Working with water

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Introduction

Water is one of the most critical components of vineyard management in irrigated areas of South Australia. Proper management has implications for quality, yield and profitability. As seen in many parts of Australia and overseas, the poor use of water can lead to undesired outcomes such as land salinisation, increased height of water tables and loss of production. In recent times, water has become a valuable commodity to buy and sell on the open market and conservation of this resource has come to the forefront of irrigation management. These factors combined with increasing environmental awareness and the prospect of environmental accountability have prompted companies such as the Orlando Wyndham Group to utilise the most up to date technology and adopt the latest research in an effort to improve the water use efficiency of its vineyard operations. One such operation in the Group is the Langhorne Creek Vineyard.

The Orlando Wyndham’s Langhorne Creek Vineyard was first established in 1995 and has expanded to 630 hectares. The vineyard has seven varieties, 157 management units, 248 irrigation valves and produces on average between 7000 and 8000 tonnes per annum. The vineyard has been designed to minimise block variability and to maximise quality and performance. The site is a substantial investment in the region by the company, and so it is important to look for strategies that will provide for long term sustainability of the soil and water resources.

Issues

Many issues are involved in promoting the need to utilise water resources as effectively and efficiently as possible. Current and future legislative requirements play a major role, with the implementation of various water allocation plans. The River Murray Water Allocation Plan, which encompasses the Angas Bremer Prescribed Wells Area, in particular has several major implications for the Langhorne Creek irrigation area. Under the plan irrigators are required to plant two hectares of deep-rooted perennial vegetation for every 100ML of water license, submit an annual report, monitor ground water wells and irrigation drainage, and in future become an accredited irrigator.

The cost of production can be improved with reduced water inputs. Reducing water use can minimise pumping costs, and irrigation infrastructure costs. Utilisation of less water can either free up water to be sold on the market or alternatively, allow for expansion without the need to purchase additional water.

The impact of agricultural development on the environment, particularly on salinity, is widely discussed. Increasingly, environmental legislators are including clauses in water allocation plans to make irrigators responsible for their impact on water resources such as the River Murray. This impact will bear a dollar cost, so water conservation now will mean a reduced cost in the future.

Vineyard Design

To aid in achieving improvements in irrigation efficiency, a vineyard must be well designed. The Orlando Wyndham Group has found that this starts with a good understanding of the soils. This understanding includes description of the soil type, the potential rootzone depth, factors that limit the rootzone depth and finally the water holding capacity or readily available water (RAW) of the soil. The Langhorne Creek Vineyard had well over 1200 pits dug prior to its development and detailed descriptions of the soil characteristics recorded. The next step was to group these soil types into management units or blocks where the variability within the block is reduced as much as is practicable. The reason for this is that different soils have different irrigation requirements. For example, a sandy soil with a deep rootzone and high water holding capacity has different irrigation requirements than does a clay soil with a shallow rootzone and low water holding capacity. In a perfect world, all the soil within a management unit will have identical characteristics and so will respond to irrigations in a uniform manner.

Once the management units have been designed, characteristics of the variety are matched as much as possible with soil types to meet the demands of particular wine styles. For example, in Langhorne Creek Chardonnay is a low vigour variety that does not require regulated deficit irrigation (RDI), is best well watered and not subject to extreme stress. To meet these requirements a soil type was chosen with deep root potential, high RAW, with a capacity to buffer the vine against stress. Alternatively Shiraz is a vigorous variety that is generally put into a RDI phase and is best when vegetative growth is controlled. In this situation a soil type with a shallow rootzone, low RAW potential that can be dried out quickly in order to achieve RDI was selected. Additionally, information about local conditions and regional history was included in the decision-making process.

Several years after establishment of the Langhorne Creek Vineyard, assessment of the original assumptions is made. Each year a number of soil pits are re-excavated to determine the actual rootzone depth and to make comparison with the original soil descriptions. Remote sensing is also used, to determine how uniform the management units are and to detect where variations in vigour are occurring. Once this information is collected and analysed, links between the soil types, vine health, quality and water use can be made.
Monitoring

In order to irrigate efficiently, every component of the irrigation system must be monitored in order to reduce the potential for over or under irrigation. Monitoring starts with the irrigation infrastructure itself. The Orlando Wyndham Langhorne Creek Vineyard conducts regular checking of dripper output, irrigation uniformity and undergoes regular maintenance in order to be confident that the right amounts of water application are occurring. If the irrigation system is not functioning to its specifications, problems with vine performance will occur.

The next phase is to monitor soil moisture levels. The Langhorne Creek Vineyard uses Diviners and Enviroscan soil moisture monitoring equipment, however the most useful tool is the simple dig stick or soil corer. No matter what device is used for soil moisture monitoring, regular calibration is always required. A dig stick is one of the most effective ways of checking if readings are appropriate.

