Nick Dry

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Workshop Outline

1. Key findings from the rootstock trial and related rootstock selection discussion- Nick
2. Root Growth and soil evaluation and impacts on management- Dave
3. Discussion on rootstock selection and management- Nick and Dave

Background and history of rootstock use

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Pre-1862- Phylloxera imported into France from North America on ‘American Vines’.

1864/65-First symptoms of vine decline appear in French vineyards.

1868- Phylloxera confirmed as the cause.

Early 1870’s- Experimentation on methods of control.

1872 (approx.) - First *V. vinifera* grafted onto American *vitis* sp.

1877- Phylloxera first recorded in Australia.

1880’s-1930- intense period of rootstock breeding.

Rootstock Breeding: 19th and early 20th century

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Rootstock	Parentage	Breeding Year
Riparia Gloire	*V. riparia*	1879
St George	*V. rupestris*	1880
3309C	*V. riparia x V. rupestris*	1881
101-14	*V. riparia x V. rupestris*	1882
Schwarzmann	*V. riparia x V. rupestris*	1891
140 Ruggeri	*V. berlandieri x V. rupestris*	1894
1103 Paulsen	*V. berlandieri x V. rupestris*	1896
SO4	*V. berlandieri x V. riparia*	1896
5BB Kober	*V. berlandieri x V. riparia*	1896
Ramsey	*V. champinii*	1900
110 Richter	*V. berlandieri x V. rupestris*	1902
5C Teleki	*V. berlandieri x V. riparia*	1922
Börner	*V. riparia x V. cinerea cv. Arnold*	1936

Adapted from table *in* Walker, A. (1992) Future Directions of Rootstock Breeding. ASEV.

Rootstock Breeding: late 20th century

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Table 2. Breeding data of new rootstocks released in the 21st century.

Common name	Country	Breeder	Breeding year	Released year	Parentage
RS-3	USA	Michael McKenry & David [illegible] (USDA)	1991[†]	2003[‡,§]	Ramsey[¶] × Schwarzmann[†,¶,††]
Merbein 5489 Merbein 5512 Merbein 6262	Australia	CSIRO	1967[‡‡]	2005[‡‡]	Complex hybrid from *V. berlandieri*[§§] Complex hybrid from *V. cinerea*
[illegible]	Hungary	Georgikon faculty		2005[¶¶]	5 BB Kober[¶] × *V. vinifera*[¶¶]
UCD GRN-1	USA	Andy Walker (University of California Davis)	–	2008[a,b]	*V. rupestris* cv. A. de Serres × *M. rotundifolia* cv. Cowart[a,b]
UCD GRN-2					[*V. rufotomentosa* × (*V. champinii* cv. Dog Ridge × *V. riparia* G. de M.[c])] × *V. riparia* G. de M.[a,b]
UCD GRN-3					[*V. rufotomentosa* × (*V. champinii* cv. Dog Ridge × *V. riparia* G. de M.[c])] × *V. champinii* cv. c9038[a,b]
UCD GRN-4					L6-1 (Ramsey[¶] × *V. riparia* G. de M.[c]) × *V. champinii* cv. c9021[a,b]
UCD GRN-5					101-14[¶] × 3-1A (*V. mustangensis* × *V. rupestris*)[e]
Matador	USA	Peter Cousins (USDA)	2000[d]	2010[d,e]	4-12A (*V. champinii* cv. Dog Ridge × *V. rufotomentosa*) × *V. riparia*[e]
Minotaur					(*M. rotundifolia* × *V.vinifera*) × 140 Ruggeri[¶,f]
Kingfisher					106/8 [*V. riparia* × (*V. cordofolia* × *V. rupestris*)] × *V. berlandieri* cv. Rességuier 1[h,i]
Nemadex Alain Bouquet	France	INRA	1987[f]	2011[g]	8 B (*V. berlandieri* × *V. riparia*) × 333 EM[¶,h,i,j]
M1	Italy	University of Milan	Ends of 1980s[h]	2014[h]	R 27 (*V. berlandieri* × *V. riparia*) × 5 C Teleki[¶,h,i,j]
M2					41 B[¶] × *V. berlandieri* cv. Rességuier 1[h,i]
M3					Self-pollination of 'Binova' (SO4[¶] mutation)[h,k]
M4					41 B[¶] × 110 Richter[¶,l]
Star 50	Italy	Cesare Intrieri (Bologna University)	1990[h,k]	2014[h]	
Star 74					
RG8	Spain	Rafael García (Vitis Navarra nursery)	1997[l]	AP[l]	
RG9					
RG10					

