Pruning to Vine Potential An Unforeseen Benefit of Applying Precision Viticulture Technologies

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Take Home Messages

1.) **What began as a water use efficiency trial, using EM38 to determine soil RAW and PCD images as one of the bench marks of irrigation effectiveness, ultimately provided information which improved the overall management of the vineyard.**

2.) **Shallow soils limit overall vine potential**

3.) **Segmented harvesting was not seen as viable or the best option. Instead, it was felt that vine balance in the vineyard could be improved by adjusting pruning rates.**

4.) **Initial findings suggest that the treatment has proven effective in delivering uniform shoot length and canopy architecture.**

5.) **Comparison with pruning trials conducted by Tony Profitt in Margaret River WA, underlines the point that there are broad applications for PV data once it is collected.**

Background

Soil surveying prior to vineyard planning and establishment is desirable, if not mandatory as is the case for some parts of Australia. In Coonawarra, however, production of a detailed soil map prior to planting has not always been the norm.

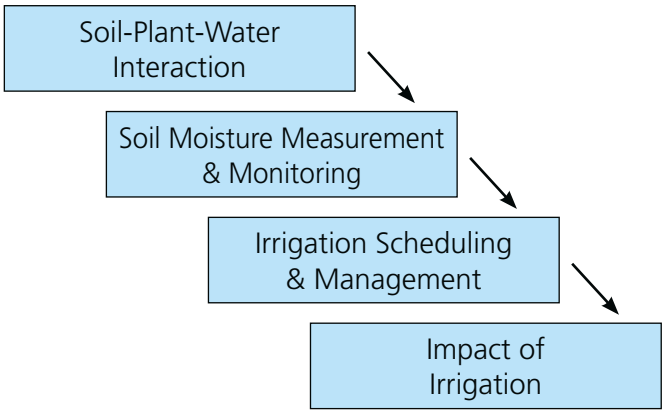
Vineyard variability is the inevitable result of uniform management across soils of varying types and depth. In this trial, soil depth was determined as a primary limiting factor on vine "potential," expressed primarily by vigour.

In the traditional sense, potential has been accounted for at pruning time, with each vine assessed in relation to its response to the previous seasons pruning. The ascendancy of mechanical pruning methods has seen the loss of much of this control and therefore increased variability. Precision viticulture (PV) technologies, however, are once again empowering vineyard managers to critically assess their vineyards and delineate zones of vine potential.

Trial Concept

Following several dry seasons and an increased reliance on irrigation, in 2006 an in – house PV trial was proposed for one of the Katnook Estate vineyards. The aim of this trial was to improve water use efficiency by undertaking an EM38 survey determining soil depth to limestone (Figure 1) and then using this information to calculate Readily Available Water (RAW), Plant Available Water (PAW) and plant water use.

Although an established vineyard, assessment followed a standard process for assessing any proposed irrigation development:



As the trial was planned to run for two seasons, benchmarking involved vineyard scoring by:

- Point Quadrat measurements
- PCD image
- yield mapping

Whilst the EM38 information (including elevation) enabled:

