

A major challenge facing grape growers is their ability to use water to moderate vineyard resilience to temperature extremes during drought due to reductions in their groundwater irrigation licenses.

This project demonstrated that turning a cover crop into a green mulch provided an alternative low-cost method to vineyard floor management of bare soils, reduced water use/loss through evaporation and also improved fruit quality. Additionally, it demonstrated the improved ability of vineyards to respond to potential climate extremes such as excessive precipitation in the off-season, increased soil organic matter to sequester carbon and reduce nutrient leaching, and out-compete invasive weeds.

Background and research approach

Vineyards face a challenging future from drought and temperature changes that rapidly degrade fruit quality and decrease high fruit premiums available to growers. Vineyard irrigation requirements increase under drought and rising heat conditions to accommodate extra water demand by the vines. Bare interrow soils between irrigated grapevines in the summer growing season can lead to greater soil water evaporation, increased heat reflectance into grapevine canopies, greater fluctuation in soil temperature, soil erosion and nutrient leaching, and invasive weed proliferation. However, bare soils persist in vineyards, particularly in table grape vineyards, where lack of adoption is due to industry perception that cover crops compete for grapevine essential water resources.

In the 1960's and 70's when all vineyards were cultivated, grape growers grew New Zealand blue lupins as a cover crop in the inter-row, They could go 4 feet high and provide high volume of organic matter but it wasn't very compatible with table grape production system and over time they drifted away from cover crops. This has also led to poor management of the vineyard floor in relation to weed management

This project aimed to demonstrate how winter cover crops can be dried into 'green mulch' in summer to alleviate these problems by covering bare soils without requiring further water resources. The research team involved Dr. Caitlin Moore from the University of Western Australia (UWA) and Colin Gordon from the Department of Primary Industries and Regional Development (DPIRD).

The project demonstrated the use of cover crops in four farms – two table grape farms in the Swan Valley (Rosic and Nuich properties) and two vineyards, Plantagenet Wines in the Great Southern and Cape Mentelle in Margaret River wine regions of Western Australia. The cover crops were then cut to act as a green mulch over the summer watering period.

Results

Results from the project showed that the cover crop did not compete with the vines for water resources during the summer fruit production months when growers rely on irrigation to keep their vines watered. This was largely because growers managed the cover crop by turning it into green mulch, cutting off the cover crop water needs and forming a protective layer over the soil surface. This provides an alternative low-cost method to vineyard floor management of bare soils, which requires regular inputs of herbicide to control weeds.

The findings reassured growers at each of the demonstration sites that their choice to use a cover crop was beneficial to their business and did not compromise fruit quality because it assisted in minimising heat extremes that can cause losses in fruit acids and decrease fruit turgor.

The results also demonstrated to the wider grower community the benefits of implementing a winter cover crop and turning it into a summer green mulch for quality fruit production. The participating growers are continuing to use cover crops. Colin also noted that Peter Nuich, from Swan Valley, commented that when he would normally irrigate in the past, water would just run off the ground and that after one season with the cover crop, there's no runoff. This indicates that there is now better water penetration into the soil profile.

Industry benefit

A major benefit of the project was that previously there wasn't much empirical evidence on the benefits of cover crops as a water-saving measure and vineyard floor maintenance, especially for table grapes. Now there is some early evidence from the project that is **myth-busting** the perception that cover crops compete with grapes for water use.

The insights from the project are timely and likely resonate within the industry for some time since table grape growers in the Swan Valley will face a 10% water allocation reduction from July 2028. A 10 % water cut in a warming climate will add further difficulty to how they manage their vineyard water use requirements. This project has demonstrated that implementing a winter-grown cover crop/summer green mulch can improve water retention in vineyards. The issue has been discussed at the Australian Table Grape Association (ATGA) and at an irrigation technology workshop with Swan Valley table grape growers in mid-2023. The combination of the cover crop project findings and the irrigation workshop, work together very well to ensure an interest in the project outcomes.

