

An aerial photograph of a vineyard on the Mornington Peninsula. The vineyard is divided into several rectangular blocks of rows of grapevines. In the foreground, a large, dark pond reflects the bright sunlight, creating a shimmering effect. The surrounding landscape is a mix of green fields, dense forests, and rolling hills under a clear blue sky. The text "MORNINGTON PENINSULA PINOT NOIR ROOTSTOCK TRIAL" is overlaid in large, white, bold, sans-serif font across the center of the image.

**MORNINGTON PENINSULA
PINOT NOIR ROOTSTOCK TRIAL**



Welcome & Introduction

Tyson Lewis

Background and workshop focus

- characteristics of trial rootstocks
- new & future rootstocks

Dr. Catherine Clarke, Agriculture Victoria – phylloxera

Jeremy Magyar, Moorooduc Estate – winemaking

Blind Tasting

Dr. Pangzhen Zhang, University of Melbourne – trial study

Named tasting of trial wines

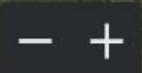
Questions & Discussion

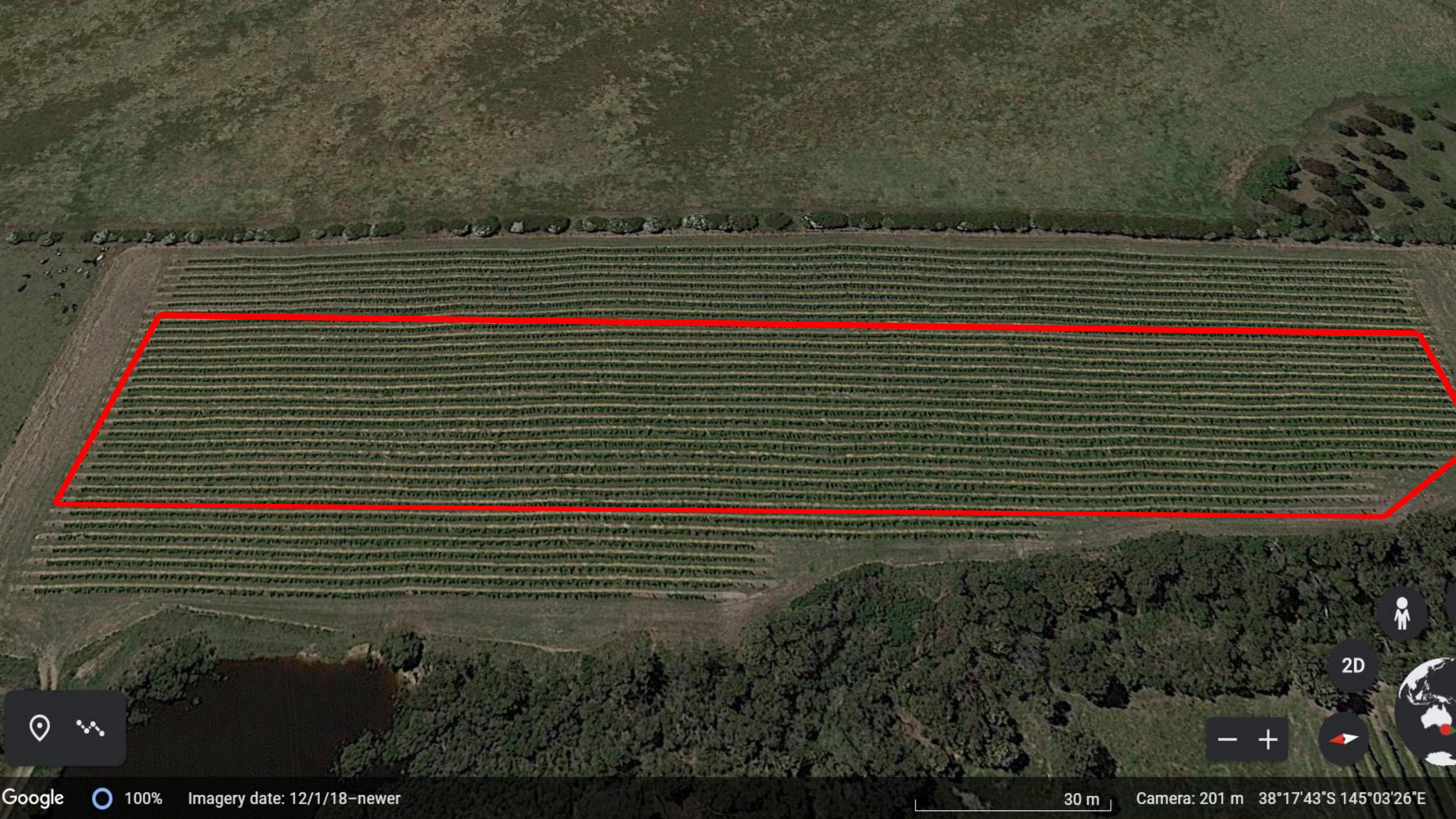






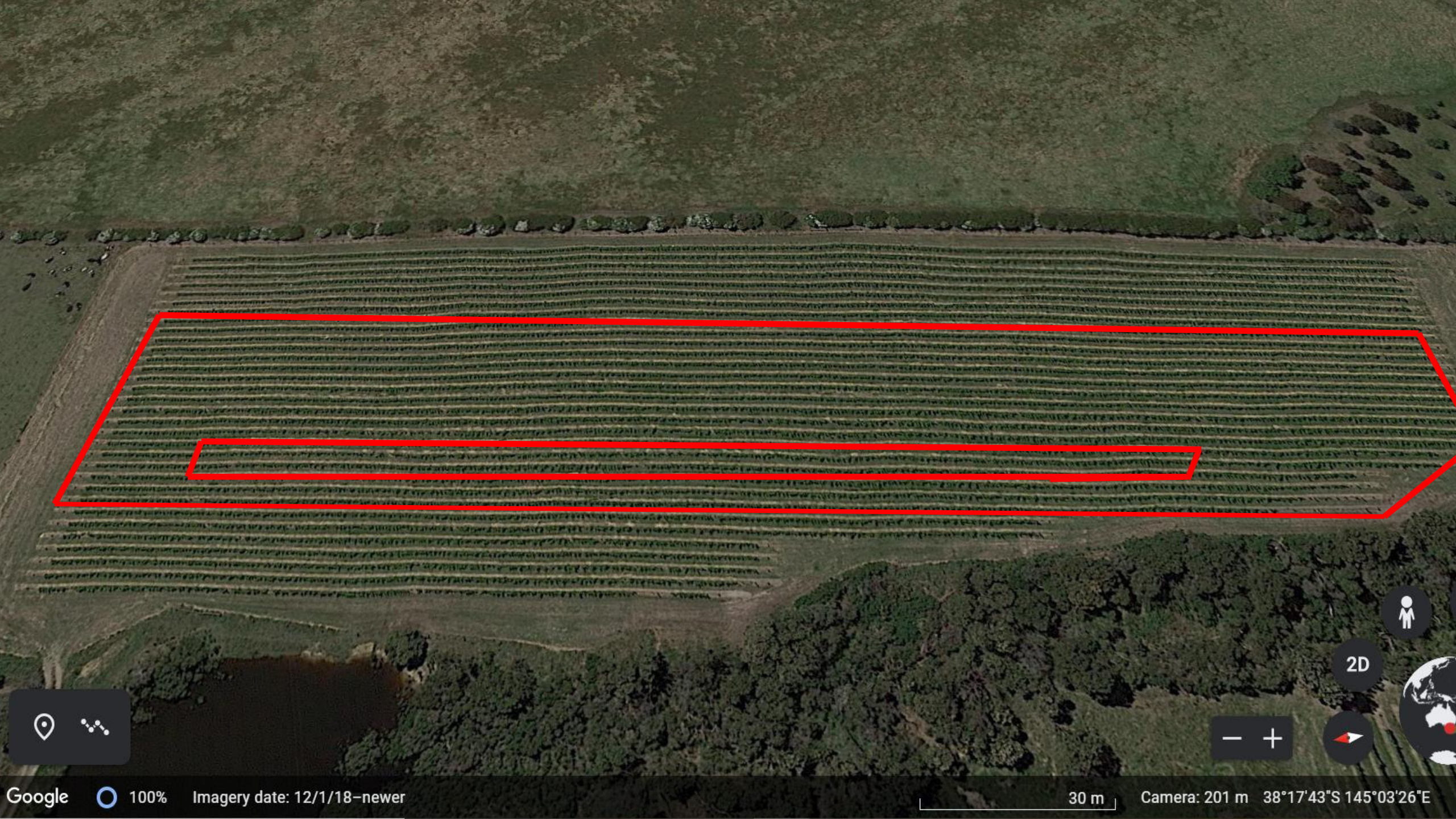
2D





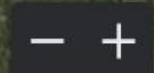
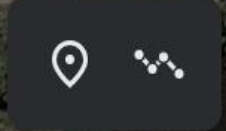
2D





2D





2D



30 m

Camera: 201 m 38°17'43"S 145°03'26"E

Studied Rootstocks and planting dates

Table 1. Studied Rootstocks and planting dates

No.	Rootstock	Plantation time	No.	Rootstock	Plantation time	No.	Rootstock	Plantation time
1	101-14	06/11/2014	6	5C Teleki	06/11/2014	11	C20	01/11/2016
2	1103 Paulsen	06/11/2014	7	3309C	06/11/2014	12	C29	01/11/2016
3	SO4	06/11/2014	8	Merbein 5489	06/11/2014	13	C113	01/11/2016
4	110 Richter	06/11/2014	9	Merbein 6262	06/11/2014	14	C114	01/11/2016
5	Schwarzman	06/11/2014	10	Merbein 5512	06/11/2014	15	Own Roots	29/09/2015

Table 2. Rootstock Trial Design

Each block represent 1 panel

Soil Sampling points

		9		12		6		5			15				
		7		4		2		3			1				
		10		11		14		13			8				

*Each box represents a panel of grapevines (5 grapevines per panel for Robinson vineyard, 4 grapevines per panel for Judd vineyard)



Experimental
Sites

Judd Vineyard

13.4 kilometres

Robinson Vineyard

Robinson vineyard

Aggregate stability



Texture: Silt Loam
pH (CaCl₂): 6.1
CEC: 18.9 cmol kg⁻¹
ESP: 2.9 %



No dispersion or slaking

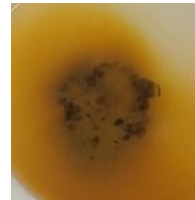
Texture: Fine Sandy Loam
pH (CaCl₂): 6.0
CEC: 8.4 cmol kg⁻¹
ESP: 7.1 %



No dispersion, slight slaking

(clear change to)

Texture: Medium Clay
pH (CaCl₂): 5.9
CEC: 45.7 cmol kg⁻¹
ESP: 11.8 %



Moderate-strong dispersion and slaking

Texture: **Med-Heavy Clay**
pH (CaCl₂): 5.8
CEC: 37.8 cmol kg⁻¹
ESP: 13.7 %



No dispersion
Slight slaking

Low Ca:Mg ratio

②

Judd vineyard

Aggregate stability



Texture: Clay Loam
pH (CaCl₂): 4.7
CEC: 29.9 cmol kg⁻¹
ESP: 2.2%



Very slight slaking

Texture: Silty Clay Loam
pH (CaCl₂): 4.2
CEC: 16.9 cmol kg⁻¹
ESP: 2.3 %



Moderate slaking

Texture: Light Clay
pH (CaCl₂): 4.9
CEC: 22.9 cmol kg⁻¹
ESP: 3.0 %



Moderate slaking

Texture: **Medium Clay**
pH (CaCl₂): 5.8
CEC: 28.2 cmol kg⁻¹
ESP: 3.2 %



Moderate slaking

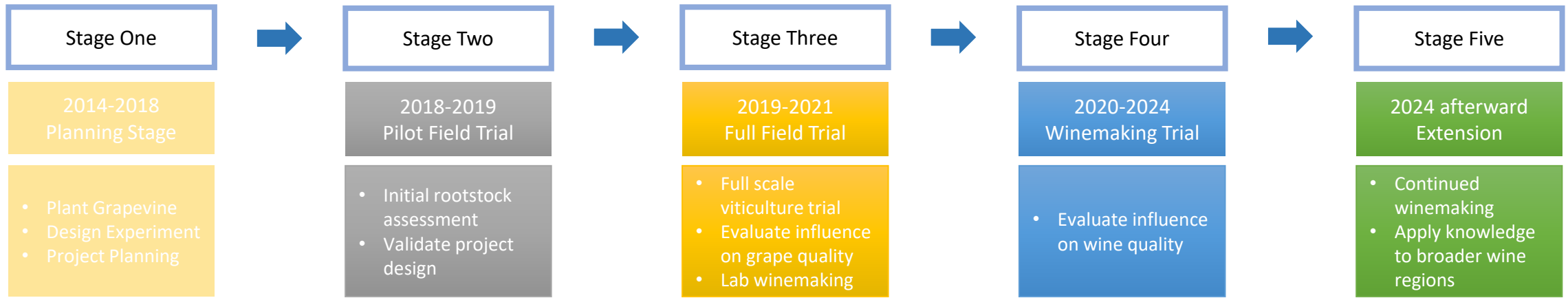
(All no dispersion)

Low Ca:Mg ratio

①

Summary of Rootstock Project framework & programs 2018-2024

Federal Government – Australian Grape and Wine Authority



Victoria & Mornington connected wine community

Rootstock Training & Education

Industry Workshop

Research Communication

International Conferences

Student Placement

Wine Marketing & Communications

Overview of the attributes of the rootstocks in the trial with reference to Pinot Noir

Nick Dry- Foundation Viticulture

LA TACHE

Table 1. Studied Rootstocks and planting dates.

No.	Rootstock	Parent species	Planting time
1	101-14	<i>V. riparia</i> × <i>V. rupestris</i>	06/11/2014
2	1103 Paulsen	<i>V. berlandieri</i> × <i>V. rupestris</i>	06/11/2014
3	5BB Kober	<i>V. berlandieri</i> × <i>V. riparia</i>	06/11/2014
4	110 Richter	<i>V. berlandieri</i> × <i>V. rupestris</i>	06/11/2014
5	Schwarzmann	<i>V. riparia</i> × <i>V. rupestris</i>	06/11/2014
6	5C Teleki	<i>V. berlandieri</i> × <i>V. riparia</i>	06/11/2014
7	3309C	<i>V. riparia</i> × <i>V. rupestris</i>	06/11/2014
8	Merbein 5489	<i>V. cinerea</i> var. <i>helleri</i> ‘Resseguier #1’ × <i>V. cinerea</i> var. <i>helleri</i> Mazade	06/11/2014
9	Merbein 6262	<i>V. cinerea</i> ‘B 58’ × <i>V. cinerea</i> B 194-1	06/11/2014
10	Merbein 5512	<i>V. cinerea</i> var. <i>helleri</i> ‘Resseguier #1’ × <i>V. cinerea</i> var. <i>helleri</i> 7651	06/11/2014
11	C20	<i>V. champinii</i> × <i>V. rupestris</i> × <i>V. riparia</i>	01/11/2016
12	C29	<i>V. champinii</i> × <i>V. rupestris</i> × <i>V. riparia</i>	01/11/2016
13	C113	<i>V. champinii</i> × <i>V. cinerea</i>	01/11/2016
14	C114	<i>V. champinii</i> × <i>V. berlandieri</i>	01/11/2016
15	Own Roots	<i>Vitis vinifera</i> L.	29/09/2015

Rootstock performance is related to the parent species

FOUNDATION
VITICULTURE

- 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. riparia:

Prefers moist soils associated with riverbanks.

from Walker, A
-shallow rooting,
water sensitive,
low vigour, early
maturity.

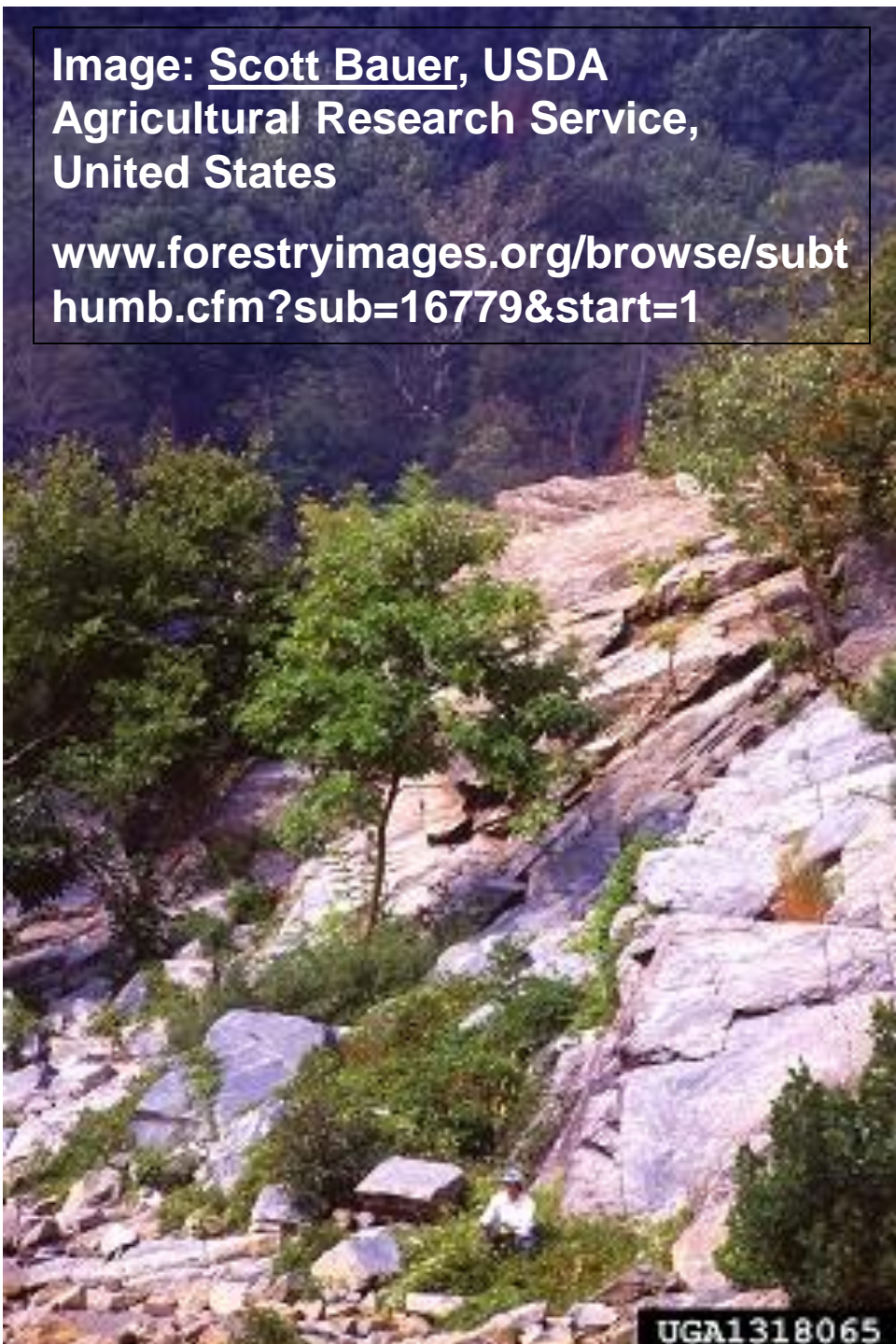


Image:

www.unihohenheim.de/lehre370/weinbau/bild_html/rebenzue/av_ripari.htm

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

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



UGA1318065

V. rupestris:

Prefers deep, gravelly, rocky soils next to intermittent streams.