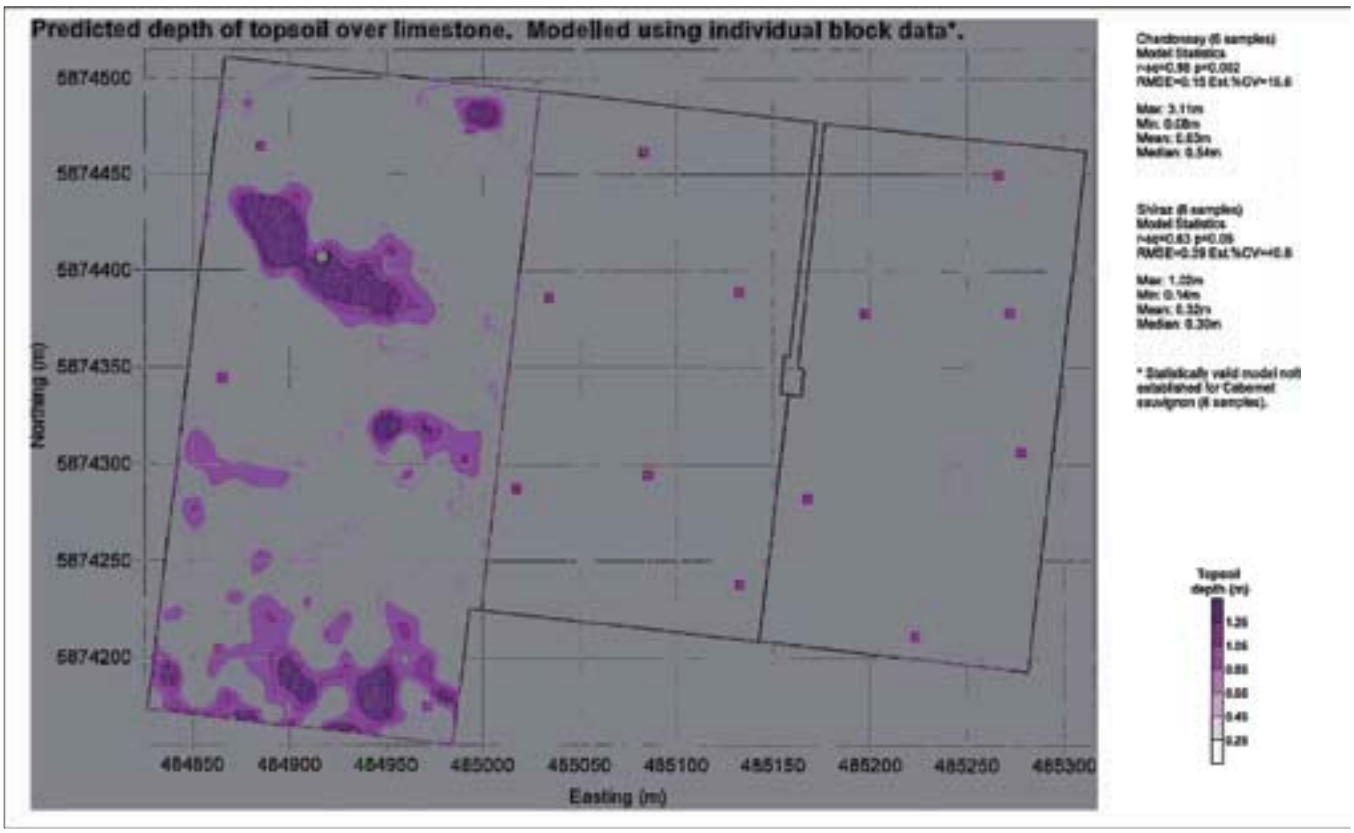
- Adjustment of Enviroscan probes (sensors)
- Installation of "Full Stop" probes and SoluSAMPLERS® in representative sites
- Calculation of soil RAW and incorporation of average gravel content
- Almost immediately, management of this vineyard changed as a result of the new information to hand. Primarily, an appreciation of the shallow average soil depth (of as little as 25cm!) meant a fundamental shift in irrigation management.

PCD – The turning point

It wasn't until the PCD image was developed (Figure 2) that the full, limiting effect of soil depth and its expression on vine potential began to be realised. Up until that time, management changes had targeted irrigation alone to avert vine water stress resulting from the soils limited water storage capacity. What the PCD image displayed, however, was that overall vine potential was affected, presumably as a combination of factors including:

