Optimising harvest date through use of an integrated grape compositional and sensory model

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Charles Sturt University (CSU)

Yarra Valley– February 2015

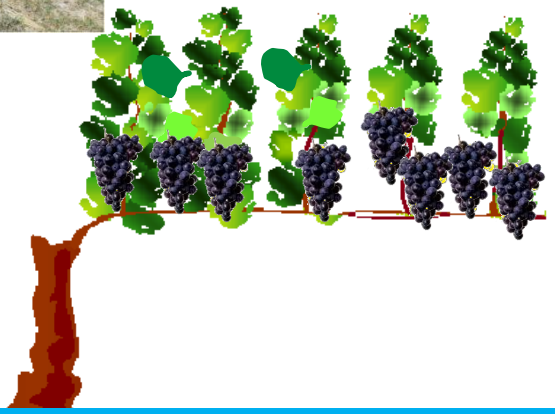
Is aromatic and mouthfeel maturity linked to the technological maturity?

- Is the concept of extended hang time necessary to reach optimal ripeness?
- Sugar concentration and flavour nexus?
- Volatile and non-volatile nexus?

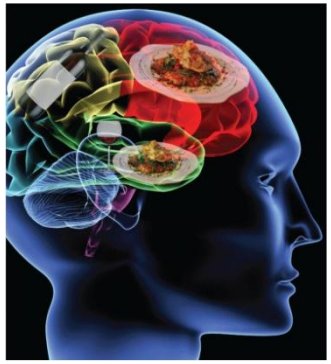
Goals (what to achieve)

- To study grape aromatic evolution during the ripening using sequential harvest
- To characterise grape composition (volatile and non-volatile) in relation to corresponding wines using sequential harvest
- Linking grape and wine composition to wine sensory attributes
- To study the role of main abiotic drivers (temperature and water) on grape/wine composition

From the vineyard to the wine and sensory:
how to capture the complexity?



An integrated approach across the value chain

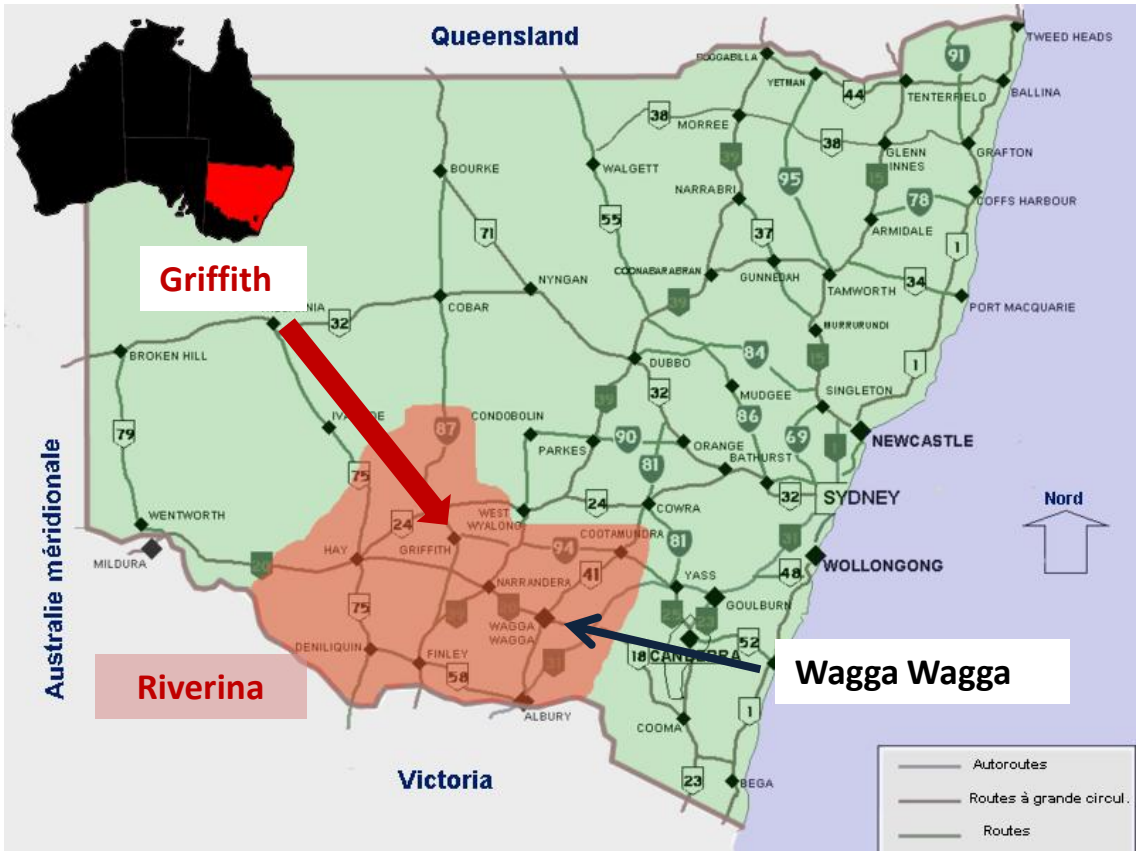


When to harvest?

- **<u>Traditional indicators</u>**: *Baume, TA, pH, colour, grape berry sensory evaluation* = perception of the wine in the mouth (*non volatile matrix*).

- **<u>New indicators</u>** related to possible wine aromatic profiles (*volatile matrix*).

Experimental design
Location



Geographical position: 34”17’00 South; 146”02”00 East
Altitude: 134 m

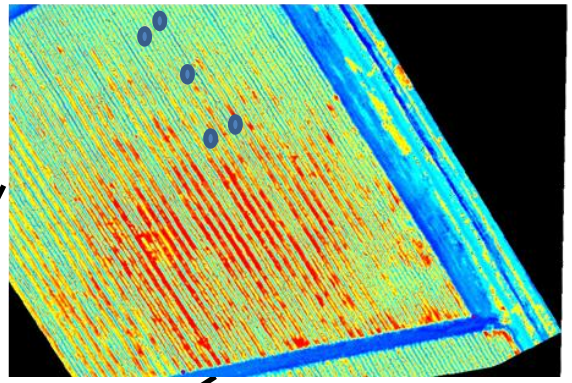
Temperature:

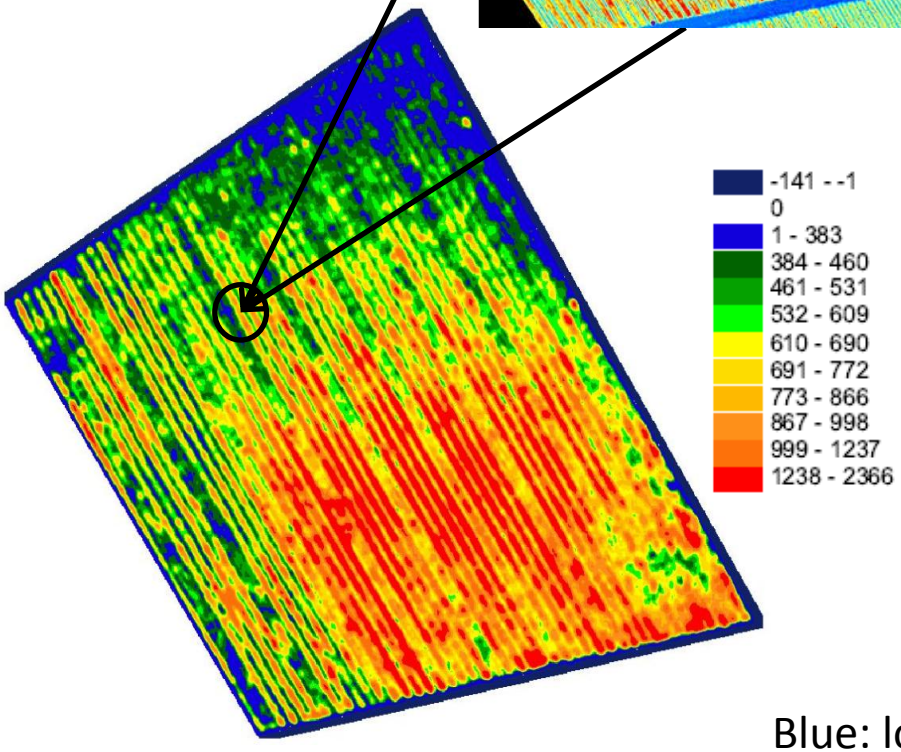
Huglin index > 3000 ➡ **Warm to Hot climate**

(Tonietto & Carbonneau, 2004; Huglin, 1978)

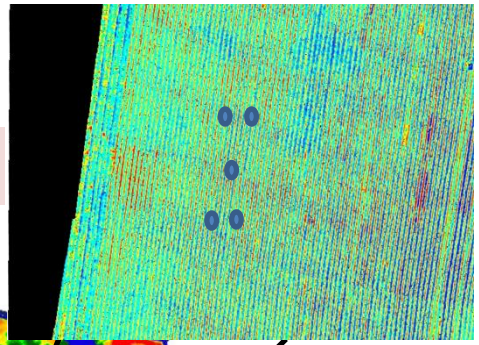
Experimental vineyards

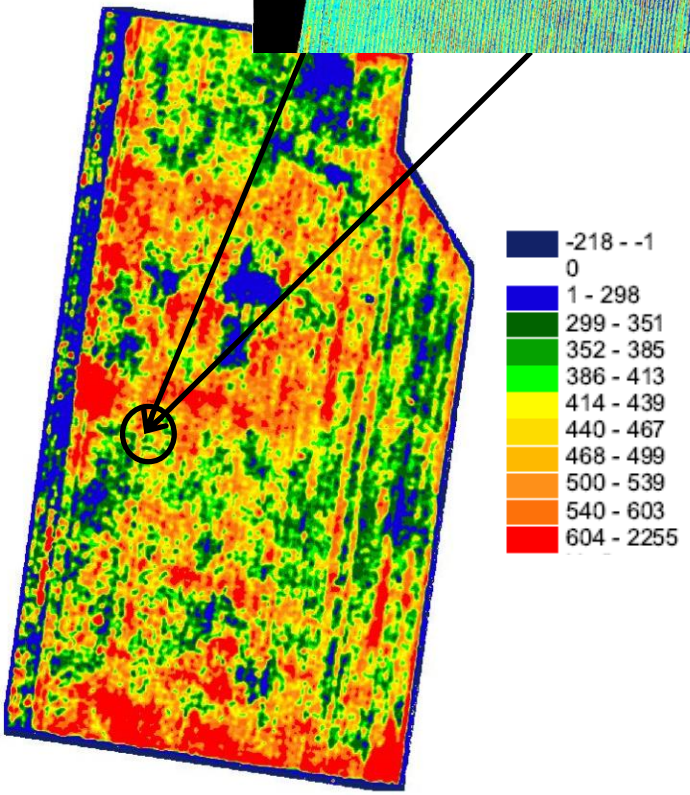
Shiraz A





Shiraz B





Blue: low vigour
Red: high vigour

Smoothed EVI images of Shiraz A and Shiraz B taken on 5 February 2014. Size of a pixel represents 50 cm in nature.

Experimental vineyards

	Vineyard **A**	Vineyard **B**
Primary shoots	73	89
Prunning mass	1476 g/vine	1006 g/vine
Clone	Minato	1654
Average yield	8 t/ha	12 t/ha

Mechanical pruning – Drip irrigation

Sprawling training system

Climatic scales

Time

Decade

Year
Season

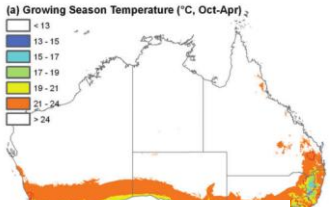
Month

Day

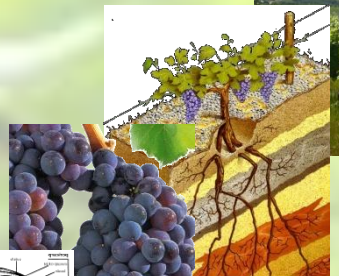
Hour

Minute

Macroclimate



Meso-climate
Topoclimate



Microclimate
Nanoclimate

Surface

Bunch
Berry

Plot
Row

District
Ward

Province
Region

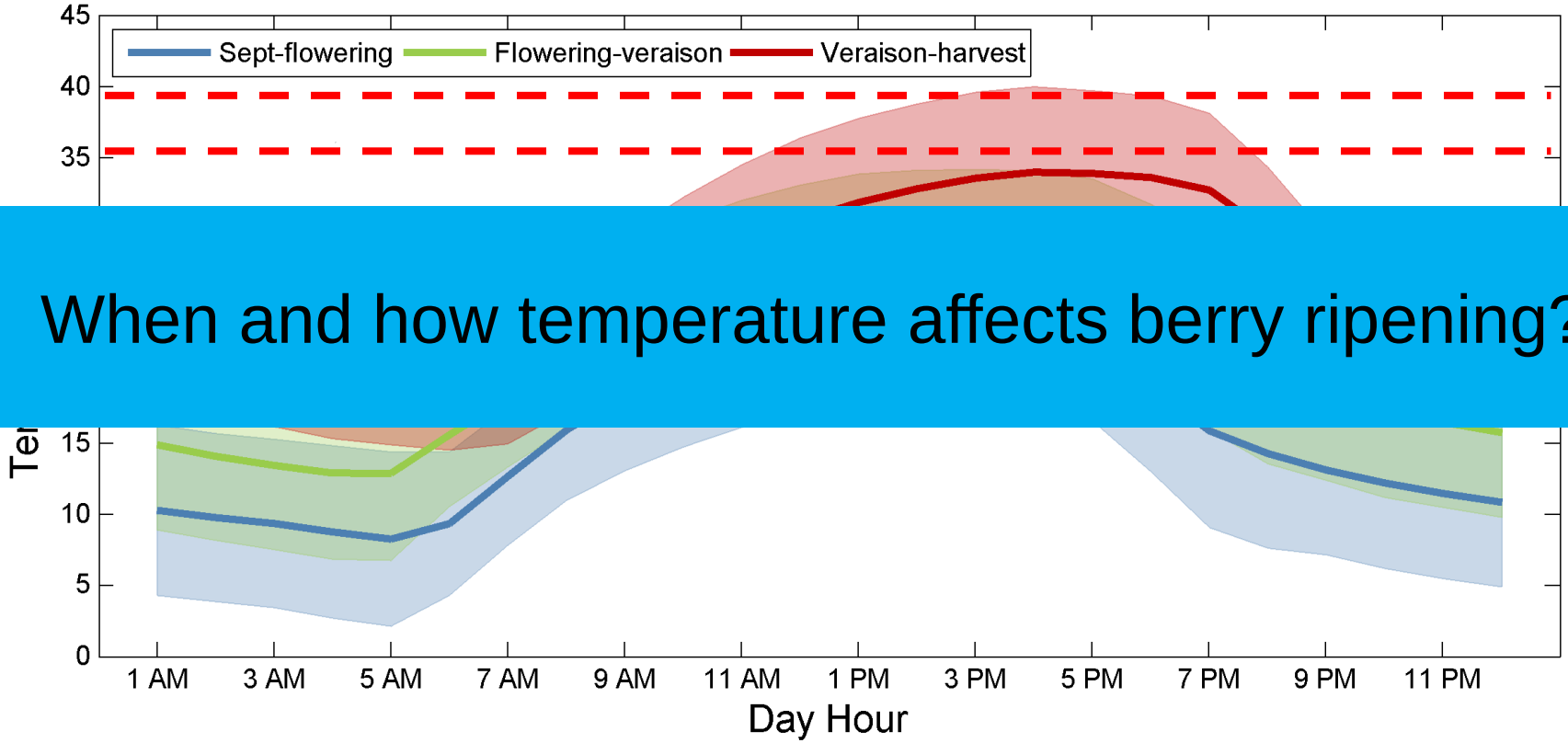
Climatic data

1. Mesoclimate (vineyard)

Weather stations in each experimental vineyard, measuring:

- Average temperature
- Relative humidity
- Rainfall
- Solar radiation
- Wind speed and direction

Average hourly temperatures for vineyard B for different stages of berry development



When and how temperature affects berry ripening?