From Walker, A.

-relatively drought tolerant,
moderate to high vigour,
mid-season maturity.

V. berlandieri- found in south-west Texas



From Walker, A.:
Deeper roots,
drought tolerant,
higher vigor,
delayed maturity,
lime and salt
tolerant.

110 Richter and 1103 Paulsen *V. berlandieri* x *V. rupestris*

General Attributes	With reference to Pinot Noir
<ul style="list-style-type: none">• Imparts mod.-high vigour• Drought tolerant• Mod.-high tolerance of salt and nematodes• Plunging root-system• Longer vegetative cycle <p>Generally used in warm-hot growing conditions.</p> <hr/> <p>FOUNDATION VITICULTURE</p>	<ul style="list-style-type: none">• Commercial/higher yield end product objectives• Sparkling production• Soils or environmental conditions require invigoration to achieve vine balance/protection of fruit.• Organic/BD/ no spray/no tillage production- weed competition and low N mean invigoration required to achieve balance/protection.

5BB Kober and 5C Teleki *V. berlandieri* x *V. riparia*

General Attributes

- Impart moderate vigour
- Moderately sensitive to drought conditions
- Generally good nematode tolerance
- Moderately sensitive to salt
- Lateral root-system
- Generally used in cooler growing conditions.

With reference to Pinot Noir

- High quality potential on moderate vigour soils in cool climates
- Sparkling production on higher vigour sites
- Good affinity with Pinot Noir
- Lateral spreading root system makes them candidates for close planting (5C Teleki in particular)
- Organic/BD/ no spray/no tillage production on high vigour sites.

101-14, 3309C and Schwarzmann

V. rupestris x *V. riparia*

General Attributes

- Imparts low vigour
- Sensitive to drought conditions
- Generally good nematode tolerance
- Fibrous root system
- Best suited to cool climate viticulture.

With reference to Pinot Noir

- 3309C is the most widely planted rootstock for premium Pinot Noir production in Burgundy, Oregon and New Zealand
- High quality potential on moderate and high vigour soils in cool climates
- Use with caution in low input systems due to low inherent vigour and higher nutrient/water requirements.

References and further reading:

Grapevine Rootstock Selector Tool

<https://grapevinerootstock.com/>

Dry, N. (2007) Grapevine Rootstocks: Selection and Management for South Australian Vineyards. Lythrum Press.

Walker, A 'Breeding Rootstocks for Use With Table Grapes'

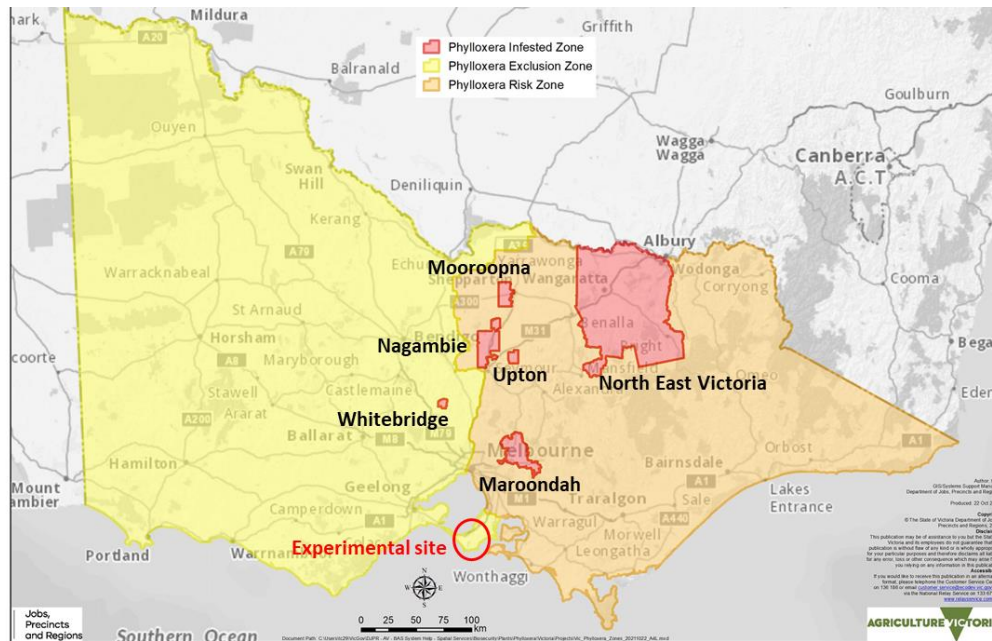
https://www.redagricola.com/cl/assets/uploads/2019/06/2_rootstock_breeding_2019.pdf

Rootstock selection trends - Key Points

- Gradual decline in own roots sales (30 to 15)
- Popularity of 3309C (sell out – 101-14, Paulsen, Teleki more)
- Victorian response to Phylloxera
- Increasing diversity of rootstock in some states
- Regional variation
- Anecdotal shift based on temperature and practise trends
- Planting a selection of different rootstocks can build a more adaptable vineyard.

The Challenge of Phylloxera

Phylloxera remains a critical issue for the Australian wine industry, as most grapevines are grown on own roots. This is especially true for Victorian wine regions.



Adaptation of Rootstock is the best option to prevent from the potential devastating damage of Phylloxera, especially for regions close to Phylloxera Infested Zones

Questions Need To Be Addressed:

- How rootstock influence grapevine performance;
- How rootstock adapt to local environmental conditions;
- How rootstock influence wine quality.



Dr Catherine Clarke
Agriculture Victoria

Grapevine Phylloxera: Latest science

Mornington Peninsula Growers and Winemakers
22nd August 2022

Dr. Catherine Clarke
Agriculture Victoria

- Feeds exclusively on *Vitis* species
- Feeding induces **galls** on roots and leaf
- **Asexual** reproduction typical - cluster of all life stage at feeding sites
- **1st instar (crawler)** most mobile stage and present on both roots & vine canopy



Root feeding form



Galls (nodosities)



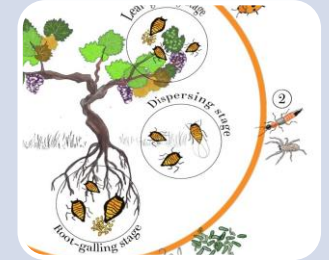
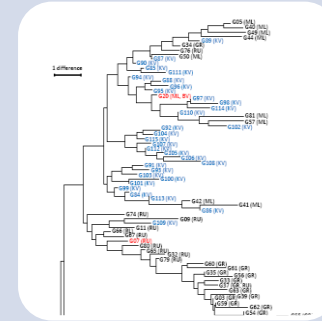
Tuberosities on
storage leaves

Leaf feeding form



Leaf galls

Phylloxera Research



Phylloxera
detection
and
diagnostics

Disinfestation

**National
Phylloxera
Management
Protocol**

National Vine Health Steering Committee
Endorsed October 2009

Rootstocks
and
phylloxera
interactions

Biology,
ecology
and
genetic
diversity

Control
options

LAMP Technology shows much promise as a field-based diagnostics tool



Emergence traps



Digging and root inspection



Samples



DNA extraction
(8 min)

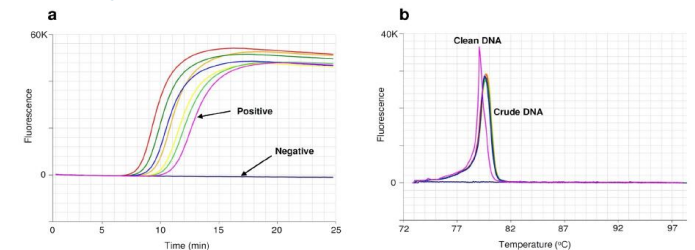


Amplification
(35 min)

- Rapid confirmation (<1hr)
- Target-specific diagnostics (+/-)
- Independent of morphology
- Field and laboratory

OPEN A diagnostic LAMP assay for the destructive grapevine insect pest, phylloxera (*Daktulosphaira vitifoliae*)

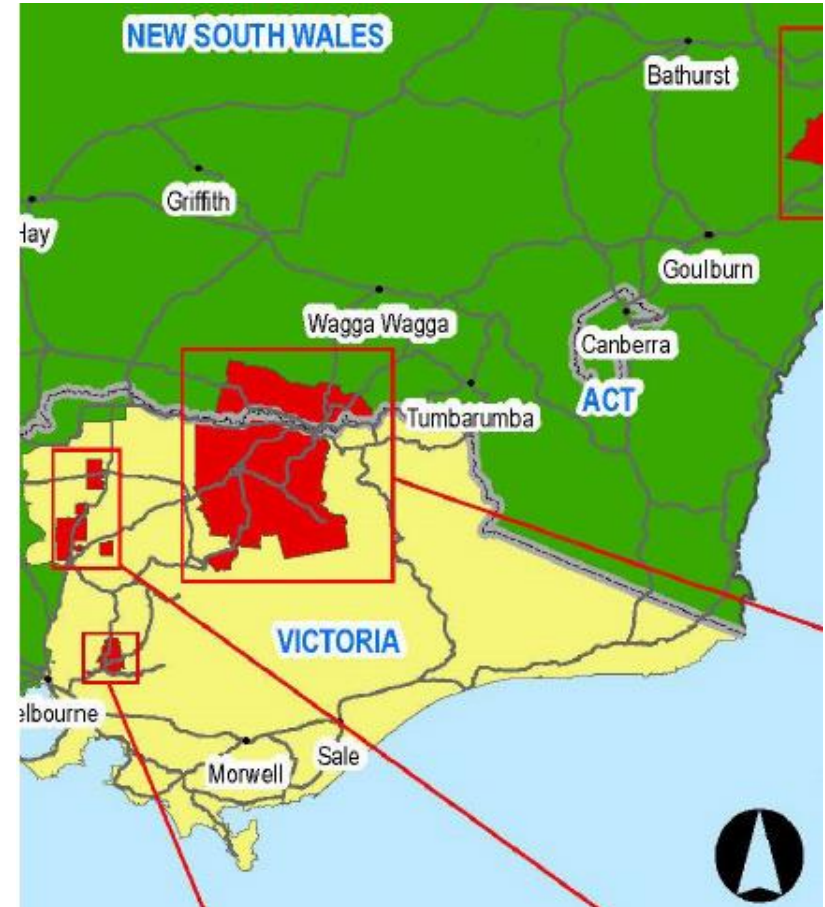
Arati Agarwal¹, J. Paul Cunningham^{1,2}, Isabel Valenzuela¹ & Mark J. Blacket^{1,3}



Quarantine Management

- Management through quarantine control areas
 - PIZ = phylloxera infested zone (*prohibiting movement out*)
 - PEZ = phylloxera exclusion zone (*prohibiting movement in*)
- Domestic Quarantine regulates phylloxera as a species.
- Management centres on farm gate biosecurity, education, regulation of phylloxera host material, vineyard machinery and equipment into and out of PIZ and PEZ.

(Lavinia Zirnsak, Senior Officer Domestic Quarantine, Ag Vic)



Vine cuttings

Clarke et al.

Hot water disinfection of grapevine material



Hot water immersion as a disinfection treatment for grapevine root cuttings against genetically diverse grape phylloxera *Daktulosphaira vitifoliae* Fitch

Machinery e.g Harvesters

Clarke et al.

Dry heat for grape phylloxera disinfection



Dry heat as a disinfection treatment against genetically diverse strains of grape phylloxera

Vehicles and harvesting bins

Clarke et al.

Efficacy of hot water and steam against phylloxera

Efficacy of steam and hot water disinfection treatments against genetically diverse strains of grape phylloxera *Daktulosphaira vitifoliae* Fitch (Hemiptera: Phylloxeridae) on viticulture equipment and machinery



Footwear and handheld tools

Clarke et al.

Efficacy of NaOCl against grape phylloxera

Effectiveness of sodium hypochlorite as a disinfection treatment against genetically diverse strains of grape phylloxera *Daktulosphaira vitifoliae* Fitch (Hemiptera: Phylloxeridae)



2% household bleach for 30s
Rinse thoroughly in water

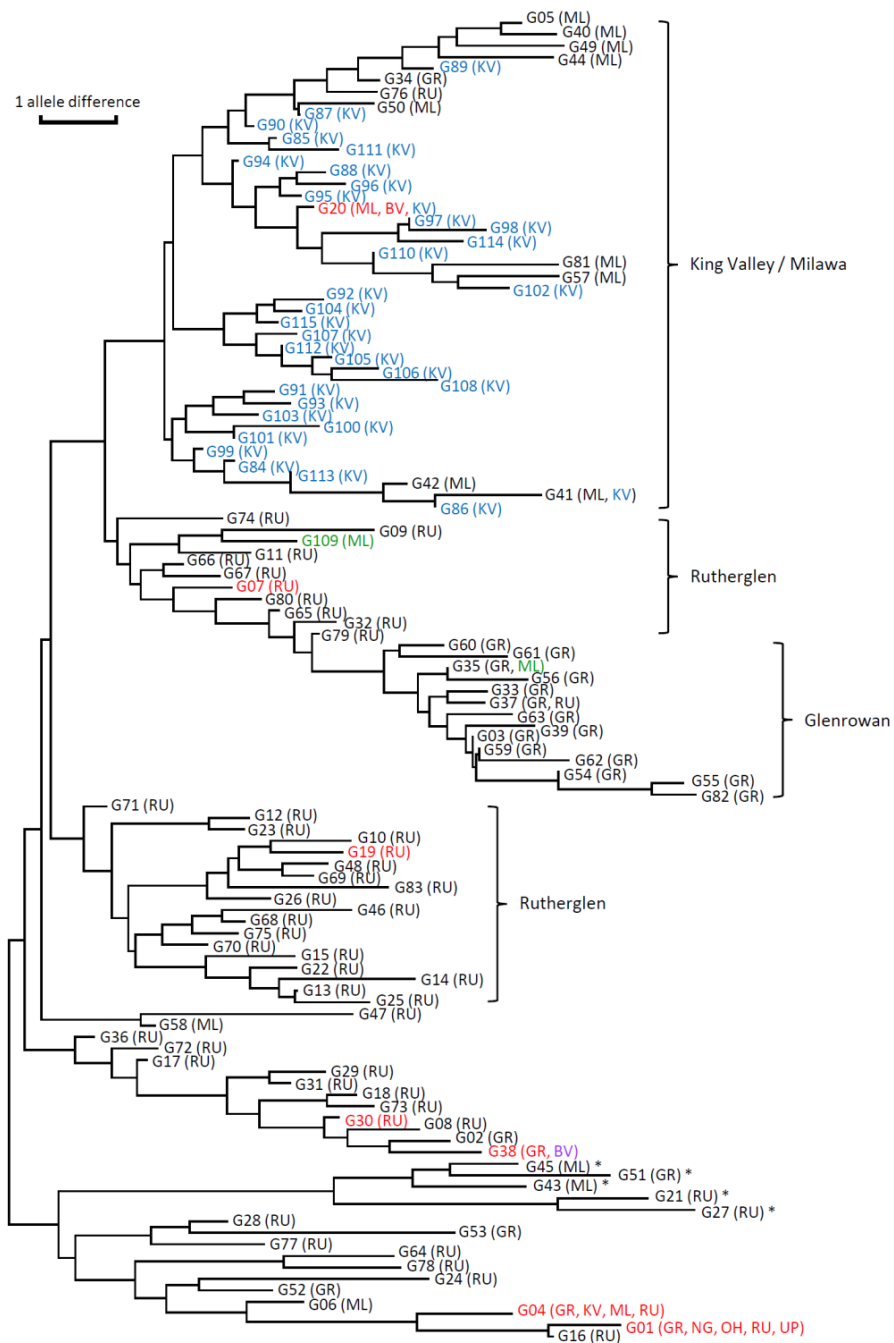


2% bleach for 60 secs
Without rinse afterwards

Alternative disinfection

Dettol a welcome addition to industry protocols



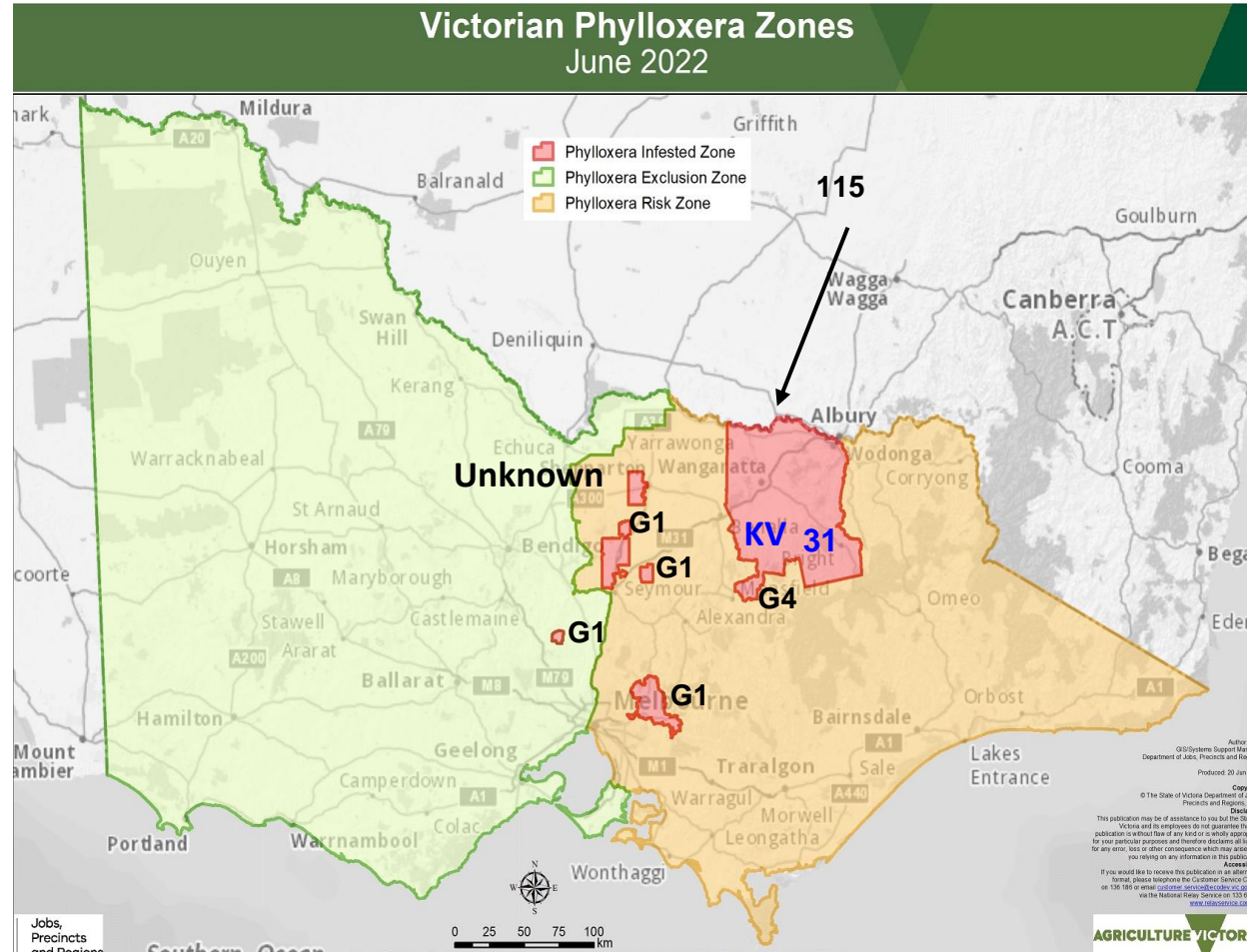


115 genotypes

Genotypes maintained in laboratory for rootstock screening research
(G1, G7, G4, G19, G20, G30 and G38)

(Umina et al. 2007 & Clarke et al. 2020)

Recent genotype distribution

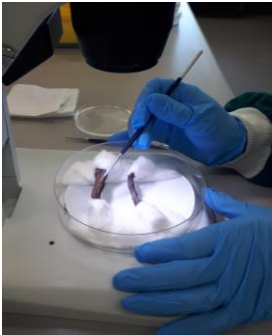


Final Report to Wine Australia

Integrated management of established grapevine phylloxera

<https://www.wineaustralia.com/research/projects/integrated-management-of-established-gra>

Three-phase testing using excised roots, potted vines and in-field



Excised roots




In- pot vines



In-field (where possible)

Wine Australia
Grapevine rootstock selector tool How to use About References



How to use

How to use

Step 1 – Before the tool can identify rootstocks for you to consider, it seeks information through a series of multiple choice options/questions about your site characteristics and the rootstock attributes that you would like to have for your vineyard. It is useful to consider the soil characteristics and climate of your site and what scion variety/(ies) you might want to plant prior to looking for a suitable rootstock(s), although it is not essential for the operation of the tool.

