

# ***Using Precision Agriculture Tools to Improve Vineyard Management***



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## **Background**

Yalumba was founded in 1849 by Samuel Smith, British migrant and English brewer, who had brought his family to Angaston seeking a new life. After purchasing a 30 acre parcel of land just beyond the south-eastern boundary of Angaston, Smith and his sons began planting the first vines by moonlight. Samuel named his patch “Yalumba” – aboriginal for ‘all the land around’. Six generations later, Yalumba is the oldest family owned winery in Australia.

Today Yalumba owns and manages vineyards in the Riverland, Barossa, Eden Valley, Wrattenbully, Coonawarra, Central Victoria and Tasmania. In addition to the Yalumba vineyards, grapes are also purchased from private grape growing families throughout Australia. Every load of grapes supplied to Yalumba from company owned and grower vineyards is expected to be of the highest standard. Maintaining such high standards has been achieved through the constant adoption of technology. In recent years the use of precision agriculture tools such as plant cell density maps and yield monitors has helped strengthen vineyard management techniques and consequently wine quality (the use of yield monitors will not be discussed in this presentation).

In 2003 Yalumba purchased its first set of plant cell density (PCD) maps to identify vineyard variability at its Smith & Hooper Vineyard located at Wrattenbully (located south east of Naracoorte, South Australia). Whilst the vineyard management team was aware of the variability within the vineyard, the actual implications caused by changes in vine vigour were not fully understood. These initial maps were the catalyst for the adoption of precision viticulture by Yalumba.

## **Overview**

Prior to the adoption of precision viticulture tools (PV) such as plant cell density maps, Yalumba, like many other wine companies and private grape growers, managed vineyards in a homogenous manner. Operations such as fungicide spraying and harvesting started at one corner and finished at the opposing corner of the vineyard. Most vineyard managers, growers and operational staff acknowledge that the vegetative growth patterns of grape vines within a single vineyard were rarely the same. While there is knowledge of the variation in vegetative growth within vineyards by key vineyard personnel, the implications of vineyard variations are not always fully understood. In some cases the impact of vineyard variability on yield, disease pressure or final wine quality can be low, but in many cases the impacts are immense. If quantified, vineyard variability can be potentially reduced through modifications to irrigation practices, such as installing of inline taps on drip tube to reduce irrigation or the use of additional drippers to increase irrigation) or through the preferential application of mulches to preserve soil moisture. While these methods do work, they are very much a ‘band-aid’ approach to the amelioration of problems created by a “blanket approach” to vineyard development and management.

density map it was identified that 45% of the grape samples were collected from low vigour sections of the vineyard. The low vigour sections of the vineyard were identified to have a much greater Baume than the higher vigour sections. Only 20% of the samples were collected from the high vigour sites. This proportional imbalance was highly likely to generate a final Baume reading for the entire block that would be misleading. The yield difference between the two sections was in some cases as great as 5.55 kg/vine, which impacted the data used to predict crop size.

In a number of cases, the higher vigour sites within a vineyard contained grape vines with large canopies with excessive leaf layering that limited the penetration of agrochemicals, sunlight and air flow. Typically these high vigour sites are well suited for the development of fungal diseases such as powdery mildew and bunch rots. The identification of high vigour sites through the use of PCD maps, in combination with the physical inspection and data collection from the different vigour sites (referred to as “ground truthing”), allows for the establishment of ‘hot spot’ monitoring sites for pests and diseases. These ‘hot spot’ sites can act as the early warning detectors for disease outbreaks. These sites of high disease pressure can also be manipulated through cultural management techniques (e.g. the use of a double cordon, lifting wires, shoot thinning, reduced inputs) to limit their susceptibility to disease.