Frequency of days when temperature exceeded 35 °C for Shiraz B

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doi:10.1093/jxb/erm055 Advance Access publication 23 April, 2007

Journal of Experimental Botany
www.jxb.oxfordjournals.org

RESEARCH PAPER

Loss of anthocyanins in red-wine grape under high temperature

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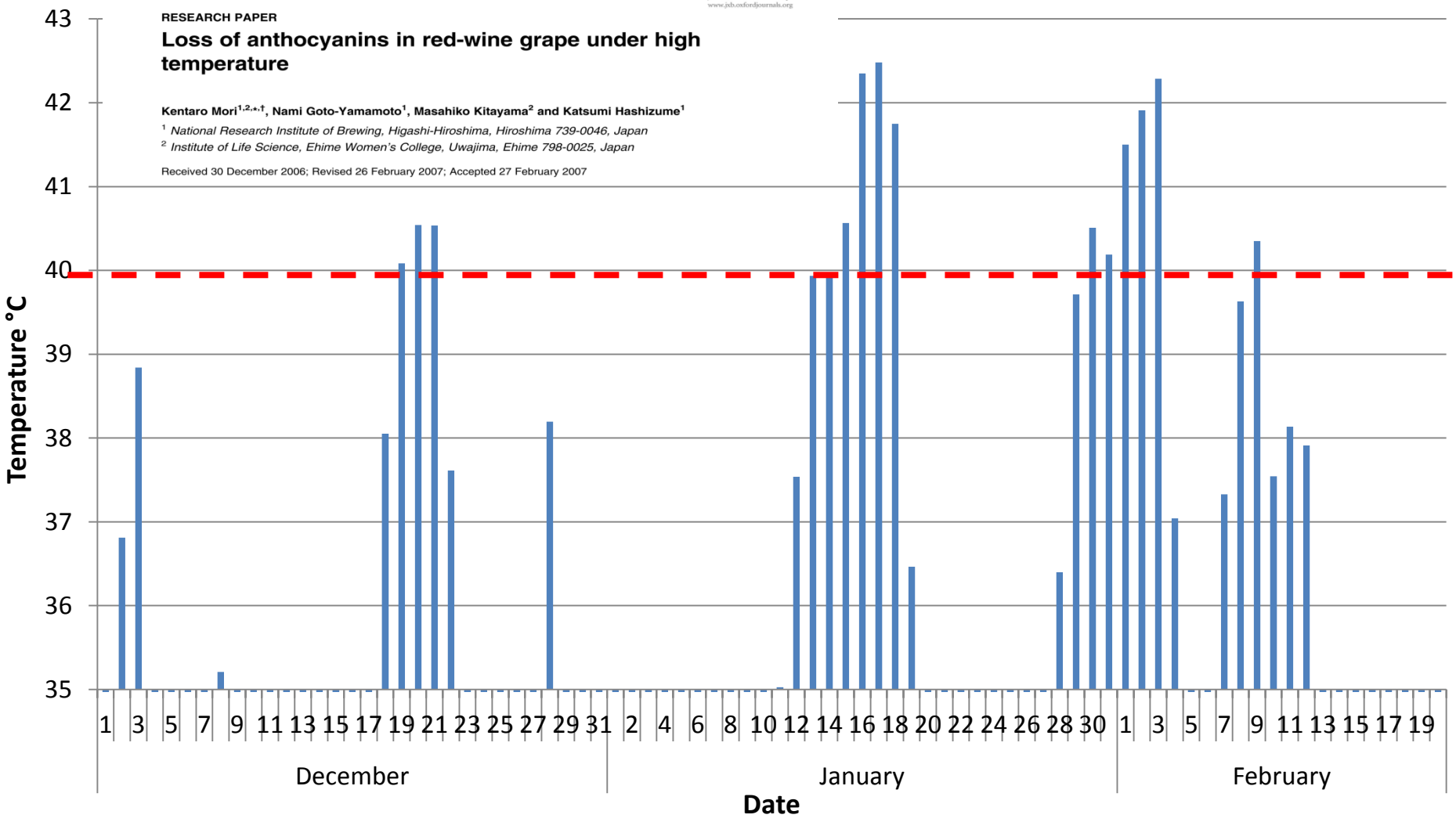


Calculated from mesoclimatic data collected inside the vineyard.

Huglin index

a 6-month heat summation

[((daily mean T–10°C.) + (daily max T –10°C.))/2]

(1 October to 31 March: to be adapted to the phenology, from bud burst to harvest)

relating heliothermic conditions of a region to its potential to ripen various cultivars

Huglin index	**Viticultural climate description**
≤1500	Very cool
>1500≤1800	Cool
>1800≤2100	Temperate
>2100≤2400	Temperate warm
>2400≤3000	Warm
>3000	Very warm

(Tonietto & Carbonneau, 2004; Huglin, 1978)

Cultivars adaptation to the HI

1500: Muller - Thurgau, Portugais bleu,...

1600: Pinot B, Pinot G, Aligoté, Gewurztraminer,…

1700: Pinot N, Riesling, Sylvaner, Gamay

1800: Cabernet - Franc, Merlot,...

1900: Cabernet - Sauvignon, Chenin, Sémillon, …

2000: Grenache, Syrah, Ugni - B, …

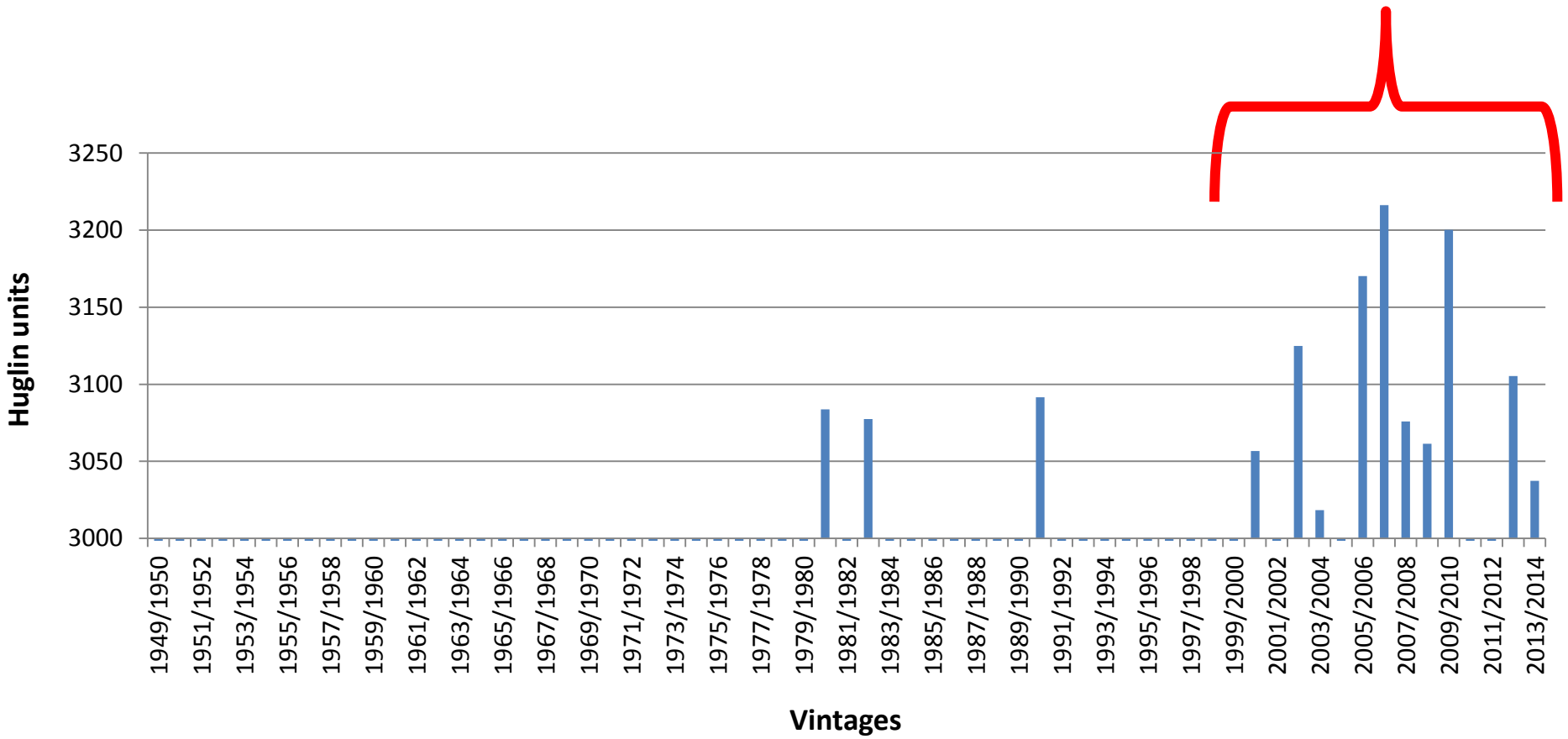
2100: Cinsault, Mourvèdre,...

2200: Carignan, Pinotage ?,…

2300: ….

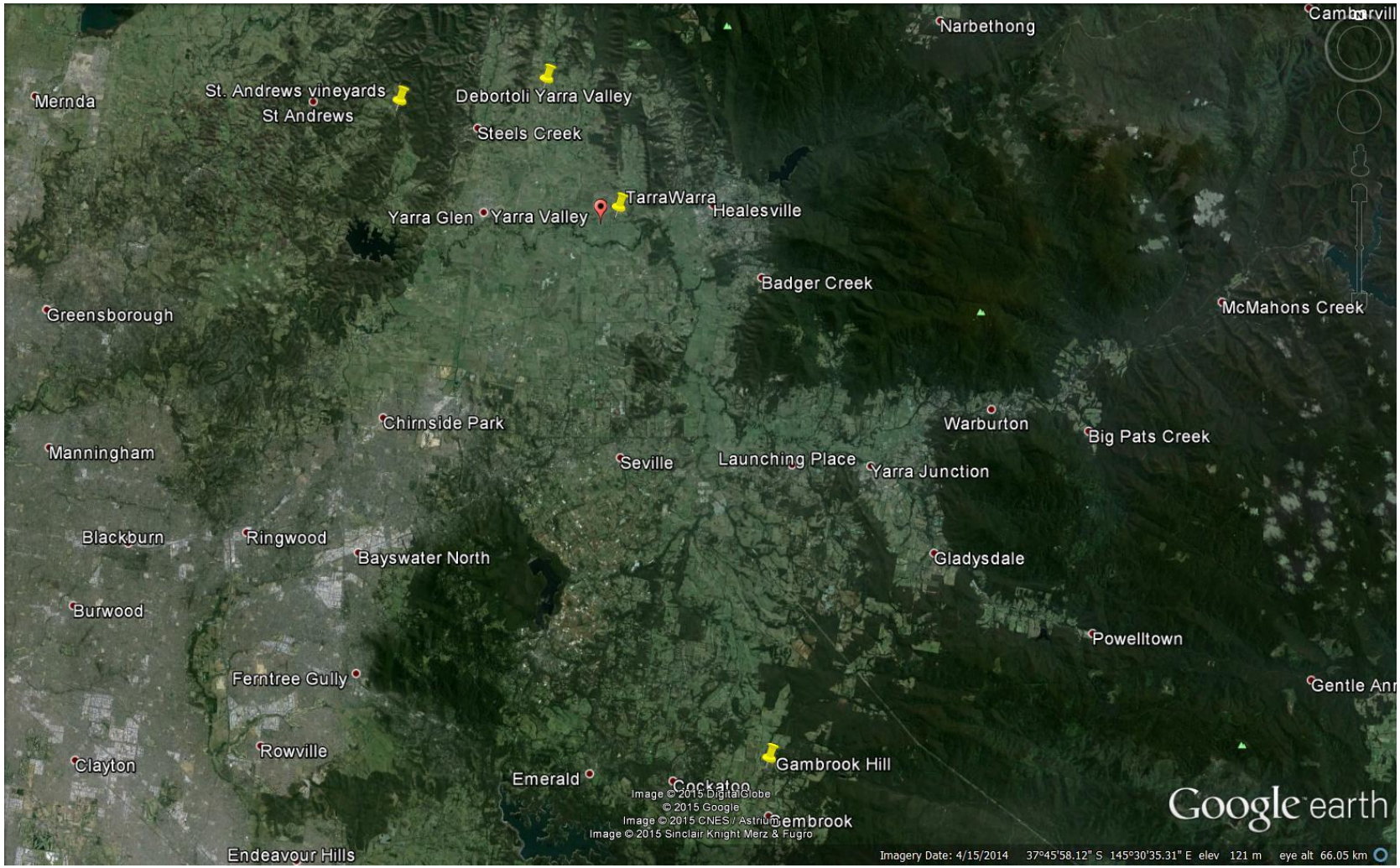
Huglin, 1978

Frequency of vintages according to Huglin index classified as very warm (HI>3000) for Griffith

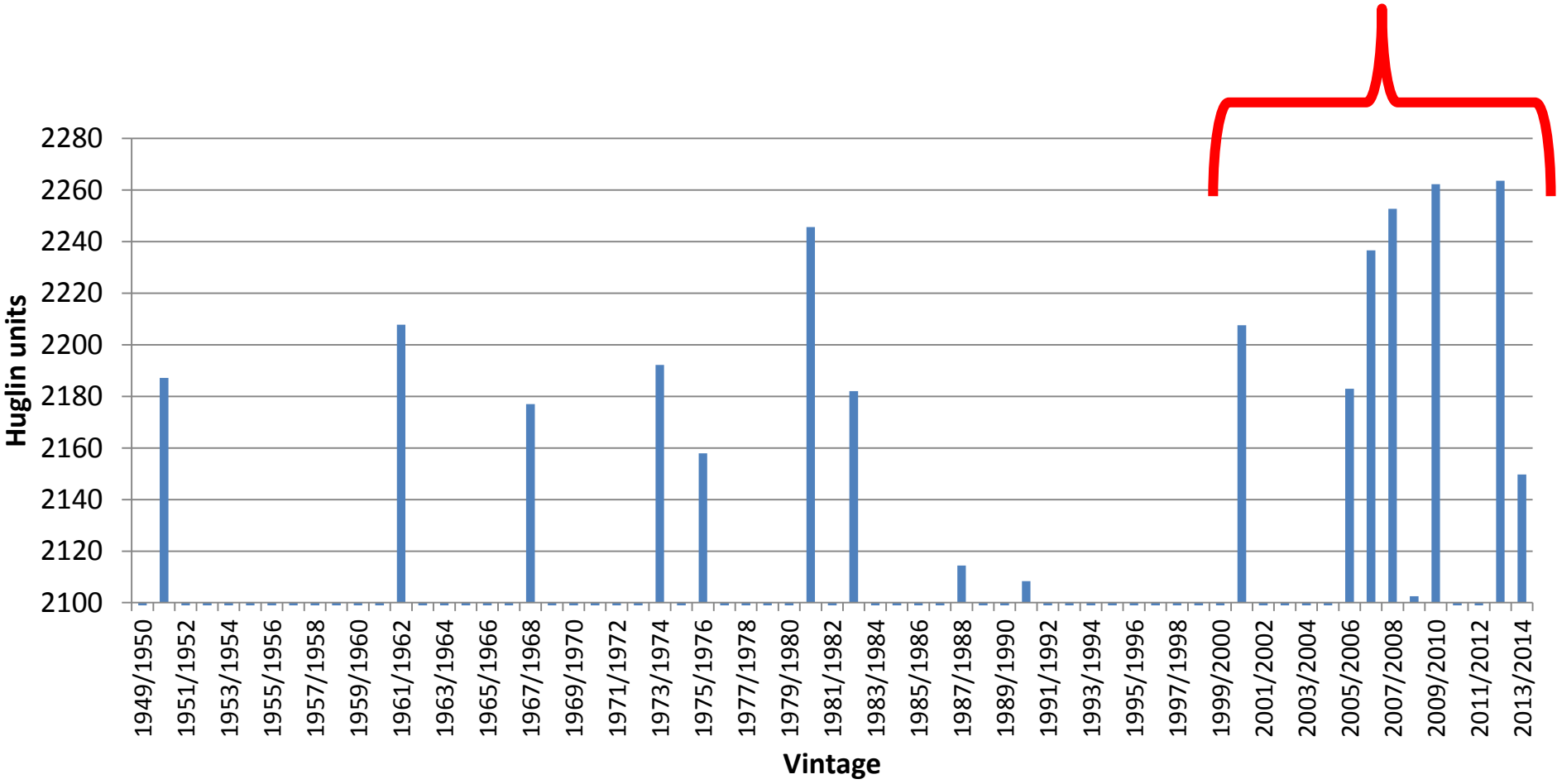


Climatic data used are SILO drilled climatic data (Department of Science, Information Technology and the Arts, Queensland State Government, Australia).

