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The establishment of Cabernet Sauvignon trials in preparation for the evaluation of clonal response to climate and management



FINAL REPORT TO WINE AUSTRALIA

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The establishment of Cabernet Sauvignon trials in preparation for the evaluation of clonal response to climate and management

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Abstract

The establishment of clonal trials takes a minimum of five years and often longer from planting to the first representative harvest. This project established trials to compare Cabernet Sauvignon clones in Margaret River, Coonawarra and the Barossa Valley in advance of formal assessment. The clonal composition was determined in consultation with the regional industry associations and with an aim to keep a strong similarity in the clones planted between the sites. The three trial sites will provide a significant resource for the systematic assessment of the impact of Cabernet Sauvignon clones on vine performance and grape and wine style.

Executive summary

The establishment of clonal trials takes a minimum of five years and often longer from planting to the first representative harvest. The South Australian Research and Development Institute (SARDI) and the other state Departments of Agriculture (or equivalent) developed and maintained these trials up until the early 1990s. Unfortunately, very few have been established since, making formal clonal evaluations of modern (recently imported or selected) clones difficult, as established trials are not in place when projects are initiated.

The main goal of this project was to establish field trials to compare Cabernet Sauvignon clones at the same site, to remove the confounding effects of climate, soil and management. In consultation with Wine Australia, three Geographical Indications were nominated for the establishment of the Cabernet Sauvignon clonal trials – these were Margaret River, Coonawarra and the Barossa Valley. The clonal composition was determined in consultation with the regional industry associations and with an aim to keep a strong similarity in the clones planted between the sites.

In Margaret River, the trial was established by chip budding into an existing Cabernet Sauvignon vineyard. The vineyard was top-worked in the spring of 2019, which accelerated the process relative to the other sites and allowed the cordons to be established within 12 months, and the first fruit to be harvested in 2021. In the Coonawarra and the Barossa Valley, the Cabernet Sauvignon clones were grafted onto 101-14 and planted in the spring of 2021. This delay was due to the discovery of virus in some of the clones of the vines that were propagated for the original planting date in spring 2019.

At the Coonawarra site, a randomised complete block trial design was used, with six vines per plot and 15 replicates. At the Barossa and Margaret River trial sites, a modified Latin square trial design was used, with three (Margaret River) or six (Barossa) vines per plot and 12-14 replicates. A high number of replicates was used across all the trial sites, as the differences between the clones were expected to be subtle and the extra replication would allow them to be quantified. For assessments that require high inputs, such as winemaking, the replicates can be easily pooled. The six vine replicates in the Barossa and Coonawarra also offer the potential to split the replicates in future to allow interactions between clone and other management practices to be investigated.

The three trial sites will provide a significant resource for the systematic assessment of the impact of Cabernet Sauvignon clones on vine performance and grape and wine style. This will potentially include the impact of climate change and how clone performance interacts with other management practices.

SARDI acknowledges the financial support from Wine Australia to complete this project and the companies in Coonawarra and Margaret River who kindly agreed to host the Cabernet Sauvignon clonal trials.

Background

Project SAR 1303 made substantial progress towards understanding the contribution of Shiraz and Chardonnay clones to regional wine styles. It identified interactions between clones and the environment that may define the contrasting wine styles between sites and regions. Unfortunately, the effects of clone, climate and soils are somewhat confounded as the individual clones were planted across a range of locations (blocks) within each vineyard site.

The establishment of clonal trials takes a minimum of five years, and often longer, from planting to the first representative harvest. The South Australian Research and Development Institute (SARDI) and the other state Departments of Agriculture (or equivalent) developed and maintained these trials up until the early 1990s. Unfortunately, very few have been established since, making formal clonal evaluations of modern (recently imported or selected) clones difficult, as established trials are not in place when projects are initiated.

A series of clonal trials across regions would allow a catalogue of clones for contrasting growing conditions; guidelines for growers with emphasis on the interaction between clones and environmental conditions to help negate the effects of climate change and an outline of clone-specific management practices. Knowledge of the interactions between clones and the environment will provide better guidance for Australian winemakers on matching clones to their environment or terroir, and potentially improve the quality of Australian wine.