Rootstock parent species

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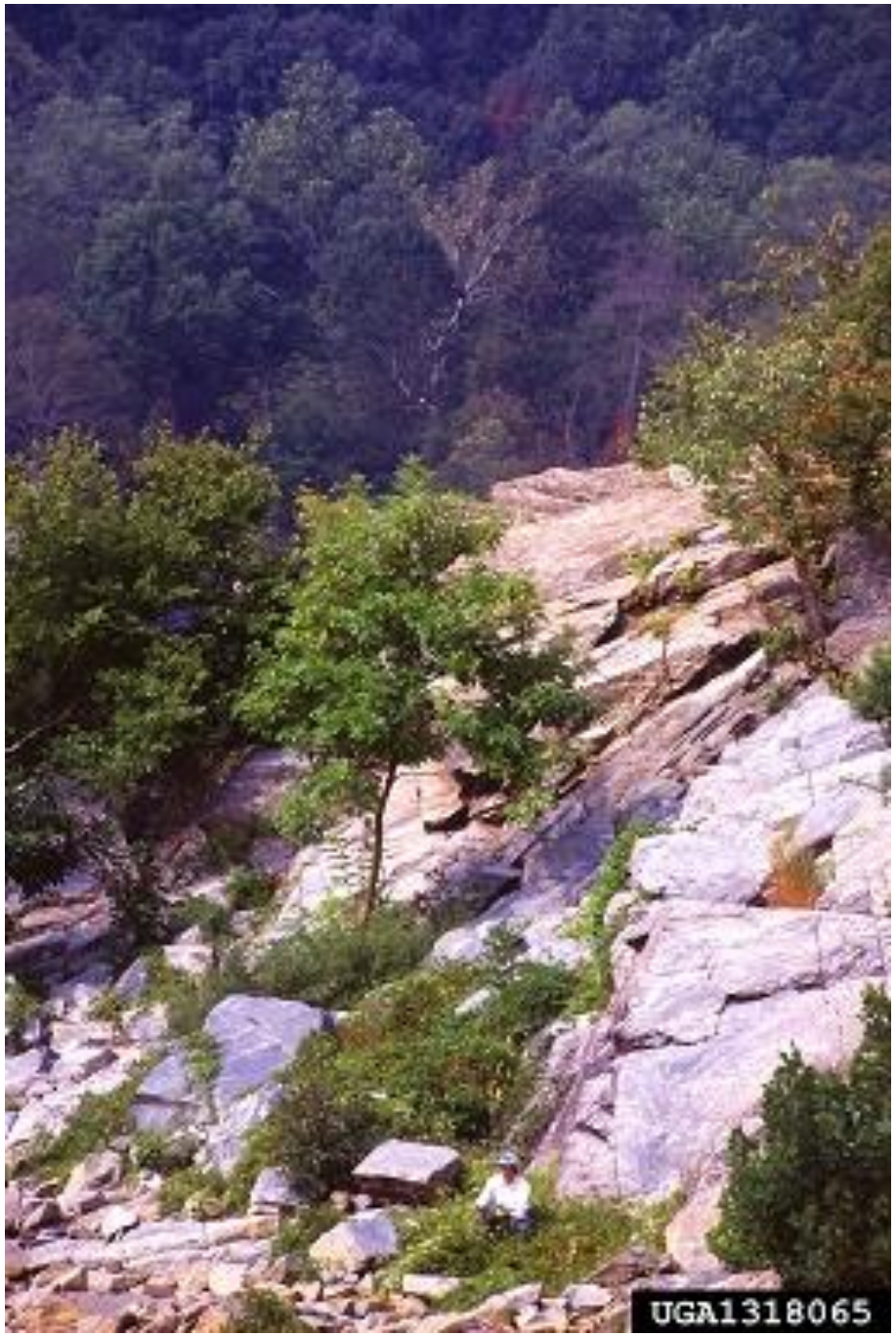
- American species co-evolved with phylloxera and so developed resistance mechanisms
- Three American *vitis* species are commonly used for rootstock breeding:
  - *V. riparia*
  - *V. rupestris*
  - *V. berlandieri*
- Each American species evolved in geographically distinct areas of North America.
- Understanding the basic characteristics of the three parents used in breeding will give an insight into the expected performance of a rootstock at a particular site.