Step 2 – Once the Rootstock Selector Tool has identified rootstocks that match with your selected site characteristics and requirements, you can find more information about each rootstock by clicking initially on the 'Show/hide details' icon then on the 'Information about all attributes for this rootstock' tab which is located at the end of the information provided under 'Show/hide details'.

Step 3 – Prior to ordering planting material, discuss the rootstock choices that the Rootstock Selector Tool has identified, by speaking to your grapevine nursery specialist, local viticulturists and the purchasing winery.

Wine Australia
Industry House, Cnr Botanic and Hackney Roads, Adelaide | PO Box 2733, Kent Town South Australia 5071
[Copyright](#) | [Disclaimer](#)

<https://grapevinerootstock.com/>

Rootstock	G1	G4	G7	G19	G20	G30
Vitis vinifera	S	S	S	S	S	S
Borner	R	R	R	R	R	R
Ramsey	T	T	T	T	T	T
Schwarzmann	R	R	T	T	T	T
110 Richter	T	T	R	R	T	R
1103 Paulsen	T	R	R	T	R	R
140 Ruggeri	R	T	R	R	R	R
5BB Kober	R	R	T	T	T	T
420A	T	R	R	T	T	R
3309C	R	R	T	T	T	T
101-14	R	R	R	R	T	R

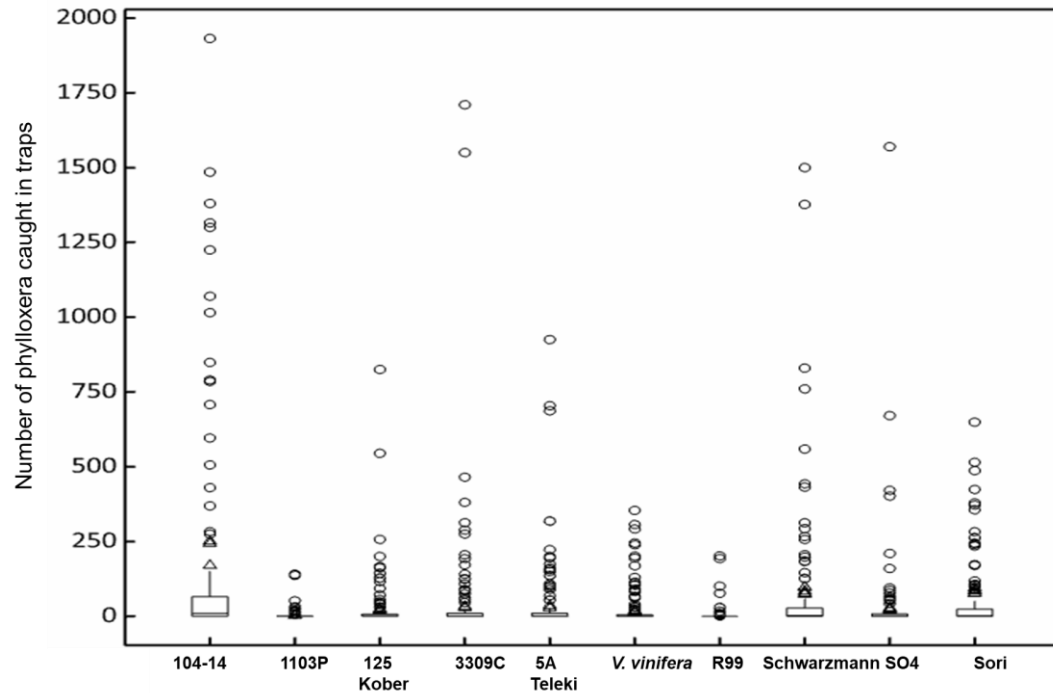
(S) susceptible, (T) tolerant, (R) resistant

VITICULTURE

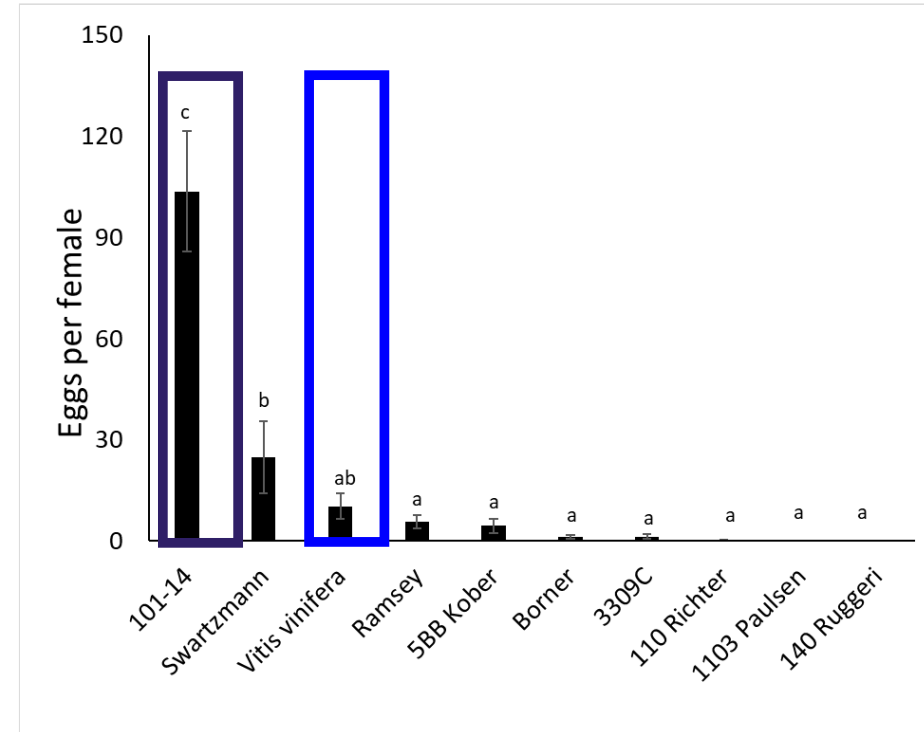
PHYLLOXERA

Rootstock tolerance and resistance to different genetic strains of phylloxera

In-field assessments- mean numbers of phylloxera caught in traps over a 3 yr period



Excised root assays – reproductive performance



- High numbers of G38 on **101-14** phylloxera compared to ***V. vinifera***
- Study **validated** current screening assays in predicting resistance / susceptibility of rootstocks
- Ability of rootstock 101-14 to withstand pressure due to G38 phylloxera infestation?

Rootstock	G1	G4	G7	G19	G20	G30	G38
3309C	R	R	T	T	T	T	T
101-14	R	R	R	R	R	R	S
110 Richter	T	T	T	R	R	R	T
1103 Paulsen	R	R	R	T	R	R	R
5C Teleki	R	R	-	T	T	T	T
C113	CP	CP	CP	CP	CP	CP	CP
C114	-	-	-	-	-	-	-
C20	-	-	-	-	-	-	-
C29	-	-	-	-	-	-	-
Merbein 5489	CP	CP	CP	CP	CP	CP	CP
Merbein 5512	CP	CP	CP	CP	CP	CP	CP
Merbein 6262	-	-	-	-	-	-	-
<i>Vitis vinifera</i>	S	S	S	S	S	S	T
S04	-	-	-	-	-	-	-
Schwartzmann	T	R	T	T	T	R	S

S- Susceptible; R- Resistant; T- Tolerant

- Not tested

INFIELD ASSESSMENTS

GLASSHOUSE TRIALS

CP- Testing underway

- **Leaf galling** phylloxera in Australia: How prepared are we?



- Management options: Biological control



- Side-by-side comparisons of existing detection methods with new LAMP approach and simulation models to determine confidence levels of field surveys.



- **Climate** scenarios: impact of elevated temperature and carbon dioxide, and reduced water availability on phylloxera genetic diversity and distribution.

- Rootstock and phylloxera interactions
- Screening commercial rootstocks identified by industry as a priority (Wine Australia and Agriculture Victoria Co-funding).
- Screening new rootstocks with durable resistant to phylloxera and nematodes (CSIRO Dr Harley Smith).



Australian Government

Wine Australia

Wine
Australia
for
Australian
Wine

PROJECT TEAM

Dr. Catherine Clarke

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Dr. Jessi Henneken

Dr. Kevin Powell



Thank you
Growers in the North East Victoria for
supporting phylloxera research



Australian Government

Wine Australia

Wine
Australia
for
Australian
Wine





Blind Tasting

An aerial photograph of a vineyard on the Mornington Peninsula. The foreground features a large, dark pond reflecting the bright sky. The vineyard is divided into several distinct sections of rows, with varying shades of green. In the background, there are rolling hills and a clear blue sky. The text "MORNINGTON PENINSULA PINOT NOIR ROOTSTOCK TRIAL" is overlaid in large, white, bold letters across the center of the image.

**MORNINGTON PENINSULA
PINOT NOIR ROOTSTOCK TRIAL**



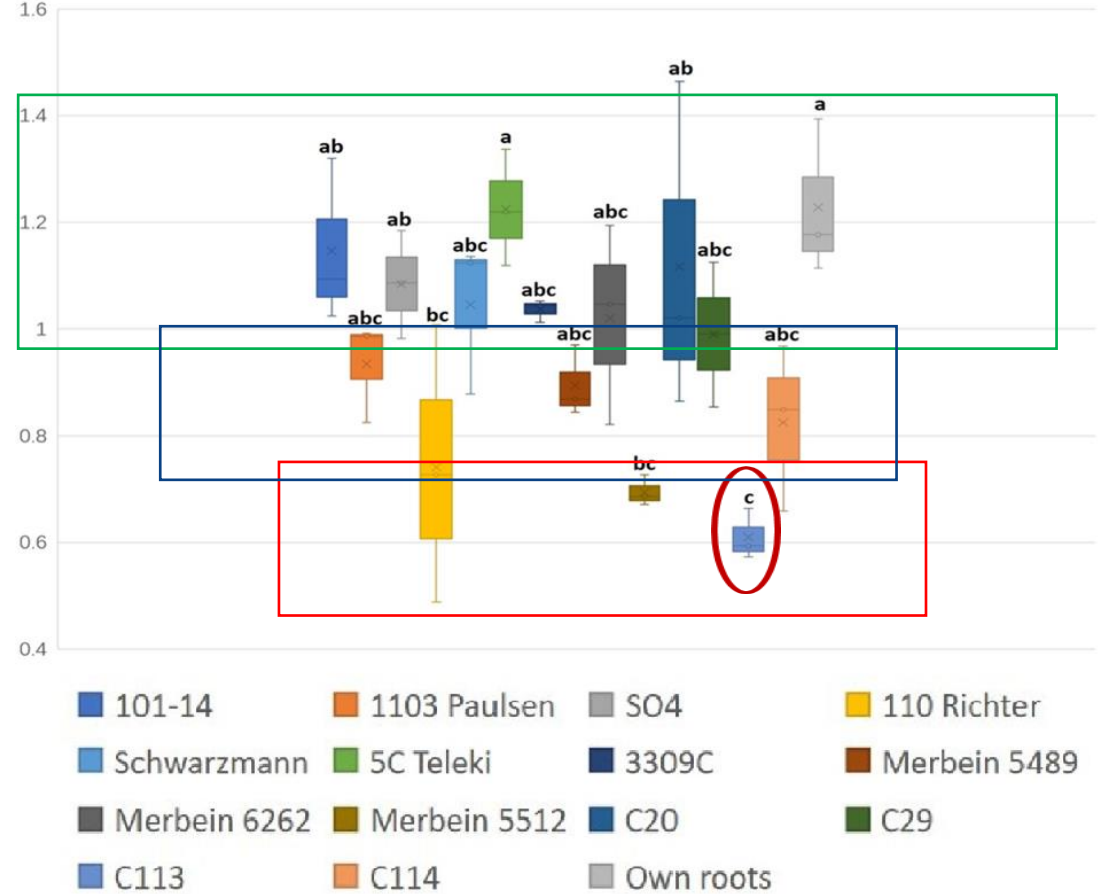
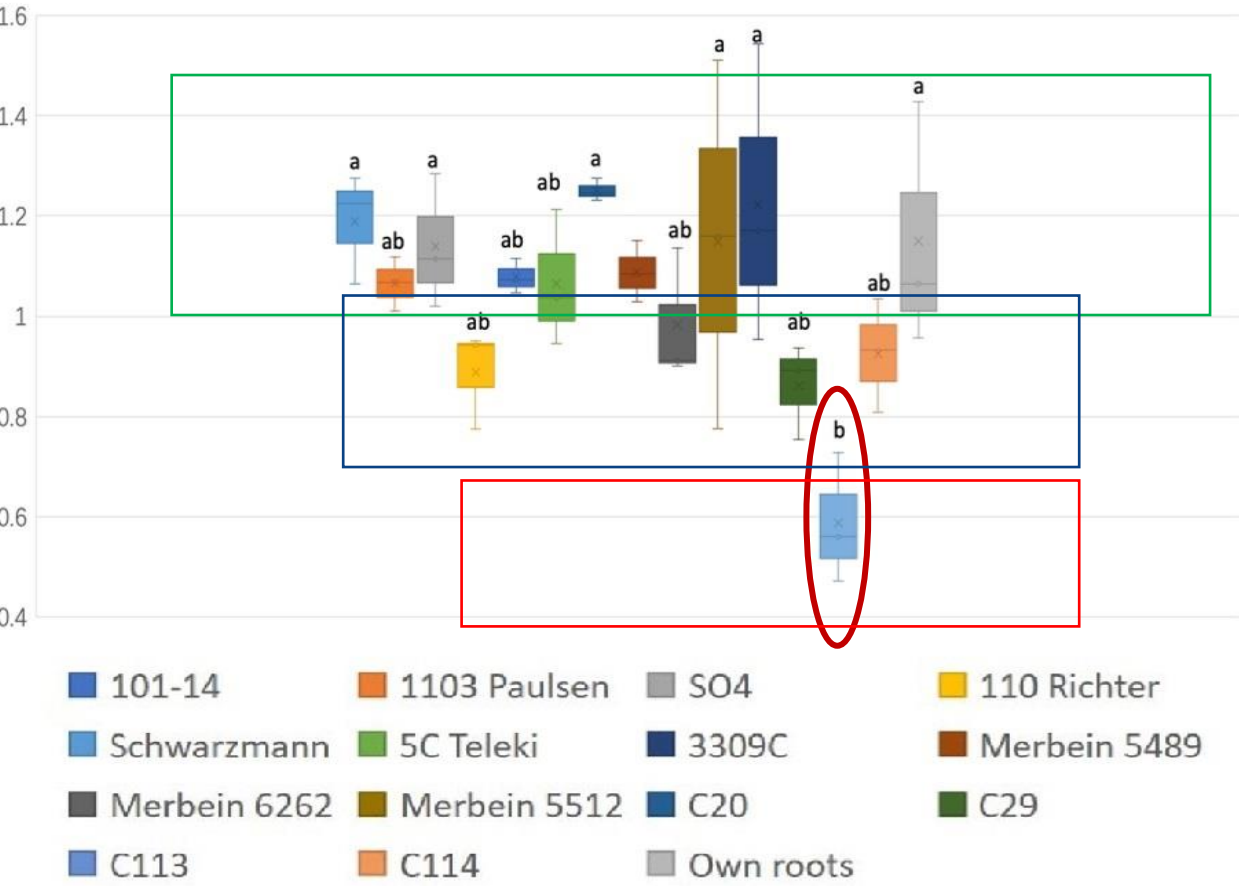
Dr Pangzhen Zhang
University of Melbourne



W24: Trialling rootstocks for MV6 Pinot Noir from vine to wine while considering phylloxera resistance, tolerance and Susceptibility

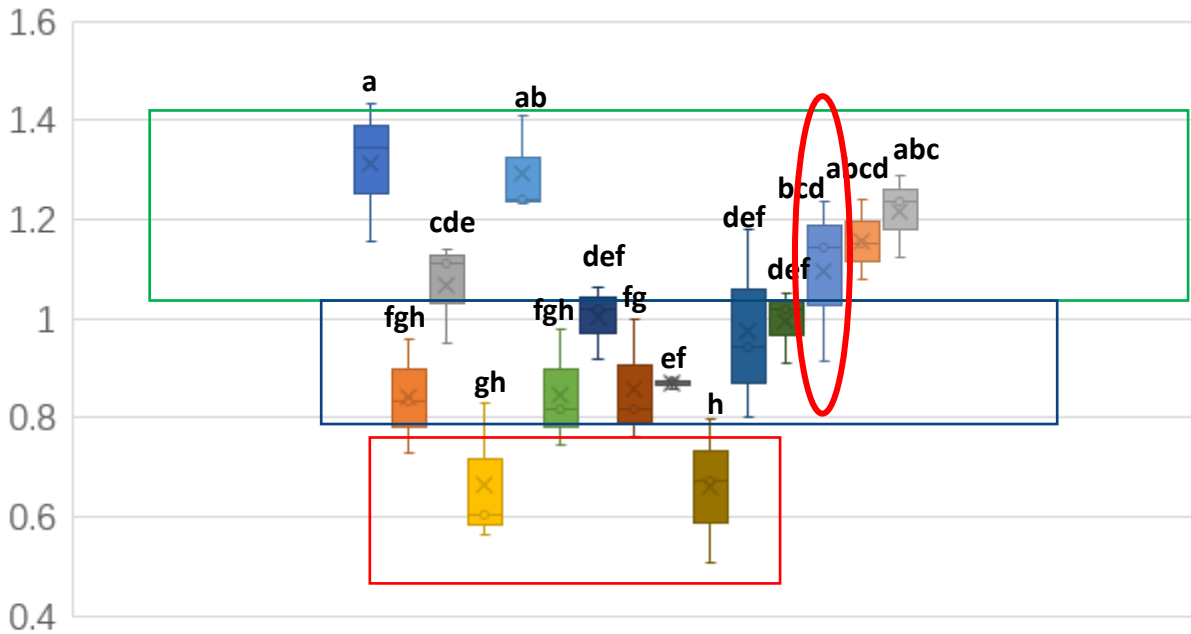
Plant Physiology and Nutrient Uptake

Leaf area index at Robinson vineyard in 2019 (left) and 2020 (right)