Project Aims

The main goal of this project is to establish field trials to compare Cabernet Sauvignon clones at the same site, to remove the confounding effects of climate, soil and management. Three field sites will be established in contracting climates, each containing at least ten Cabernet Sauvignon clones which will be selected in collaboration with industry.

Objective (Year 3 deliverable)	**Activities**	**Target date**
Field trials to compare Cabernet Sauvignon clones planted in three contrasting climates, each containing at least ten Cabernet Sauvignon clones.	• Establish trials in three selected regions.	
	• Check and maintain trial sites, replacing poor performing plants as required.	

Method and Results

In consultation with Wine Australia, three Geographical Indications were nominated for the establishment of the Cabernet Sauvignon clonal trials – these were Margaret River, Coonawarra and the Barossa Valley. The clonal composition was determined in consultation with the regional industry associations and with an aim to keep a strong similarity in the clones planted between the sites. This was challenging with the Western Australian site as quarantine regulations mean that vines cannot be moved directly into Western Australia, and the existing germplasm contrasts with what is available in the eastern states. This meant the composition of the trial established in Margaret River was not identical to the other sites (Table 1), but overall, there were seven common clones across the trial sites.

The method of trial establishment also differed between the GIs. In Margaret River, the trial was established by chip budding into an existing Cabernet Sauvignon (clone SA126) vineyard (Figure 1). The vineyard was top-worked in the spring of 2019, which accelerated the process relative to the other sites (see below) and allowed the cordons to be established within 12 months (Figure 2), and the first fruit to be harvested in 2021. The replicated trial was designed with three vines per plot and 12 replicates (Figure 3) as a modified Latin square. Two additional proprietary clones were included by the industry collaborator that hosted the trial.

Figure 1: Chip budded vines, shortly after bud burst.



Figure 2: Top-worked vines in the winter of 2020 (i.e. 10 months after chip budding).

