Vineyard remote sensing – practical applications

Across vineyard variability can have a serious impact on grape quality as well as yield.

Early and pre harvest remote sensing are being applied at Taylors as tools for improving vineyard productivity.

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Taylors Wines was established in the Clare Valley, South Australia, in 1969, when the first Cabernet Sauvignon vines were planted on the original 123 hectare property, near Auburn. In 2007, the vineyard operation has expanded to an Estate of over 500 hectares of established plantings. Many of the original vineyards are in the process of being removed and replanted.

Since 2005, we have introduced precision viticulture (PV) applications into our work practices, to help improve our factual knowledge of the vineyards. One tool that we have found particularly helpful is aerial remote sensing, in the form or digital multi-spectral imagery (DMSI). We purchase this from a precision agriculture service provider for approximately $27 per hectare.

DMSI is essentially a digital photograph of the blue, green, red and infra-red light reflected from the vine canopy. This data can be expressed as either NDVI (normalised difference vegetation index) or PCD (plant cell density). For vineyards, this 'snapshot' is typically taken at veraison, the growth stage when the berries turn soft and begin to ripen. This is usually taken in January or February one to two months prior to harvest. PCD data is delivered to us via the internet, and loaded into a free software package called Viewpoint. This software allows us to view the imagery and analyse one or more data layers (www.deltadatasystems.com).

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Our data from the PCD maps has helped to improve vineyard outputs. Based on the maps we have started to divide blocks into differential management zones, in an attempt to reduce the inherent variability, or to exploit differences to maximise returns in quantity and/or quality.

Figure 1 illustrates how we can take advantage of different zones. Our pre-harvest 2006 PCD image of this block indicated higher plant vigour on the western half of the rows; this was confirmed by inspecting the vines prior to pruning in winter. Therefore, the block was divided into two zones (indicated by the red line) and the high vigour zone was pruned more lightly than the low vigour zone. The expected outcome of this change is that the high vigour zone will have a larger number of buds from which the 2007 crop can grow, thus potentially increasing the production level in the higher potential zone.

In other blocks, we are investigating options to improve under-performing areas and reduce the degree of variability. If high cost solutions

such as irrigation system upgrades are required, the PCD images (from more that one season) will help us identify the exact area where change is needed. If soil inputs are required, such as ripping, fertiliser or surface mulch applications, these can be avoiding areas where they are not needed, or may even be detrimental.

Figure 2 shows an example where we have identified a poor performing area due to salt accumulation in shallow soil. PCD and yield maps were used to define the area to be treated, and applications of gypsum, lime and organic compost were applied to try and remedy the situation.

Yet to be explored in detail at the Taylors Wines Estate is the opportunity to use pre-harvest remote sensing data to identify zones of different quality fruit. The ripening speed and flavours that develop in the grapes and wine are often attributed to vine 'balance', i.e. the proportion of crop to vegetative growth. The PCD image can guide us to different vigour zones, which may present grapes that are ripening faster or slower than another zone, or indeed taste different. Harvesting these zones separately, either at the same time as two different parcels for the winery, or on different days at the optimal time for each parcel, can improve the chances of making wine of the desired quality and style.

In recent seasons, some growers and service providers have been investigating the value of early season remote sensing, targeted at flowering time (October to December, depending on the region). As there is much greater time between capture and harvest, there are greater opportunities to influence the outcome of that season, typically through water and nutrient management. While we have not yet undertaken this at Taylors Wines, we did obtain a spring 2006 PCD image for a different reason . . . frost.

Like many parts of Southern Australia, frost events during October 2006 had a significant impact on our vineyards. An opportunity arose to capture digital multi-spectral imagery of the property soon after our worst frost, giving us a very accurate record of the impact (Figure 3). We will use this information during Vintage 2007 to carry out targeted harvesting of partially affected blocks, and continue to refer to it as we look at frost prevention and protection options in the future.

It is worth noting a word of caution at this point – that all remote sensing maps will look variable. By their very

Figure 1. 2006 PCD image of a Cabernet Sauvignon block that was pruned differently on the Western half, aiming to produce more fruit for the 2007 harvest. Grid 250m.