V. rupestris:
Prefers deep, gravelly, rocky soils next to intermittent streams.

Image: Scott Bauer, USDA Agricultural Research Service, United States

www.forestryimages.org/browse/subthumb.cfm?sub=16779&start=1

V. berlandieri- found in south-west Texas

Image: Julie Wyatt at www.treklens.com

V. riparia:
prefers moist soils associated with riverbanks

Image: www.unihohenheim.de/lehre370/weinbau/bild_htm/rebenzue/avripari.htm

Coonawara Rootstock Trial: summary

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Vigour	Rootstocks and average pruning wt/vine- V15, V16, V19.
Higher	1103 Paulsen- 2.3kg/vine 140 Ruggeri- 2.2kg/vine
Medium	110 Richter- 1.8kg/vine Ramsey- 1.6 kg/vine M5512- 1.6 kg/vine M5489- 1.5 kg/vine
Lower	Own roots- 1.1 kg/vine Börner- 0.9kg/vine M6262- 0.8 kg/vine

- Strong relationship between rootstock and vine vigour.
- Rootstock effect on vine vigour is thought to have had a significant impact on yield and quality.

Rootstock trial performance based on principal bi-plot analysis

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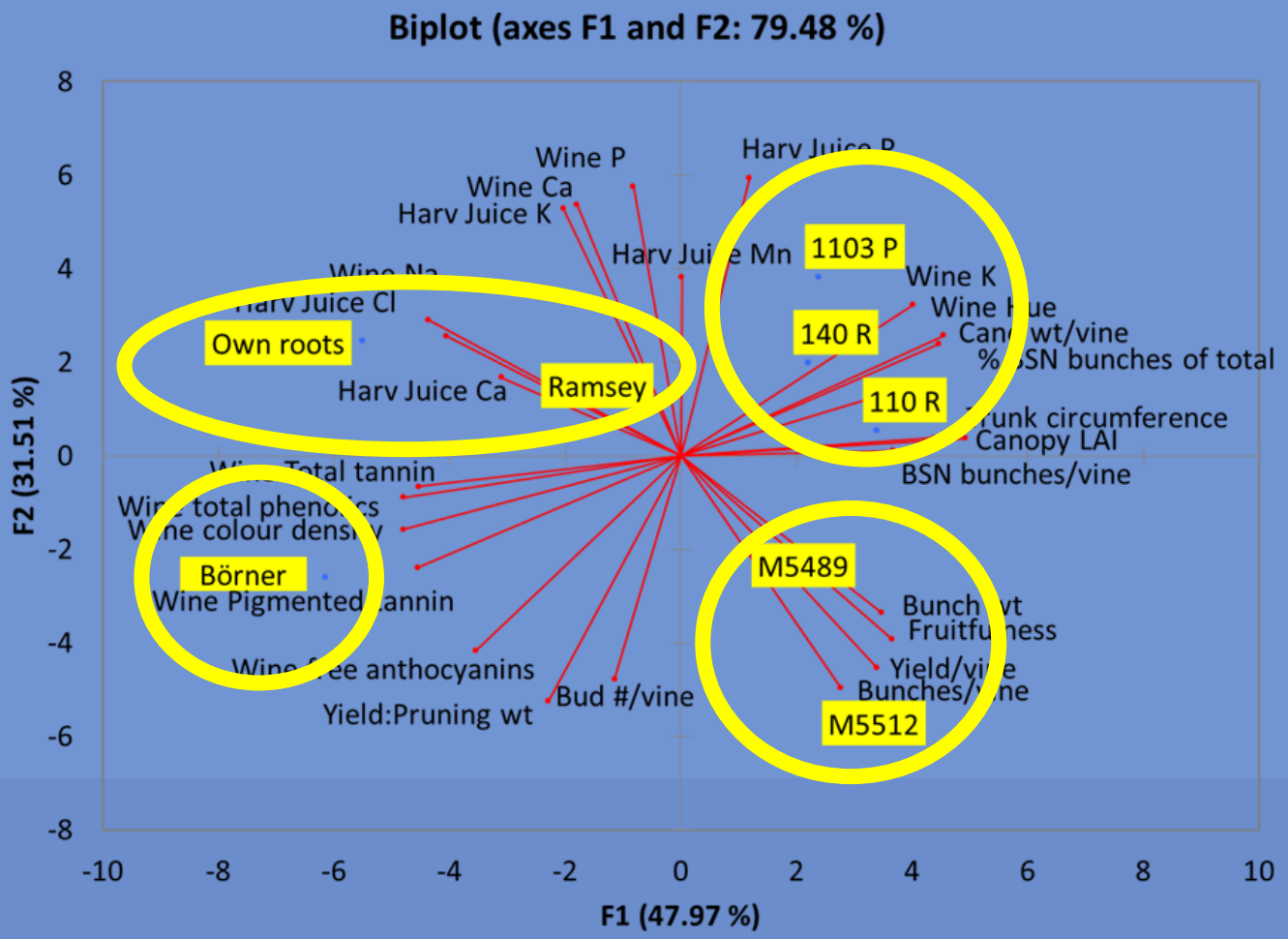