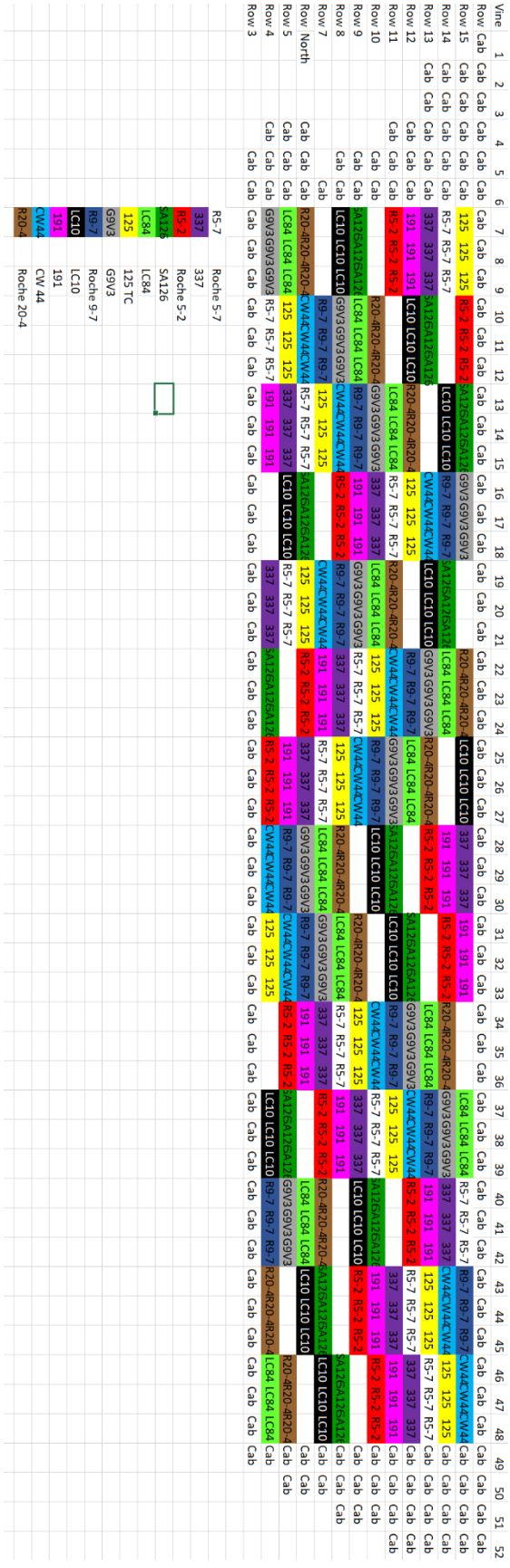


Table 1: The distribution of the clones across the trials in the different Geographical Indications

Clone	Origin[1]	Margaret River	Barossa Valley	Coonawarra
Roche 5-7	Selected from the Westfield vineyard, Frankland River, originally sourced from the Houghton vineyard, Swan Valley.	X		
337	Selected in Bordeaux.	X	X	X
Roche 5-2	Selected from the Westfield vineyard, Frankland River, originally sourced from the Houghton vineyard, Swan Valley.	X		
SA126	Selected from the Barossa Valley by SARDI.	X		
LC84	Selected from Langhorne Creek.	X	X	X
125 TC	SA125 following FSAC, selected from the Barossa Valley by SARDI.	X	X	X
G9V3	Selected from Concannon, California, and FSAC treated.	X	X	X
Roche 9-7	Selected from the Westfield vineyard, Frankland River, originally sourced from the Houghton vineyard, Swan Valley.	X		
LC10	Selected from Langhorne Creek.	X	X	X
191	Selected in Bordeaux.	X	X	X
CW 44	Selected from a trial in Coonawarra in 1973 by SRADI	X	X	X
Roche 20-4	Selected from the Westfield vineyard, Frankland River, originally sourced from the Houghton vineyard, Swan Valley.	X		
C7V5	Selected from Oakville, California.		X	X
ENTAV 412	Selected by ENTAV-INRA® from Val-de-Loire		X	X
FPS 12	Selected in Chile, and thought to be originally from Bordeaux in the 1880's.		X	X
SAVII 01	Reported to be Italian clone ISV-FV6		X	X
ENTAV 338	Selected by ENTAV-INRA® from Bordeaux area		X	X
SAVII 02	Reported to be French clone 169		X	X

[1]Most details for this table were sourced from Fennessy et al. (2018).

Figure 3: Trial map of the Cabernet Sauvignon clones in Margaret River.
Note blank plots on the map represent proprietary clones that were included in the trial by the vineyard that hosted the trial.



The trials at Coonawarra and the Barossa Valley were planted in the spring of 2021. This considerable delay relative to the Margaret River planting was due to two factors. Virus was detected in some of the clones of the vines that were propagated as green pots for planting in the spring of 2019. This could have compromised the trial due to the virus's potential impact on clone performance and the high likelihood that infection would spread to other clones in the trial. These vines were destroyed. The replacement vines were propagated as dormant plants with the expectation that this would result in more successful establishment, especially as the establishment of potted vines can be poor if they are part of a larger block that is planted using dormant material. By the time the virus was confirmed it was too late to propagate vines for planting in 2020 and therefore it was delayed until 2021. The Cabernet Sauvignon clones were grafted onto 101-14.

Vines were replanted into existing vineyards at both sites. In the Barossa, the vineyard was cleared of the existing vines, posts and wire and all of the infrastructure was replaced. In Coonawarra, the existing vines were cut and treated with herbicide before the cordon was removed. The infrastructure, including the posts, wire and irrigation remained in place. In order to minimise the risk of mistakes, flagging tape was used to mark each dormant vine individually and to mark out the trial ahead of planting (Figure 4). The vines were planted using a water jet system at both sites (Figure 5). Replacement vines were grown in pots, over the summer in the shade house and dead vines were replaced the following season. Approximately 5% of the vines were replaced at Coonawarra and less than 3% at the Barossa site This was considered a very good outcome with very consistent vine growth (Figure 6). Following planting, the trials were labelled with cattle tags to ensure that the clones were clearly denoted (Figure 7).

