Within Block Variability in Grapes - An Example

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Over the last 5-10 years there has been much talk and interest in the potential applications of "Site-specific" farming especially in regards to crop management. In the past few years this has spilt over from the broadacre industries into horticulture. In viticulture the research and application of site-specific crop management (SSCM) is still in its infancy. However the potential of SSCM in a high value crop is making people sit up and take notice. This document is aimed at illustrating the amount of variability inherent in winegrape blocks and the potential that exists for SSCM in Viticulture.

"Does variability exist?" is the key question. If variability does not exist or cannot be managed then SSCM is not applicable to the production system. Variability in production systems is often a function of size. The larger the production area the more likely that there is variation, either environmental or managerial. The small nature of many winegrape blocks, often only 1-10 hectares in size, may help to minimise variability and preclude the need for SSCM. An analysis of two years yield data in the Cowra region does not confirm this suspicion. The highly sensitive nature of the vines interaction with the local environment (terroir) counters the smaller area. A survey of grain and pulse crops revealed similar co-efficients of variation to winegrapes. The larger mean of winegrapes compared with grains/pulses results in a larger range of yield values. In Figure 1a the yield of a 3 hectare block of Merlot varies threefold from 6 to 17 ton/ha.

Figure 1a: Yield Map - Merlot, 2000

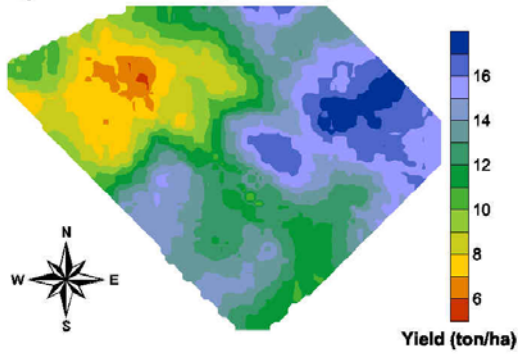
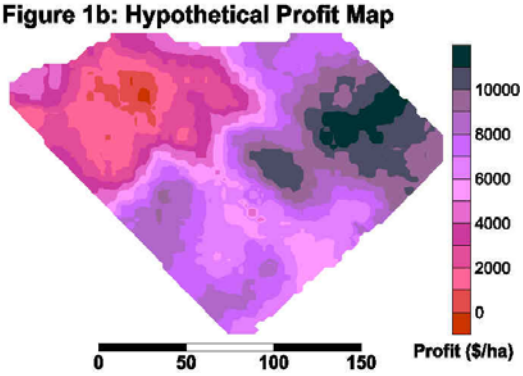


Figure 1b: Hypothetical Profit Map

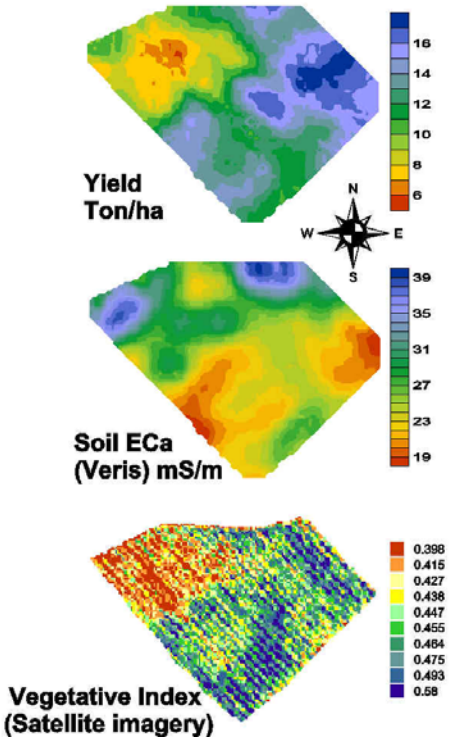


When this is coupled with the higher value of the crop there is a large profit gradient within even small blocks of grapes (Figure 1b). (NB. Data used for this analysis is hypothetical however ball park figures are used. Winegrapes are valued at $1000/ton and cost of production $5000/ha).

From the analysis the value of the crop across the block grades from $0/ha, or operating at a loss, to a profit of over $10,000/ha. So having seen this variability and its cost, the next key question is can we minimise this variability and maximise productivity? There are two ways to approach this problem, either treat the cause or remedy the symptoms. The cause is predominantly environmental variation. By designing vineyards based on our knowledge of the local environmental variation it is possible to minimise this effect. Remedying the symptoms refers to the scenario with existing vines where environmental variation is now inherent in the blocks and differential management is needed to minimise the variation. Ultimately SSCM of vines will encompass both facets. Improved vineyard design will decrease the inherent environmental/terroir variability then differential or site-specific management will help maximise production across the block. While researchers within the CRC for Viticulture and the Australian Centre for Precision Agriculture are investigating the remedy there is no concerted effort yet to treat the cause.

We have already seen that production is variable, so is it possible to predict this variation prior to planting and use the information in vineyard design? Figure 2 shows a preliminary investigation into this question.

Figure 2: Comparision of methods of describing production variability



Shown together with the yield is a mid season aerial image of the Normalised differences Vegetative Index (NDVI) and a subsoil apparent electrical conductivity (ECa) map produced using the Veris 3100 EC cart. From the images the strong correlation (r^2 = 0.75) between yield and NDVI is apparent. Areas of low yield have a low NDVI and vice versa for areas of high yield and NDVI. This is not unexpected as vegetation is often a good indicator of yield. However for vineyard design taking imagery of planted vines is too late and a pre-planting indicator is needed. The Subsoil map shows a similar spatial pattern to the yield map however it is negatively correlated i.e. areas of low yield tend to have a higher ECa value and vice versa for areas of high yield and low ECa. The subsoil conductivity map explains ~56% of the variation in the yield map. The reason for the yield-ECa relationship has yet to be established but may stem from water logging, if irrigation scheduling is based on the lighter textured soil, or a heavier clay subsoil retarding root growth and penetration. What is apparent is the discrete area within which the lower yield occurs. Identification of this area pre-planting may have prompted the grower to use an alternative variety or rootstock in this area. This may negate the depressed yields observed. This plan of action however is not yet plausible as no methodology or guidelines have been established for the correct use of ECa data, either Veris or EM, in vineyard layout. Also there are other sources of production system information available that have yet to be investigated e.g. ground penetrating radar is capable of plotting soil thickness. When these alternative data sources are combined with the ECa data we may be able to explain a lot more of the yield variation.