A principal biplot analysis was developed using the data collected in V19; included was the viticulture data, wine measurements and sensory profile and preference data. Based on the biplot analysis it was possible to group the rootstock treatments by similarity and describe their relative performance.

Börner

V. riparia x V. cinerea cv. Arnold

A phylloxera 'immune' rootstock developed in Germany.

- Low vigour and low yield across all three seasons of data collection.
- Open canopy/good vine balance.
- Performed well in wine quality measurements.
- Should be considered for further commercial evaluation.
- Need to establish and manage with consideration for the 'riparia' parentage i.e. water and lime issues.
- Limited availability.

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<u>2022 observations:</u>

- Lower vigour, some basal leaf yellowing
- Possibly needs deeper soils, closer planting

M5489 and M5512

complex hybrids from *V. berlandieri*

Australian rootstocks developed for local conditions.

- Medium vigour across all three years of data collection.
- Highest yielding treatments in V19
  - M5512 = 8.8kg/vine & M5489 = 6.4kg/vine
- V19 field walk indicted that these two treatments looked to be in 'good balance'.
- Performed well in V19 wine evaluation.
- Should be considered for further commercial evaluation.

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<u>2022 observations:</u>

M5489- moderate vigour, high yields, no yellowing

M5512- mod.-high shoot growth, moderate yield

➔ Both high root density and root length

110 Richter

V. berlandieri x V. rupestris

A moderate vigour, drought tolerant option.

- Medium vigour across all three years of data collection (similar to M5512, M5489 and Ramsey).
- Ranked 3rd in yield in V19 (6.3 kg/vine) behind M5512 and M5489.
- Grouped with 1103P and 140R in principal bi-plot analysis ➔ wine evaluation tended towards herbal/higher methoxy characters.
- Change of management for best outcomes?

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<u>2022 observations:</u>

Moderate-high vigour (lower than 1103P and 110R).

'Well suited to red, limited soils as a drought tolerant option- not suited to black or sandy loam soils'

1103 Paulsen & 140 Ruggeri

V. berlandieri x V. rupestris

Drought tolerant, higher vigour options.

- Higher vigour and declining yields
- High wine potassium, high methoxy levels, lowest wine scores.

➔ Homogenous management appears to have impacted performance……

- Do these rootstocks have a place in Coonawarra?
- How should they be managed to get benefits from drought tolerance while still producing consistent quality?