At the Coonawarra site, a randomised complete block trial design as used, with six vines per plot and 15 replicated. This was the most efficient way to fit the trial in an irregularly shaped block that was bordered by eucalyptus trees (Figure 8). At the Barossa trial site, a modified Latin square trial design was used, with six vines per plot and 14 replicates (Figure 9). The clones SAVII 01 were repeated at the Barossa site and SAVII 02 in the Coonawarra to make an even number of treatments in each replicate. This facilitated a regular shape to the replicates and an orderly trial design. A high number of replicates was used across all the trial sites as the differences between the clones were expected to be subtle and the extra replication would allow them to be quantified. For assessments that require high inputs, such as winemaking, the replicates can be easily pooled. The six vine replicates also offer the potential to split the replicates in future to allow interactions between clone and other management practices to be investigated.

Figure 4: Marking out the trial in the Barossa Valley (upper) and Coonawarra (lower)



Figure 5: Vines being planted at the Barossa Valley site.
Water jet planting system (left) and recently planted vine (right)



Figure 6: Cabernet Sauvignon Vines in the Barossa Valley (upper) in the second season following planting.
The vines are up to the wire and very evenly established.



Figure 7: Cabernet Sauvignon clone labels prepared ahead of installation.



Figure 8: Trial map of the Cabernet Sauvignon clones in Coonawarra.
The ‘x’ denotes vines that are not included in the trial and the large number denote the 15 blocks.

