Long-term properties of rootstocks

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Rootstocks – what they are

Grafted vines have been widely used in Australia for decades. They consist of a *scion* - the fruiting part of the vine, that is grafted to a *stock* - the rooted part of the vine (hence the *rootstock*).

Scions are selected for the characteristics of their fruit. In Australia, these are drawn from the species *Vitis Vinifera*, which originated in Eurasia.

Rootstocks are drawn from American species of the *Vitis* genus, either as singular species or as inter-species hybrids, including hybrids with *Vitis vinifera*. Most rootstocks in use in Australia were either developed in Europe in the late 19th century or developed in USA in the 20th century.

Rootstock from Europe are generally designated by the name of their breeder and the number of the breeder's selection, for example 5C Teleki designates a selection made by Teleki's son from Teleki's 5A selection. Naming of stocks developed in USA generally does not follow this convention. Some rootstock names also include a 4-digit accession number, which was assigned during importation and gives information about the source of the planting material.

Rootstocks are an important asset to Australian viticulture. Across South Australia, the most common rootstocks are Ramsey, 1103 Paulsen, 101-14, 140 Ruggeri and Schwarzmann.

Rootstocks - what they can do

Rootstocks can increase vine tolerance to soil pests, salinity, drought, water-logging and unfavourable soil pH. They can also be used to manipulate vine vigour.

However, most of what we know about the properties of rootstocks is based on observations of potted immature vines or of field vines within the first decade of their life. It is unclear what happens to these properties as vines age past their first decade.

To fill some gaps in our knowledge, SARDI focussed on three areas of rootstock research, namely:

- stability of rootstock effects on yield over time.
- increasing the number of rootstocks known to exclude salt in a supplementary irrigation area.
- effects of reduced irrigation on salt exclusion by rootstocks.

Stability of rootstock effects on yield over time

To understand whether a rootstock's effect on yield is a stable property over three decades, we re-visited an established Shiraz rootstock trial in a supplementary irrigated area. In 2010 and 2011, we measured vine yields in an established Shiraz rootstock trial at Coonawarra in the Limestone Coast GI. The trial was planted 25 years ago and yields were measured when the vines were between three and six years of age. At that young age, the yields of vines on all rootstocks and on Shiraz own roots were equal, but the yield of young vines grafted to Petit Verdot was lower.

Over time, the picture has changed (Figure 1). At 24 and 25 years of age, the yields of vines on 5C Teleki 8344, 101-14, 5C Teleki 8343, 420A, 1616 and Petit Verdot were less than those on own roots and 5CTeleki A6V18.

Rankings of rootstocks by yield were not stable over three decades.

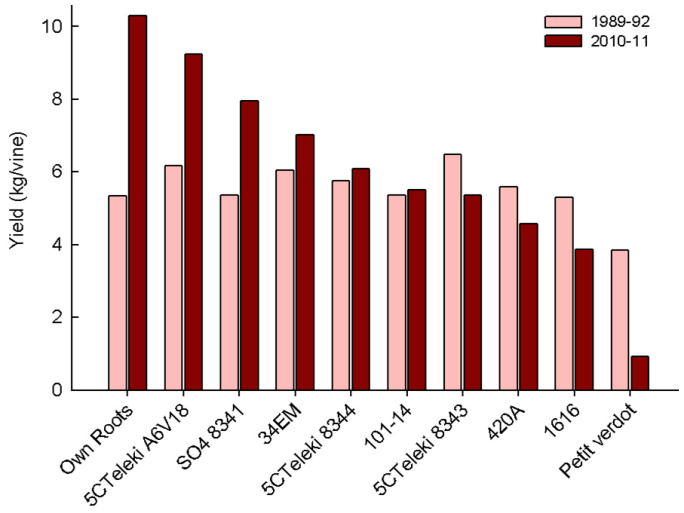

Figure 1. The effect of rootstock on the average yield of grafted Shiraz vines at 3–6 years of age and 24–25 years of age.

Increasing the number of rootstocks known to exclude salt

To increase the number of rootstocks known to exclude salt in a supplementary irrigation area, we analysed a SARDI trial which contained rootstocks in addition to those already being assessed within the study area. SARDI and CSIRO have Chardonnay rootstock trials at Padthaway in the south east of South Australia. Both trials contain vines on eight rootstocks and on own roots and three rootstocks are common in both trials. Supplementary irrigation at both sites used saline water (electrical conductivity greater than 1.6 dS/m).

In 2010, when the vines were 24 years old, we harvested the SARDI rootstock trial, juiced the fruit (by hand pressing) and analysed the levels of sodium and chloride. The levels in fruit from own rooted vines were similar to those found by CSIRO for four to five year old vines (Table 1).

	Juice sodium (mg/L)		Juice chloride expressed as sodium chloride (mg/L)	
Rootstock	SARDI 2010	CSIRO* 1996-97	SARDI 2010	CSIRO* 1996-97
Own Roots	48	46	120	122
Ramsey	27	41	36	54
K51-40	28	41	262	163
Schwarzmann	16	48	45	48
SO4 8341	12		40	
5CTeleki A6V18	23		61	
Fercal	19		41	

* Walker et al. 2010 AJGWR **16**:243-257

Table 1. The effect of rootstock on the concentrations of sodium and chloride in juice from fruit on grafted Chardonnay vines at two rootstock trial sites in Padthaway (data from K51-32 and Freedom not shown).