Locations: Yarra Valley

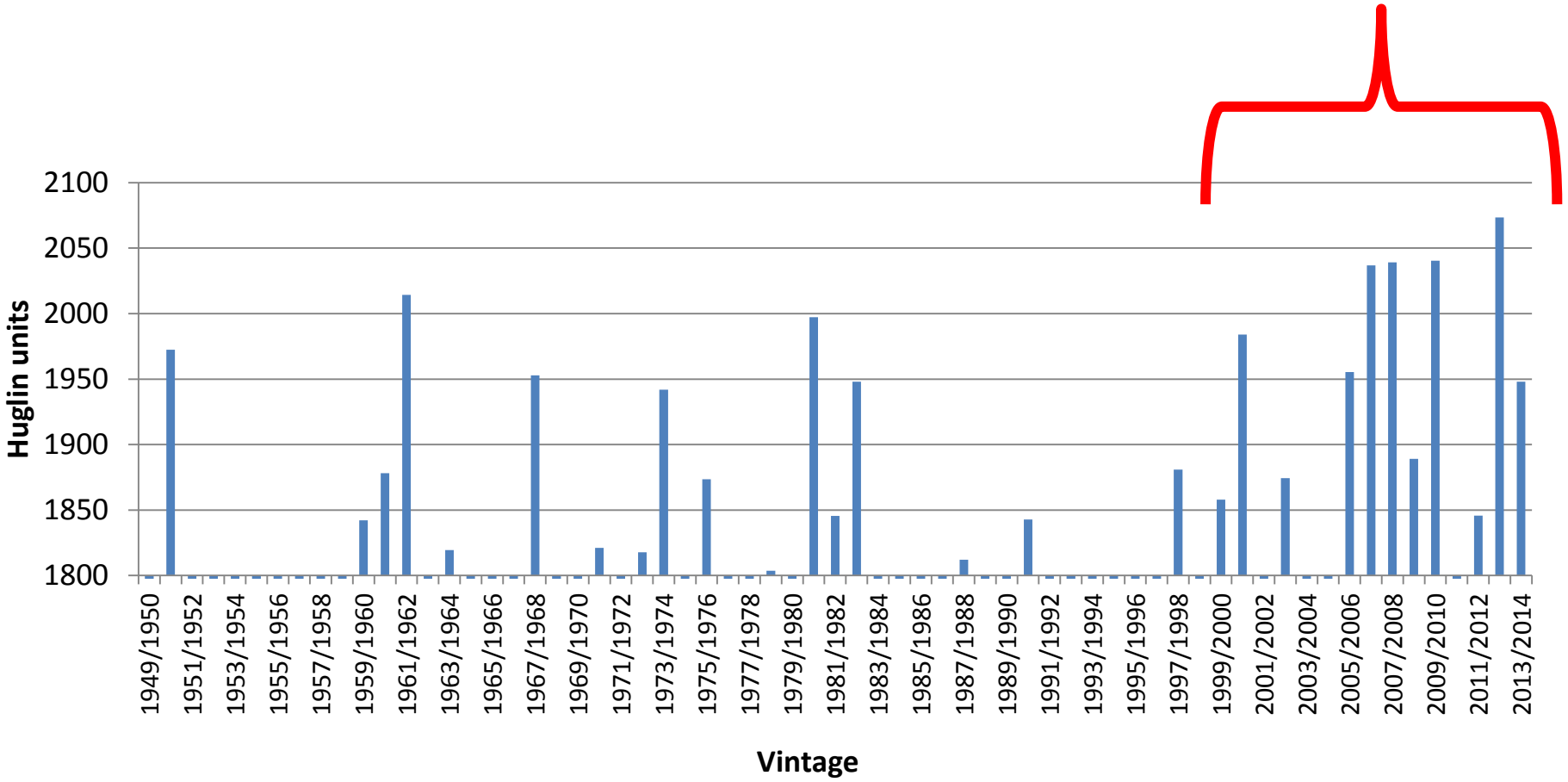


Frequency of vintages according to Huglin index classified as temperate warm (HI>2100≤2400) for TarraWarra vineyards



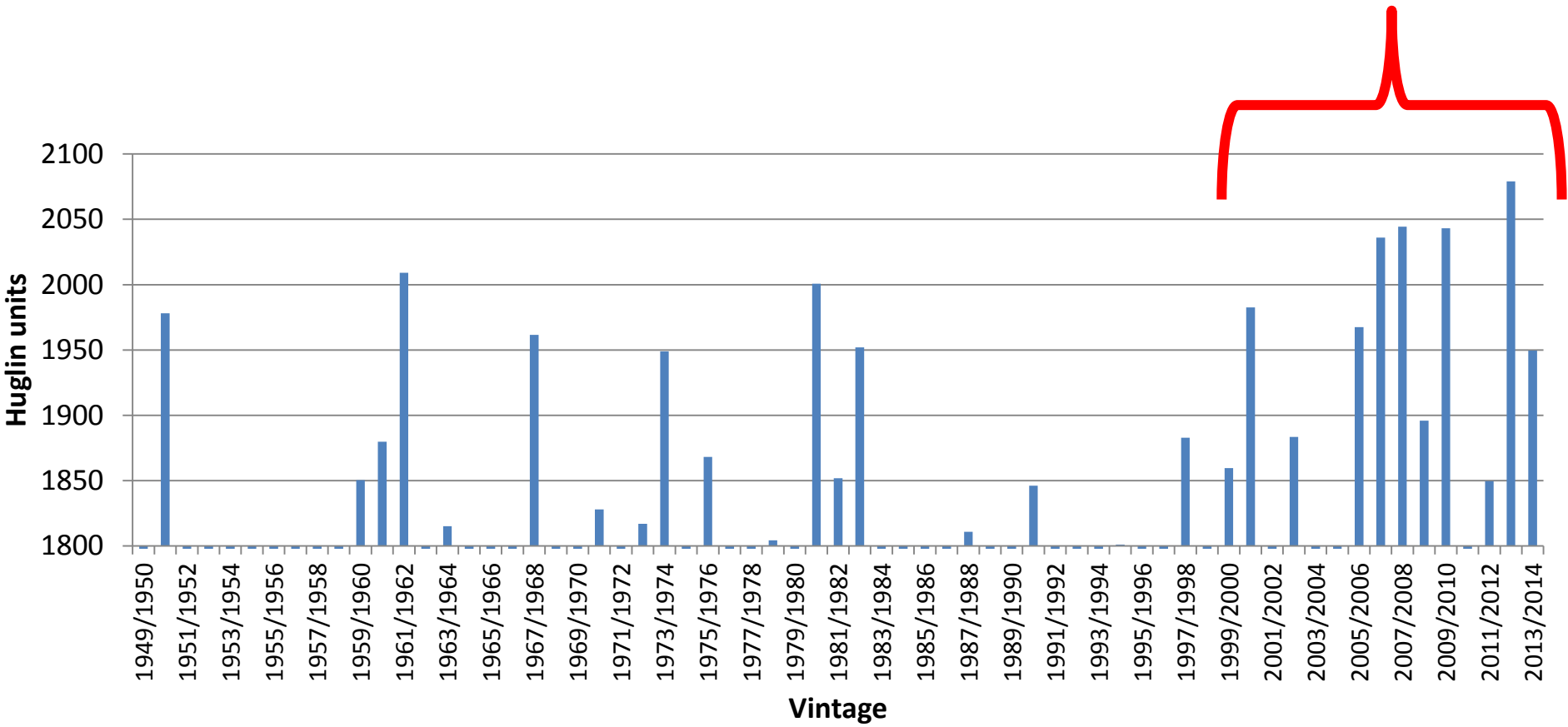
Climatic data used are SILO drilled climatic data (Department of Science, Information Technology and the Arts, Queensland State Government, Australia).

Frequency of vintages according to Huglin index classified as temperate (HI>1800≤2100) for DeBortoli vineyards



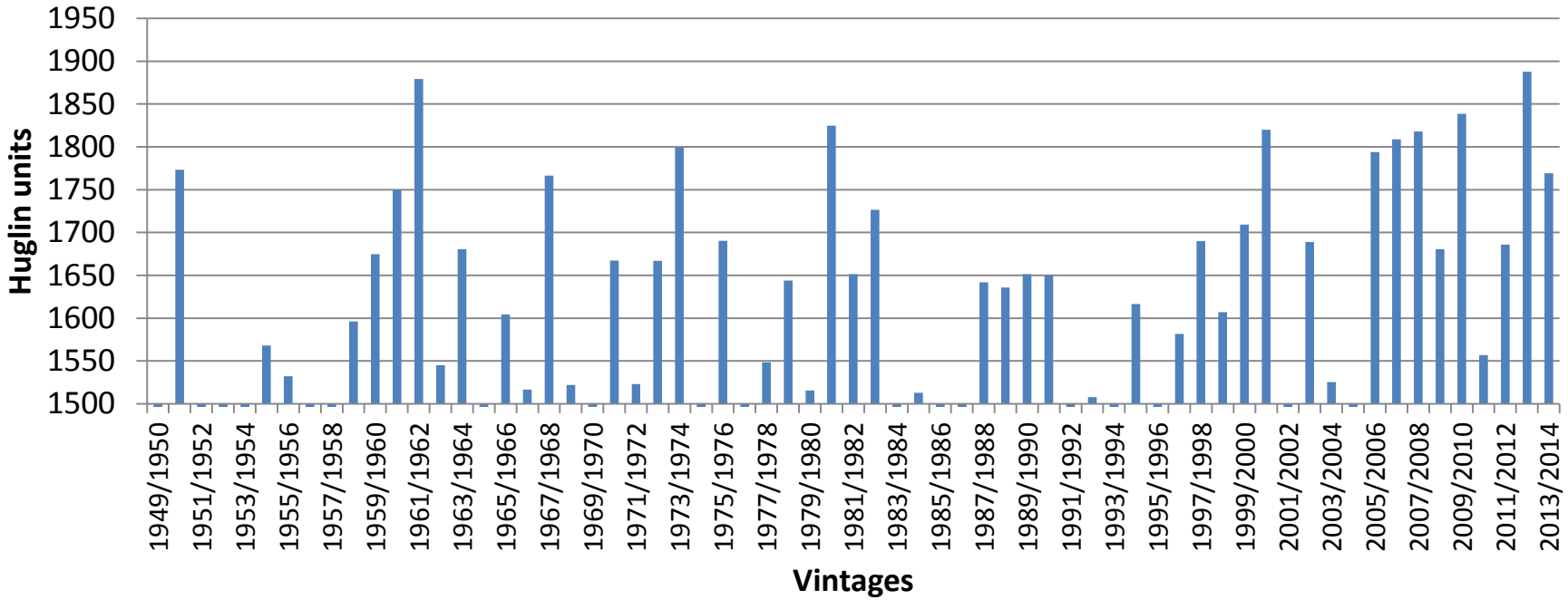
Climatic data used are SILO drilled climatic data (Department of Science, Information Technology and the Arts, Queensland State Government, Australia).

Frequency of vintages according to Huglin index classified as temperate (HI>1800≤2100) for St. Andrews Vineyards



Climatic data used are SILO drilled climatic data (Department of Science, Information Technology and the Arts, Queensland State Government, Australia).

Frequency of vintages according to Huglin index classified as cool (HI>1500≤1800) for Gambrook vineyards



Climatic data used are SILO drilled climatic data (Department of Science, Information Technology and the Arts, Queensland State Government, Australia).

Cold night index

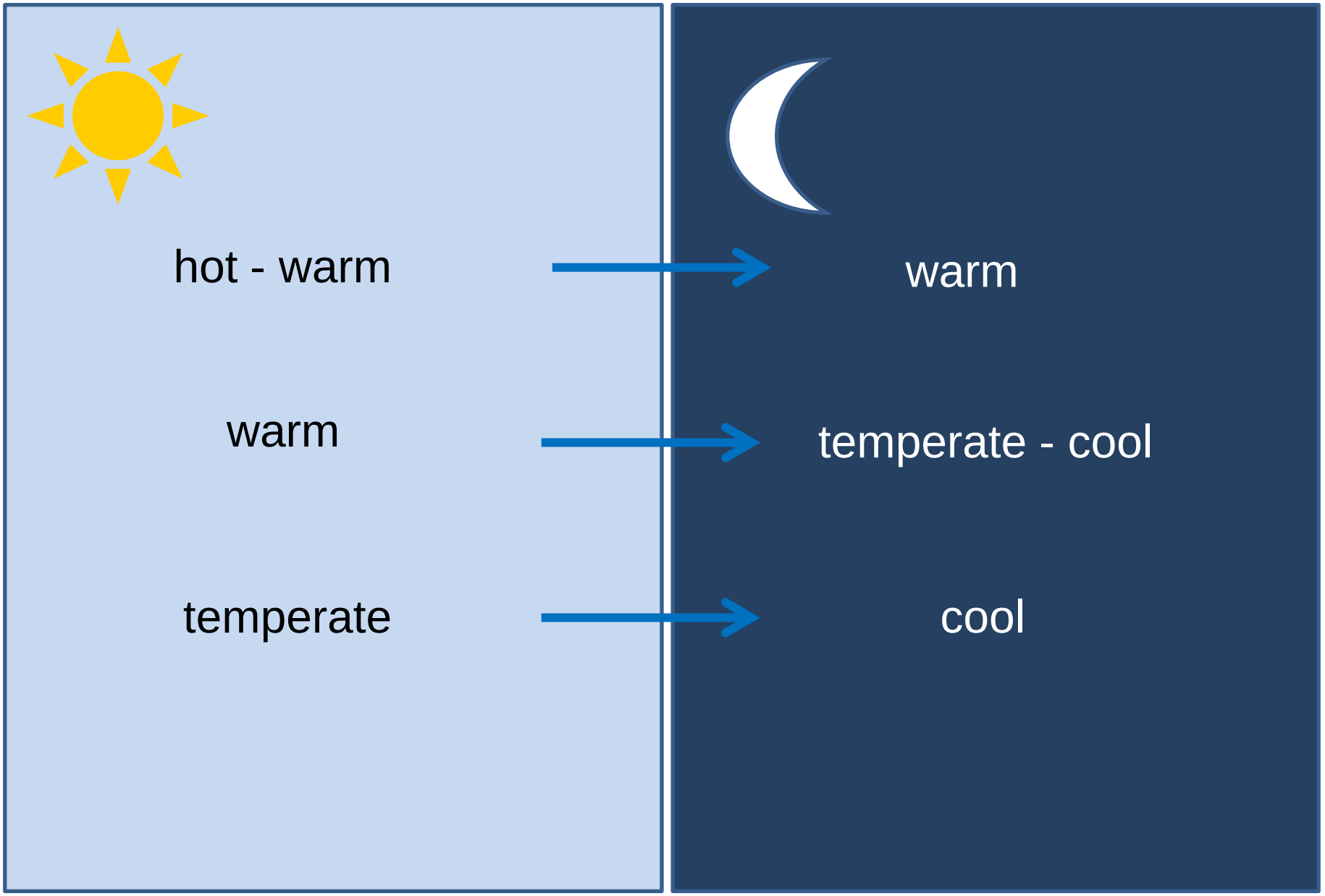
is the average of the minimal temperature one month before harvest (it could be calculated 2 or 3 months before harvest as well).

