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AUSTRALIAN WINE RESEARCH INSTITUTE

Murray Valley Winegrowers Inc. cover crop
demonstration post-vintage report

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Introduction

July 2020 saw the commencement of an exciting multi-year activity for the Murray Valley Regional Program. The activity, designed and delivered by the Australian Wine Research Institute with funding support from the Wine Australia Regional program, has a focus on improving soil health and vineyard sustainability through the use of midrow and under-vine cover crops.

The aim of the cover crop demonstration is to show growers how sown cover crops can be used effectively in Murray Valley vineyards to improve soil health and suppress weeds without having a negative impact on yield.

The first two years of the project (FY 20/21 and FY 21/22) involved establishing two cover crop demonstration sites – one in Swan Hill and one in Irymple (SuniTafe). In the third year, FY 22/23, data was collected from the SuniTafe site to measure the impact of the cover crop treatments on vine yield, weed suppression and soil properties.

Materials and methods

1. Trial design

A number of cover crop treatments were established to demonstrate how different species selection can be managed to achieve the intended outcomes. Cover crop species were carefully selected for each demonstration site based on the following parameters: suitability to deliver the intended outcomes, soil type, climate, water availability, vineyard floor management practices, vineyard layout and where the cover crop was to be established (under-vine or midrow). The treatments are presented in Table 1.

Table 1. Cover crop demonstration treatments at the SuniTafe site

Treatment	Midrow	Treatment	Under-vine
Treatment 1	Medic	Treatment 5	Medic
Treatment 2	Cocksfoot	Treatment 6	Cocksfoot
Treatment 3	Creeping saltbush	Treatment 7	Lucerne
Treatment 4	Volunteer sward	Treatment 8	Volunteer sward

2. Site preparation

With the understanding that good site preparation is required for effective cover crop establishment, targeted herbicide applications were used to ensure the seed bed was weed-free prior to sowing.

3. Seeding

The cover crops were sown in Swan Hill in May 2021 and in Irymple in May 2022 at the rates shown in Table 2. The medic treatment consisted of four medic species (*Medicago truncatulata*, *Medicago scutellate*, *Medicago polymorpha*, *Medicago littoralis*) combined to give a total



Figure 1. Seeding midrow cover crop with Taege seeder.

seeding rate of 25 kg/ha. All the medic seed was pre-treated with rhizobium bacteria to help ensure nodulation and nitrogen fixation.

All treatments were sown using a quad bike towing a six-row Taege direct drill seeder. The Taege seeder is 1.6 m wide with a 25 cm space between each row. The midrow treatments were sown with one 1.6 m pass down the centre of the vines (Figure 1). The under-vine cover crops were sown with one run each side of the vine row, with the other runs blocked off (Figure 2). The saltbush was sown in one row along the centre of the midrow.



Figure 2. Seeding under-vine cover crop with Taege seeder

Table 2. Cost and seeding rates of cover crops planted at SuniTafe, May 2022

Treatment	Species	Common name	Rainfall range (mm)	Seeding rate (kg/ha)	Seed cost (\$/kg)	Cost (\$/sown ha)
Medic	<i>Medicago truncatula</i>	Jester	250 - 400	6	\$11.00	\$264.50
	<i>Medicago scutellata</i>	Silver snail	300 - 700	7	\$9.50	
	<i>Medicago polymorpha</i>	Scimitar	250 - 650	6	\$11.00	
	<i>Medicago littoralis</i>	Seraph	250 - 650	6	\$11.00	
Cocksfoot	<i>Dactylis glomerata</i>	Summadorm	400 - 550	7	\$22.00	\$154.00
Saltbush	<i>Atriplex semibaccata</i>	Creeping saltbush	250 - 900	6	\$140.00	\$840.00
Lucerne	<i>Medicago sativa</i>	Lucerne	250 - 800	5	\$16.50	\$82.50

4. Cover crop maintenance

After establishment, periodic visits were made to each site to check progress and provide weed management using a wick wiper and line trimmer as required. The under-vine area of the midrow treatments were kept weed-free using herbicide applications. The midrow treatments were mown as required.