Sound science and drone technology

The demonstrations utilised collected data on soil moisture variability, and microclimate effects and tried novel tools such as drones for thermal imagery. The spatial variability in vineyard water use was shown by proxy through the drone thermal imagery.

The drone imagery for the Rosic vineyard in the Swan Valley showed an even distribution of watering across the vineyard area surveyed, indicating the grower was doing a good job managing his vineyard water supply. This demonstrated how new technology, like drone imagery, could be applied to help growers manage their vineyard water requirements.

The use of drones to measure the thermal temperature of the canopy in the Swan Valley was an unexpected benefit. The strong visual impact of drone imagery was an eye-opener for both of us as researchers and the industry. A key point is that it's kicked off that discussion [about cover crops] and it will keep going... From an industry point of view it's a one year project. You can't achieve much in that time frame. I think the fact that industry is talking about this meant the project was successful. Colin Gordon, DPIRD Senior Technical Officer, Fruit and Perennial Crops

The drone imagery can indicate effective water management. A drone thermal image can be used to detect areas, like a vineyard, that might have patches of vines that are hotter than the rest and thus indicate the area needs more water. For grape vines, when it's hot and under stress, you would expect to see a different colour imagery coming up. The drone imagery from the demonstration site (Rosic property) showed a very even distribution of leaf surface temperature across the vineyard, there were no hot spots – indicating the grower is doing a good job at regulating water supply to all his vines.

Potentially, drone technology could be attractive management tool for large commercial growers in the future¹. Drone visual imagery adds another layer of information to complement soil moisture probes and temperature

¹ The project provided expertise in data interpretation. Analysis of longer-term data collected over a season and relating to vineyard water use takes time from a grower's already busy schedule. This project provided growers with more detailed information about vineyard water use than they may have otherwise achieved on their own. Smaller growers are likely to find the cost of the technology and data analysis prohibitive. Furthermore, many of them can regularly ground check their property for irrigation leaks or insufficient water delivery.

sensors. The latter gives good temporal information but only covers a very small area. The drone imagery provides a larger spatial perspective of water use for the whole vineyard patch. The combination of the two measurement approaches provides good spatial and temporal information for a vineyard (and potentially other crops).

Future possibilities and uses

The Swan Valley sites are ideal sites for interstate visitors and Drought Hub members to visit given their close location to Perth airport; they have been used for extension efforts and are included in future plans to demonstrate technologies to manage the challenges of a drier and hotter climate that Western Australian growers will face.

DPIRD has some funding for the Gnamptera Mound in terms of water use efficiency grants for water licence holders and Swan Valley table grape growers could apply for these. The growers association has ideas on how the funds can be utilised and the possibility of accessing the funds for more research into cover crops, irrigation and what can be done with the two together.

There is still a lot more we could do to investigate and quantify these water savings further, but our results from this one-year project indicate cover cropping can be a viable approach to managing water in vineyards, and could help growers in areas like the Swan Valley adapt to future water restrictions... We've now got some initial data and initial evidence for future pilot demonstrations - it's opened up more questions that we could look at in the future. I'm now curious to know more about cover crops²... So there are many opportunities coming from this...The drone was one snapshot measurement in time. To really assess vineyard water stress through thermal imaging you need multiple images captured over a longer time period. The single timepoint drone image just demonstrated that yes, this technology works for spatial vineyard assessments, but further work is needed to use it as an early warning or indicator tool of vineyard water stress. Caitlin Moore, UWA



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² Caitlin identified a range of potential research questions raised as a result of the project: the differences between treatment and no treatment, assessing different measures for example periodic measurements of heat imagery, heat transfer through the soil profile, different cover crops species, use with different trellis systems, drip versus sprinkler systems and also perhaps look at the carbon and soil impacts on impact as well demonstrations in other geographic locations such as Carnarvon.