Its interest is to help to charaterize the ripening of a cultivar in a particular environment.

The four climate classes according the the cold night index (°C.) are:

- **Warm night: CI > 18**
- **Temperate night: CI > 14 ≤ 18**
- **Cool night: CI 12 ≤ 14**
- **Very cool night: CI ≤ 12**

Day and night temperature and wine styles?



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PLOS ONE

Is Transcriptomic Regulation of Berry Development More Important at Night than During the Day?

Markus Rienth[1,2], Laurent Torregrosa[2], Mary T. Kelly[3], Nathalie Luchaire[2,4], Anne Pellegrino[4], Jérôme Grimplet[5], Charles Romieu[6]*

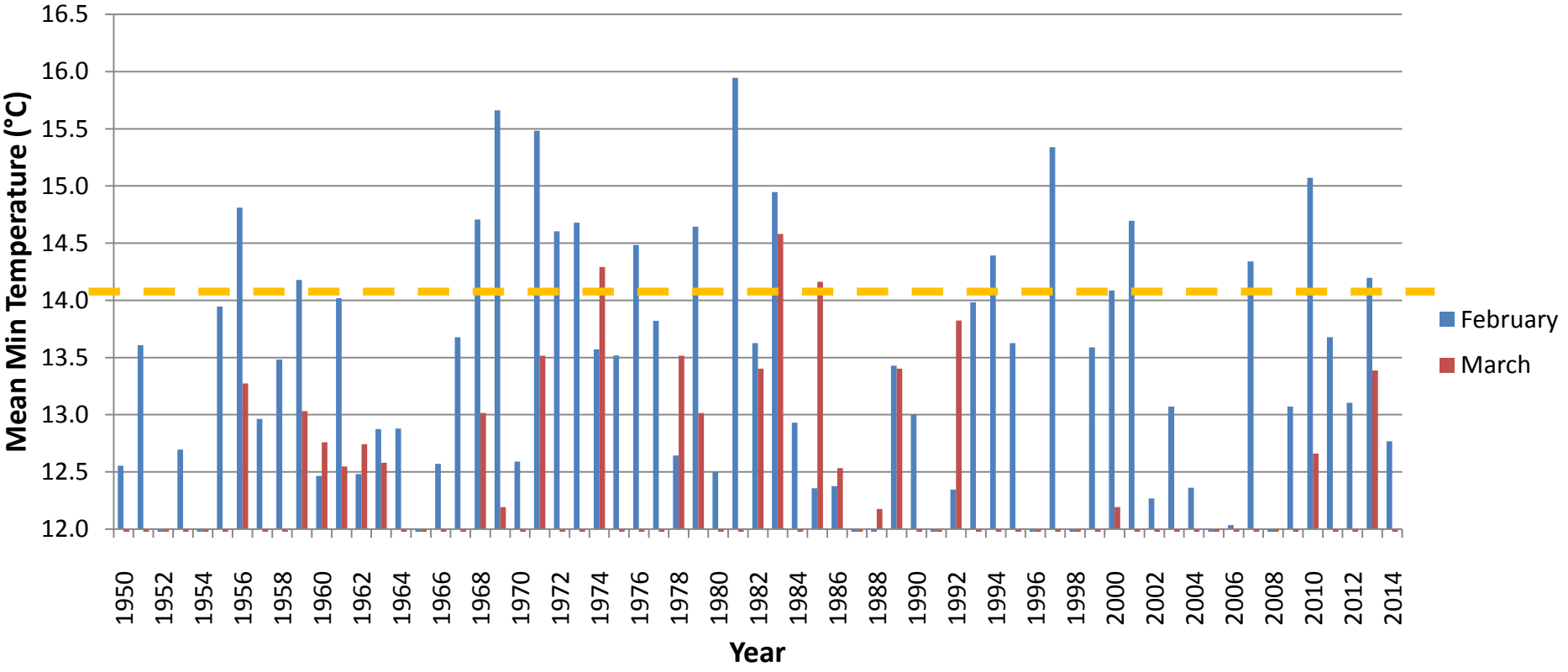
1 Fondation Jean Poupelain, Javrezac, France, 2 INRA-SupAgro, UMR AGAP, Montpellier, France, 3 Laboratoire d'Oenologie, UMR1083, Faculté de Pharmacie, Montpellier, France, 4 INRA, UMR LEPSE, Montpellier, France, 5 ICVV (CSIC, Universidad de La Rioja, Gobierno de La Rioja), Logroño, Spain, 6 INRA, UMR AGAP, Montpellier, France

9273 developmentally modulated probsets.

All day-detected transcripts were modulated at night, whereas 1843 genes were night-specific.

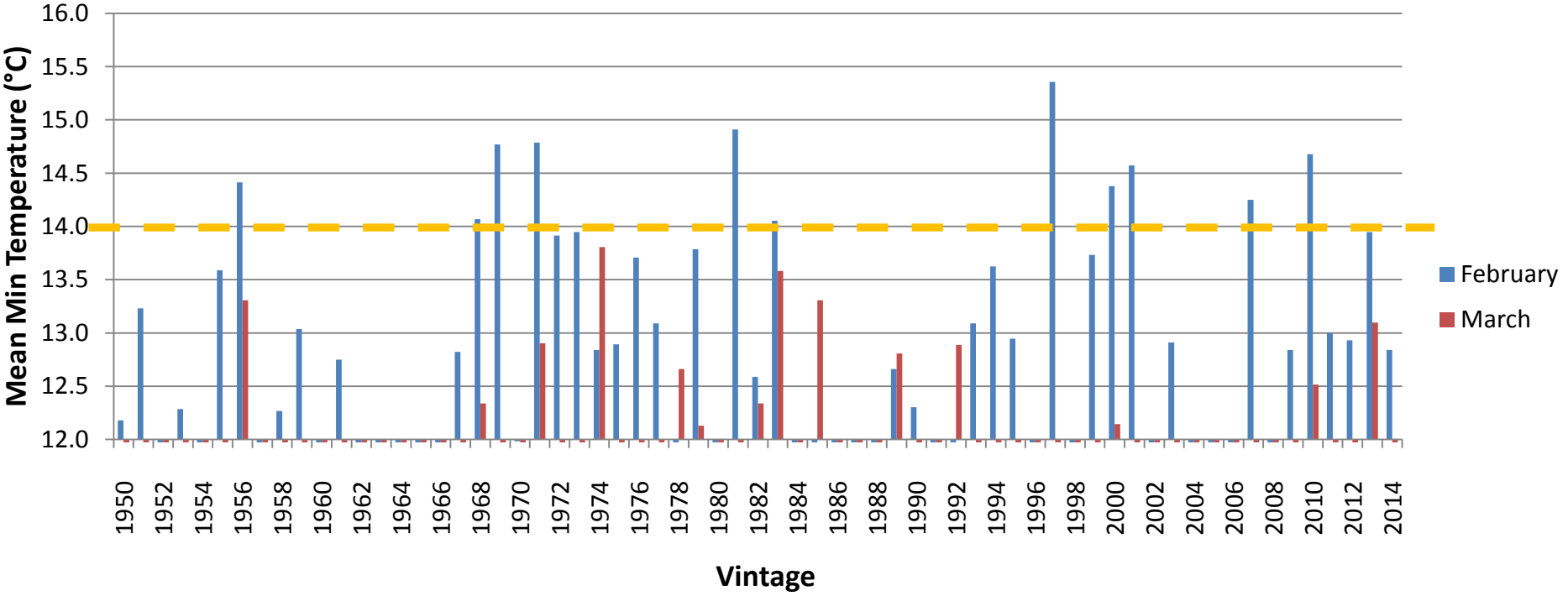
Frequency of vintages with mean minimum February and March temperature above12°C for TarraWarra vineyards

Very cool to cool nights



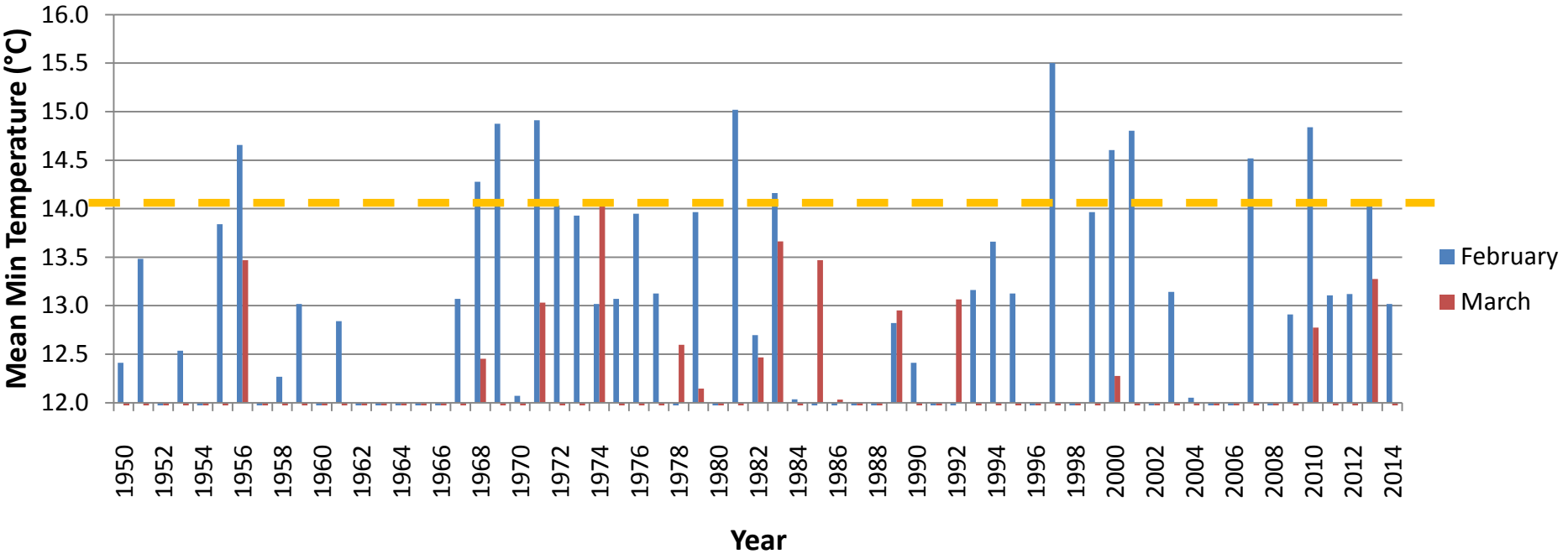
Frequency of vintages with mean minimum February and March temperature above12°C for DeBortoli vineyards

Very cool to cool nights



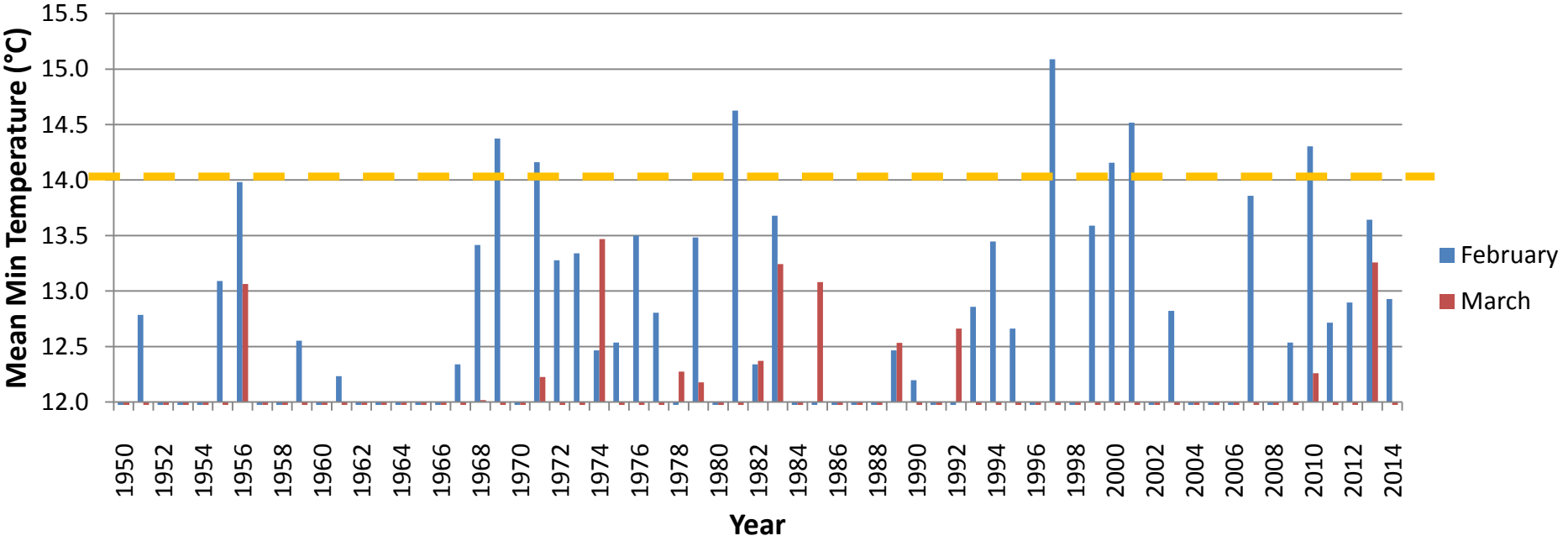
Frequency of vintages with mean minimum February and March temperature above12°C for St. Andrews vineyards

Very cool to cool nights

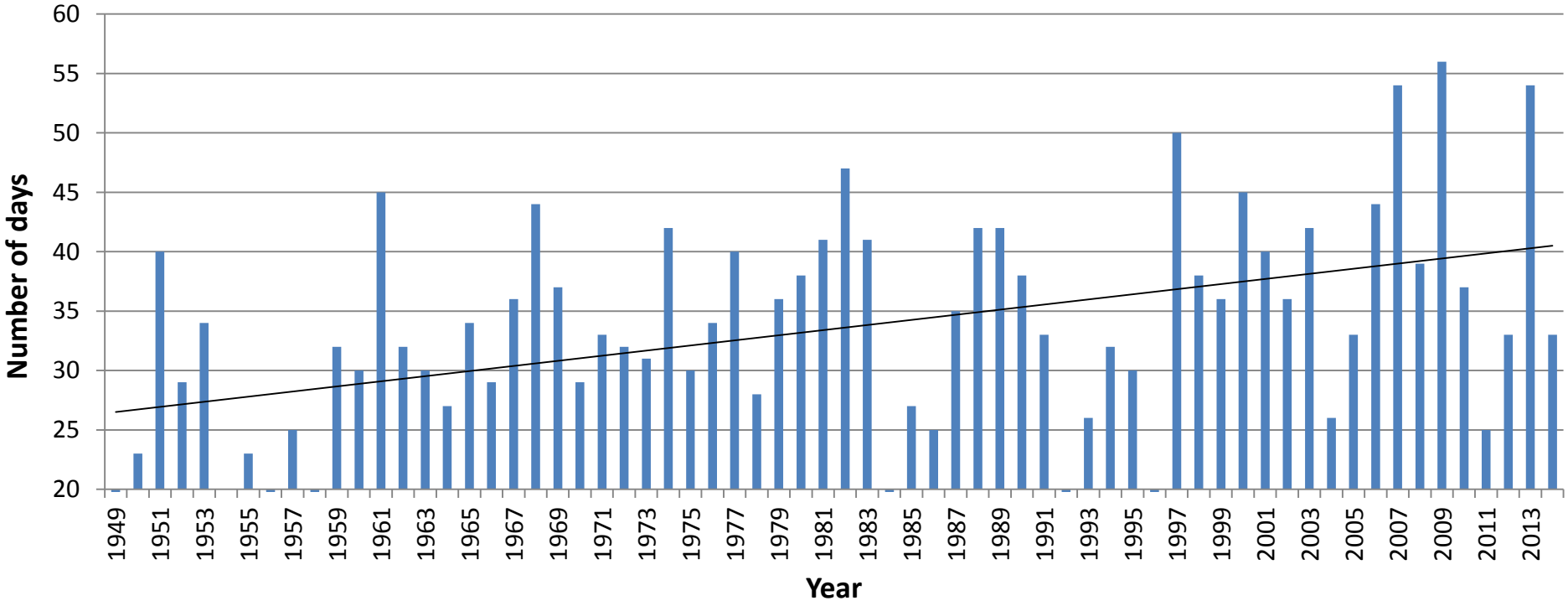


Frequency of vintages with mean minimum February and March temperature above12°C for Gambrook vineyards