5. Irrigation management

Phytech plant sensors were used to provide information about the irrigation requirements of each treatment. At SuniTafe, the demonstration treatments were all on the same irrigation valve, meaning each treatment received the same amount of irrigation. Irrigation was applied across the whole demonstration site to meet the needs of the vines with the highest irrigation needs. The cocksfoot treatment had the highest irrigation demand (Figure 3).

6. Harvest

The SuniTafe demonstration site was harvested on 28 February 2023. Each treatment was harvested separately to measure the interaction between cover crop treatment and yield. It should be noted that the demonstration sites were not designed to obtain an experimental data set for statistical analysis but to demonstrate the interaction between cover crop treatments and wine-grape yield. Results are presented in Figures 4 and 5. There was no wine-grape harvest at the Swan Hill site due to severe disease pressure.

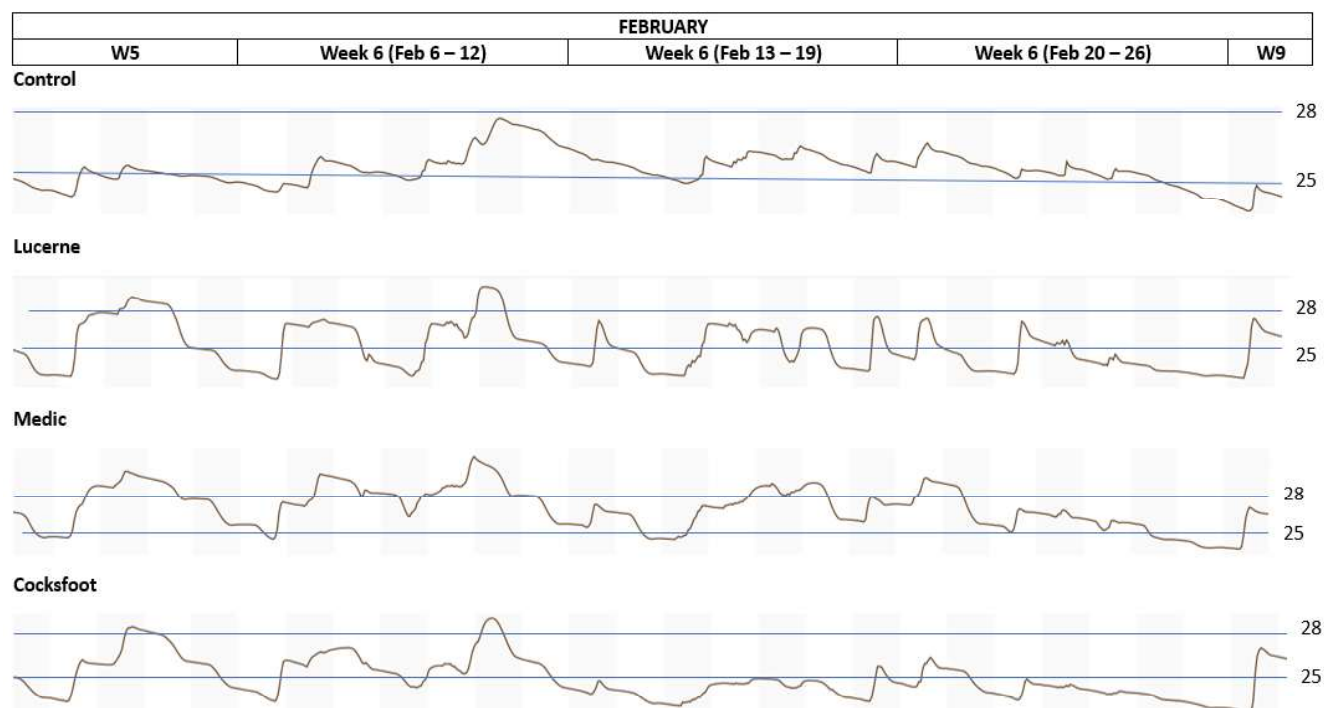


Figure 3. Changes in soil moisture content (mm/m) at 1 m depth over a three-week period for each treatment at SuniTafe, February 2023.

