SPAA Precision Ag Symposium

WACA, Perth, WA

August 2013

Precision Viticulture – how vignerons are using spatial information to improve their business

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We provide support for acquiring and processing spatial data and using the resulting information to implement vineyard management plans.

Key Findings/Take Home Messages:

- Wine grapes are a 'high value' crop with the focus on producing *consistent yield and quality* rather than on maximising yield.
- A recent industry survey indicates that 66% of respondents believe that precision viticulture technologies are already delivering, or will deliver, a benefit to their business.
- Use of high resolution spatial data has generally focused on 'output'. Selective harvesting has been shown to be highly profitable whether used in small or large production wineries.
- Vineyard variability is not always considered as something to remove – it is often regarded as a 'positive feature' to produce grapes that suit certain wine styles.
- Due to low crop prices and high production costs, there is an increasing use of spatial information to differentially manage 'inputs' (irrigation water, fertilizers, canopy management, soil amendments, sprays and labour) to achieve commercial economic benefits.
- Other vineyard uses of high resolution spatial information include sampling and monitoring practices, vineyard design and re-design, and field experimentation.

Introduction

Following the introduction of Precision Viticulture (PV) technologies to the Australian wine industry in the late 1990's, and the associated research during the intervening years, an increasing number of vignerons are recognising the value of understanding the inherent variability in the performance of their vineyards in order to achieve commercial economic benefits. This paper gives a brief overview of how PV is perceived by the industry and how high resolution spatial information is being used in vineyards and the benefits that are being derived.

Technology adoption
A 2013 survey of grape and wine industry attitudes to Precision Viticulture (PV) and its adoption indicate that, across a broad spectrum of industry involvement (grapegrowers, winemakers, consultants, contractors and industry association representatives) and business sizes, 66% of respondents believe that PV is already delivering, or will deliver, a benefit to their business. Furthermore, 74% of respondents expect to be using at least one element of PV in the next three years (Bramley, in press). The responses to the survey also indicate that the two major limitations to further adoption of PV are implementation costs and the lack of technical advice/support and easy-to-use tools and software (Bramley, in press).

Application of spatial information in the vineyard

Selective harvesting
Selective harvesting to improve the uniformity of fruit delivered to wineries continues to deliver significant commercial benefits. Numerous commercial examples exist that demonstrate an increased profitability using this approach (Smart, 2005; Proffitt et al., 2006). The economic benefits for four case studies are shown in Table 1 (Bramley et al., 2005).

Table 1. Economic benefits of selective harvesting for grape production and/or wine production. The benefits shown are based on the harvesting of fruit from different zones of the vineyard on the same day. Note that increased benefits are sometimes realised by harvesting zones on different days.

Region	Variety	Income benefit ($) - grape production	Income benefit ($) - wine production
Clare Valley, SA	Riesling	54,904 (+77.8%)	
Padthaway, SA	Shiraz	4,657 (+3.2%)	272,971 (+20.5%)
Margaret River, WA	Shiraz	12,300 (+12.5%)	
Margaret River, WA	Cabernet Sauvignon		139,480 (+19.2%)

Yield monitor data in conjunction with knowledge about the costs of grape or wine production has also been used to construct gross margin maps (Bramley and Proffitt, 1999; Bramley, 2010). These are powerful and currently under-utilised tools for identifying and addressing poor and/or variable financial performance in vineyards.

Targeted management
Managing inputs (eg. irrigation water, fertilizers, canopy management, soil amendments, sprays and labour) has not been the major objective for vignerons who have generally concentrated on managing outputs (ie. yield and quality). This is changing in response to low crop prices, increasing production costs and environmental constraints such as the lack of irrigation water. Numerous commercial examples exist of targeted management, including the application of irrigation water, fertilizer and mulch/compost to manage vine vigour and associated crop yield and fruit quality, and pruning, leaf removal and herbicide spraying to reduce costs. Some of these are described in Proffitt et al. (2006).

Sampling and monitoring
Sampling and monitoring are key activities that are required throughout the year and include yield forecasting, berry maturity analyses, tissue and soil collection for nutritional analyses, and bud fruitfulness, pest, disease and vine health assessment. The availability of high resolution spatial data has improved the accuracy and reliability of such activities (Proffitt et al. 2006), as well as reducing costs in some instances.

