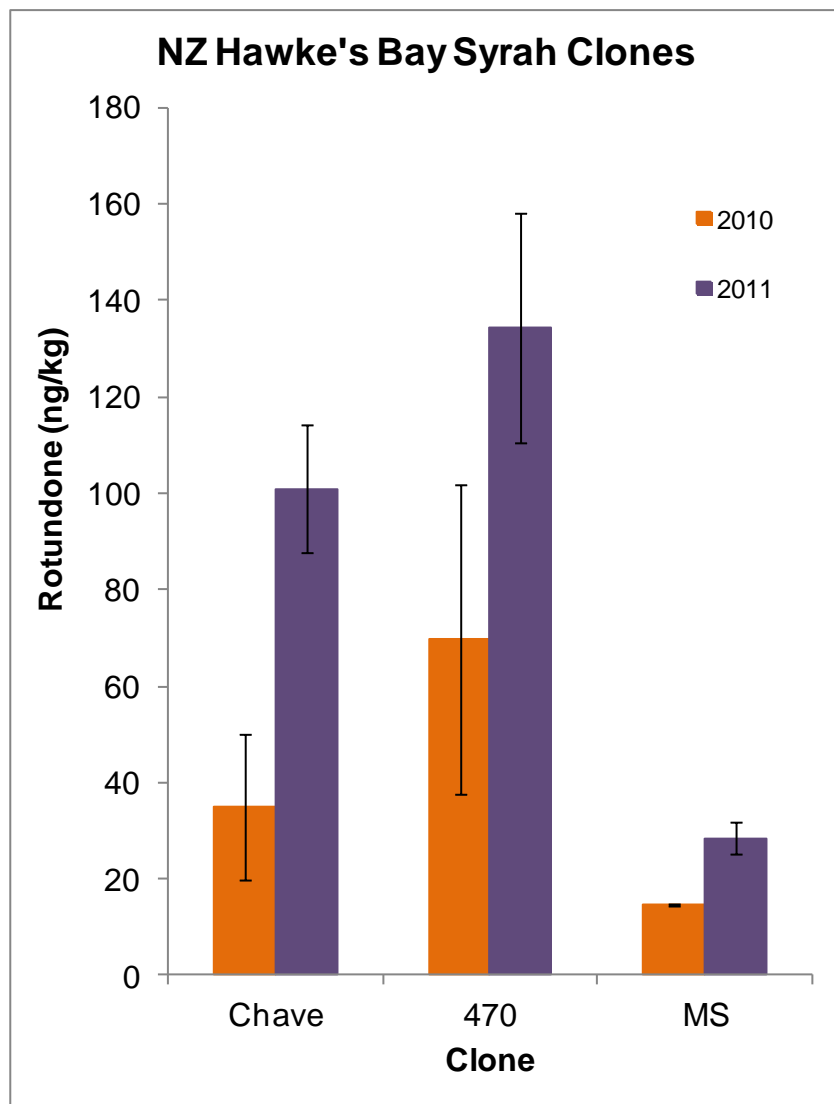
- ❖ Fruit exposure
- ❖ Leaf removal time
- ❖ Crop load
- ❖ Vine vegetative vigour
- ❖ Clones