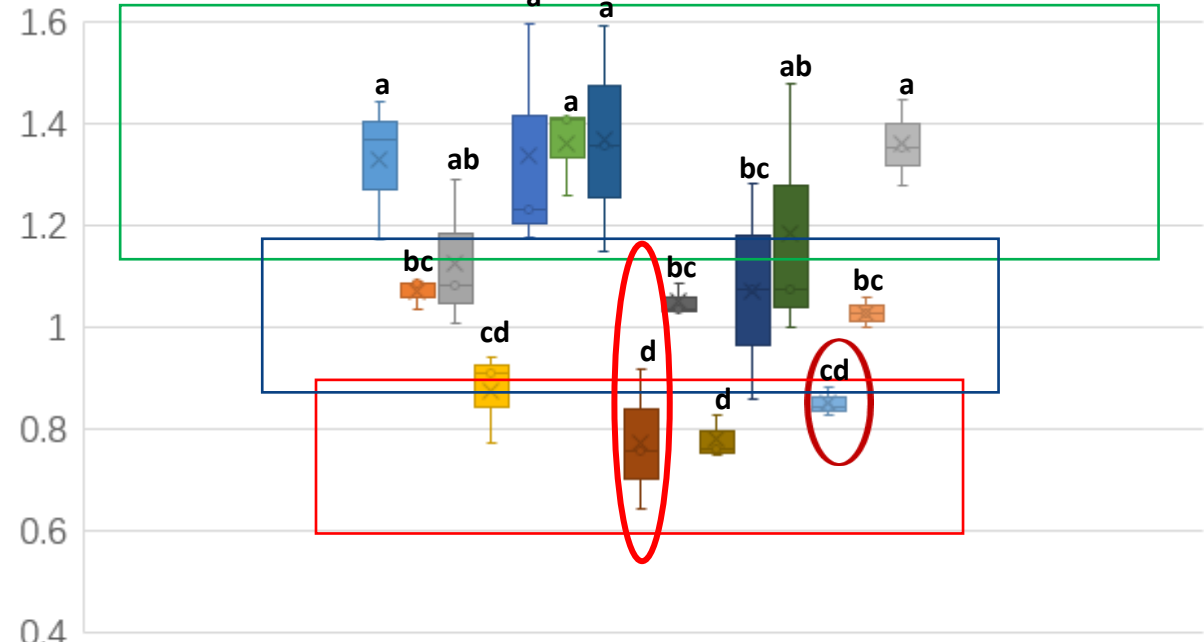


Group 13 (C113) had the lowest leaf area index compared to other groups in both vintages.

Leaf area index at Robinson vineyard in 2021 (left) and 2022 (right)

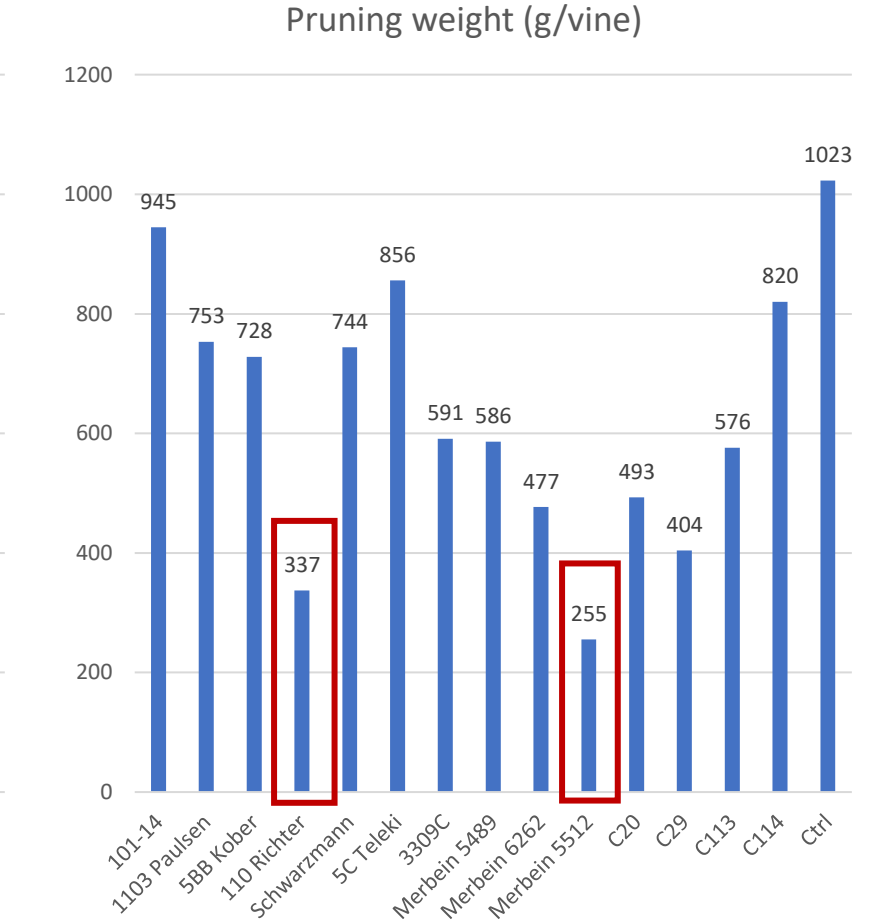
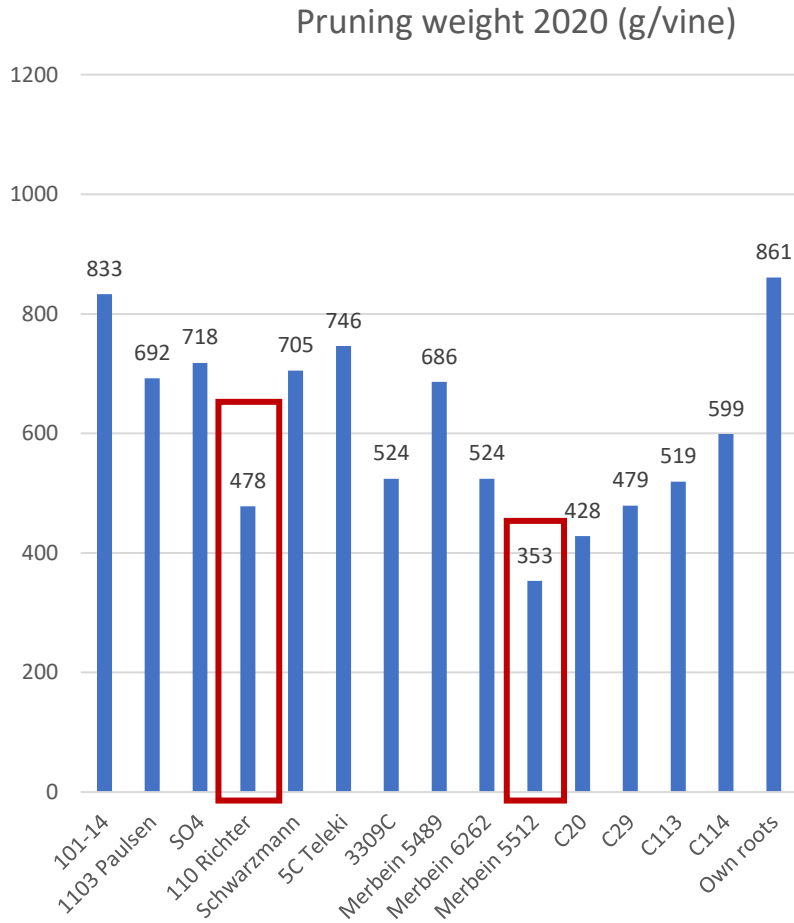
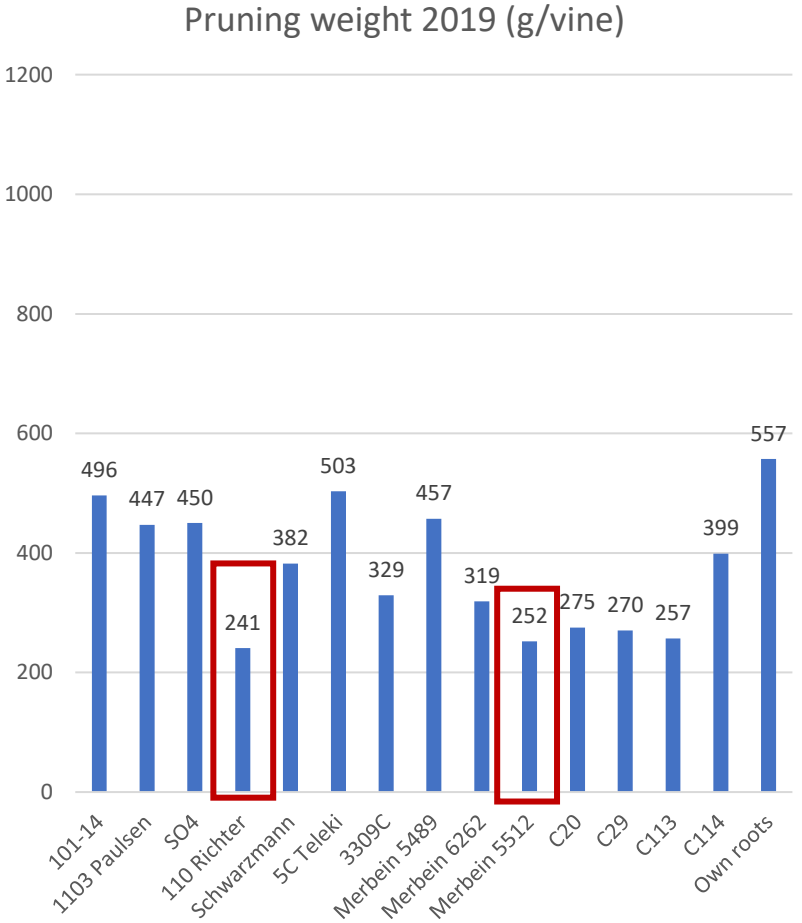


- 101-14
- 1103 Paulsen
- SO4
- 110 Richter
- Schwarzmann
- 5C Teleki
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- Merbein 5489
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- C114
- Own root



- 101-14
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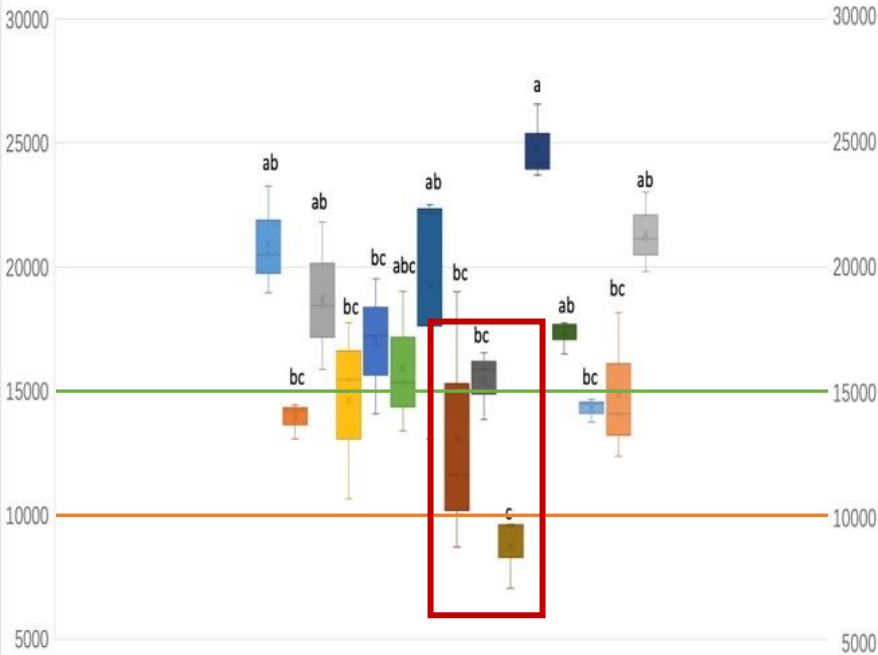
Pruning Mass in Robinson Vineyard in 2019, 2020 and 2021



Pruning mass of own root was highest over past 3 vintages. 110 Richter had the lowest in 2019 followed by group 10 (Merbein 5512). In 2020 and 2021, Merbein 5512 had the lowest pruning mass. Pruning mass of all rootstocks increased substantially in 2020, likely due to the older vine age and/or higher vigour in 2020.

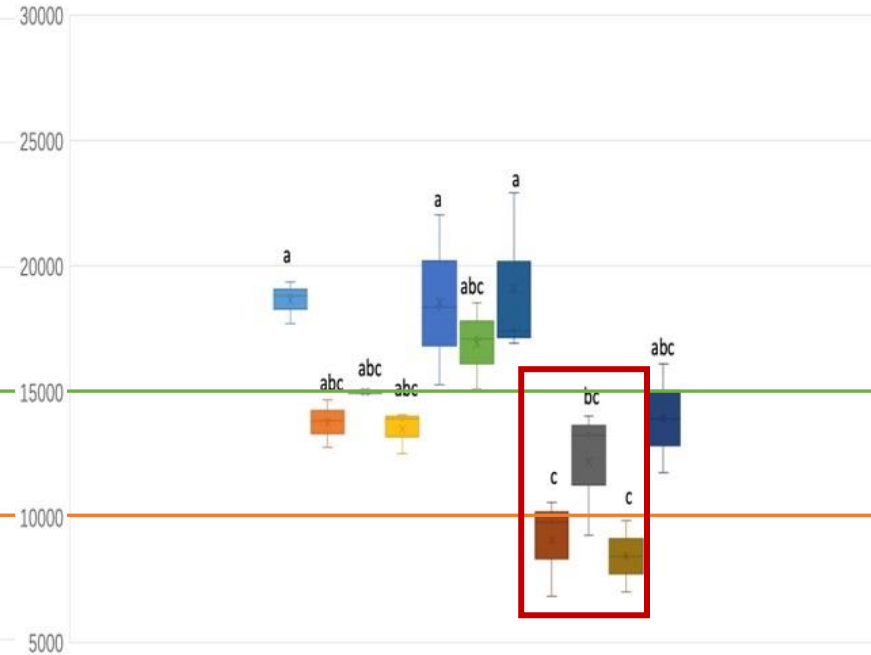
Petiole and Soil Nutrients -- K in 2019 (Potassium, mg/kg dry matter)

Robinson vineyard



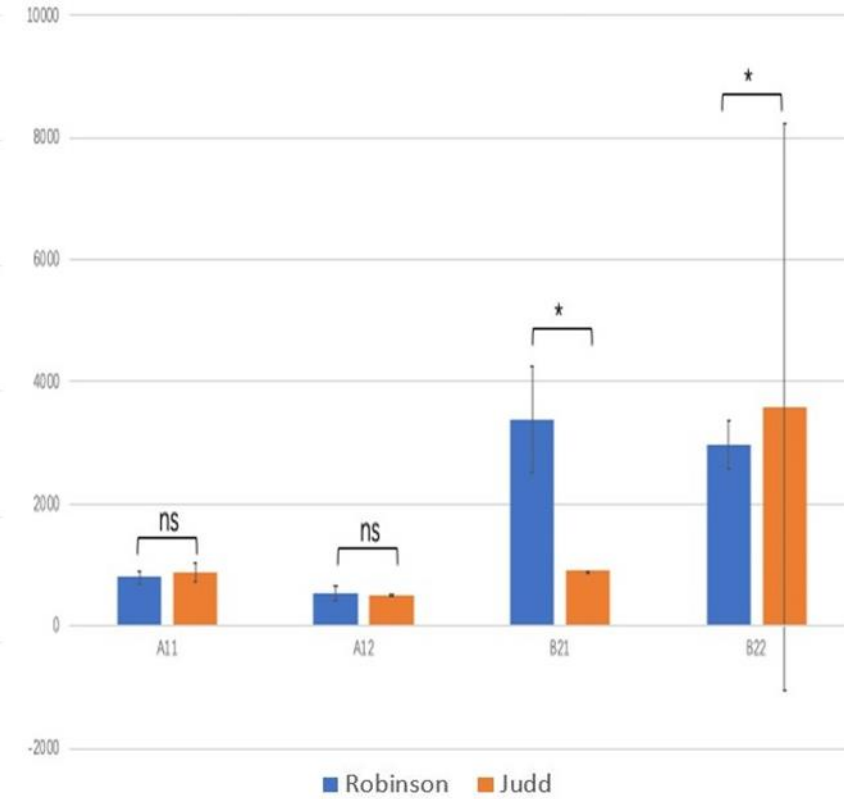
- 101-14
- Schwarzmann
- Merbein 626
- C113
- 1103 Paulsen
- 5C Teleki
- Merbein 5512
- C114
- SO4
- 3309C
- C20
- Own roots

Judd vineyard



- 101-14
- Schwarzman
- Merbein 6262
- Merbein 5489
- 1103 Paulsen
- 5C Teleki
- Merbein 5512
- SO4
- 3309C
- C29
- Own roots

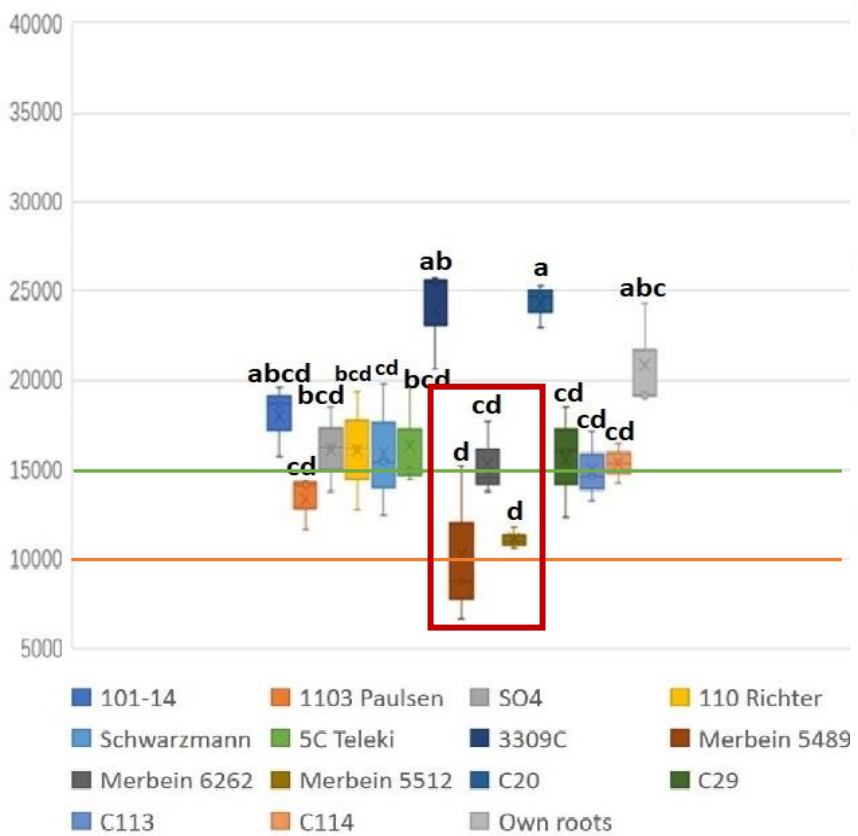
Soil concentrations



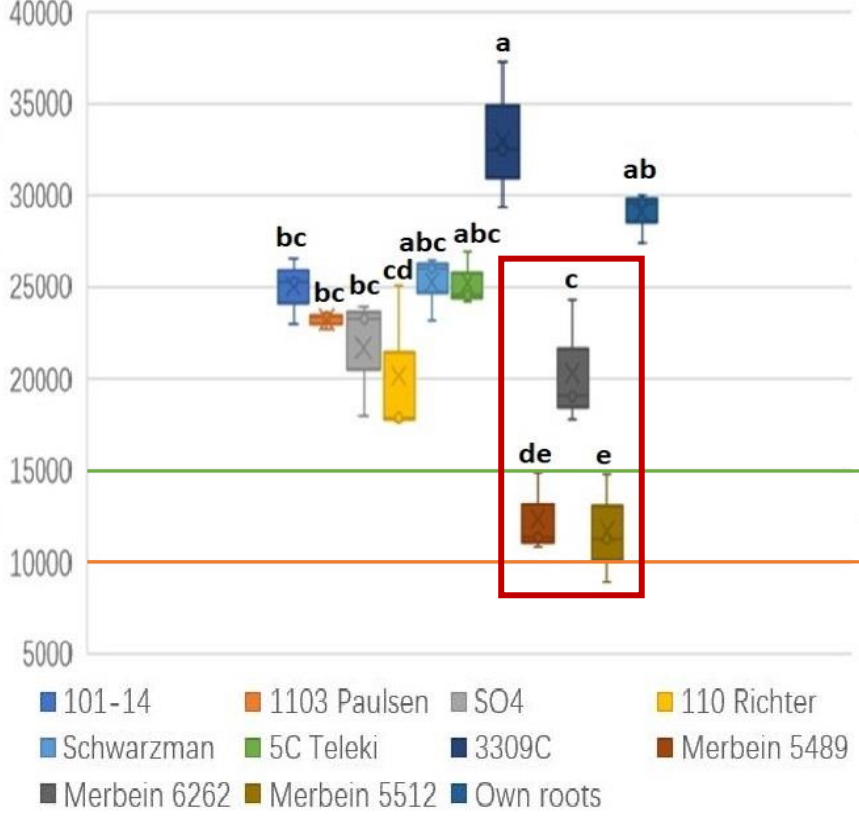
Under the orange line means deficient, above green line means adequate, above red line means toxic.