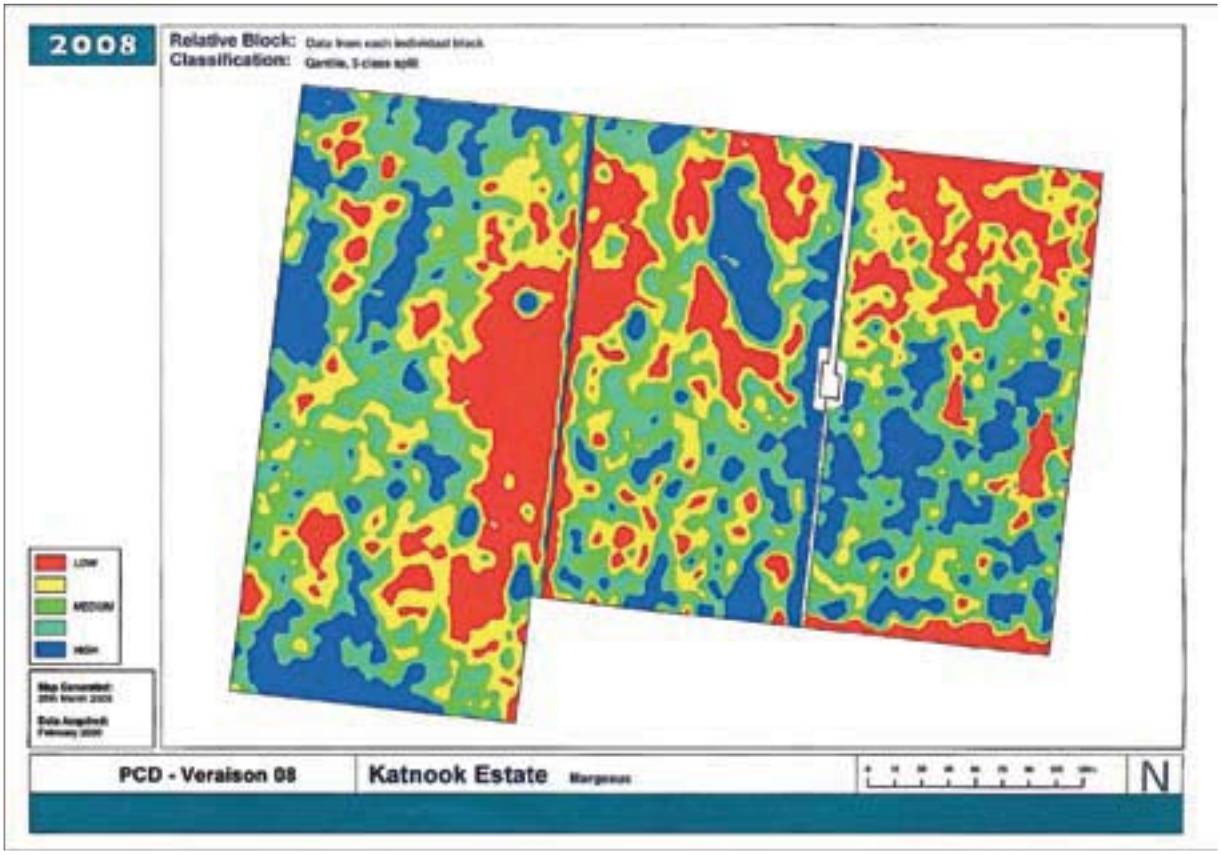
- restricted root zone
- increased soil temperature
- low soil RAW as a result of limited water storage capacity and increased gravel content
- Restricted nutrient storage

Figure 1: *EM38 Map developed for the Katnook Estate trial vineyard. An r^2 value of 0.98 shows a strong relationship between conductance and depth to limestone in the areas represented (middle vineyard not displayed in this image).*



The survey includes the location of:
i. Enviroscan probes,
ii. Soil survey "ground truthing" sample points

Figure 2: *PCD image developed for the Katnook Estate trial vineyard, displaying management units (insert). Soil effects were masked for a significant portion of this image, as a result of back-to-back frost events. Needless to say, PCD is a useful tool for mapping frost damage.*



Plant Physiology & Pruning – a simple overview

With the aim of pruning being to maintain a harmony between growth, yield and quality, management must take into account the vines physiological requirements in a given environment. In a shallow soil environment, a limited root zone below ground will only be able to support a proportionately limited canopy above ground. The vineyard manager can make decisions at pruning time to regulate the level of this canopy, with the desired goal being vines of moderate vigour (Smart & Robinson, 1991).

