Cooperative Research Centre for Viticulture

Australian Government
Grape and Wine Research and Development Corporation

# MANAGING VINEYARD VARIABILITY



## FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **CRV 04/06S**

Principal Investigator: **Erika Winter and Tony Proffitt**

Research Organisation: Cooperative Research Centre for Viticulture

Date: **30.5.06**

| | |
|---|---|
| **Project Title:** | **Managing Vineyard Variability** |
| CRCV Project Number: | 4.5 |
| Period Report Covers: | 1 July 2004 – 30 June 2006 |
| Author Details: | Erika Winter<br>GrapeLinks<br>2 Kosciusko Court<br>Wheelers Hill VIC 3150<br><br>Phone: 03 9561 8511<br>Fax: 03 9561 8522<br>Mobile: 0417 355 851<br>Email: e.winter@bigpond.net.au |
| Date report completed: | June 2006 |
| Publisher: | Cooperative Research Centre for Viticulture |
| ISBN OR ISSN: | To be advised |

Copyright: © Copyright in the content of this guide is owned by the Cooperative Research Centre for Viticulture.

Disclaimer:
The information contained in this report is a guide only. It is not intended to be comprehensive, nor does it constitute advice. The Cooperative Research Centre for Viticulture accepts no responsibility for the consequences of the use of this information. You should seek expert advice in order to determine whether application of any of the information provided in this guide would be useful in your circumstances.

---

The Cooperative Research Centre for Viticulture is a joint venture between the following core participants, working with a wide range of supporting participants.

## Table of Contents:

**Report**


| | |
|---|---|
| **1. Abstract** | **3** |
| **2. Executive Summary** | **4** |
| **3. Background and Objectives** | **5** |
| **4. Outputs and Performance Targets** | **6** |
| **5. Method** | **6** |
| **6. Results** | **7** |
| **7. Outcome/Conclusion** | **7** |
| **8. Recommendations** | **7** |


**Appendices**


| | |
|---|---|
| **Content of the book** | **8** |
| **Communication** | **9** |
| **Intellectual Property** | **9** |
| **Staff** | **9** |
| **Other contributors** | **9** |
| **Financial reconciliation** | **10** |


### 1. Abstract:


The book “Precision Viticulture – a guide to adoption and use” by Tony Proffitt, Robert Bramley, David Lamb and Erika Winter and printed by Winetitles, discusses the various tools and technologies associated with Precision Viticulture (PV) and how someone interested in using them might make a start in adopting PV practices. It provides information about how spatial information should be acquired, delivered and used, thereby empowering a potential user with the questions that need to be asked of a service provider. The practical application of Precision Viticulture is a central theme to the book and a number of commercial case studies are presented. As there is no similar book or other reference material available to wine producing countries of the world, this publication allows the Australian wine industry to show-case their advanced technology on the world-stage.

**2. Executive Summary:**

The book "Precision Viticulture – a guide to adoption and use" by Tony Proffitt, Robert Bramley, David Lamb and Erika Winter and printed by Winetitles, discusses the various tools and technologies associated with Precision Viticulture (PV) and how someone interested in using them might make a start in adopting PV practices. It provides information about how spatial information should be acquired, delivered and used, thereby empowering a potential user with the questions that need to be asked of a service provider. The practical application of Precision Viticulture is a central theme to the book and a number of commercial case studies are presented.

This book was a project funded by the Cooperative Research Centre for Viticulture which is a joint venture between Australia's viticulture industry and leading research and education organisations. It promotes cooperative scientific research to accelerate quality management from vine to palate. Australian viticulturists and winemakers are key stakeholders in the CRCV, contributing levies matched by the Commonwealth Government and invested by the Grape and Wine Research and Development Corporation in the Centre.

The material presented in this book derived from Precision Viticulture research and development undertaken by CSIRO, The University of New England, Charles Sturt University and the Cooperative Research Centre for Viticulture (CRCV) in partnership with industry collaborators. The latter have been many and varied, but particular thanks is due to many of the staff and management of Southcorp Wines (now Foster's Wine Estates), AHA Viticulture and Vasse Felix for their enthusiastic adoption of Precision Viticulture, and viticulturists such as Colin Peterson (Peterson's Wines) for allowing unfettered access to their vineyards and staff resources. Richard Hamilton, Colin Hinze, John Matz and Bruce Pearse also deserve special mention. Much of the research in this book would not have yielded results without the contributions of Susie Williams, Dean Lanyon, Kerstin Panten, Jackie Ouzman, John Louis, Gary McKenzie, Allan Mitchell, Graham Hyde and Andrew Hall.