Vineyard design and re-design
High resolution soil maps have been used to provide insights into the spatial variation in soil properties at scales which are applicable when designing new vineyards or re-developing older vineyards. The

information has been shown to be a cost-effective means of positioning inspection pits. Accurate boundaries delineating changes in soil properties, coupled with topographical information, have assisted with matching grape varieties to desirable soil types, designing irrigation and drainage systems, and locating infrastructure (eg. roads, dams, frost fans and buildings) and instrumentation (eg. weather stations and soil moisture/salinity monitoring devices).

Airborne imagery has been used to redesign irrigation systems to improve vine uniformity and fruit quality. In one example (Leonard 2009), the outcome resulted in significant wine show achievements. Imagery, coupled with elevation and soil property changes, has been used in the design of a vineyard re-development project (Bramley et al. 2010). In a further example of the use of spatial information in this category of vineyard application, the location of frost fans using a digital elevation model (DEM) and GIS routines to map the predicted flow of cold air across the landscape resulted in the saving of fruit estimated to be of a value similar to the total cost of the project ($250,000) (Proffitt and Bramley 2010). Hence, the frost fans paid for themselves in the first year of installation.

Field experimentation

Spatial variability within vineyards presents problems for researchers and grape growers wishing to conduct field experiments. It is also problematic for vineyard managers when deciding where to apply changes in management that will deliver benefits. The commercial availability of spatial data, coupled with geostatistical methods, has led to the use of whole-of-vineyard block experimental approaches being used rather than small plots (Bramley et al. 2011; Panten and Bramley 2011).

Conclusions:

Through the use of high resolution spatial data over the past 14 years or so, vignerons have and continue to demonstrate that knowledge of the inherent variability of their vineyards can improve their management practices and gain benefits (economic or otherwise). This is verified in a 2013 wine sector survey. The survey suggests that if the technology becomes cheaper and the technical advice/support and accompanying tools and software become easier to use, then the adoption rate should increase. To some extent, this will also depend on how and when the industry addresses the current over-supply problem and associated low grape prices.

Acknowledgements:

Symposium organisers for providing me with the opportunity to represent the grape and wine industry and demonstrate how Precision Agriculture technologies are benefiting vignerons across the country.
CSIRO Sustainable Ecosystems and the referenced vineyards and wine companies for allowing me to use their data.

References:

Bramley, R.G.V. (in press). Wine sector attitudes to the adoption of Precision Viticulture. Wine and Viticulture Journal.

Bramley, R.G.V. (2010). Precision viticulture: Managing vineyard variability for improved quality outcomes. In: Reynolds, A.G. (Ed.). Managing Wine Quality, Volume 1. Woodhead Publishing, UK. pp. 445-480.

Bramley, R.G.V. and Proffitt, A.P.B. (1999). Managing variability in viticultural production. The Australian & New Zealand Grapegrower and Winemaker, 427. 11-16.

Bramley, R.G.V., Proffitt, A.P.B., Hinze, C.J., Pearse, B. and Hamilton, R.P. (2005). Generating benefits from precision viticulture through selective harvesting. In: Stafford, J.V. (Ed.). Proceedings of the 5th European Conference on Precision Agriculture. Wageningen Academic Publishers, The Netherlands. pp. 891-898.

Bramley, R., Hinze, C. and Gobbett, D. (2010). Spatial data for improved design of vineyard (re-) planting. The Australian & New Zealand Grapegrower and Winemaker, 557. 44-53.

Bramley, R.G.V., Evans, K.J., Dunne, K.J., and Gobbett, D.L. (2011). Spatial variation in response to 'reduced input' spray programs for powdery mildew and botrytis identified through whole-of-block experimentation. Australian Journal of Grape and Wine Research, 17. 341-350.
Leonard E. (2009). PA gives Yalumba an edge. SPAA Newsletter 5(2). 6-7.
Panten, K. and Bramley, R.G.V. (2011). Viticultural experimentation using whole blocks: Evaluation of three floor management options. Australian Journal of Grape and Wine Research, 17. 136-146.
Proffitt, T., Bramley, R., Lamb, D. and Winter E. (2006). Precision Viticulture – a new era in vineyard management and wine production. Winetitles, Adelaide.
Proffitt, T. and Bramley, R. (2010). Further developments in Precision Viticulture and the use of spatial information in Australian vineyards. Australian Viticulture. 14(1). 31-39.
Smart, R. (2005). Tamar Ridge takes a bird's eye view for harvest planning. Australian and New Zealand Wine Industry Journal, 20(5). 9-11,102.