Petiole and Soil Nutrients -- K in 2020 (Potassium, mg/kg dry matter)

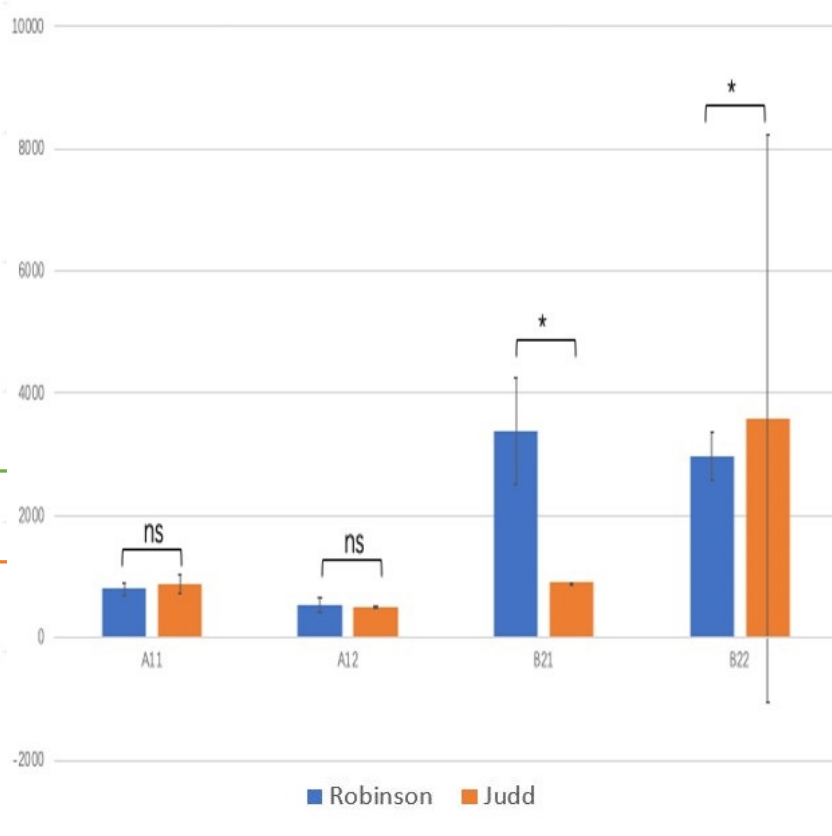
Robinson vineyard



Judd vineyard



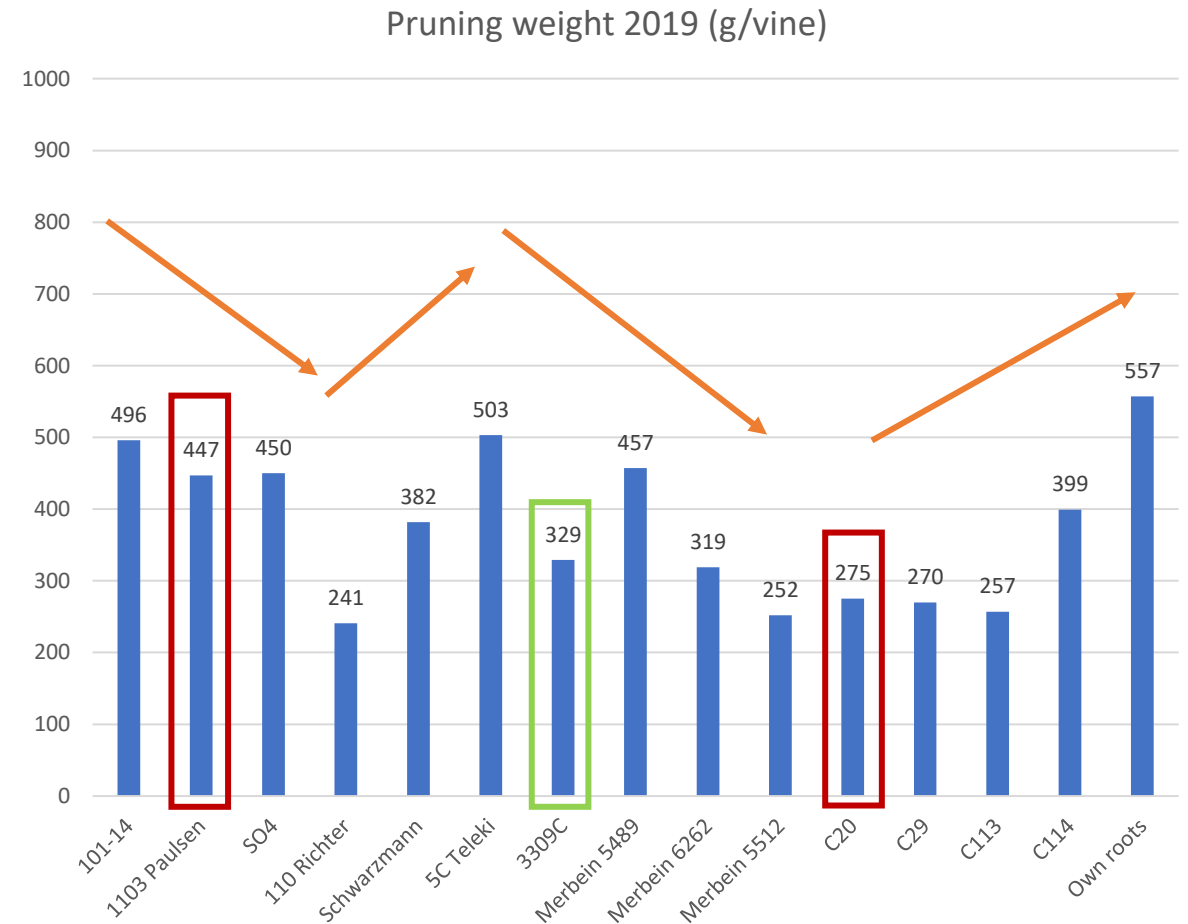
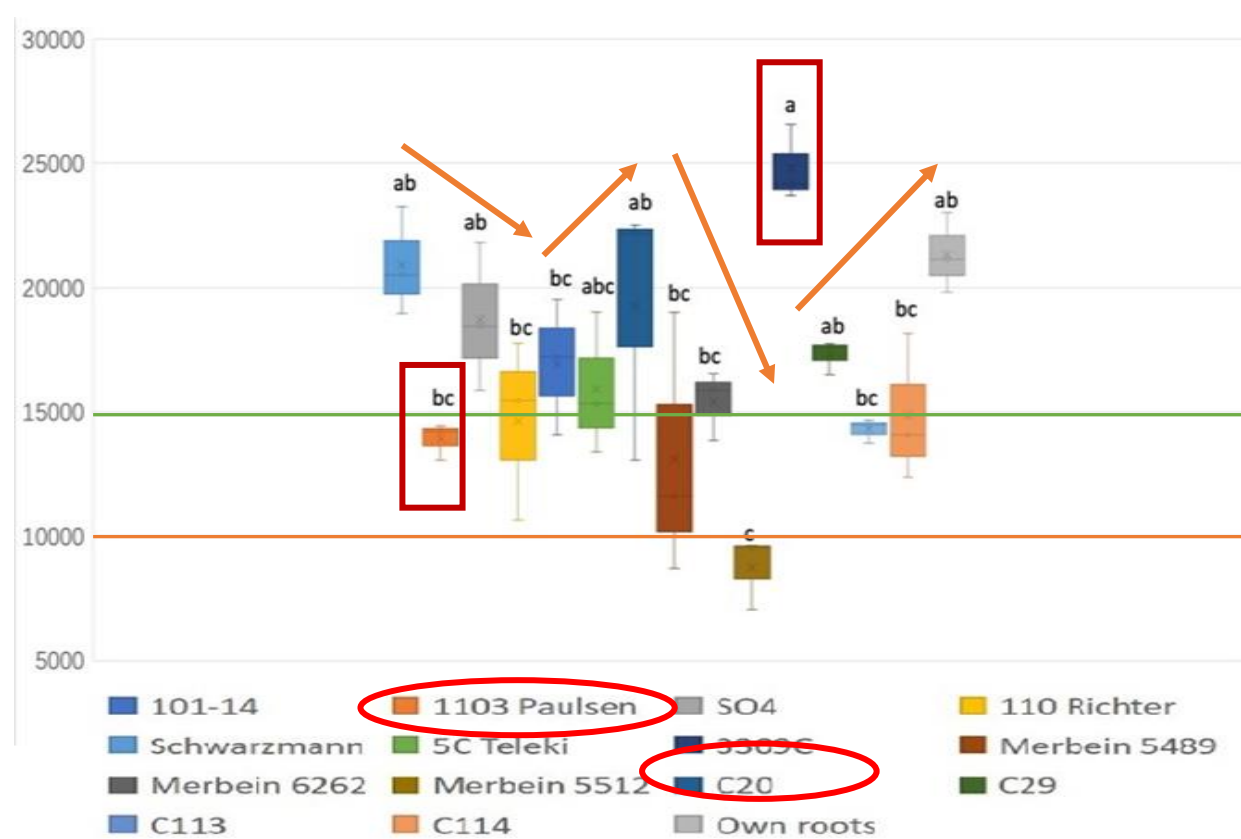
Soil concentrations



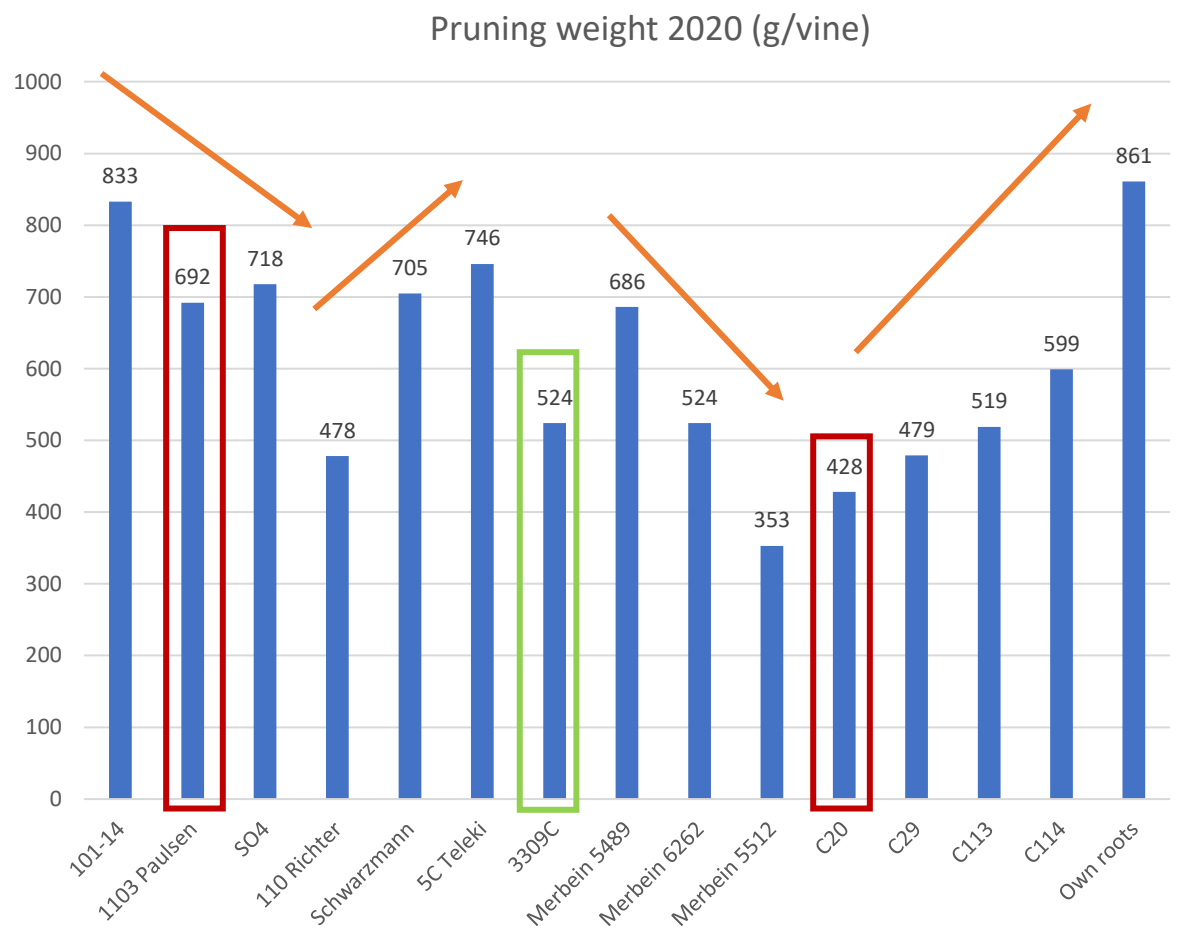
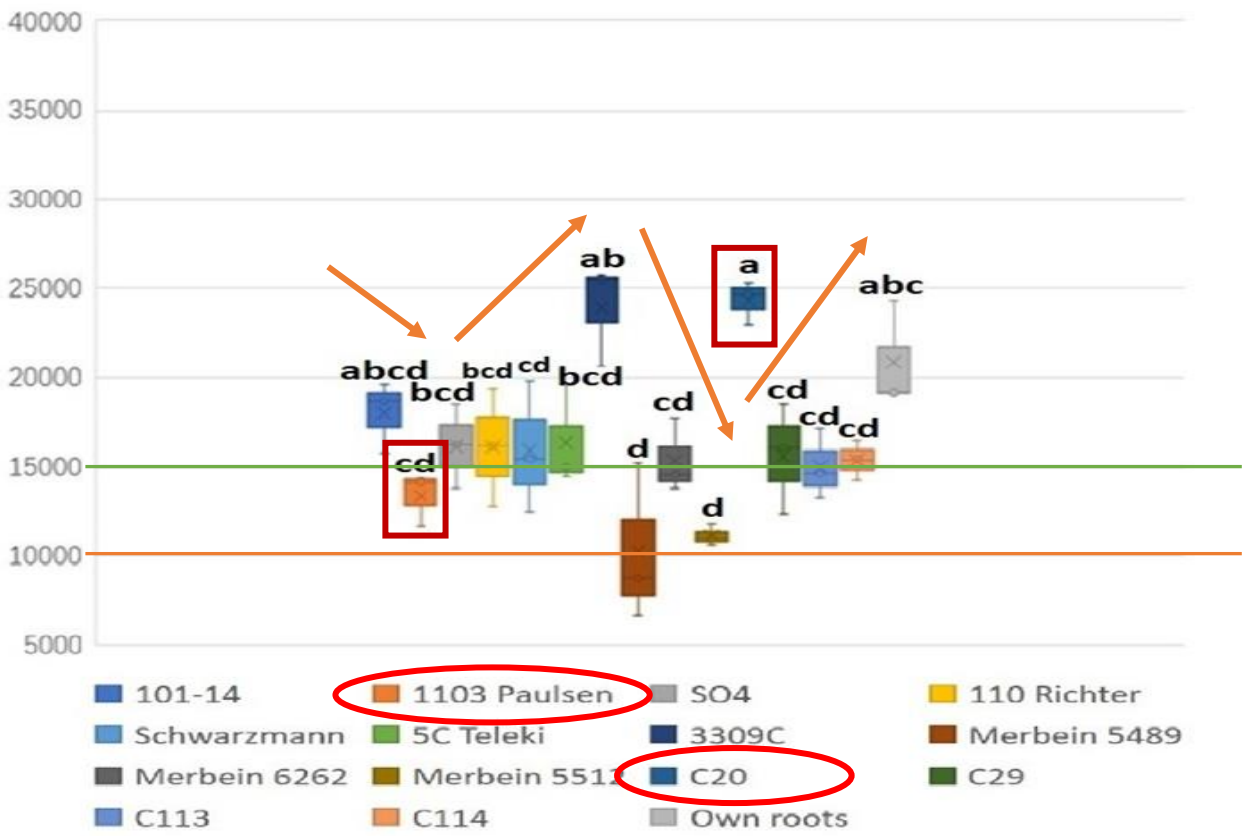
Under the orange line means deficient, above green line means adequate, above red line means toxic.

Merbein 5489 and Merbein 5512 both in both vineyards showed K deficient in both vintages. Increased K content was observed in Judd vineyard in 2020 vintage compared to 2019 vintage. Potassium concentration in the soil of Judd vineyard is not significantly higher than that in Robinson vineyard. Reason of increased K absorption in Judd vineyards remains uncertain, likely due to potential higher K content in the soil and less clay content in B layer soil in Judd vineyard.