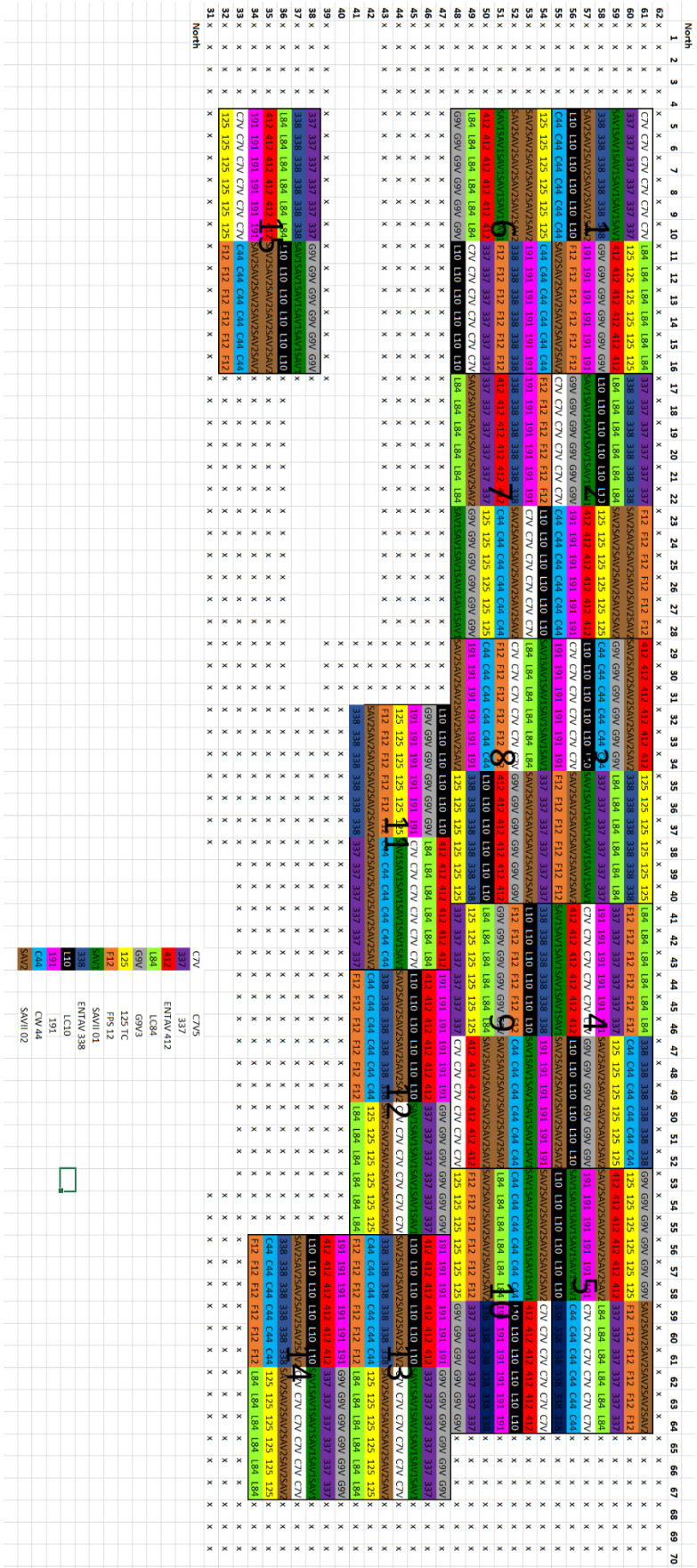


Figure 9: Trial map of the Cabernet Sauvignon clones in the Barossa.
The block was completed using additional plantings of SAVII2.

Outcomes and Conclusions

This project successfully established three Cabernet Sauvignon clonal trials in the Barossa Valley, Margaret River, and Coonawarra GIs. The planting of the trials in Coonawarra and the Barossa was delayed by the detection of virus in the original material and the time needed to propagate replants. The additional time to propagate dormant grafted vines ensured evenly established trials with very few missing vines.

The three trial sites will provide a significant resource for the systematic assessment of the impact of Cabernet Sauvignon clone on vine performance and grape and wine style. This will potentially include the impact of climate change and how the clones interact with other management practices.

The site in the Margaret River was top-worked and has quickly returned to full production. Vine production and wine style metrics are currently being assessed as part of Wine Australia's regional program in Western Australia. The sites in Coonawarra and the Barossa will take a further season before they bear any fruit and at least two more seasons before they reach full production.

Recommendations

The establishment of the three Cabernet Sauvignon clonal trials provides a significant resource for the systematic assessment of the impact of Cabernet Sauvignon clone on vine performance and grape and wine style. Once the sites in Coonawarra and the Barossa are full established, a larger research project needs to be developed to take full advantage of this opportunity.

Further investment in the establishment of similar trials for other varieties would be warranted. This could be completed as part of a co-ordinated effort across the regional programs.

The contrast in establishment time, cost and the flexibility of establishing a clonal trial using top-working in the Margaret River was significant compared to planting new vineyards in the Barossa and Coonawarra. Trials to evaluate clones have traditionally been established as new plantings, however, the potential to use top-working needs to be further investigated. This includes protocols to ensure that such trials are not perturbed by virus and to better understand the time required for the top-worked vines to become fully established.

Appendix 1: Communication

A presentation titled ‘Establishment of Cabernet Sauvignon Clonal Trials’ was provided to Coonawarra Vignerons Association on 27 September 2021.

Appendix 2: Intellectual Property

The clonal trials and associated trial maps included in this report.

Appendix 3: References

Fennessy, R., Fisher, D., and Taylor, A. (2018). A review of five wine grape variety clones in Western Australia. (Department of Primary Industries and Regional Development: Perth, Western Australia). pp 23.

Appendix 4: Staff

This project was overseen by Dr Paul Petrie and was managed in parts by Dr Mike McCarthy, Dr Marcos Bonada and Mr Darren Graetz. Technical support was provided by Mr Bruce Henderson and Mr Han Chow. Operational support was greatly appreciated from Mr Roger Maywald at the SARDI Nuriootpa Research Station and our industry collaborators in Margaret River and Coonawarra. We would like to acknowledge the statistical support provided by Dr Ray Correll, and Mr Richard Fennessy from the Western Australian Department of Primary Industries and Regional Development for providing a strong link to our Western Australian site.