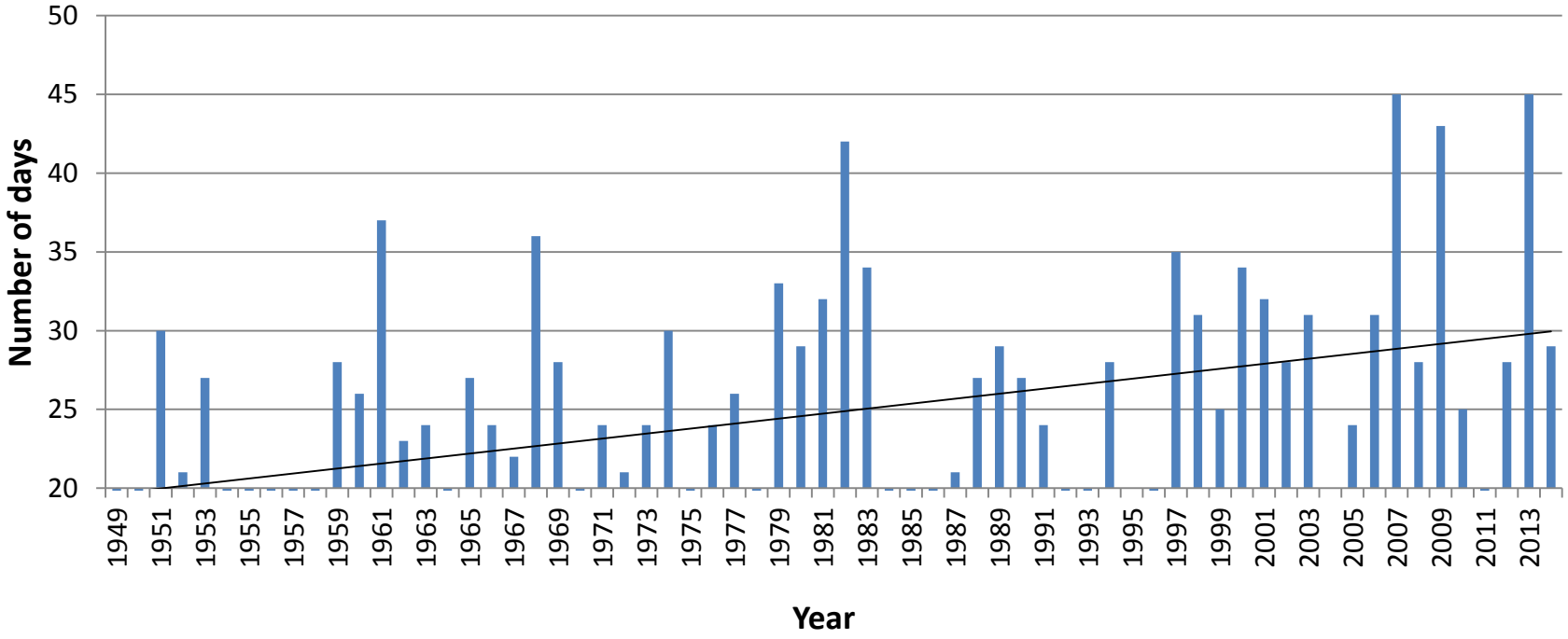
Very cool to cool nights



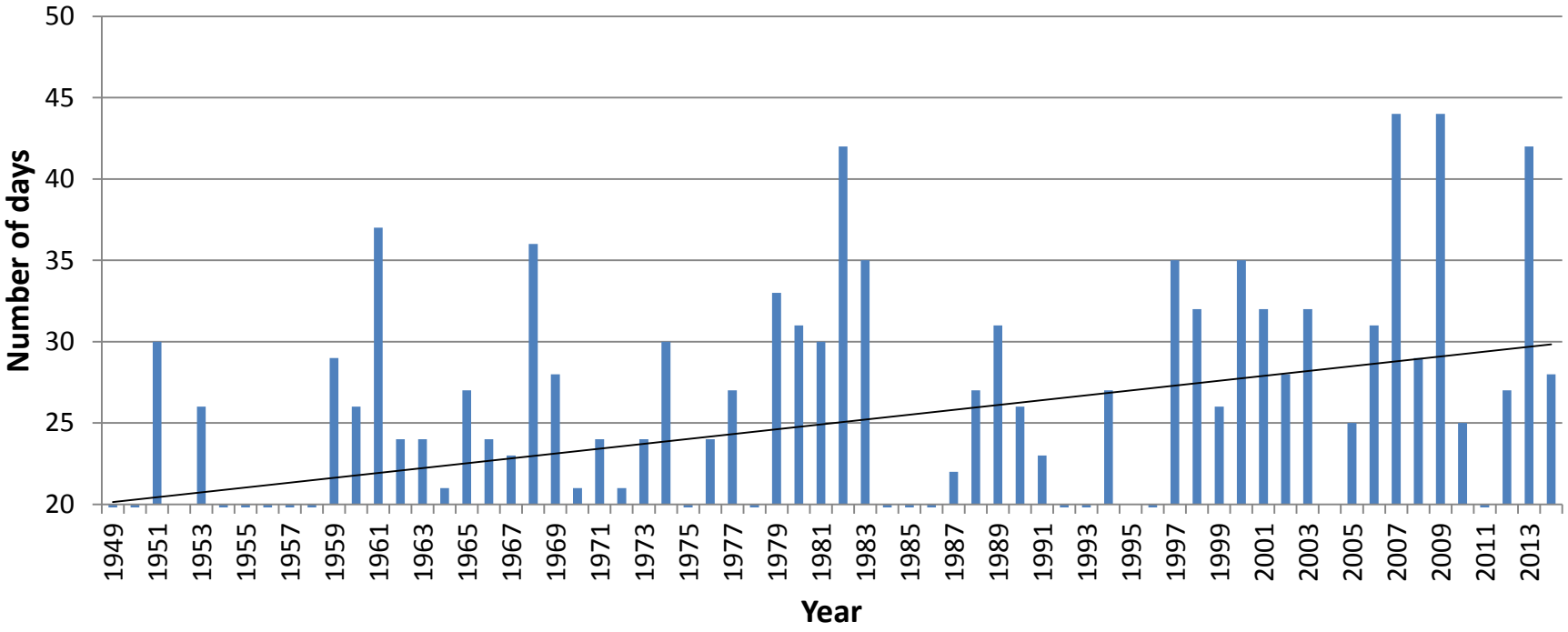
Frequency of days in a vintage with max temperature 30°C or above for TarraWarra vineyards



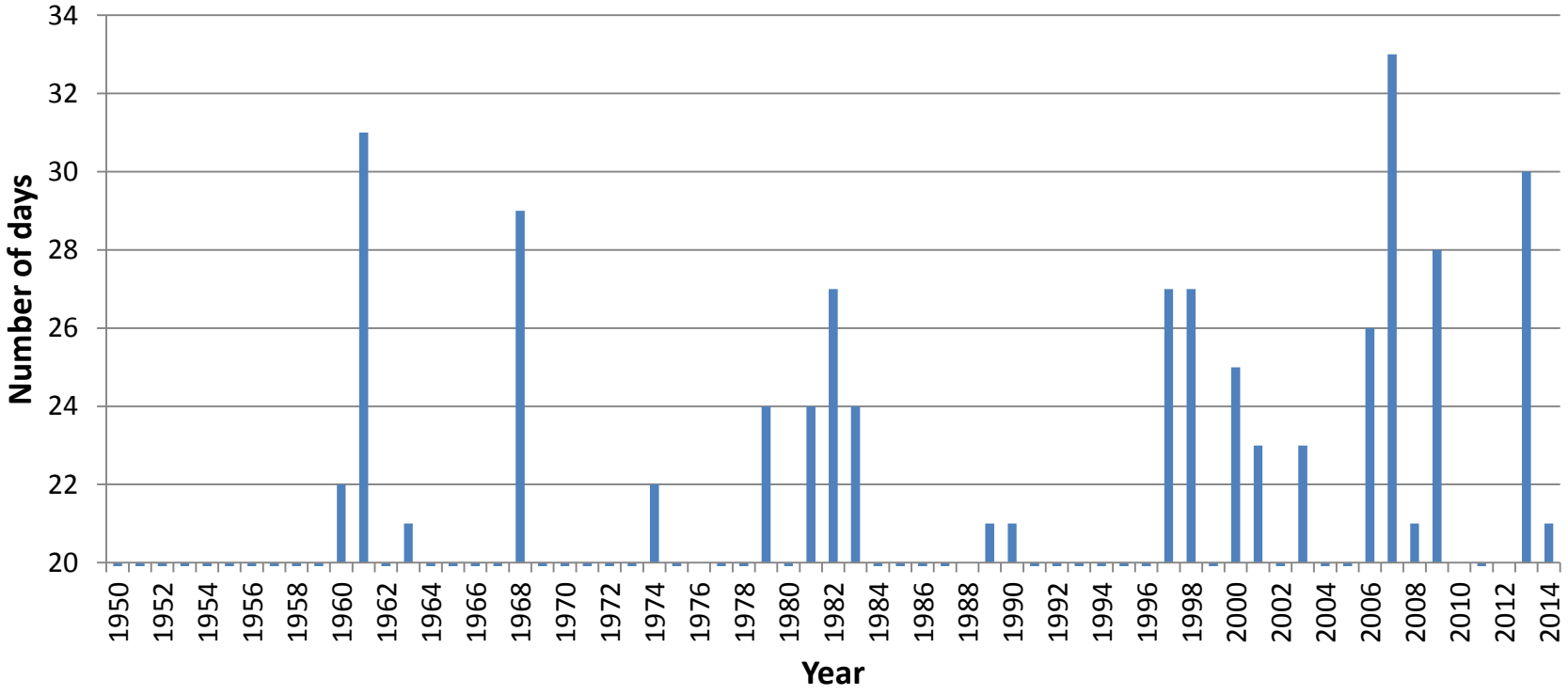
Frequency of days in a vintage with max temperature 30°C or above for DeBortoli vineyards



Frequency of days in a vintage with max temperature 30°C or above for St. Andrews vineyards



Frequency of days in a vintage with max temperature 30°C or above for Gambrook vineyards

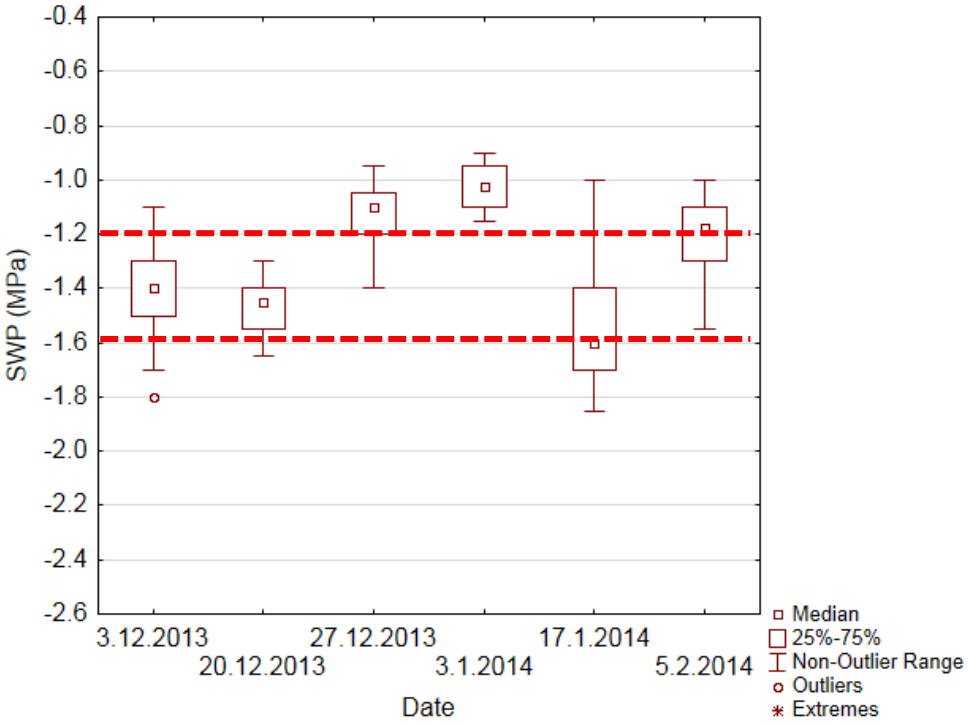


Vine water status
Soil moisture

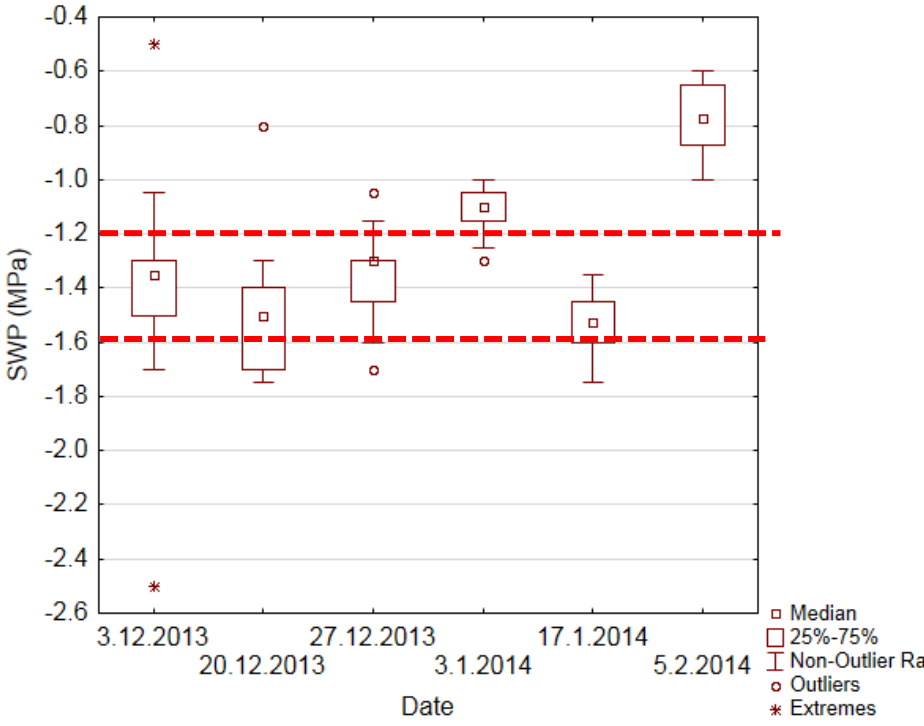
When and how vine water status affects berry ripening?