# Clone and crop load



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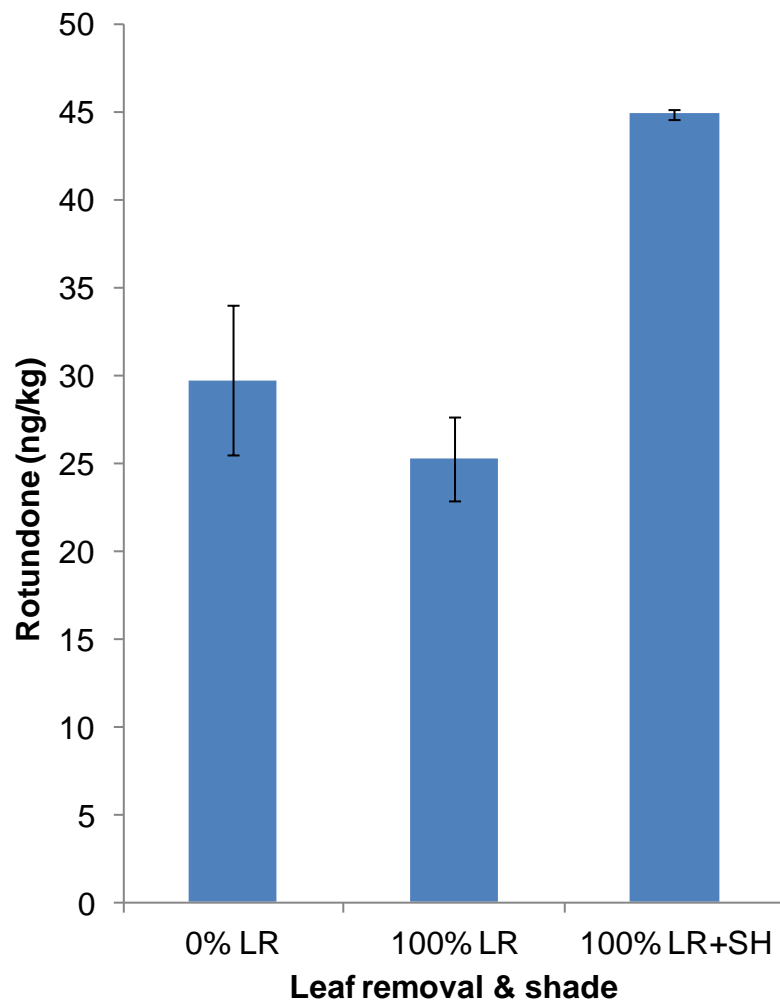


# Leaf removal

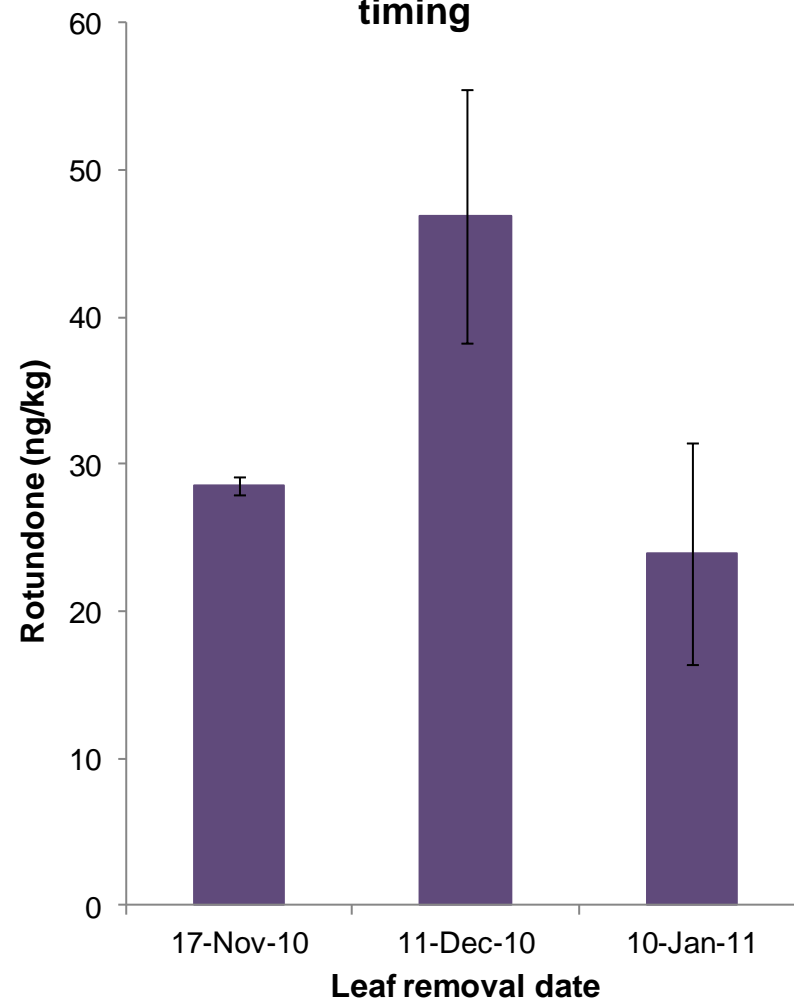


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**NZ Hawke's Bay Syrah 2011 – Leaf removal**