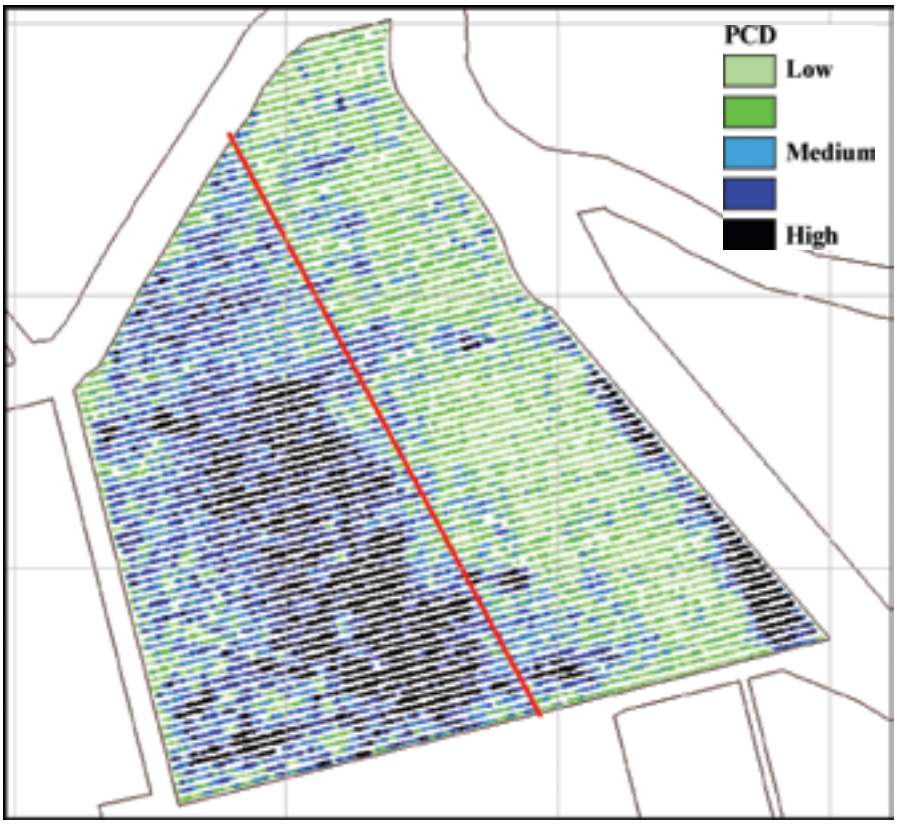
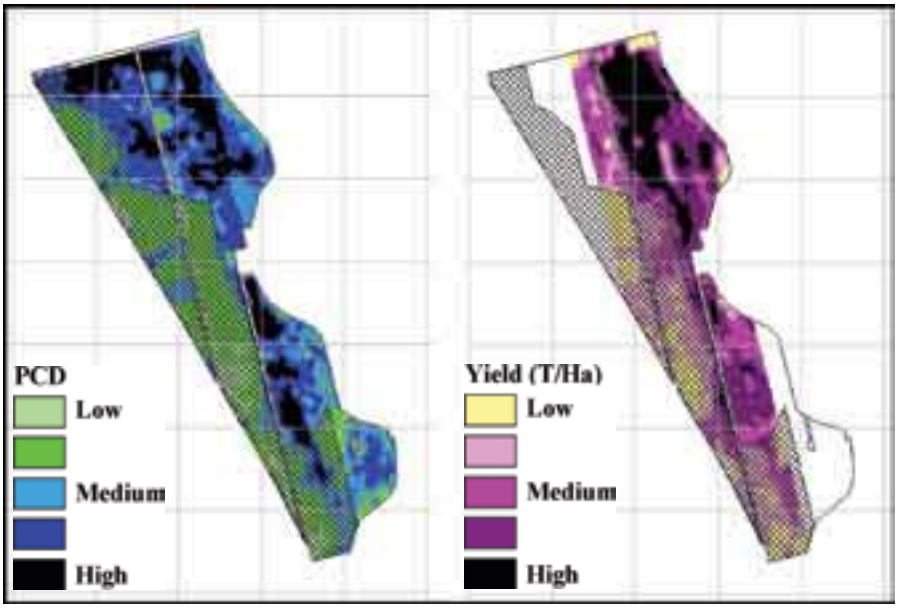


Figure 2. 2006 PCD and Yield maps of a Chardonnay block with poor performing zones identified for additional inputs. Grid 100m.