Results and discussion

1. Demonstration site observations

Visual observations were made at the SuniTafe demonstration site in early spring and late summer. Visual observations included establishment success, weed suppression, vine vigour and health assessments. The visual observations and yield data are presented below. Samples were taken for soil chemical and soil health analysis. The results from the soil chemical and soil health analysis will be presented in the final project report.

1.1. Establishment success and weed suppression

Midrow cover crops

Medic

The four medic species established and grew well, enjoying the benefits of above-average rainfall (Figure 4A). Following seed set and then senescence, the medics were mown to control the summer weeds that had emerged. Unfortunately, the medics were mown lower than desired, and the mulching value of the crop was diminished however, a very good seed bank remained on the soil surface (Figure 4B).

It is generally preferable to mix the annual ryegrass with medics as they are complimentary in growth and provide benefits to soil quality not realised by medics alone however, the site manager's allergy to ryegrass prevented this.

Cocksfoot

The midrow cocksfoot treatment established very well and grew over the winter/spring period until late spring, when it senesced. In higher rainfall regions, the cocksfoot may continue to grow into the early summer months depending on soil moisture levels. The senesced cocksfoot

provided a good mulch layer on the soil surface, helping to suppress summer weeds like caltrop (Figure 5A). Some prickly lettuce was still evident in the cocksfoot treatment.

Saltbush

A single row of saltbush was sown down the centre of the midrow, recognising that individual plants will spread to about 1.5 metres. Creeping saltbush only grows to about 15 cm high, but generates a thick mat on the soil surface, suppressing weed growth and keeping soil temperatures cool. Unfortunately, the establishment of this cover crop was rather sporadic (Figure 5B), which was probably caused by the seeder resisting operating at very low output revolutions and therefore switching on and off (it has an electric motor drive for the seed distributor).

Saltbush can be difficult to establish but given the plant's recognised benefits of providing habitat for beneficial insects, there is potential to mix seed in with cocksfoot or medic at low rates, and thereby have some plants but not a solid stand of saltbush in the midrow.

Volunteer sward

Over winter, the volunteer control was mostly barley grass, which was mown as per standard practice on the property. A mix of summer weeds including fleabane, prickly lettuce and caltrop were evident, enjoying the lack of soil cover remaining in the midrow (Figure 6A).

A. Medics, 19 September 2022



B. Medics following mowing, 28 February 2023



Figure 4. Midrow medic cover crops at SuniTafe

A. Cocksfoot in dormant state, 28 February 2023



B. Saltbush, 28 February 2023



Figure 5. Midrow cocksfoot and saltbush cover crops at SuniTafe

A. Volunteer sward with fleabane, prickly lettuce and caltrop, 28 February 2023



Figure 6. Midrow volunteer sward at SuniTafe

Under-vine cover crops

Medic

The medic mix performed very well, producing lots of biomass over winter and spring (Figure 7A), then senescing following seed set to leave a mulch about 5 cm deep under-vine. This was not enough to suppress the germination of all summer weeds, so they received one application of Basta (Figure 7B). In a non-chemical situation, the medic could be mown with two passes during the season. This treatment is expected to regrow again this autumn, germinating with the opening rains.

Cocksfoot

While this variety of cocksfoot is genetically programmed to be summer dormant, when supplied with irrigation, it has continued growing strongly over the summer period (Figures 8A and 8B). Some summer weeds grew from the edges of the cocksfoot this year, which competed with the cocksfoot before it was fully established. Now that the cocksfoot is established, it is not expected that there will be any weed issues in future years. The need for extra water to maintain yields in the cocksfoot treatment remains a concern. Next season, we intend to trial using a knockdown herbicide application in spring to induce summer dormancy. This will potentially overcome the yield loss while still providing effective suppression of weed growth.