The variability of vegetative growth within a vineyard can influence wine quality. Vineyard variability can lead to the development of unbalanced “sweet & sour” wines due to the inclusion of grapes that are under and over ripe. PCD maps, extensive ground truthing and data collection has allowed Yalumba to identify “harvest zones” within single vineyards. For example, in a Cabernet Sauvignon vineyard at Coonawarra, the low vigour sites contained grapes that were constantly exposed to sunlight. These grapes were riper than the grapes found in the higher vigour sites, plus they contained cooked/ stewed characteristics and had a higher anthocyanin and phenolic concentration. The grapes in the low vigour sites displayed a greater intensity of green characters (methoxypyroazines). These grape characteristics of the low and high vigour sections (cooked/ stewed and green) are not desirable for the making of high quality wine. The balanced sections of the vineyard displayed grape characteristics that were desirable and variety specific. The development of harvest zones ensured that the different sections of the vineyard are harvested at the precise time. Harvesting of these zones occurs in the following methods. If there is minor variation between the harvest zones (variability between zones determined via data generated from grape samples collected from each zone and through physically tasting grapes), then all of the zones from the vineyard are harvested at the same time and picked into separate bins. If there is considerable variation between the harvest zones, a number of picks will occur over a period of time. In most cases the harvest zones from an individual vineyard are kept separate during the winemaking process and blended as finished wine where appropriate. The process of harvesting via zones has helped reduce the problems of sweet and sour wines and significantly improved wine quality.

Having an intimate knowledge of the variability within a vineyard and the soil in which the vineyard grows provides enormous benefits when it comes to redeveloping a vineyard. Considering the life of a vineyard can be many decades, getting the development stage right can make a world of difference. Leading up to the redevelopment of Solar A (5.6ha vineyard block located at the Yalumba Menzies Vineyard, Coonawarra), PCD maps were collected in 2003, 2005 and 2006. In each year, these maps were ground truthed and data was collected and analyzed to help understand how each of the different sections within the vineyard impacted grape and wine quality. Prior to the redevelopment, the variability within the vineyard was managed via ‘band-aid’ measures. In an attempt to control the high vigour sites, inline traps were installed into the drip line to reduce the amount of water/ fertilizer being applied. In June 2007 the old Solar A vineyard was removed and preparations began for the planting of the new vineyard. The soil type of the site was terror rossa (red-brown soil over limestone). While soil pit data already existed for the site, the numbers of soil pits were limited as the old soil survey was based on a traditional 75m x 75m grid. To gain a better understanding of the depth of the limestone a 10m x 10m soil depth survey was completed. When the soil depth survey and the PCD maps were

compared, there was a strong relationship between soil depth and vine vigour. In addition, the change in distribution of vine vigour patterns between the three PCD maps captured in 2003, 2005 and 2006 did not alter greatly. With an understanding of the variation in soil depth and its relationship to vine performance, the Yalumba management team was able to develop a new irrigation system that was tailored to the different vigour sections within the vineyard. This irrigation system allows for more precise application of water and fertilizers so that all of the low vigour and high vigour sites can be managed completely separately from each other. In addition, the use of PCD maps also allows for the precise placement of soil moisture monitoring equipment which further facilitates better management of variable sites. This approach has moved away from the 'band-aid' approach to managing vineyard variability.

## **Conclusion**

The adoption of simple and affordable precision viticulture tools such as plant cell density maps has allowed Yalumba to gain a greater understanding of how vineyard variability can have an impact on vineyard management decisions. A lack of understanding can lead to a number of errors, such as incorrect crop forecasts or improper harvest timing. By understanding the impacts of vineyard variability, Yalumba has developed a number of procedures to ensure that data generated for critical decisions is more robust and reflects what is actually happening within a vineyard.

It must be pointed out that vineyard variability differs from vineyard to vineyard. Not all high vigour sites are going to be excessively vigorous with poor colour grapes that make average quality wines. In some cases a high vigour site of a vineyard will be the site of perfection. Implications of vineyard variability will be dependant on variety, climate and management. Trying to understand vineyard variability through the use of technology alone is an error in itself. But in combination with regular ground truthing this technology can significantly improve the management decisions made by vineyard mangers, growers and winemakers.