Petiole and Soil Nutrients -- K in 2019 (Potassium, mg/kg dry matter)



Petiole and Soil Nutrients -- K in 2020 (Potassium, mg/kg dry matter)

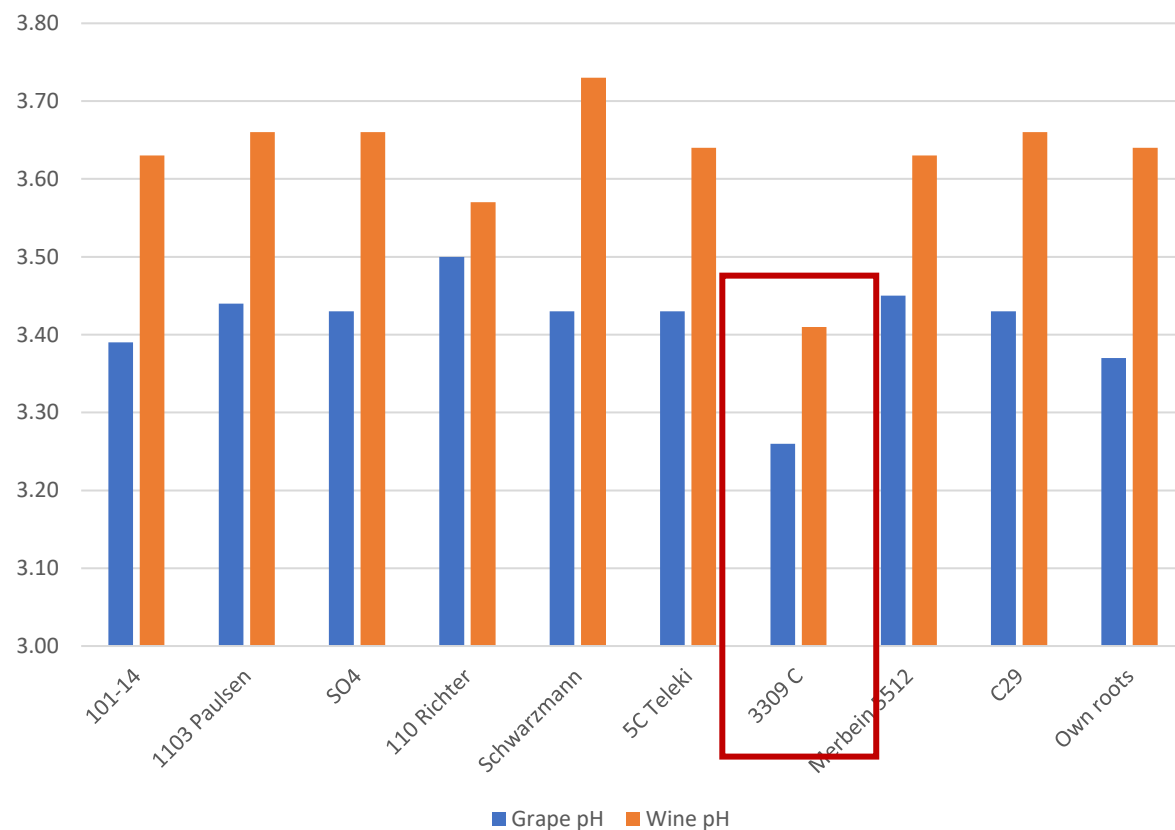


In both vintages, rootstocks with high petiole K concentrations tend to show high pruning mass, except 1103 Paulsen, 3309C and C20. Likely due to the roles of K in catalysing protein synthesis (Kadam, Wadje, & Patil, 2011) and tolerating water stress (Cochrane & Cochrane, 2009)

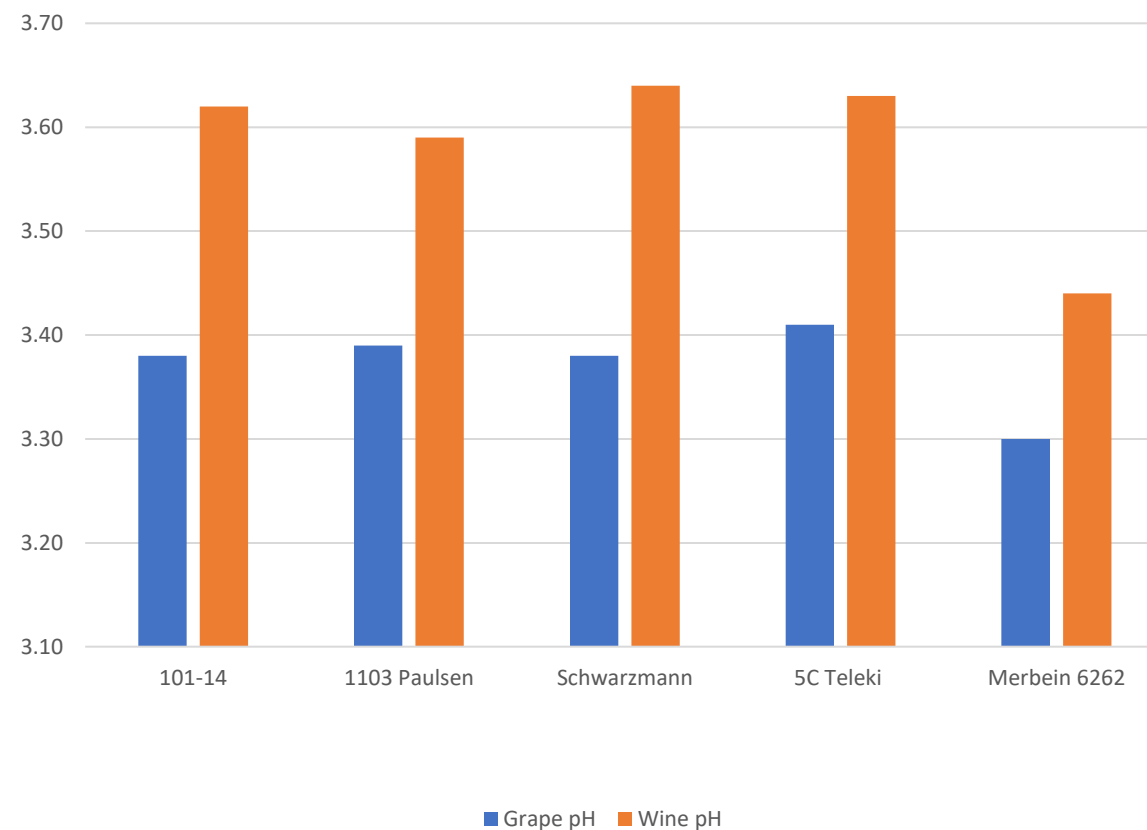
Lab-based Berry and Wine Analysis

Berry pH in 2020 and 2021 vintages – Measurement at Winery

Grape and Wine pH 2021 vintage

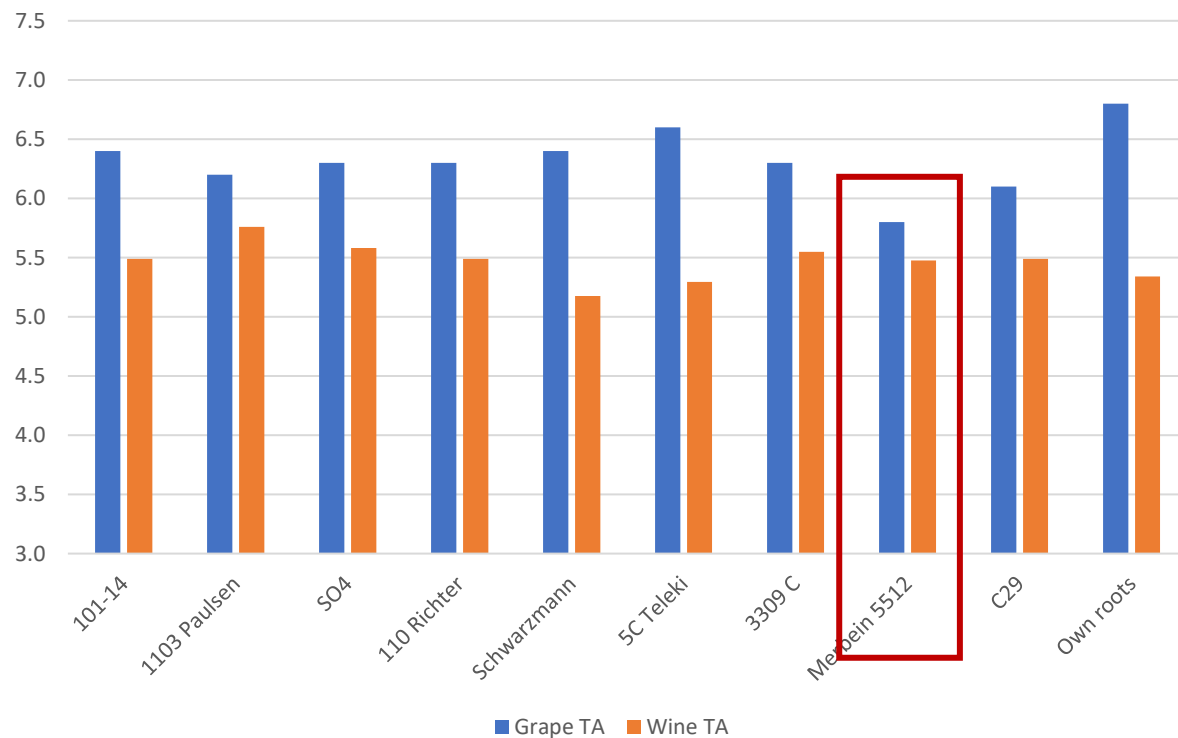


Grape and Wine pH 2020 vintage

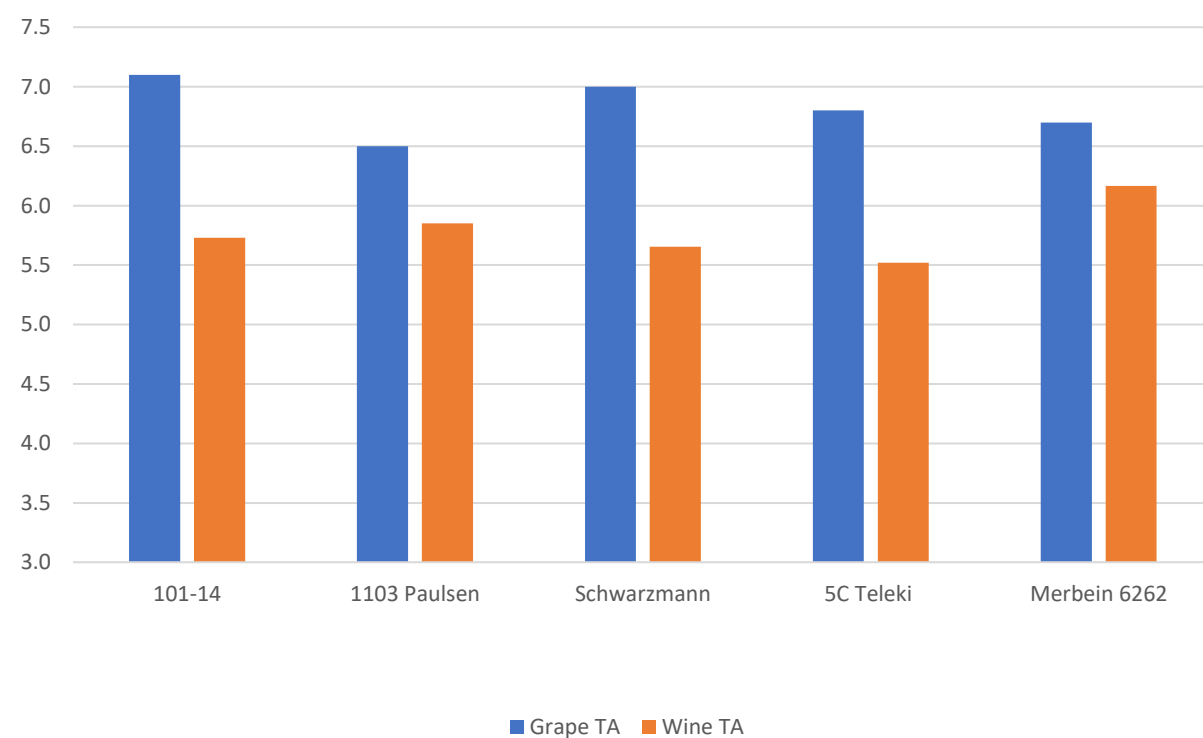


Titratable acidity in 2020 and 2021 vintages – Measurement at Winery

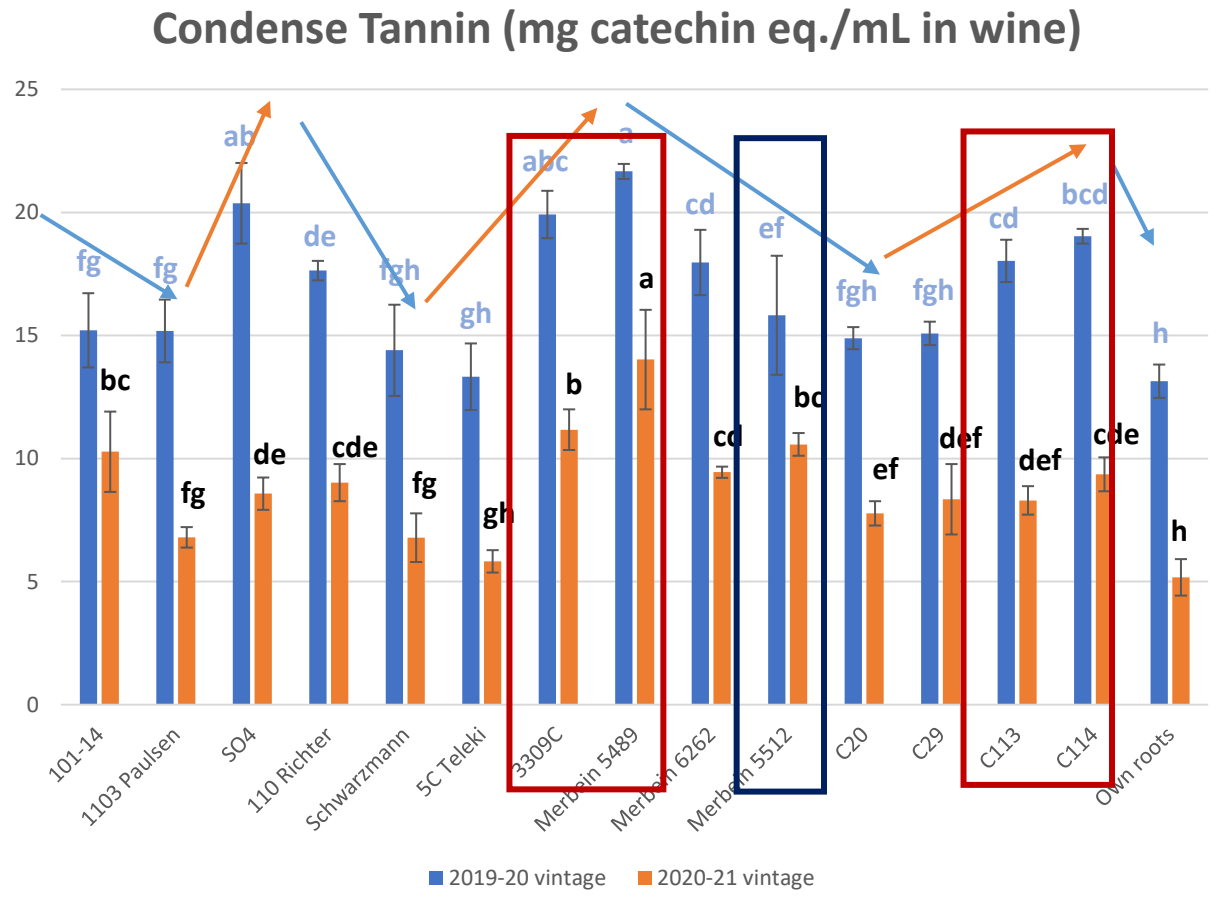
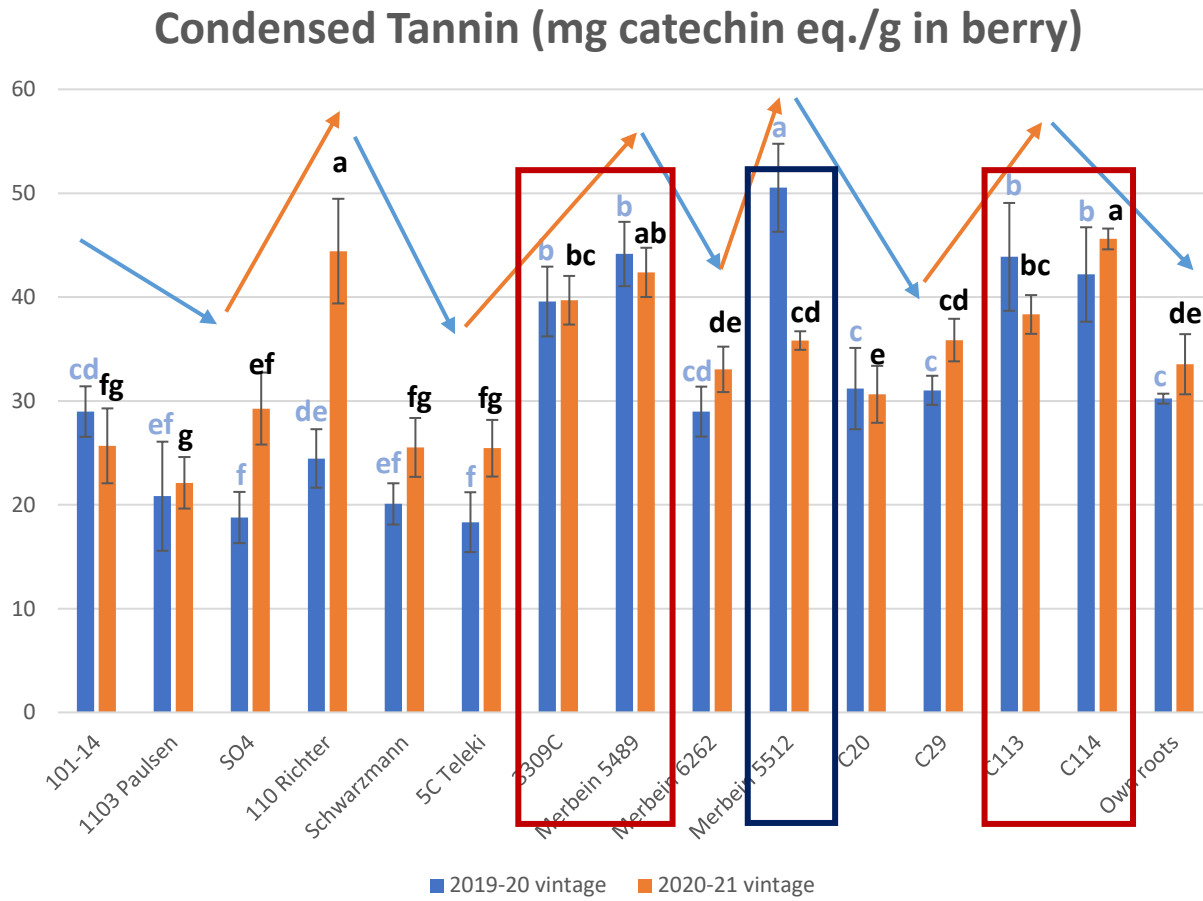
Grape and Wine TA 2021 vintage