**NZ Hawke's Bay Syrah 2011 – Leaf removal timing**

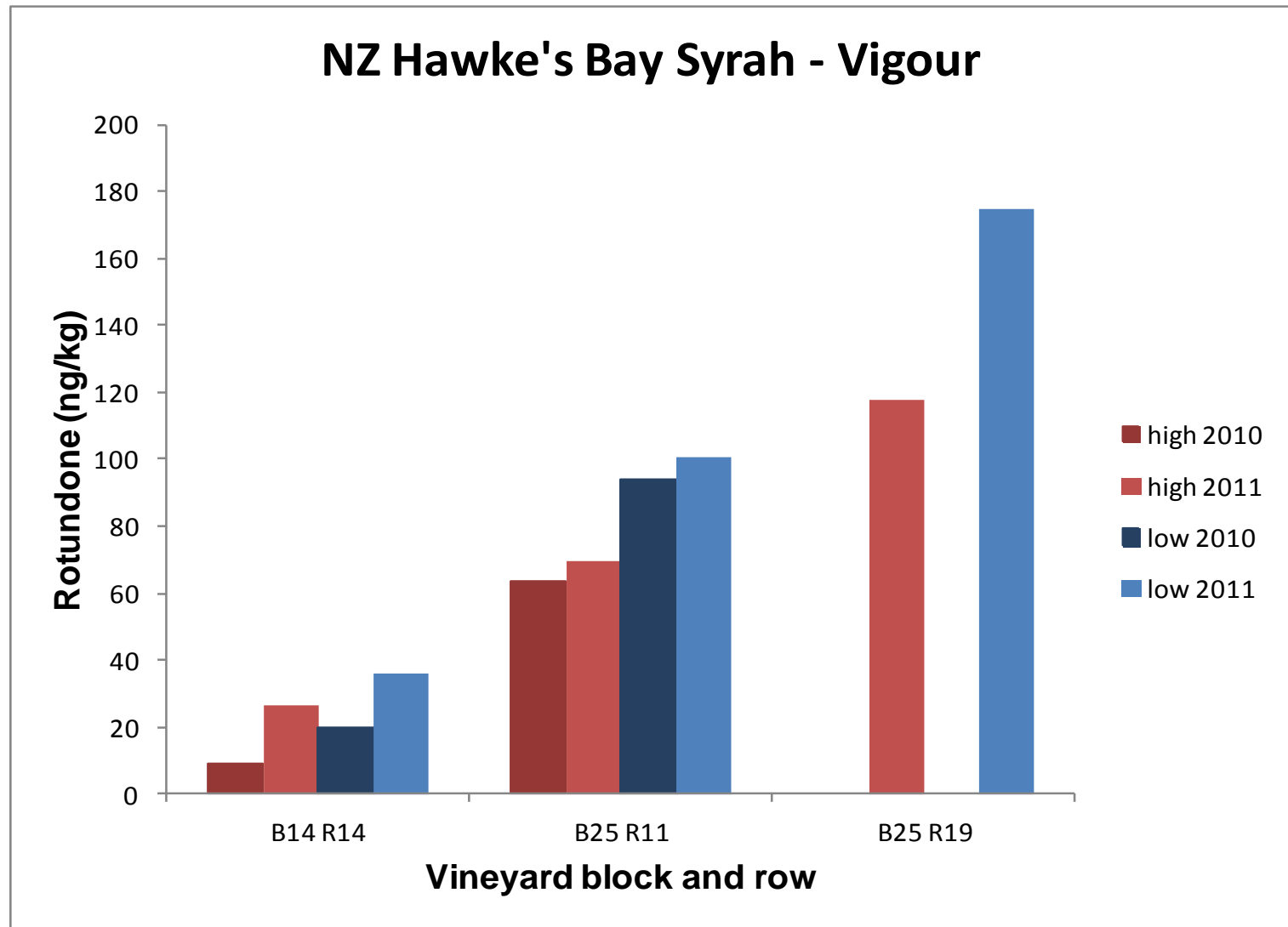


**Trunk Circumference: 163mm**  
**LLN: 2.73**  
**Gaps: 