The positioning of soil moisture devices is always a difficult question and depends on several factors. Site selection depends on the variety, the uniformity of the soil type within the management unit and our vineyards selected stress thresholds. For example, Figure 1 shows a block with a range of RAW values and is planted to Chardonnay. Orlando Wyndham's Langhorne Creek Vineyard prefers to have Chardonnay that is well watered so that the vines are not stressed and the fruit has the desired amount of exposure. In this instance the monitoring device would be placed at the lowest RAW point within the management unit in order to ensure that the entire unit is watered adequately.

The second example is more complicated. In Figure 2 the variety is Shiraz on the same range of RAW values. In this case the aim is to have the monitoring device in a position that will cover about 70 to 80% of the block, however this results in several issues. When most of the block is watered adequately, the points on the graph that are below the monitoring point will be under-watered while the points at the top end of the spectrum will be over-watered. At this point management decisions come into play and adjustments can be made. Mulch products, additional drippers, or soil amelioration may be used to improve the under-irrigated zone. The over-irrigated zone would be more of a concern as excessive drainage may occur. In these zones the number of drippers may be reduced or if the area is large enough then it may be necessary to create an additional management unit.

Once the site has been selected then information gained from soil pits is utilised to set the depth to which the sensors should read. Rootzone depth information can be used to set the depth of the majority of sensors. The Langhorne Creek Vineyard regularly checks the depth at which vines are drawing water and this may alter depending on the season and how factors such as infiltration may affect the depth of irrigations.

Overlaying all of this is regular monitoring of the vines themselves. Soil moisture sensors generally look at a single point within the vineyard, so by monitoring the vines for evidence of stress at different times of the year, irrigation scheduling is fine-tuned. In addition monitored vines can assist in setting critical high and low soil moisture points for each soil moisture monitoring device.

Scheduling

There are many components to irrigation scheduling that must be considered in addition to soil moisture levels. Initially the time to commence irrigation of red varieties in spring is sometimes difficult to determine. Vines can appear healthy and vigorous even when the information from soil moisture sensors are reading dry. This can occur if vines are accessing water past the sensor depth of the devices or if they are obtaining water from the mid rows. By optimising when you start spring irrigations irrigators can reduce the potential for undesired drainage to occur and make better use of the winter soil moisture store.
The Langhorne Creek Vineyard also considers the irrigation infrastructure capacity and the number of shifts required to water the property. Starting a program earlier than necessary may be required in order to apply enough water to sustain the vine through an extended hot spell that has been forecast.

Weather conditions must be well understood. Accurate forecasts can give irrigators prior warning of extreme events so that soil moisture levels can be built up to prevent vines becoming overly stressed. However if temperatures change adjustments can be made in order to avoid over irrigation.

Understanding the factors associated with the soil type is important in order to ensure that vines receive enough water on the day of extreme weather events and so reduce the likelihood of crop loss. Many low RAW soils only have a limited capacity to hold water. In some cases an extremely hot day can draw out more moisture than is capable of being stored so prioritising these blocks becomes critical.

Finally how much water is lost to evaporation is considered. Management units watered at the hottest time of the day will be receiving less water than is expected due to evaporation losses, therefore in some cases additional water is scheduled to compensate for these losses on low RAW soil types that have low infiltration rates.

Water Conservation
Orlando Wyndham is continuing to improve its water use efficiency and is always seeking to find ways of reducing water use without affecting profitability or quality. For example, mulch has been used on Chardonnay and Riesling, and has achieved up to a 15% reduction in water use. Mulch is now being applied to zones within other management units that have been identified from remote sensing data.

Partial Rootzone Drying (PRD) is now being implemented on red varieties such as Shiraz, Cabernet Sauvignon and Merlot. At the start of the 2002-2003 season Orlando Wyndham will have over 60 hectares converted to PRD in Langhorne Creek. Early results have shown that water savings of up to 40% can be achieved, however further refinement of the time between irrigations on each side is required to limit the potential for yield loss.

Above all else improvements to irrigation efficiency continues at Orlando Wyndham, Langhorne Creek by refining the fundamentals. Significant savings of water continue to be achieved from season to season by a combination of ensuring that there are well calibrated soil moisture monitoring devices, improving the flexibility of the irrigation system, regular monitoring of vines, soils and weather, and improving the reaction time to extreme weather events.

Conclusion
In conclusion in order to get the best performance from irrigation water, the key is monitoring. Monitoring of the equipment, soils, vines and weather will ensure the maximum return from a valuable water resource.

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