Stem water potential measurements

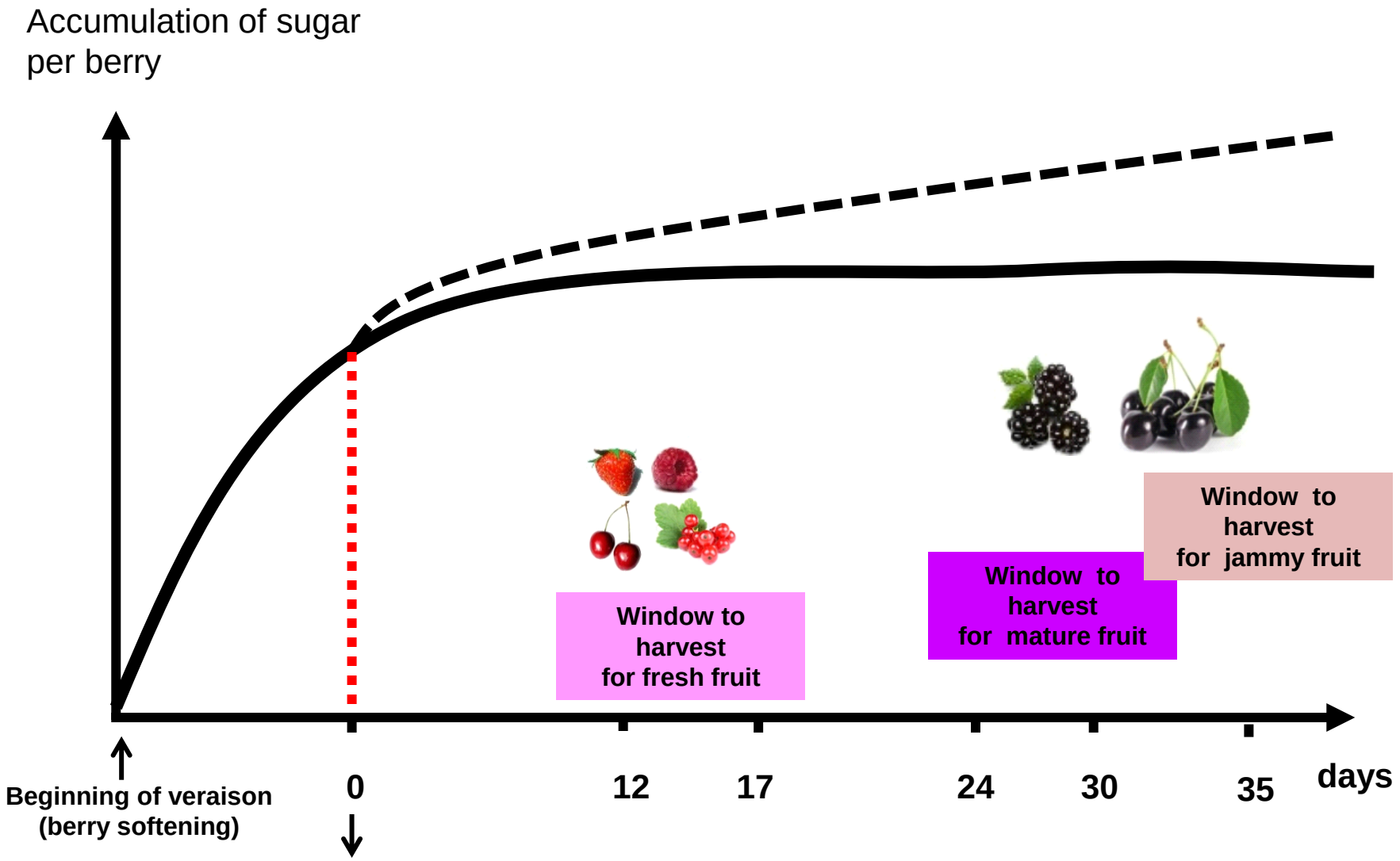
Vineyard A



Vineyard B

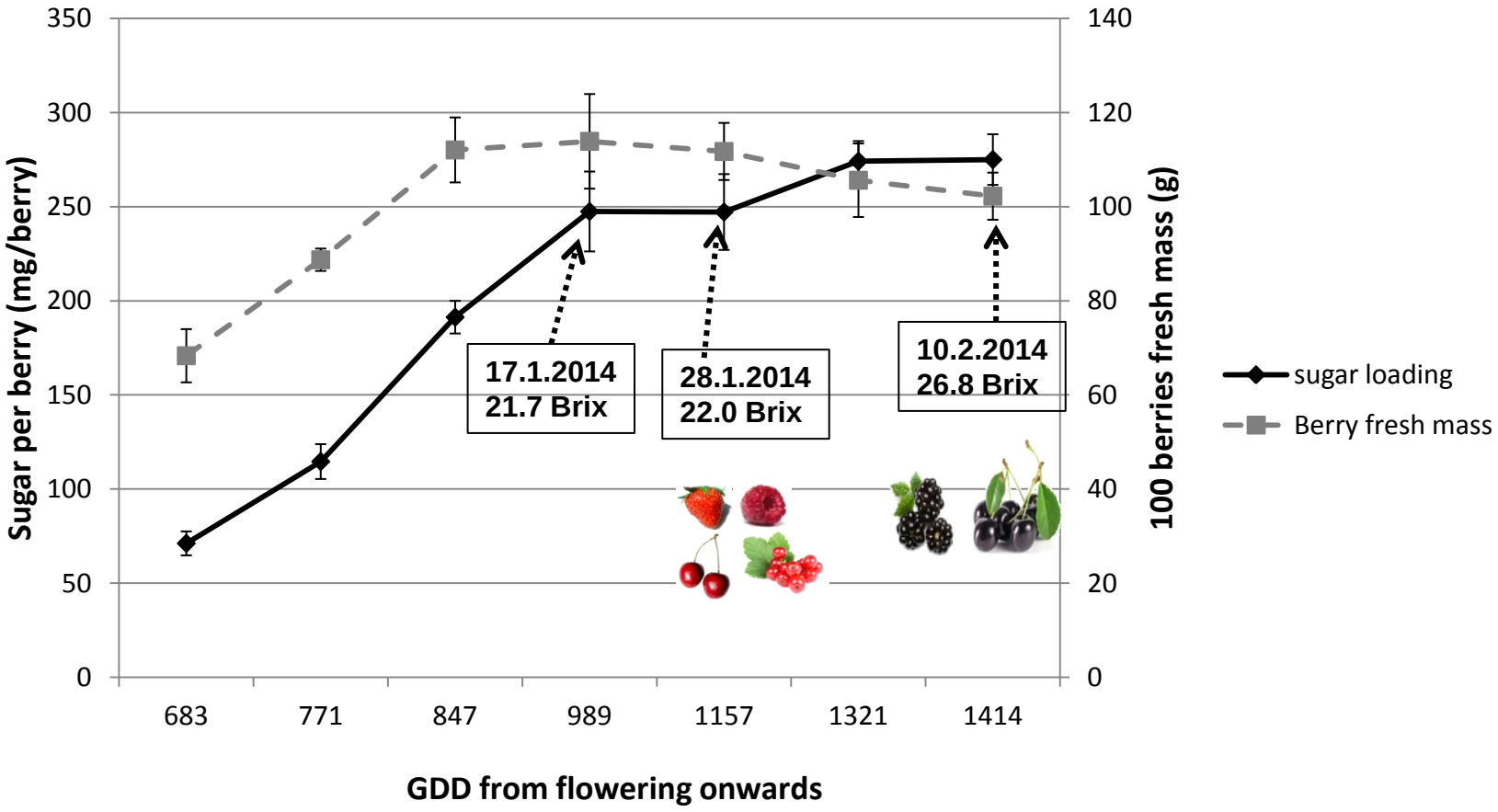


Shiraz sequential harvest proposed model

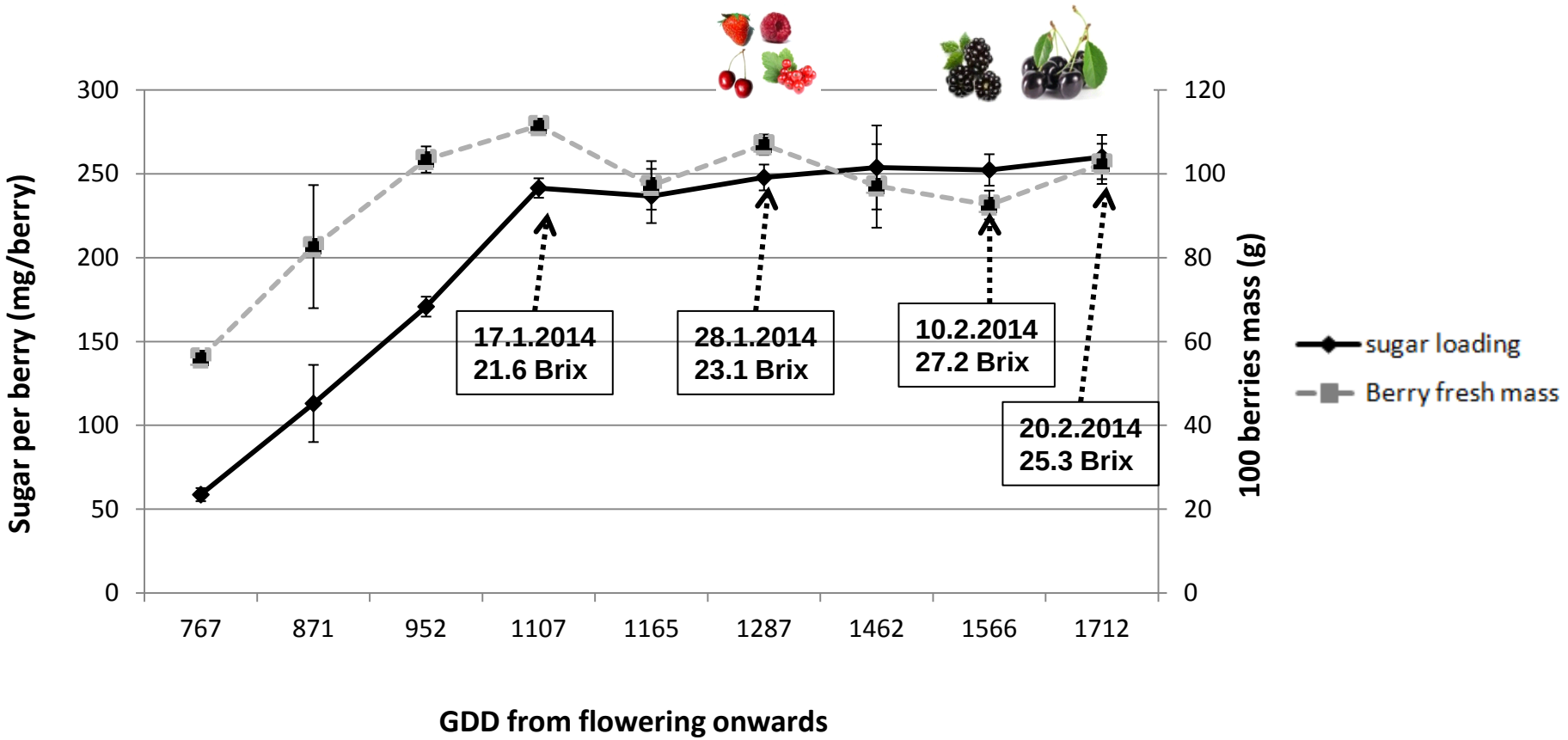


Day 0 = when sugar per berry reaches a plateau, typically 20-22 °Brix

Sugar loading curve for Shiraz A



Sugar loading curve for Shiraz B



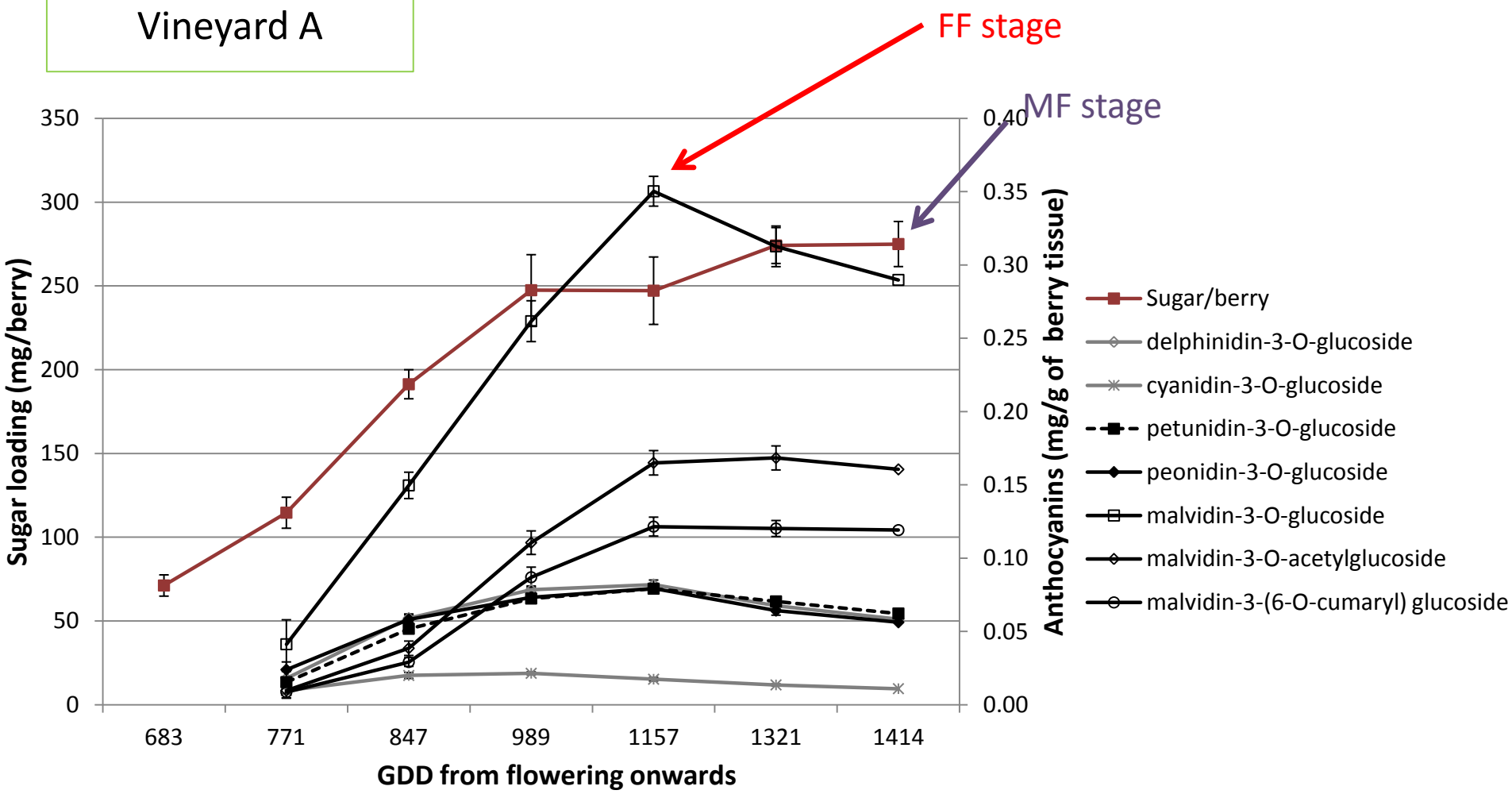
Basic parameters of maturity

	Vineyard A		Vineyard B		
	Fresh Fruit	Mature Fruit	Fresh Fruit	Mature Fruit	Jammy Fruit
	Harvest 1	Harvest 2	Harvest 1	Harvest 2	Harvest 3
Date	28.1.2014	10.2.2014	28.1.2014	10.2.2014	20.2.2014
Baume	12.5	14.9	13.1	15.1	14.1
TA (g/L)	5.36	3.3	6.1	3.4	3.1
pH	3.70	4.36	3.52	4.10	4.04