1.5%**



**Trunk Circumference: 129mm**  
**LLN: 0.795**  
**Gaps: 29%**



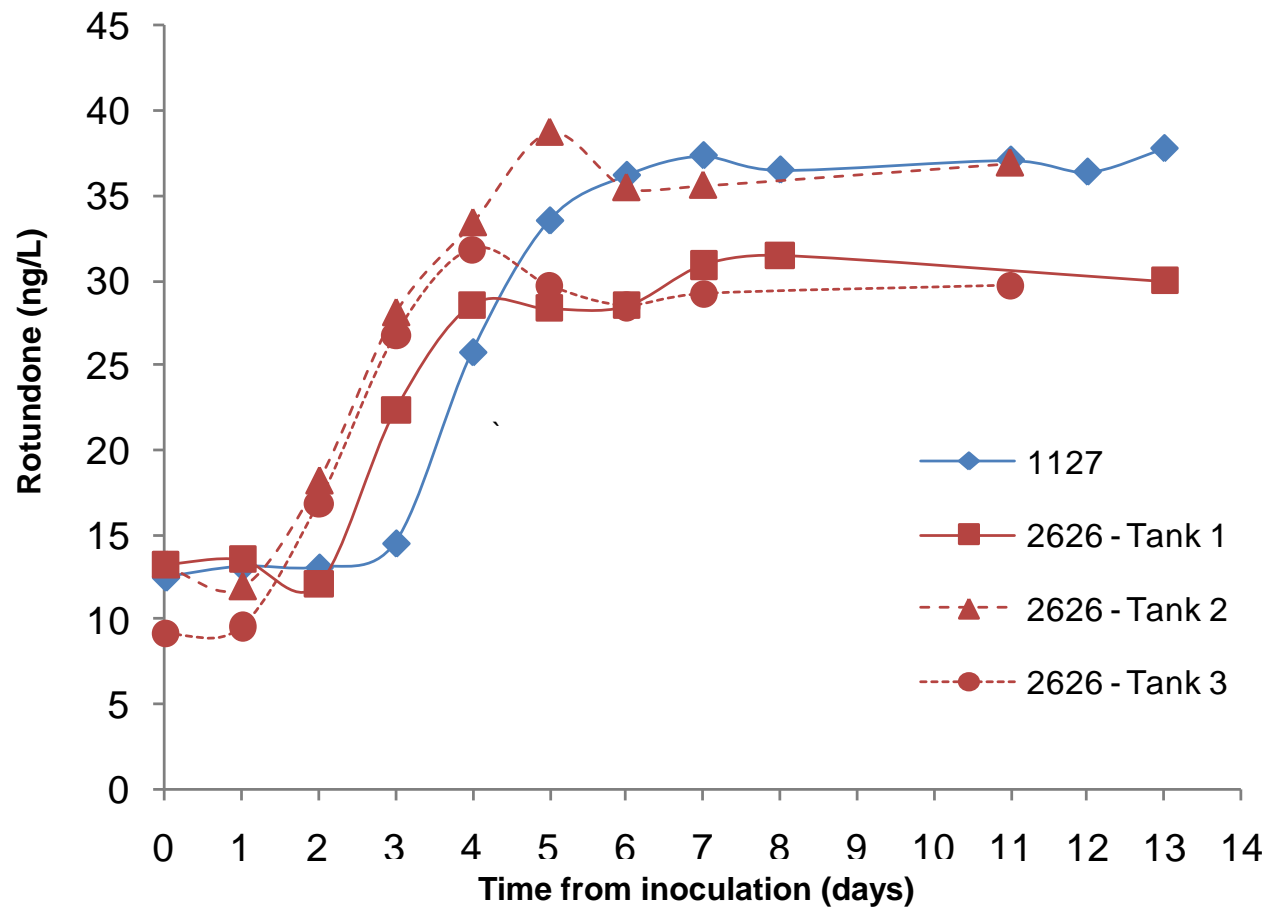


# Rotundone extraction during winemaking