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<u>2022 observations:</u>

- Both high vigour and high root density and volume.
- *‘too much vigour to control in wetter springs or where there is frost control required’.*

Ramsey

V. champinii

Drought tolerant, higher vigour option.

- Highest yield in V15, lowest yield in V19
- Medium vigour in V19
- Surprisingly paired with own roots in the principal biplot analysis.

➔Shallow soils inhibited Ramsey's normal high vigour, high yield nature?

➔Does it still display drought tolerance?

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<u>2022 observations:</u>

Low-moderate vigour, some yellowing

Horizontal thick roots

Impact of rootstock on root physiology and drought tolerance

From Marin et al. 2021

- Impact on root architecture leads to a greater volume of soil explored ➔ greater branching of the fibrous roots and greater number of root tips (Gullo et al. 2018).
- Drought tolerant rootstock 1103P (*V. berlandieri x V. rupsetris*) continue to grow more roots at depth during the summer dry period compared with 101-14 (Alsina et al. 2011).
- Drought tolerant rootstocks are able to move water through their roots and trunks more readily than drought sensitive rootstock (Alsina et al. 2011)

Impact of rootstock on vine performance: zero irrigation Spring 2007-February 12th 2008- SUNRAYSIA

101-14 *(V.riparia x V. rupestris)*

1103 Paulsen *(V. berlandieri x V. rupsetris)*

Images used with permission from Sommer, K. et al. (2010)

3309C and 101-14

V. riparia x V. rupestris

High potential rootstock for premium production

- 3309C the most widely planted rootstock in cooler climate, premium production regions in France, New Zealand and North America➔ Has only been commercially available in Australia for around 15 years.
- Reportedly less sensitive to dry conditions compared with 101-14.
- More sensitive to saline conditions compared with 101-14 (3309C has similar susceptibility as own roots

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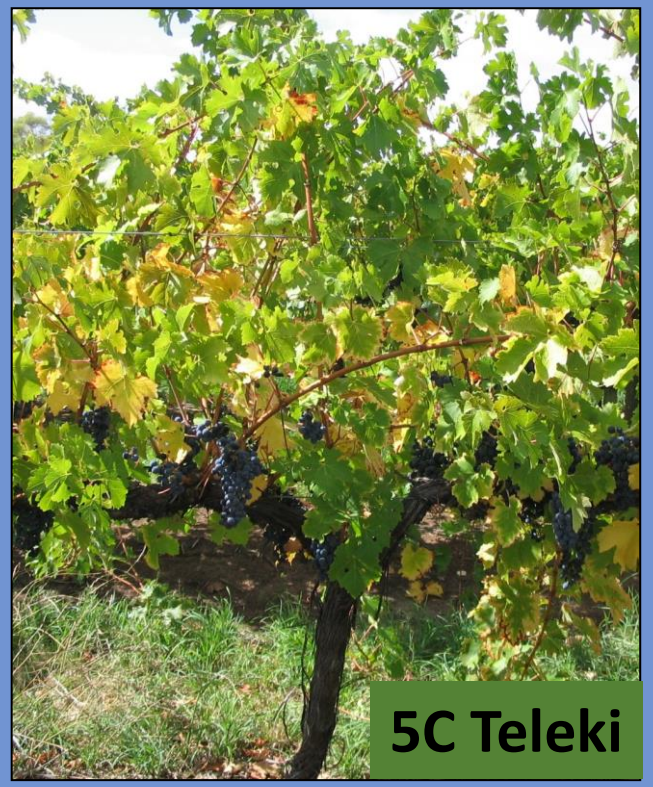
Local Performance:

Both lower vigour, gets good balance early, need to keep canopies fresh at back end of season *'less water more often'*

5C Teleki

V. berlandieri x V. rupestris

Moderate vigour rootstock with proven quality outcomes



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Season	Treatment	Ave. yield (kg/m)	Ave. pruning wt (kg/m)	Ave. shoot wt (g)
2006 and 2007	Own roots	1.8	0.5	32
	5C Teleki	2.4	0.55	35

Summary

- Rootstock performance is site specific.
- There is no ‘perfect’ rootstock for your site, understand the rootstock attributes and then establish and manage the vineyard accordingly.

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