Remotely sensed data is being gathered pre harvest and even at flowering to help improve vineyard management.

nature, vigour maps will be coloured from the lowest value to highest. Their appearance can be modified by changing the number of colour increments used, and how the data is divided into those increments (e.g. using set increments, data percentiles or standard deviation from the mean). Whichever method is used, the same rule applies that the data must be ground truthed. It is critical that the user of the data determines if the variability shown by the imagery is significant enough to warrant further action.

Equally as important as ground truthing, is measuring the impact of changes made in management. In the case of the first two examples regarding differential management (Figures 1 and 2), it is important that we asses any change in yield and economic impact, so that we know if our decision was correct. To help achieve this, we have installed grape yield monitors on both of our machine harvesters to enable us to map our grape production. These devices have been quickly adopted by our harvester operators, and are now integrated into the process of vintage.

For more information
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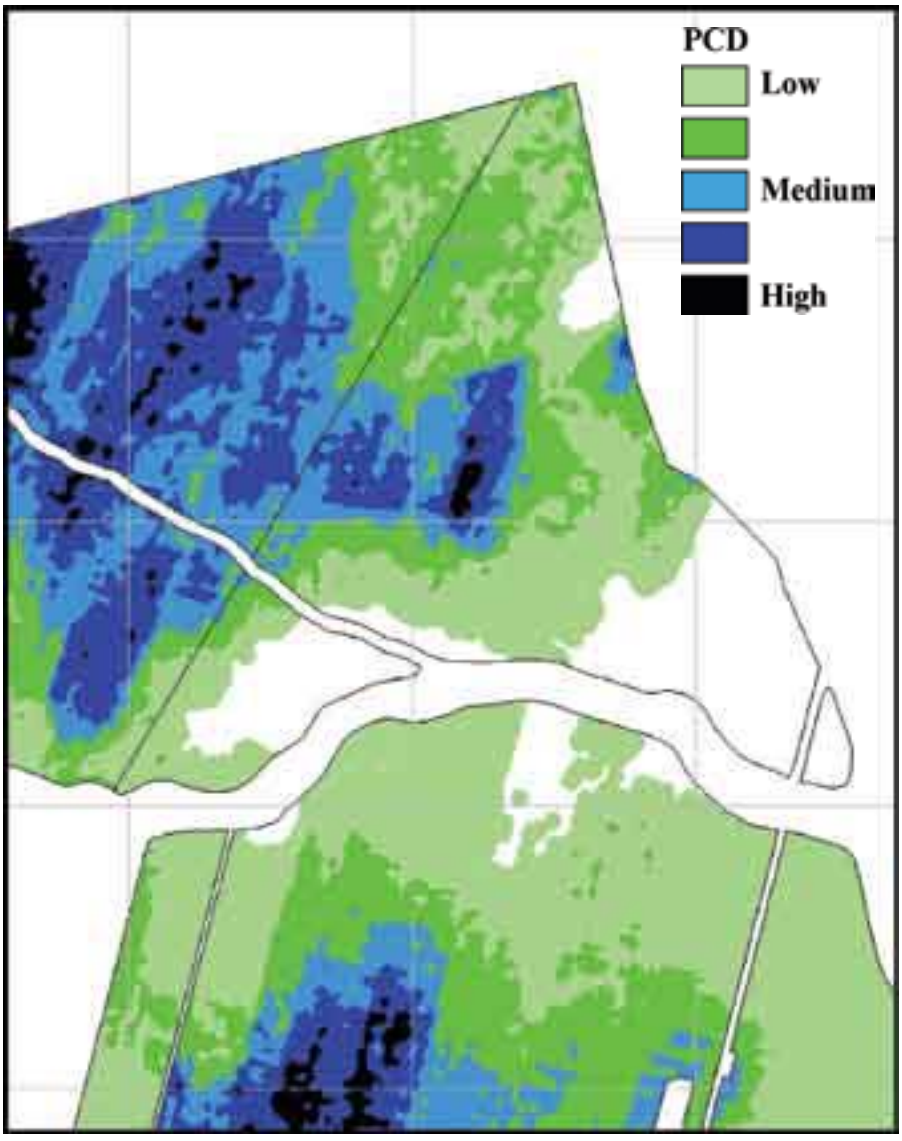

Figure 3. November 2006 PCD image showing the extent of frost damage in one area of the Taylors Wines Estate. White areas inside the block boundary had no detectable green tissue, while areas coloured pale green were severely affected by frost. Grid 250m.