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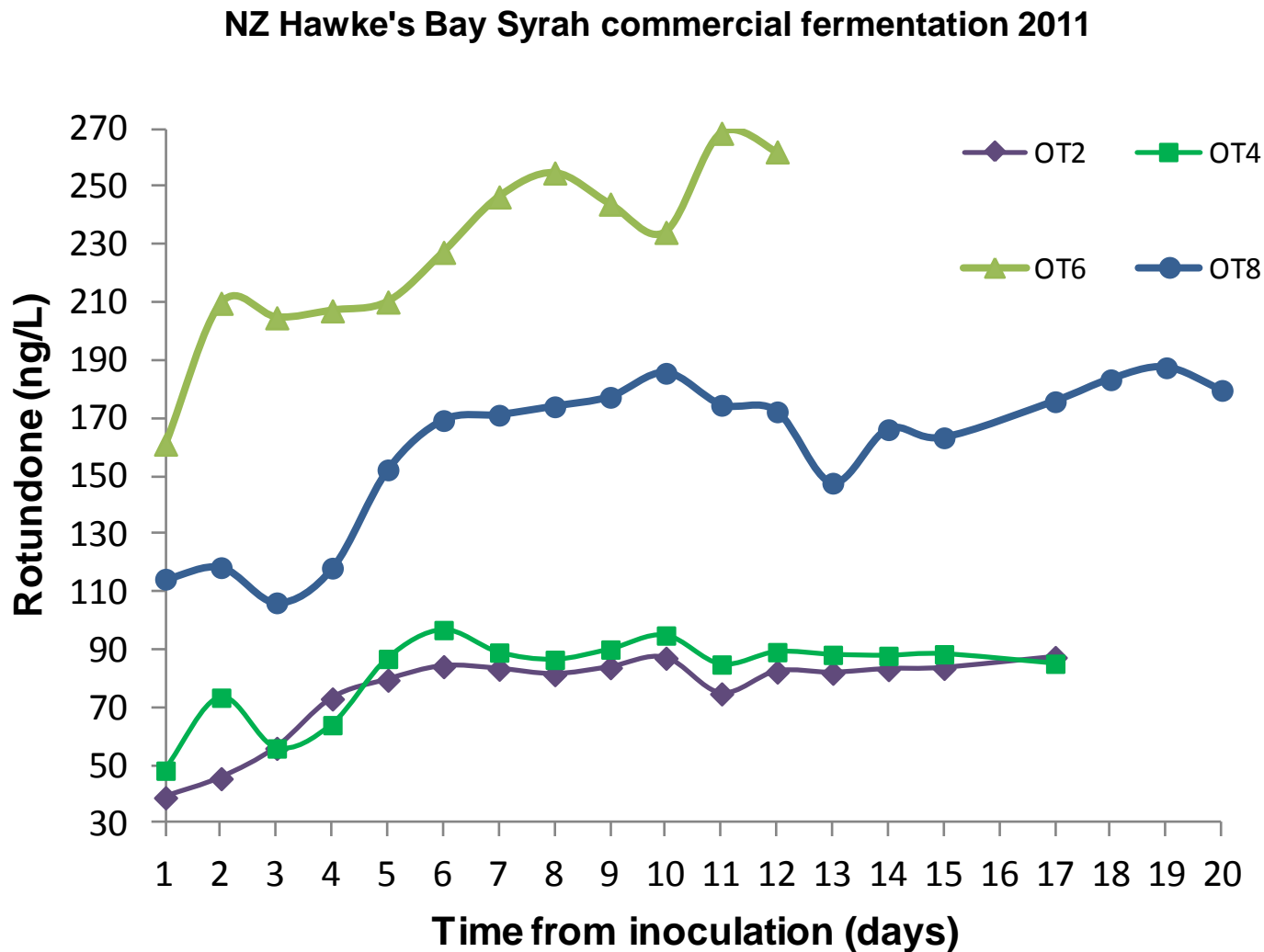
**Adelaide Hills Shiraz commercial fermentation 2009**