At both sites, the concentrations of chloride in juice (expressed as sodium chloride) were well below the maximum allowable in wine of 1000 mg/L (Table 1). However, some consumers can detect an effect of salt on taste at concentrations below 1000 mg/L.

At the CSIRO site, juice from vines grafted to Ramsey, K51-40 and Schwarzmann had the same juice sodium concentration as vines on own roots. In contrast, at the SARDI site, the sodium concentrations in juice from vines on seven of the eight rootstocks were less than that in juice from vines on own roots.

The effects of Ramsey, K51-40 and Schwarzmann rootstocks on juice chloride concentrations were the same at the CSIRO and SARDI sites. Juice from vines on Ramsey and Schwarzmann had low concentrations of chloride. At the SARDI site, vines on Fercal and SO4 also had low concentrations of chloride in juice.

The low concentrations of sodium and chloride in the juice from Chardonnay vines on Fercal and SO4 indicates that their salt exclusion behaviours are the equal to those of the more well-known salt excluding rootstocks such as Ramsey and Schwarzmann. At the SARDI site, the yields of vines on Fercal and SO4 were equivalent to or greater than those of vines on Ramsey and Schwarzmann.

Effects of reduced irrigation on salt exclusion

To understand whether reducing irrigation by 30% affects the ability of rootstocks to exclude salt from Shiraz vines growing on saline soils we analysed fruit from a rootstock and irrigation trial in a fully irrigated area. For four seasons, we applied full and 30% reduced irrigation treatments to a Shiraz rootstock trial on saline soils (4.1 dS/m) in the Riverland. Irrigation water was non-saline (0.4 dS/m). Overall, reducing irrigation by 30% caused a 31% yield loss. In the last season, berries were collected before harvest and frozen. Berries were thawed at a later date, homogenised (a process that extracts more chloride than hand pressing), clarified and the juice analysed for sodium and chloride.

Even though this site had saline soils, the concentrations of chloride (expressed as sodium chloride) in all juices were well below the maximum allowable in wine of 1000 mg/L (Figure 2).

The average chloride levels in juice from vines on Ramsey and 140 Ruggeri were about 50% higher than the levels in juice from vines on 1103 Paulsen and Schwarzmann (Figure 2). Reducing irrigation increased the average chloride level by 15%. Reducing irrigation did not affect the sodium levels in juice from vines on Ramsey, 140 Ruggeri, 110 Richter and Schwarzmann, but it doubled levels in juice from vines on 1103 Paulsen. Juice from vines on Ramsey had more than twice the sodium of juice from vines on 110 Richter.

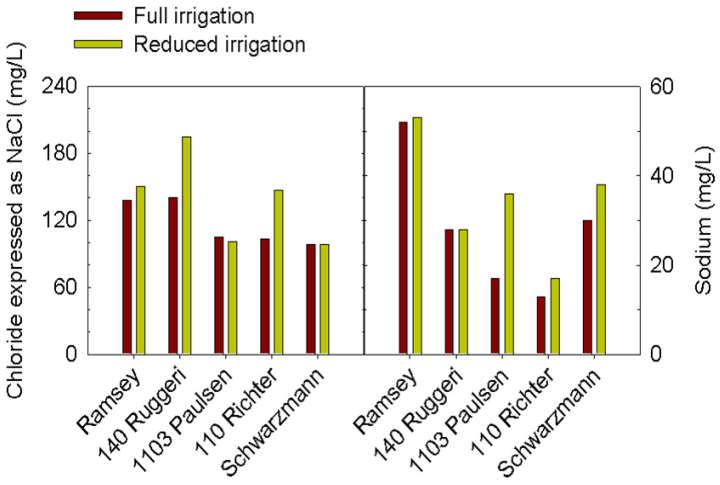

Figure 2 The effect of irrigation and rootstock on the chloride (expressed as sodium chloride) and sodium levels in juice from fruit from grafted Shiraz vines.

On saline soils, reducing irrigation by 30% causes a 15% rise in chloride levels in juice from grafted vines, but did not affect sodium levels except in juice from vines on 1103 Paulsen rootstock.

Summary – new knowledge

- The rootstock effect on Shiraz yield can change with vine age. Over three decades, the yields of Shiraz vines on 5C Teleki 8344, 101-14, 5C Teleki 8343, 420A, 1616 declined relative to yields of vines on own roots and 5CTeleki A6V18.
- In the supplementary irrigated area of SE Australia, salt exclusion from Chardonnay vines on the rootstocks Fercal and SO4 was the equal of that by the more well known rootstock Ramsey.
- At a saline site in the Riverland, the use of rootstocks kept salt concentrations in juice well below the allowable maximum in wine. Reducing irrigation by 30% doubled the sodium concentration in juice from Shiraz vines on 1103 Paulsen, but did not affect the concentrations in juice from vines on Ramsey, 110 Richter, Schwarzmann and 140 Ruggeri.

More information

More detail on the trials described in this fact-sheet are contained in 'Salt tolerant rootstocks for long-term sustainability in the Limestone Coast SAR 09/03', which can be downloaded at www.gwrdc.com.au.

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