Commercial harvest dates coincided with mature fruit harvest stage

Anthocyanins in grape berry

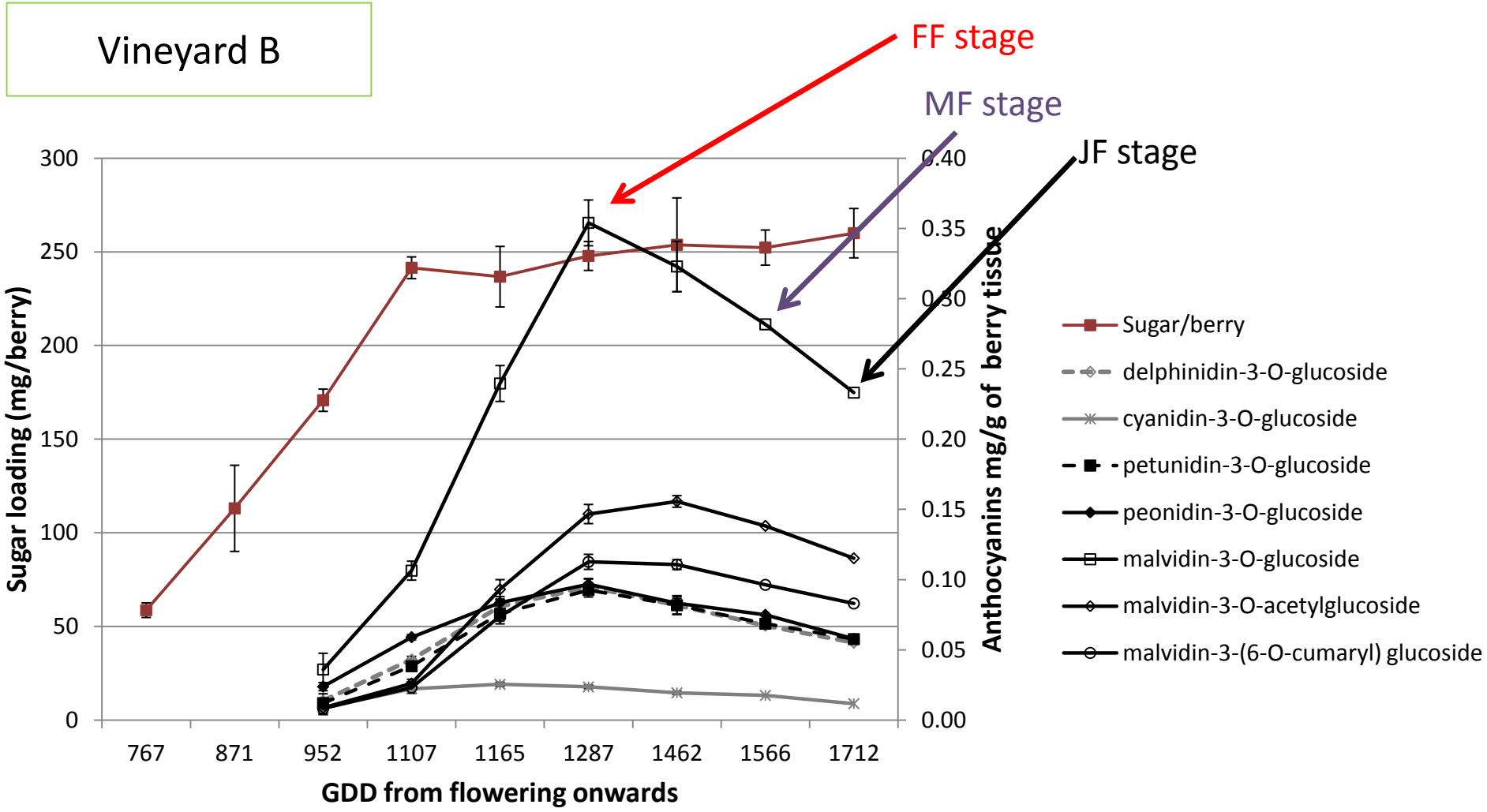
Vineyard A



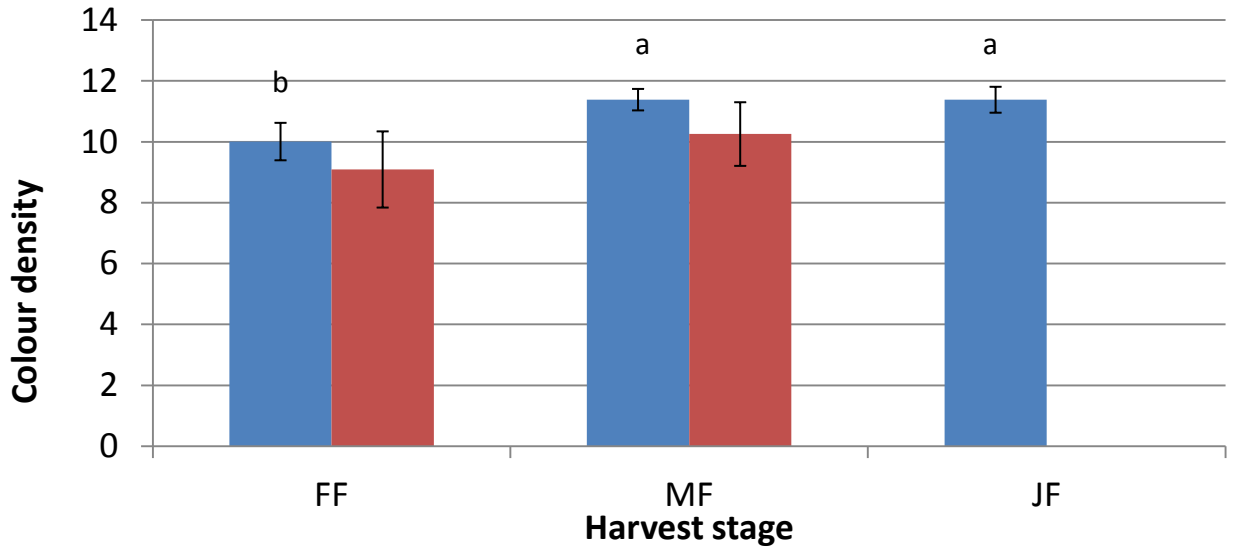
Anthocyanins are expressed as an equivalent of malvidin-3 glucoside.

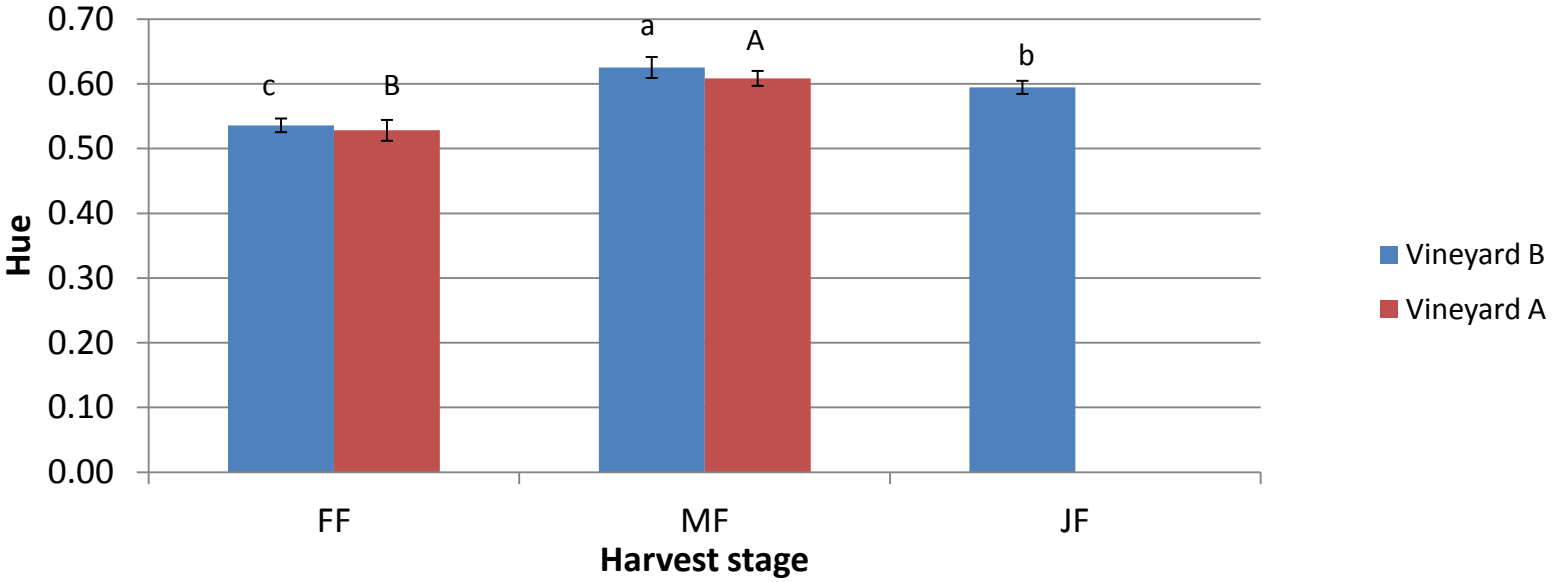
Anthocyanins in grape berry

Vineyard B

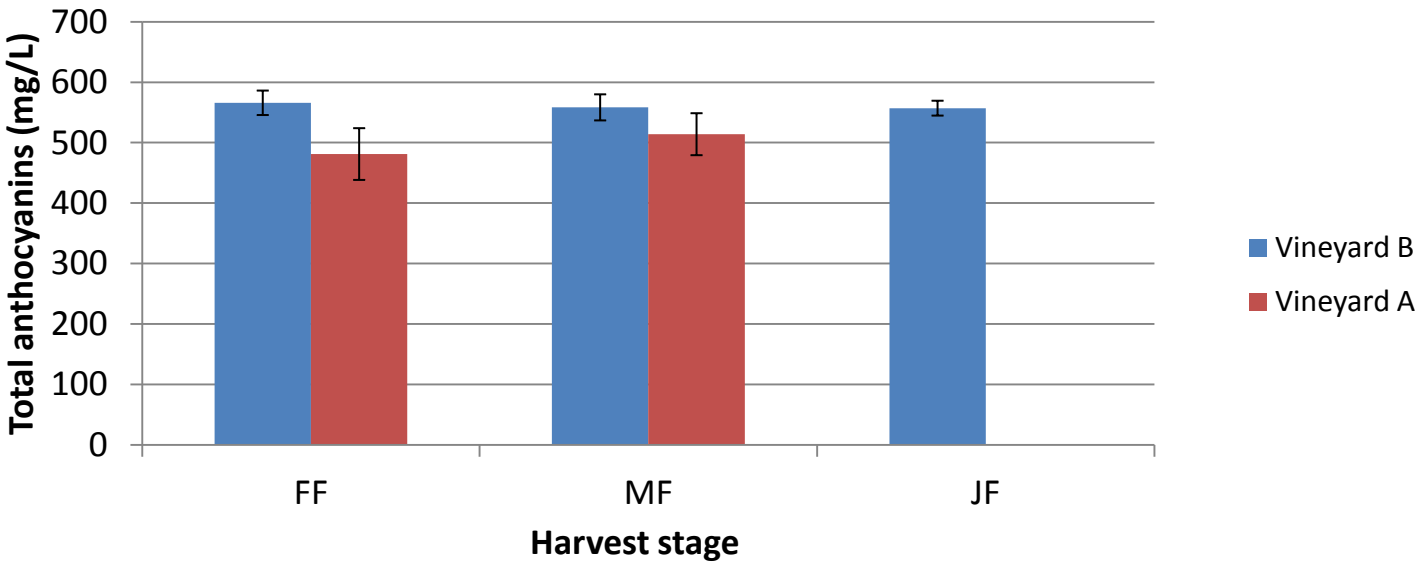


Wine colour

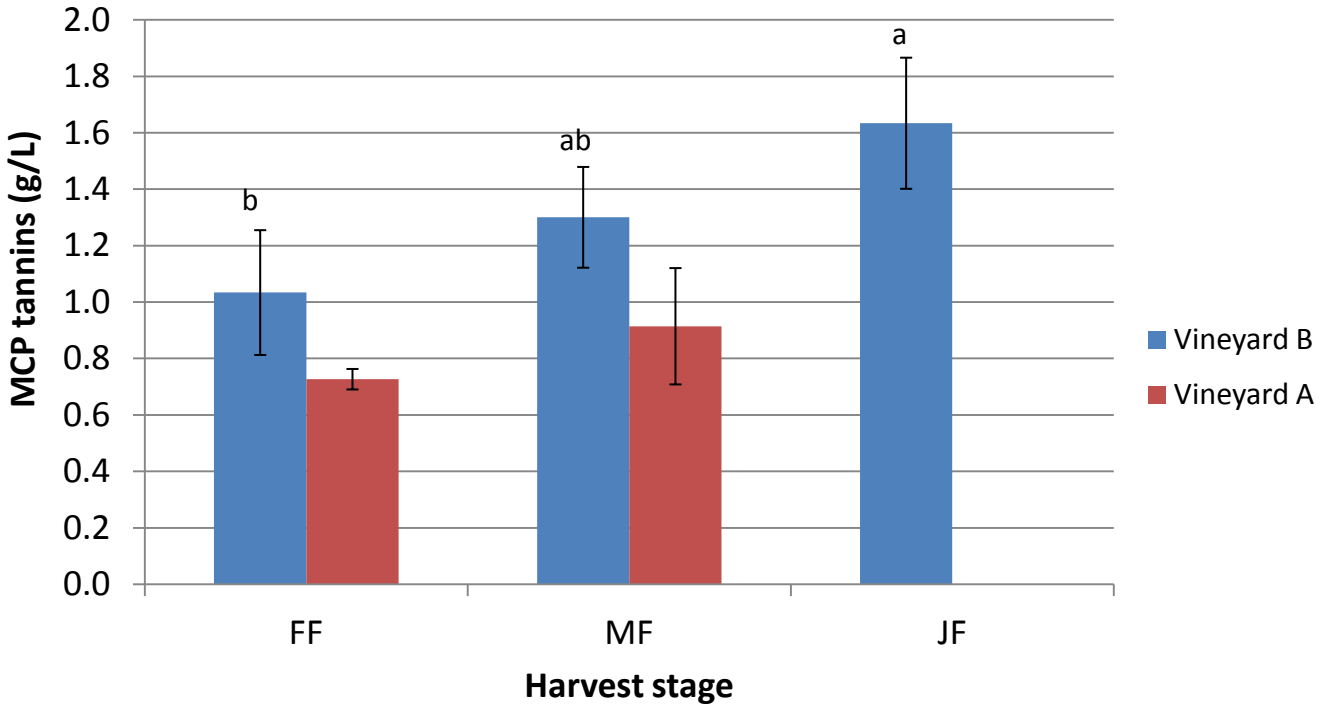

14
12
10
8
6
4
2
0
Colour density
b
a
a
FF
MF
JF
Harvest stage
Vineyard B
Vineyard A


0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Hue
c
B
a
A
b
FF
MF
JF
Harvest stage
Vineyard B
Vineyard A