# Rotundone extraction from berries during winemaking



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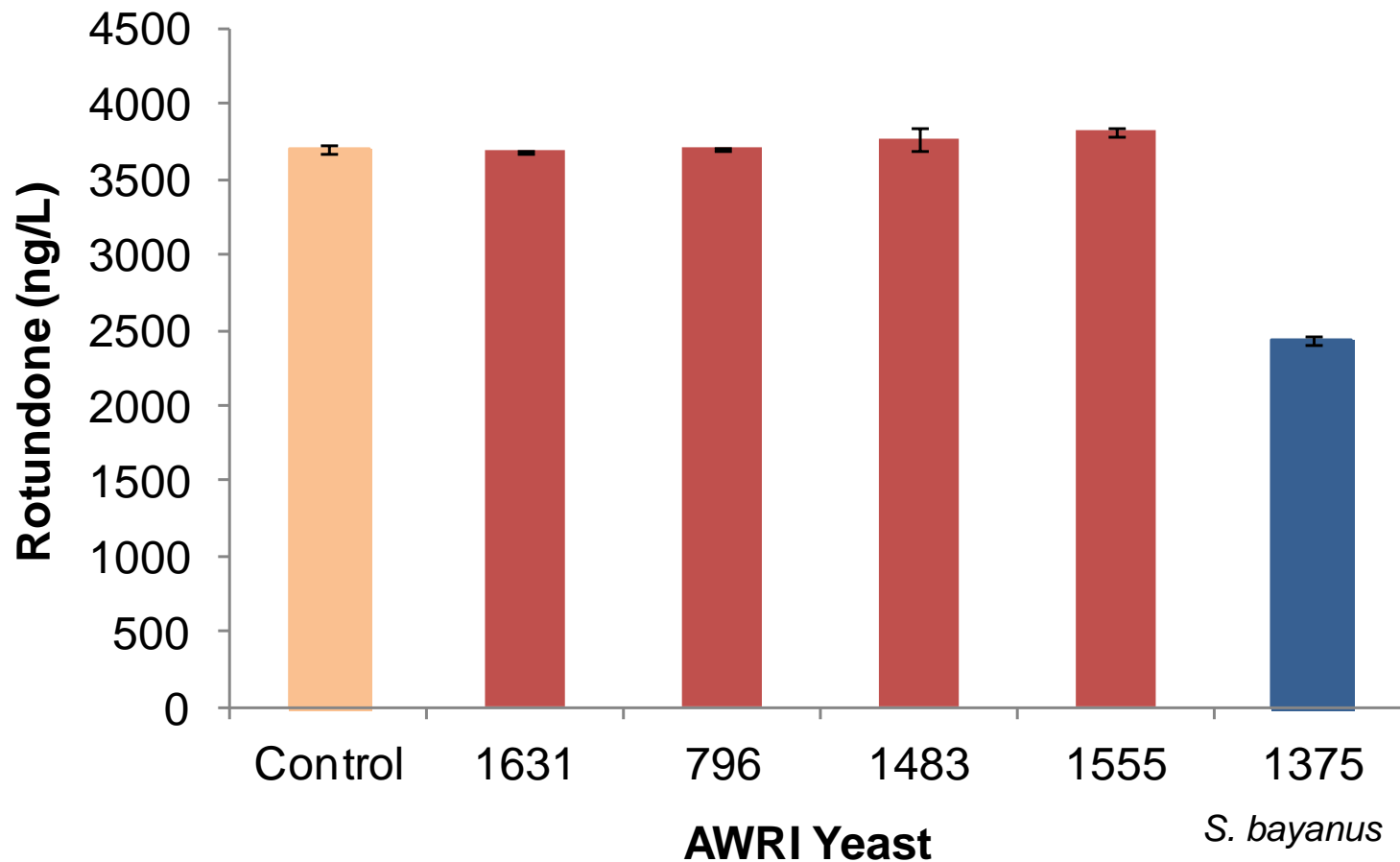


# Can yeast affect rotundone levels during fermentation?



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## Fermentation in defined juice medium 2011