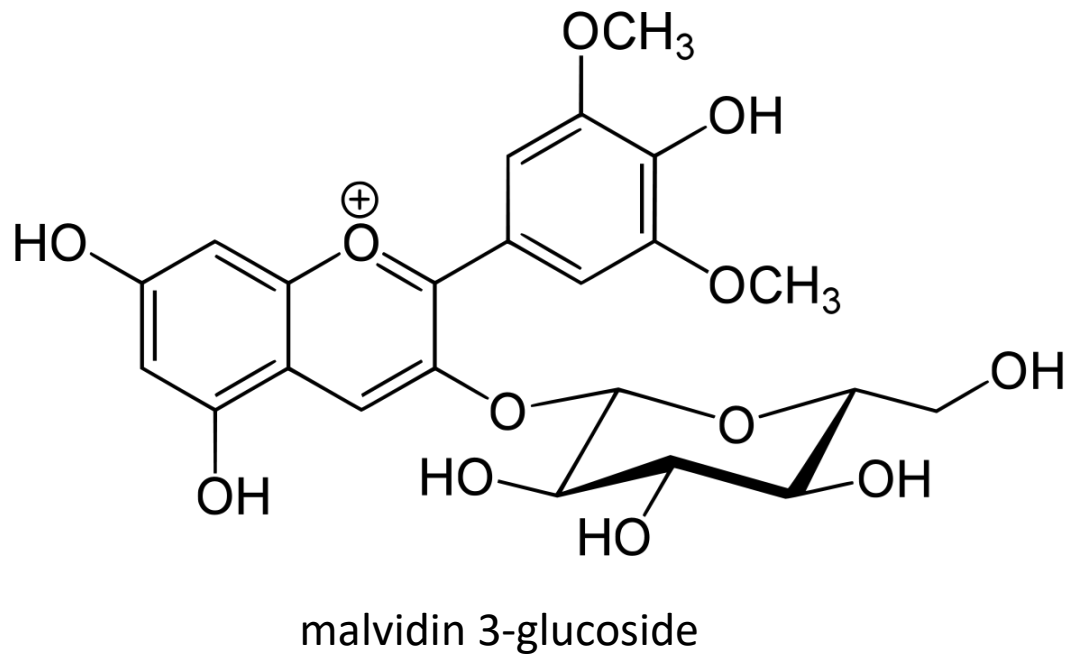
Grape and Wine pH 2020 vintage



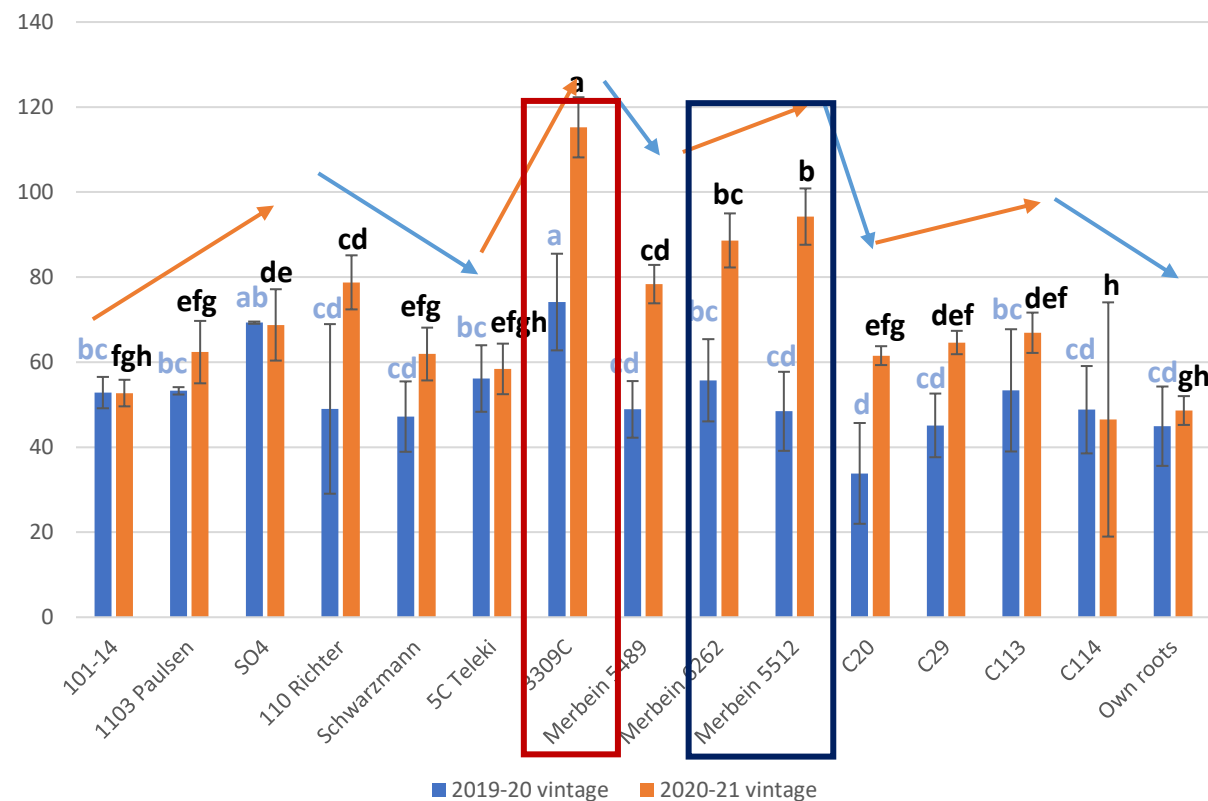
Berry and wine condensed tannin content in 19-20 and 20-21 vintages



Wine anthocyanin content in 2019-20 and 2020-21 vintages



Malvidin 3-glucoside content (mg/L in wine)

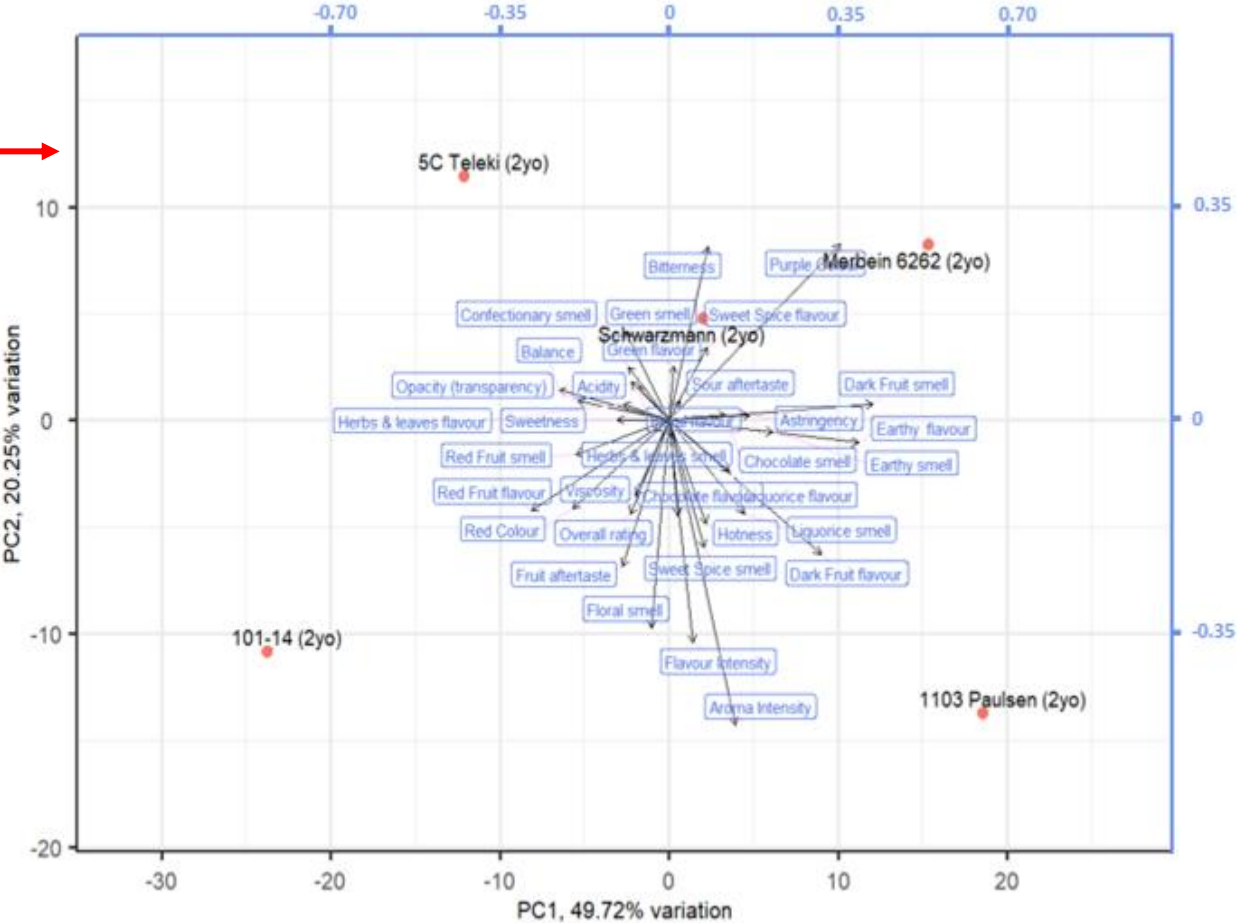
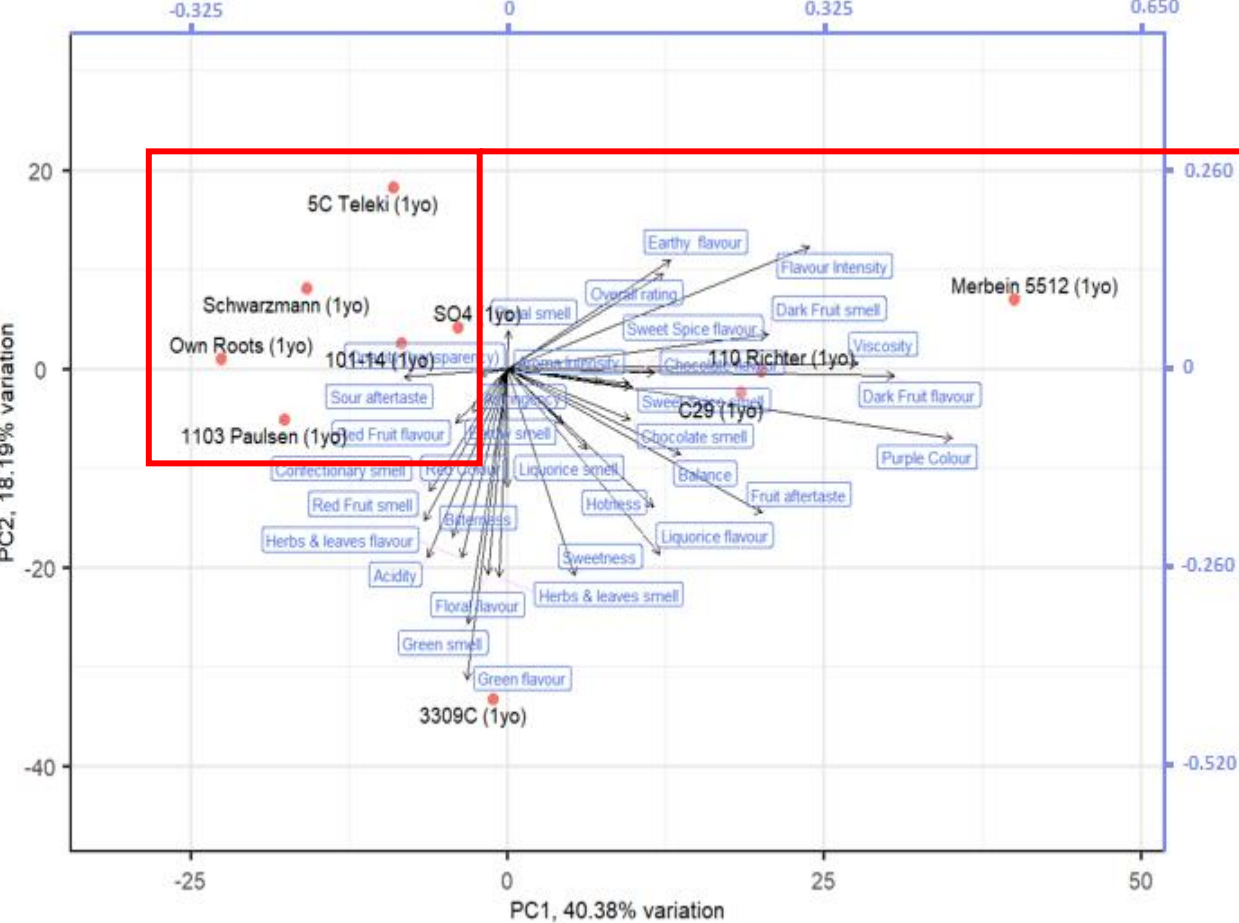


Sensory Evaluation by Professional Panels

Aroma intensity, flavour intensity, and overall rating of 1-year old (left) and 2-year-old (right) wine



PCA plots on sensory evaluation results of 1-year old (left) and 2-year-old (right) wine



Acknowledgement to all collaborators

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Mr Hugh Robinson (Peninsula Vinecare)

Mr Tim Brown and Ms Imogen Dillon (Ten Minutes by Tractor)

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Mr Adam Hall (Yalumba Nursery)

Mr Richard McIntyre and Jeremy (Moorooduc Estate)

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Victoria State Government – Wine Victoria

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Structured Tasting Reveal

Rootstock Attributes Flyer: C29



Image taken at start of veraison 2021

Nutrient Uptake Ability

Magnesium absorption



Potassium absorption



Calcium absorption



Sodium absorption



Phosphorus absorption



Berry Quality

Berry pH



Berry titratable acidity



Berry total free phenolic content



Berry total flavonoid content



Berry condensed tannin content



Phenology Performance

Anthesis time



Veraison time



Physiology Performance

Leaf area index

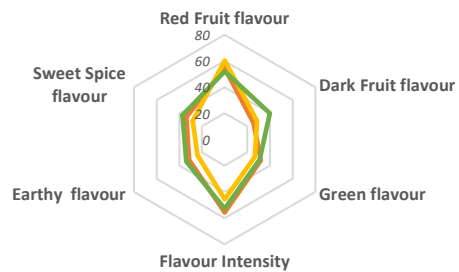


Pruning mass

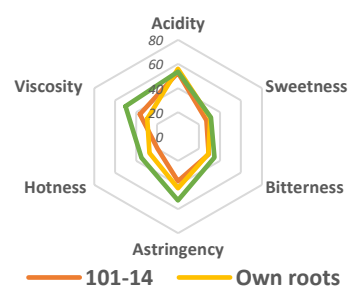


1-year-old wine 2021 vintage

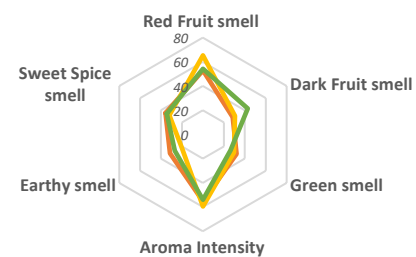
Wine Flavour



Wine Taste/Mouthfeel



Wine Aroma



Wine Colour

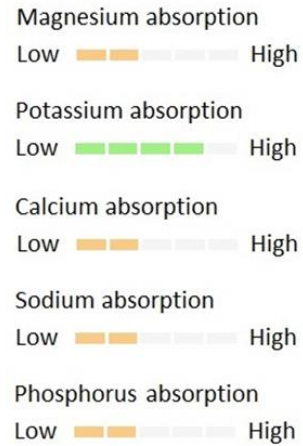


Rootstock Attributes Flyer: 101-14

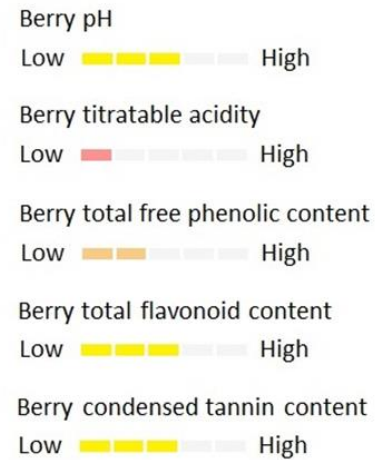


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



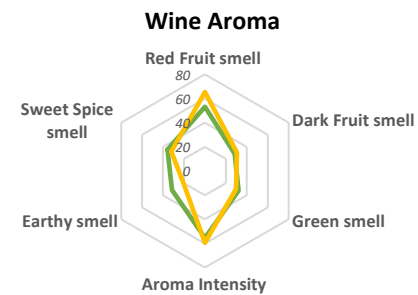
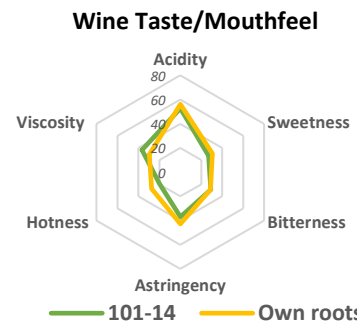
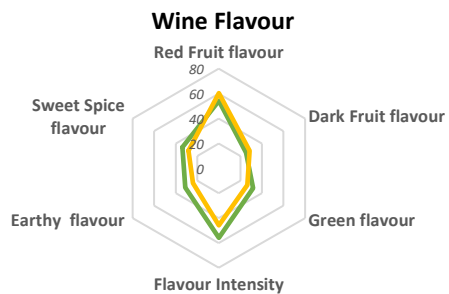
Phenology Performance



Physiology Performance



1-year-old wine 2021 vintage



Wine Colour

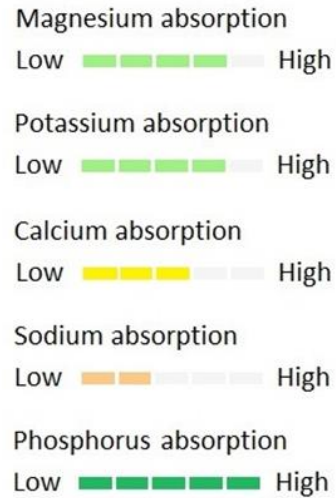


Rootstock Attributes Flyer: Own Roots

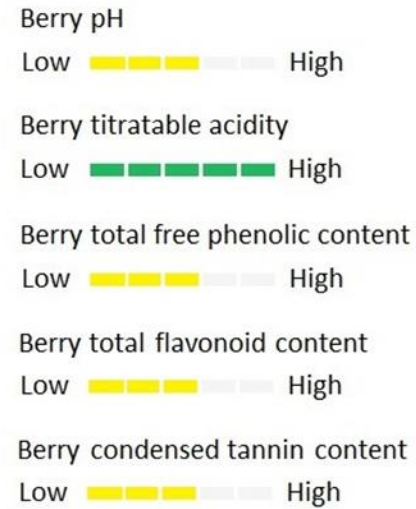


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



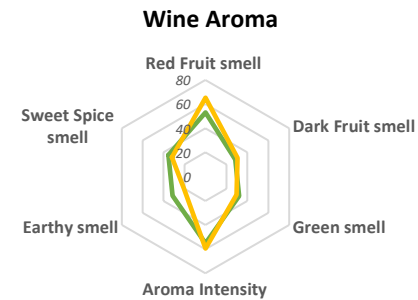
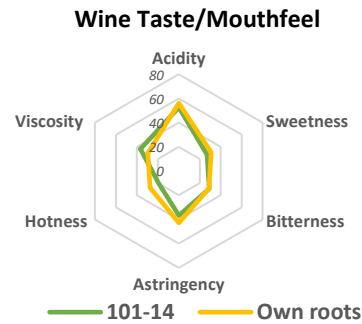
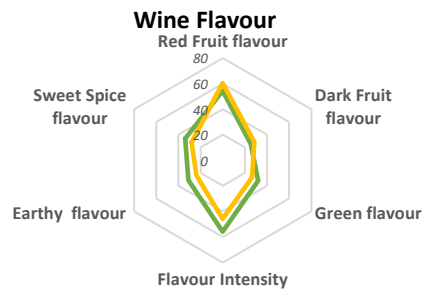
Phenology Performance