Trial Response – Pruning

In this trial, the economics of segmented harvesting were not seen as viable. Rather, it was felt that the aim should be to improve the quality of the fruit from the low potential zone by pruning vines in each of the management zones to different levels.

Ultimately, zones identified as having high potential were pruned lightly, with more buds left and areas displaying low potential were pruned harder. The philosophy behind this being that fewer buds will result in less shoots of higher vigour. This has the overall effect of providing sufficient leaf area to ripen fruit in the low potential area, to the same quality as the remainder.

At the time of writing, only Point Quadrat sampling had been completed, with figures suggesting that the variable pruning rates have resulted in similar canopies and fruit exposure for each of the treatments.

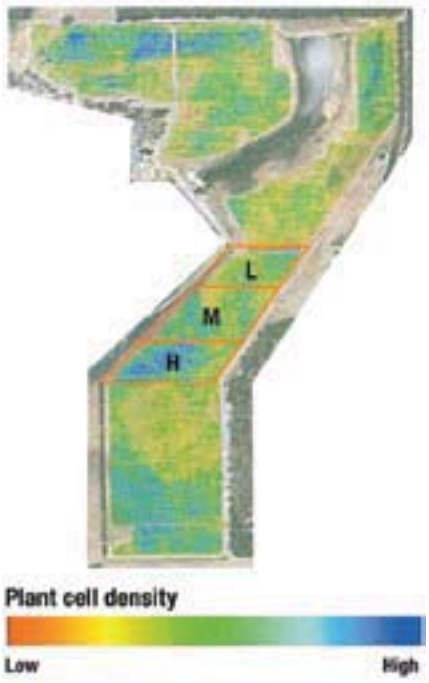
Same Data – Different ends . . .

It is of interest to note that another example of where PCD information has been used to assess pruning rates resulted in an entirely different application. In a trial example undertaken by Tony Profitt and Andrew Malcolm (Margaret River WA), a vineyard was segmented into three zones based on vine vigour: high, medium or low. Subsequently, "piece rates" paid to pruners were adjusted according to the difficulty of pruning vines in each zone and the time allocated to work on the vines. Furthermore, each pruner was allocated a set number of rows in each zone to ensure an equal allocation of work.

This policy had the effect of maintaining high morale and low truancy, whilst completing pruning on time and delivering an estimated saving in pruning cost of 11.6%.

For further detail, refer to: Proffitt et. al. 2006, *Precision Viticulture, A new era in vineyard management and wine production*, Winetitles, p.76

Figure 3: *PCD image used to identify zones of high, medium and low (H, M & L) vine vigour (Proffitt et. al., 2006)*



Conclusions

Using multiple PV tools enabled both the identification of distinct vineyard zones, along with the primary causal factor for vineyard variability (soil depth). With this identified, management of the vineyard could be adjusted to compensate for the effect of soil depth. In this case, changes were made to irrigation management and pruning rate.

The same information could similarly be used for other applications or changes to management practice. This emphasizes that there are broad applications for PV data once it is collected.

References

Smart, R. & Robinson, M., 1991, "*Sunlight into Wine, A Handbook for Winegrape Canopy Management*" Winetitles Adelaide, pp.17 - 23

Proffitt, T, Bramley R., Lamb, D., Winter, E., 2006, "*Precision Viticulture, A new era in vineyard management and wine production*," Winetitles, pp.49-55, 76

Macrae, I, 1991, "*The management of shallow and potentially unstable soils*," Wine Industry Journal (February), pp. 32-34