Lucerne

The lucerne stand was slow to establish and also suffered from intermittent seed distribution, which generated a patchy stand. Where the lucerne was established, it grew well under-vine, and was flowering at the time of harvest, attracting several flying insect species (Figure 9A).

A. Medic under-vine and cocksfoot in the midrow, 19 September 2022



B. Under-vine medic with summer weeds treated with Basta, 28 February 2023



Figure 7. Under-vine medic cover crops at SuniTafe

A. Under-vine cocksfoot and volunteer plants in the midrow, 19 September 2022



B. Cocksfoot under-vine suppressing summer weeds, 28 February 2023

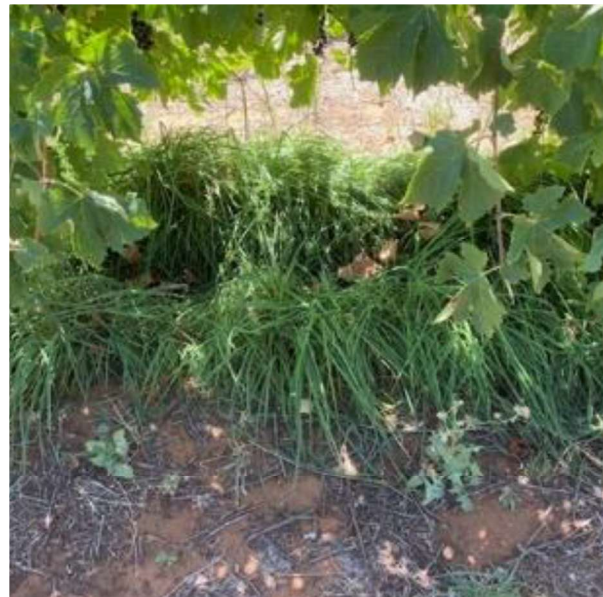


Figure 8. Undervine cocksfoot covercrop at SuniTafe

E. Lucerne under-vine, 28 February 2023



Figure 9. Undervine lucerne covercrop at SuniTafe

1.2. Yield

Midrow cover crops

The results from the midrow treatments showed a yield reduction associated with the midrow saltbush (of 9%) while the yields from the midrow medic and cocksfoot treatments were very similar to the midrow volunteer control (Figure 10). The yield reduction observed with the saltbush treatment was most likely due to the saltbush continuing to actively grow over summer, while the cocksfoot and medic had senesced over summer. It is generally recognised that drip-irrigated vines in the warm, dry inland regions have little interaction with or dependence on the midrow, so this influence of the saltbush on yield is unexpected.