Wine colour

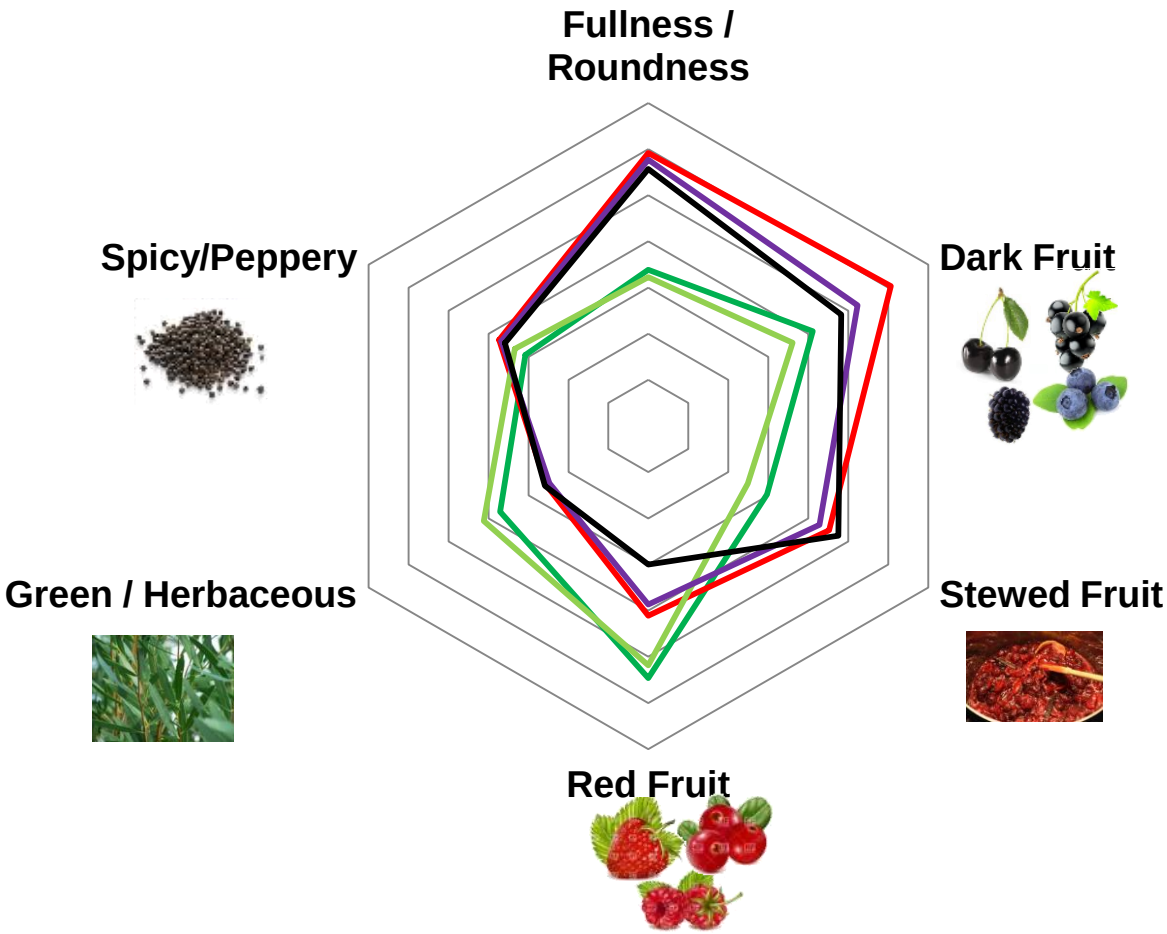

Total anthocyanins (mg/L)
700
600
500
400
300
200
100
0
FF
MF
JF
Harvest stage
Vineyard B
Vineyard A

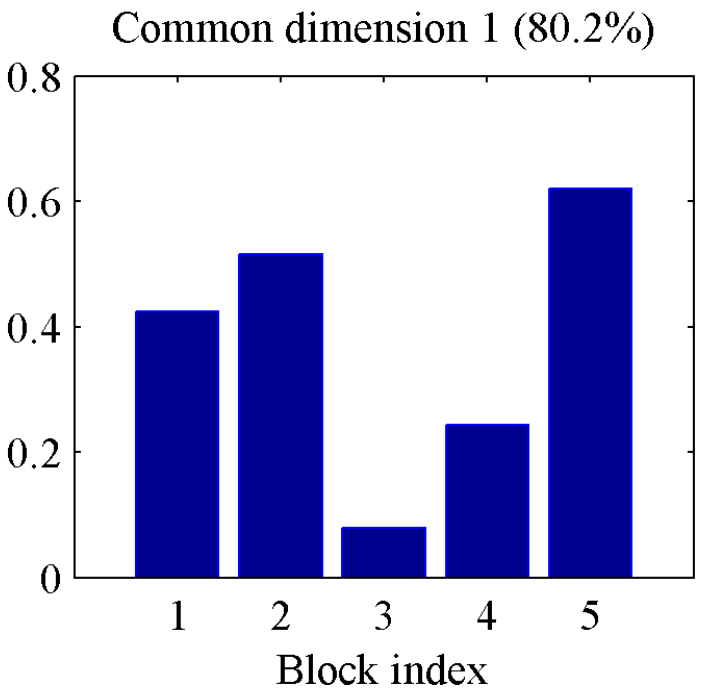
Wine tannins

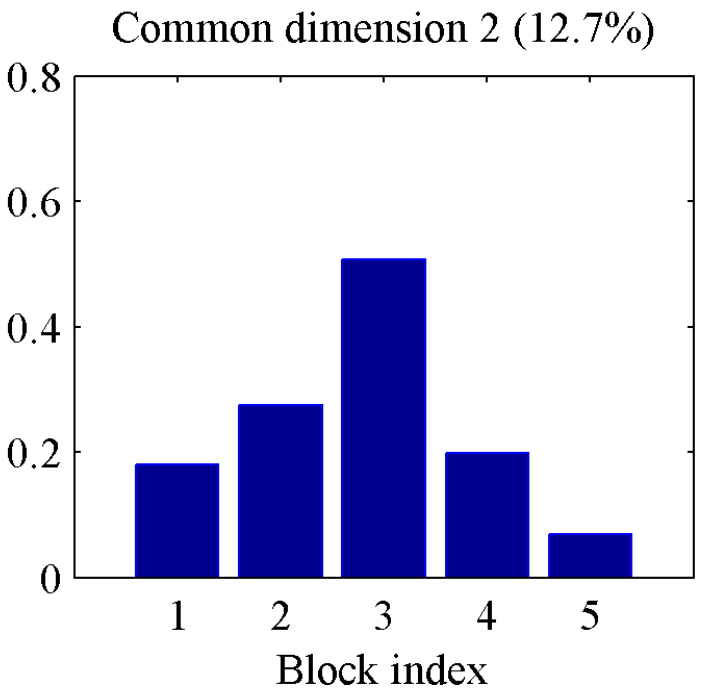


MCP tannins are expressed as an epicatehin equivalent.

Wine sensory evaluation

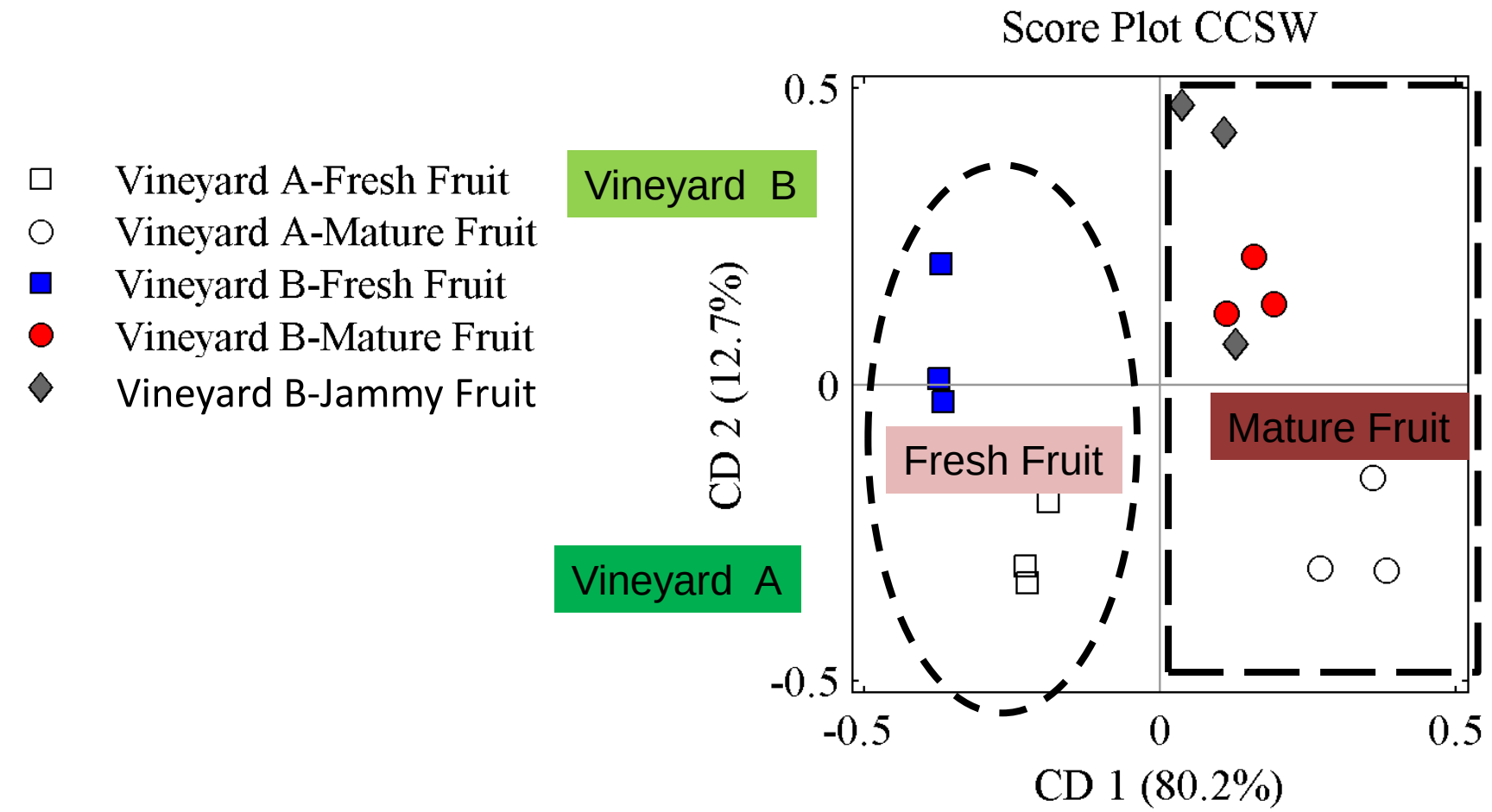




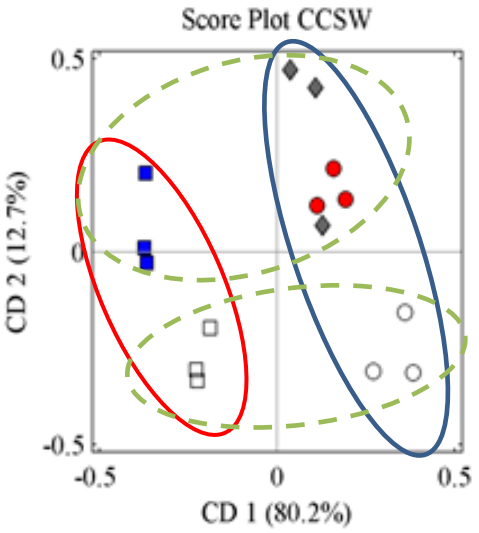


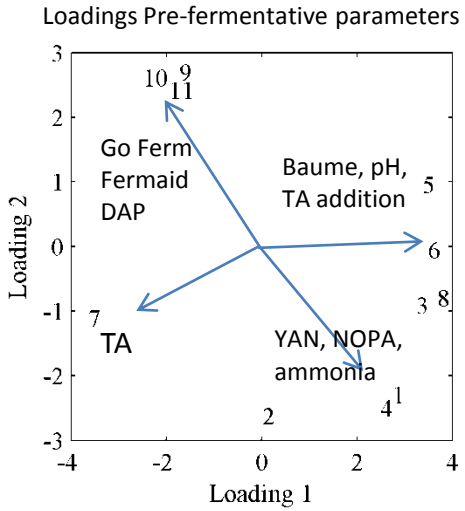
1 Pre-fermentative parameters
2 Berry Terpenes and Norisoprenoids
3 Berry Amino Acids
4 Wine Volatiles
5 Wine Sensory Evaluation

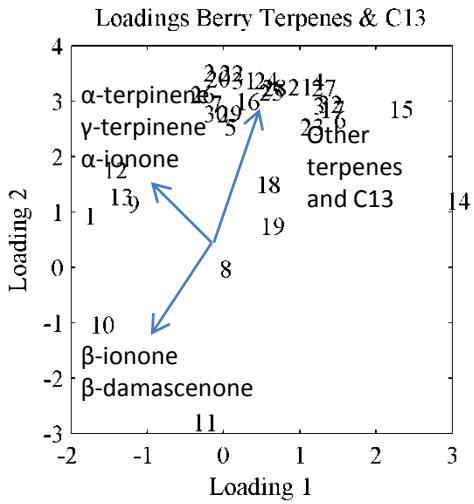
Correlating grape and wine chemical with wine sensory composition

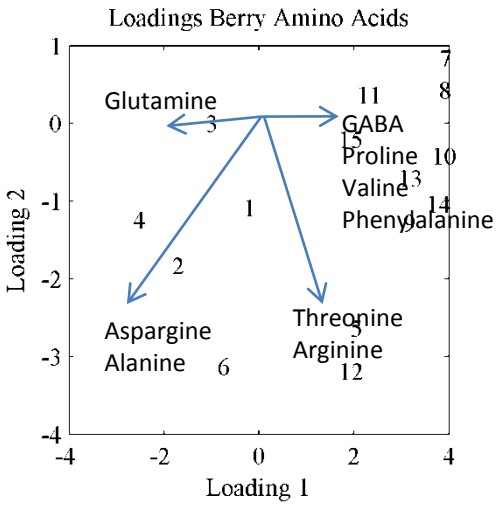


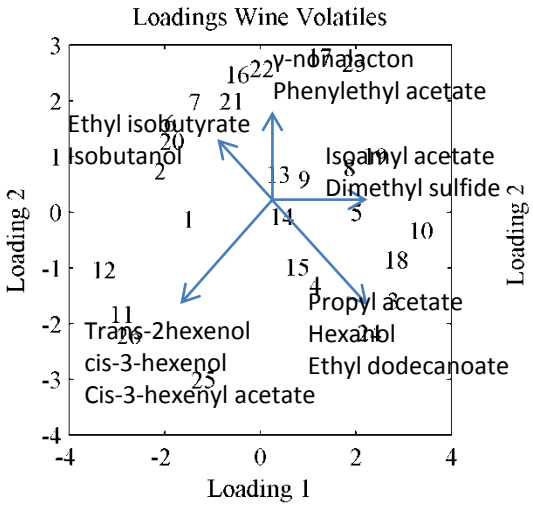
Vineyard A-Fresh Fruit
Vineyard A-Mature Fruit
Vineyard B-Fresh Fruit
Vineyard B-Mature Fruit
Vineyard B-Jammy Fruit

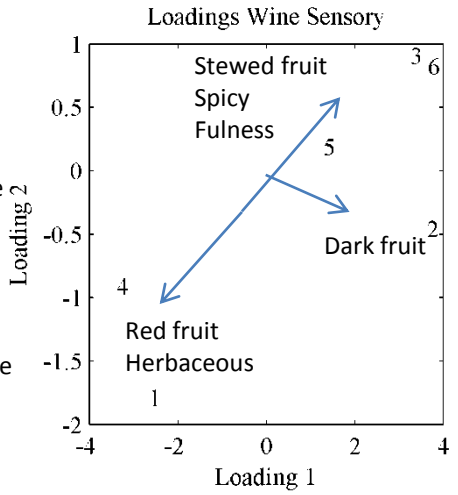












Wrap up

- For Shiraz there is a clear aromatic difference in the wines from grapes harvested sequentially (fresh fruit and mature fruit)
- Harvest date was the major driver of wine style, irrespective of vineyard site and management, clone ….
- Grape and wine chemical composition did change according to the harvest date
- Commercial harvest dates from the wineries coincided with mature stage
- More to come about the possible role of abiotic factors (temperature and water)

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Thank you

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NSW GOVERNMENT | Department of Primary Industries

NEW SOUTH WALES wine

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