Physiology Performance



1-year-old wine 2021 vintage



Wine Colour

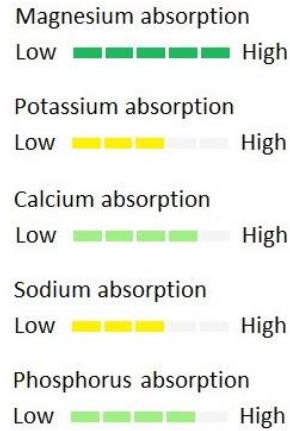


Rootstock Attributes Flyer: Paulsen 1103

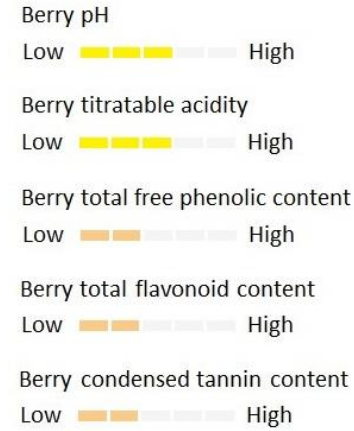


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



Phenology Performance

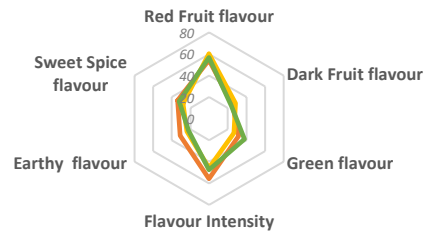


Physiology Performance

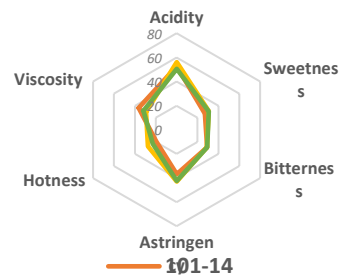


1-year-old wine 2021 vintage

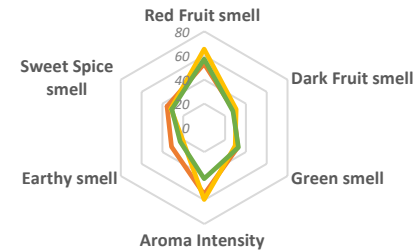
Wine Flavour



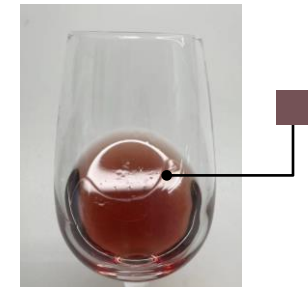
Wine Taste/Mouthfeel



Wine Aroma



Wine Colour

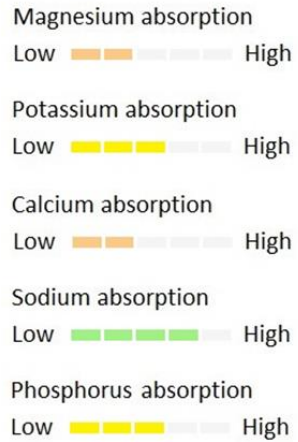


Rootstock Attributes Flyer: Schwartzmann

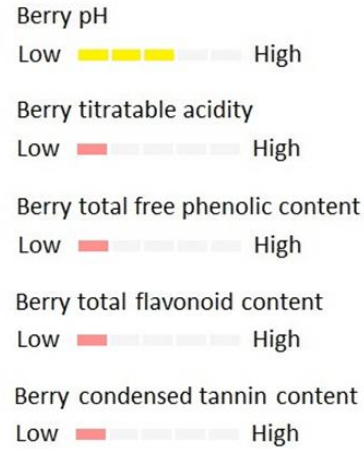


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



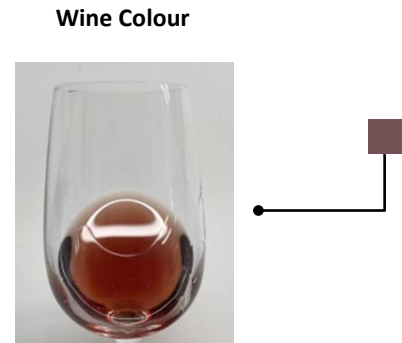
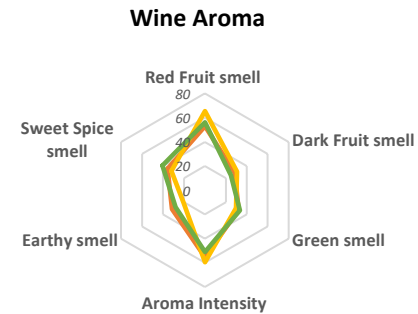
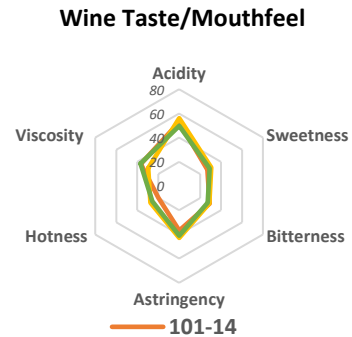
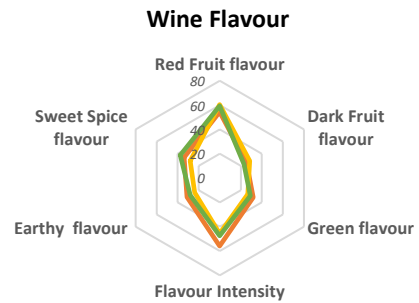
Phenology Performance



Physiology Performance



1-year-old wine 2021 vintage

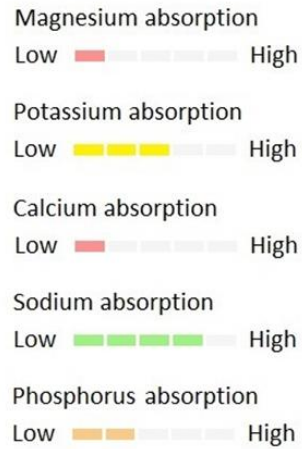


Rootstock Attributes Flyer: SO4

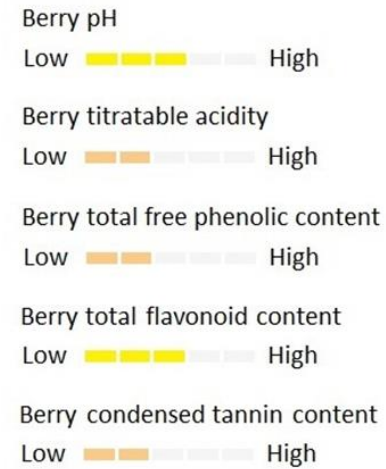


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



Phenology Performance

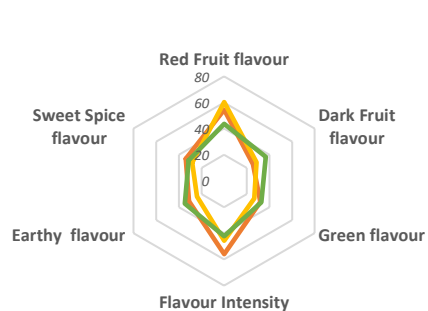


Physiology Performance

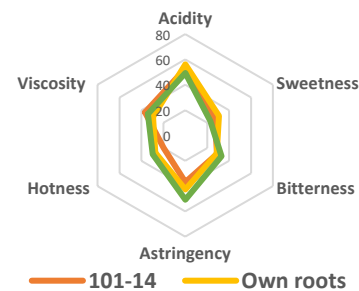


1-year-old wine 2021 vintage

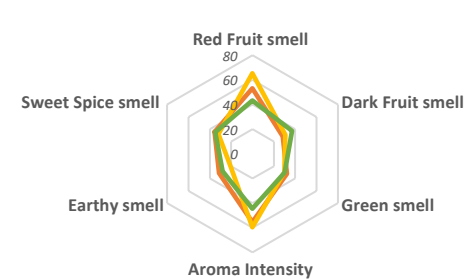
Wine Flavour



Wine Taste/Mouthfeel



Wine Aroma



Wine Colour

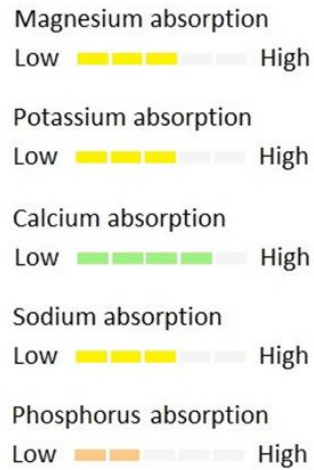


Rootstock Attributes Flyer: 5C Teleki

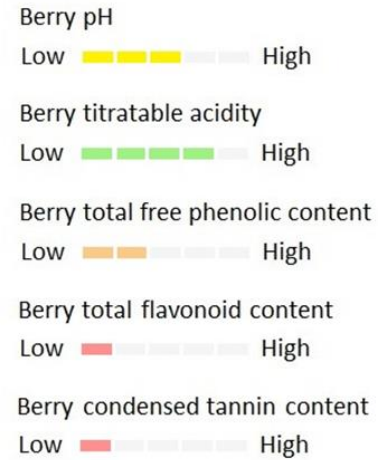


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



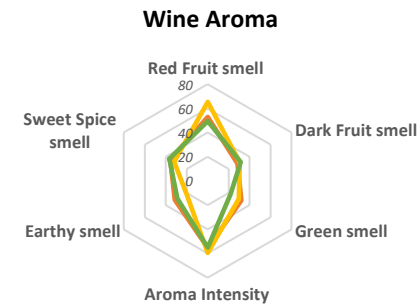
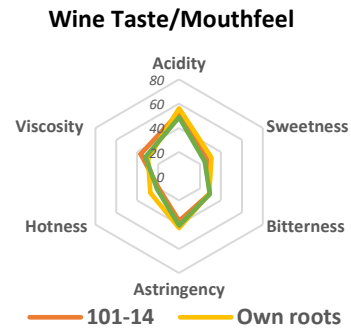
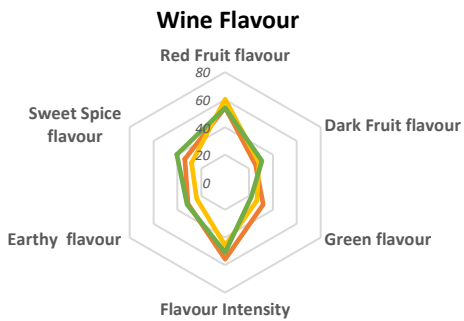
Phenology Performance



Physiology Performance



1-year-old wine 2021 vintage



Wine Colour

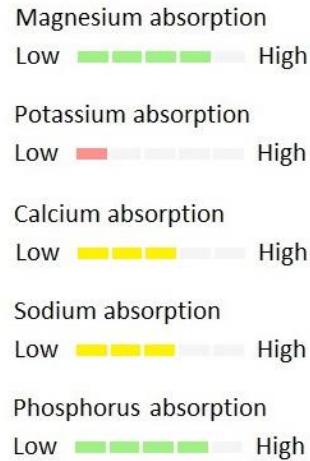


Rootstock Attributes Flyer: Merbein 5512 (Not Tasted)

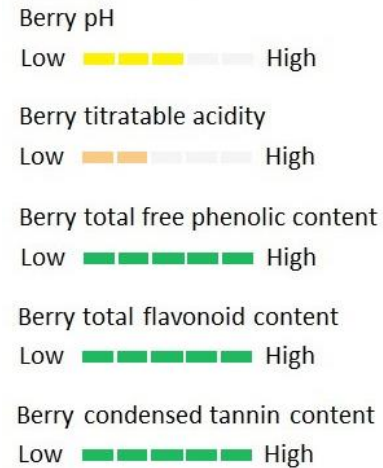


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



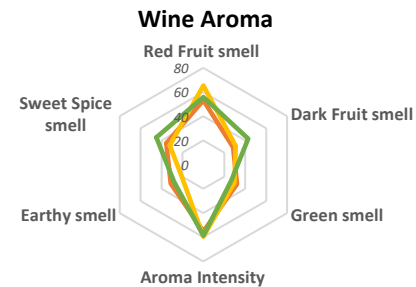
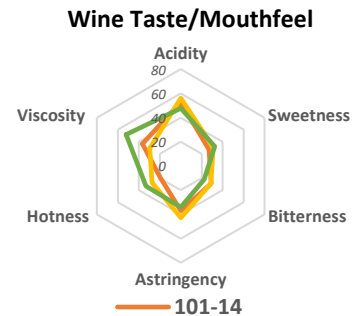
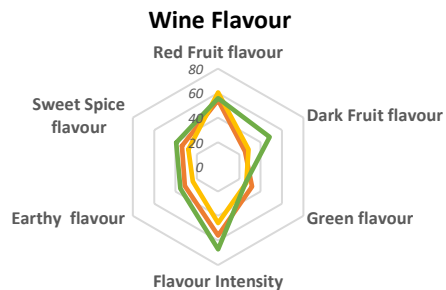
Phenology Performance



Physiology Performance



1-year-old wine 2021 vintage



Wine Colour

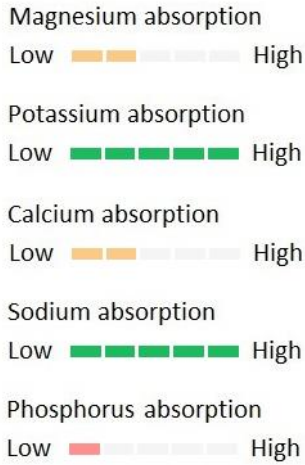


Rootstock Attributes Flyer: 3309C (Not Tasted)

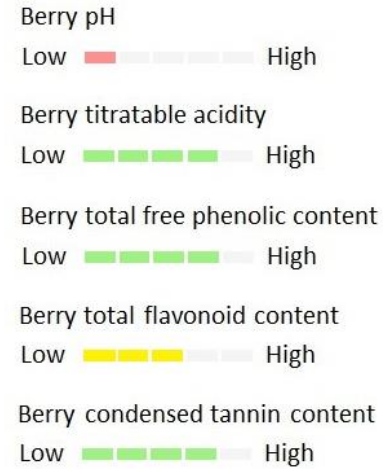


Image taken at start of veraison 2021

Nutrient Uptake Ability



Berry Quality



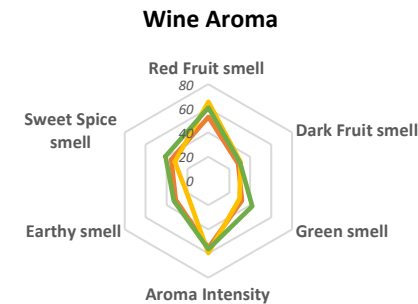
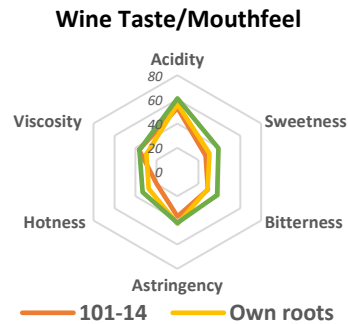
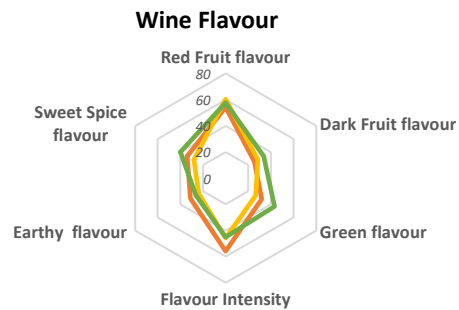
Phenology Performance



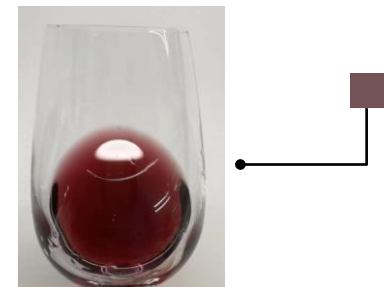
Physiology Performance



1-year-old wine 2021 vintage



Wine Colour



Rootstock Attributes Flyer: 110 Richter (Not Tasted)



Image taken at start of veraison 2021

Nutrient Uptake Ability

Magnesium absorption



Potassium absorption



Calcium absorption



Sodium absorption



Phosphorus absorption



Berry Quality

Berry pH



Berry titratable acidity



Berry total free phenolic content



Berry total flavonoid content



Berry condensed tannin content



Phenology Performance

Anthesis time



Veraison time



Physiology Performance

Leaf area index

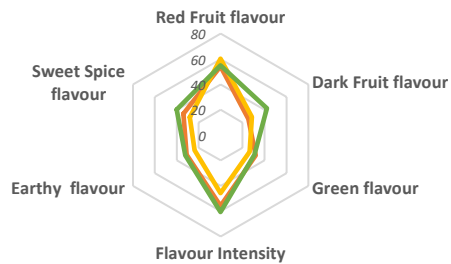


Pruning mass

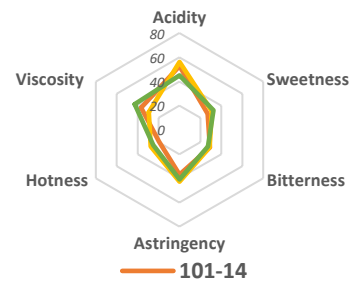


1-year-old wine 2021 vintage

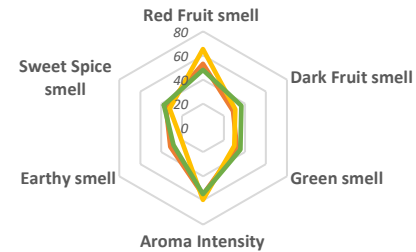
Wine Flavour



Wine Taste/Mouthfeel



Wine Aroma



Wine Colour





Questions

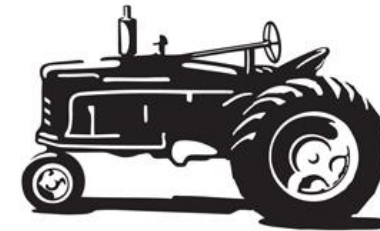
Thanks to our winery partners

MOOROODUC ESTATE



Ten Minutes by Tractor

MORNINGTON PENINSULA



Thanks to our project partners



Wine
Australia
for
Australian
Wine



M
P
Y MORNINGTON
PENINSULA
WINE