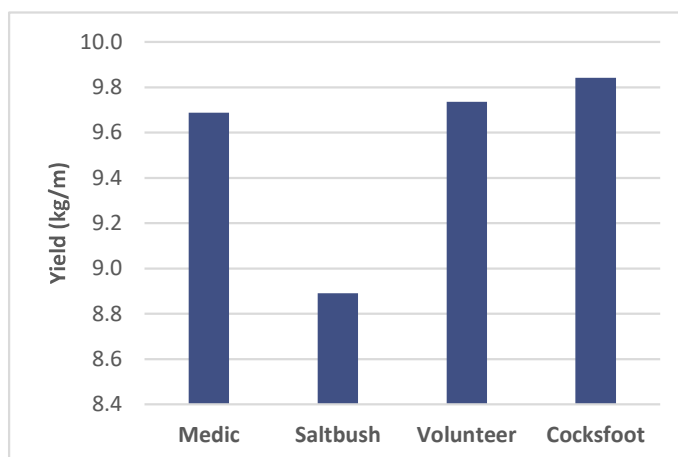


Figure 10. Vine yield in midrow cover crop treatments at SuniTafe, 2023

Under-vine cover crops

The results from the under-vine treatments showed that, compared to the volunteer control, the cocksfoot and lucerne treatments reduced yields by 17% and 11% respectively (Figure 11). Despite additional water being applied, yield reductions were expected for these treatments, as they were both actively competing with the vines for water and nutrients. Anecdotally, there was a lighter green canopy in the cocksfoot treatment, suggesting the grass had availed itself of nitrogen at the expense of the vines. Despite the yield reduction, the weed suppression benefits of cocksfoot were considerable, so it is intended to spray out a portion of this treatment in spring 2023 in an attempt to reduce the yield suppression.

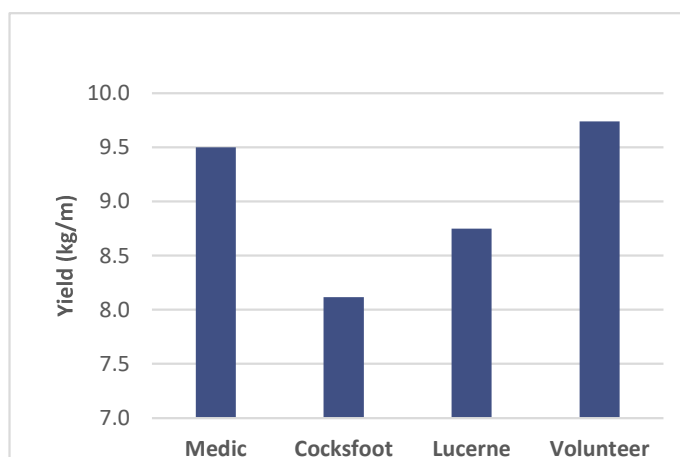


Figure 11. Vine yield in under-vine cover crop treatments at SuniTafe, 2023

The medics, which senesced in October, do not appear to have had any impact on yield. All the varieties used are determinate – they will not continue growing even if the conditions are suitable – so, despite the irrigation applied, they have senesced and await the autumn rains when conditions will be conducive to their germination. In the meantime, they will have mulched the soil surface, provided some shading for the soil and beneficial insects, added nitrogen and will slowly be improving soil quality, including an increase in soil carbon.

Conclusion

The demonstration sites at Irymple (SuniTafe) and Swan Hill have shown that when suitable species of cover crops are sown both mid-row and under-vine, they can provide effective weed suppression in vineyards at minimal cost, and with minimal to no impact on yield – especially when irrigation water is inexpensive and readily available. The wetter-than-average conditions experienced across the Murray Valley region during the 2021 and 2022 seasons provided excellent conditions for the cover crops, enhancing their establishment and growth. Seed set in the annual medics has now provided a seed bank in the soil, which should ensure their long-term recruitment when rainfall is sufficient. The mid-row cocksfoot also shows considerable promise as a weed-suppressing cover crop that is cheap, easy to establish and low maintenance. Prostrate saltbush could be readily included with the seed mix of the medic or cocksfoot to add some biodiversity and beneficial insect habitat to the midrow. Cocksfoot, if sown under-vine, will suppress yields unless additional water and potential nutrients are applied, but it is a very effective weed suppressant. In areas where sub-soil compaction is an issue, the bio-drilling mechanism of lucerne could be used to open up the sub-soil under vine. Once it had performed this function, it could then be removed using herbicides.

The proposed plan for the next stage of this project is to fine-tune the management of the existing cover crop treatments and look to support other sites to select and establish cover crops to meet desired outcomes. The ability for weed suppression without a yield penalty that is enabled by a knockdown herbicide applied in spring, will be trialled in the 2023-24 season. Data will continue to be collected from the existing cover crop sites to provide information to the region about the capacity of cover crops to build soil carbon and increase the water-holding capacity of the soil.

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