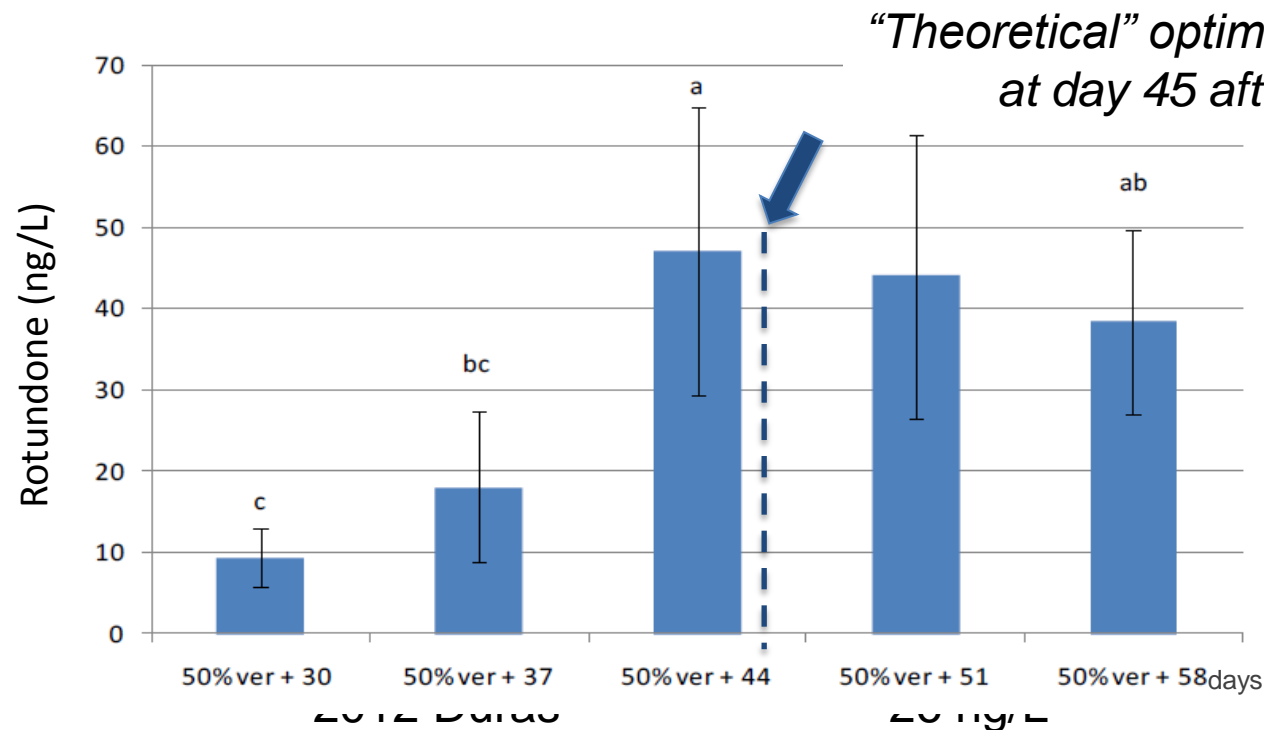
# Rotundone in French Pyrenees wines



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Olivier Geffroy, IFV Sud-Ouest

## 2011 Duras microvinification at 5 levels of maturity



### **IFV viticulture trials:**

Irrigation / Elicitor / crop load

Control

Leaf removal

### **2011**

43-48 ng/L

37 ng/L

12 ng/L

### **2012**

29-36 ng/L

27 ng/L

12 ng/L

# Variability across the vineyard & vintages:



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Nathan Scarlett, RWG; Rob Bramley, CSIRO; Damien Sheehan, MLG



## Role of:

- genome x environment?
- grape vine?
- in the soil, above surface?
- climate & climate change?
- terroir?

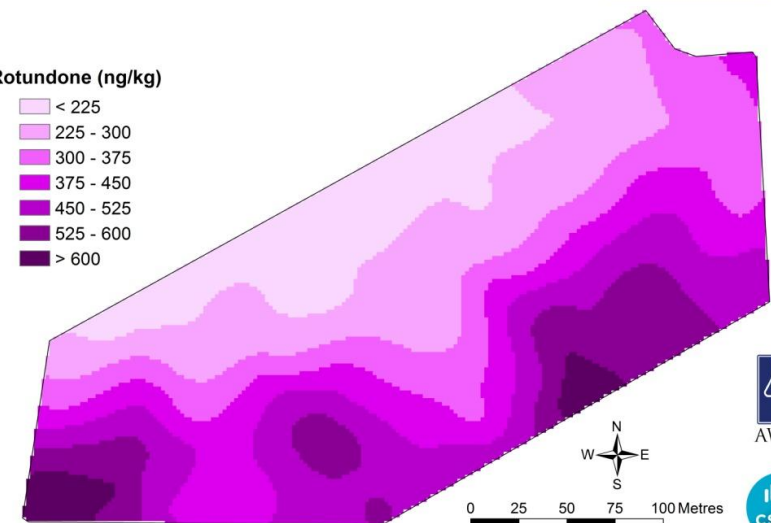
## 2012 Rotundone level in grapes

- 177 vines sampled
- 74 – 1081 ng/kg
- distinct spatial pattern  
otherwise uniform TSS, TA, colour,...

Rotundone variation, 2012 - Mt Langhi Ghiran

MOUNT LANGHI GHIRAN

Rotundone (ng/kg)



AWRI



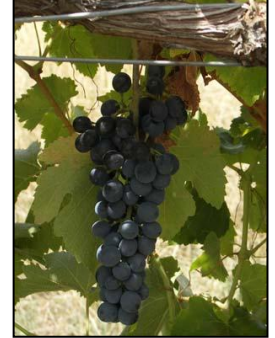
CSIRO

# Conclusions and future directions



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



# Acknowledgements



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



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