During the production stages, drafts of this book were commented upon by the Editorial Reference Group consisting of members of research organisations (Dr. Jim Hardie, CRCV; Peter Mansfield, CRCV; Tony Clancy, GWRDC; Dr. Dean Lanyon, CSIRO, SA; Dr. Andrew Hall, Charles Sturt University, NSW; Dr. Greg Dunn, University of Melbourne, VIC; John Whiting, DPI, VIC), practitioners (Bruce Pearse, Vasse Felix, WA; Dr. Richard Hamilton, Foster's Wine Estates, SA; Colin Hinze, Taylor's Wines, SA; Grant Yates, Foster's Wine Estates, SA; Bob Kennedy, Beyond Broke, NSW), and service providers (Dr. Frank Honey and Andrew Malcolm, SpecTerra Services, WA; Tom Wisdom, Selwyn Viticultural Services, WA; Terry Evans, SARDI, SA; Dr. Bernd Kleinlagel, Advanced Technology Viticulture, SA; Dr. Rohan Rainbow, Southern Precision Agriculture Association, SA).

The first draft of the book was circulated to the Editorial Reference Group and discussed at a meeting held in Mildura on 6th May 2005. A second draft was discussed in detail by the authors at a meeting held in Melbourne on 10th October 2005. A third draft was circulated to the Editorial Reference Group in early December 2005. The authors then reviewed all verbal and written feedback from the ERG and made appropriate changes. All members of the ERG who provided feedback are acknowledged in the book. A foreword was written by Jim Hardie (CRCV). A fourth draft was reviewed by the first 3 authors for technical detail and by the last author (Erika Winter) for style and consistency. To check compliance for the fulfilment of the project objectives, a fifth draft was also read by representatives of GWRDC and CRCV. A sixth draft was finally submitted to Winetitles on 22 May 2006.

## 3. Background:

### Introduction

Grapegrowers and winemakers have known that vineyards are spatially variable for as long as they have been growing grapes and making wine. Without the methods for observing or reacting to this variation, they have had to live with this variability and have therefore managed large vineyard blocks as though they were uniform. However, uniform management is clearly not an optimal strategy. The aims of Precision Viticulture (PV) are to gain better control over grape and wine production by recognising that there are areas within vineyards that differ from each other, and to provide the means by which these areas can be separately managed. PV enables this to happen by using a number of tools and technologies which allow vineyard attributes to be measured and displayed at high spatial resolution. By using this information, better and more targeted management decisions can be made which have an increased likelihood of delivering the expected outcomes compared to conventional viticultural management.

In recent years there have been a number of articles written in industry journals and newsletters, and conference papers and workshops presented discussing the concept of Precision Viticulture and the associated tools and technologies. However, because the concept and technology is new to the industry, there are a lack of service providers and consultants equipped with sufficient knowledge and experience to help grapegrowers and winemakers implement PV. In order to expediate the adoption of PV, reference material is required which outlines the various tools and technologies and how someone interested in using them might make a start in adopting PV practices.

This project focuses on improving the adoption rate of Precision Viticulture and has the following objectives:

### Objectives

- To make available nationally, comprehensive and up-to-date information on the use of Precision Viticulture technologies to support the adoption of best practice in the management of vineyard variability. This information is to be provided in the form of an easily-understood book.

- To equip industry support personnel (eg. consultants, IDO's, training providers, etc.) with information that will enable them to train and support grapegrowers and winemakers in the use of the technology so that they can make more informed management decisions in relation to managing variability in their vineyards.

Initially, the project also intended to produce a training manual and visual material which were to be trialled at workshops. During the progress of the project it was considered more important that the key focus was the production of a high quality book. Two key researchers agreed to contribute to the book providing that the style and content was of sufficient quality to have international as well as local appeal. The CRCV agreed to this change which placed greater emphasis on the book rather than the training material and workshops.

Outputs and performance targets were modified as shown below, with changes highlighted in pink and deletions in yellow. Final delivery targets were met and highlighted in red.

## 4. Outputs and Performance Targets:

**2004-2005**

| Outputs | Performance Targets |
|---|---|
| 1. Managing vineyard variability book | • Compile data, methods and testimonials by May 05<br>• Manuscript produced by 31 May 05<br>• Industry review of manuscript by 8. June 05<br>Draft of book incorporating review produced by 22 June 05 |
| 2. Managing vineyard variability workshops | • Liaison with On Farm Trials program and their regional associations for initial planning for workshops by 30 June 05 |

**2005-2006**

| Outputs | Performance Targets |
|---|---|
| 1. Managing vineyard variability workshops | • Workshop design and planning by 30 August 05<br>• Four workshops delivered by 31 October 05<br>• Workshop kit finalised by 28 February 06 |
| 2. Managing vineyard variability handbook | • Final version of handbook incorporating outcomes of ERG and further testimonials produced by 31 May 06<br>• Handbook completed by 30 June 06 |
| 3. Evaluation and report | • Evaluation of project outcomes, the status of other relevant extension projects and current industry climate to produce a recommended model for continuing progress towards the project objectives by 30 June 06<br>• Final report submitted by 30 June 06 |

## 5. Method:

It was critical for the success of this project to attract the cooperation of two key Australian researchers in Precision Viticulture, namely Dr. Robert Bramley and Associate Prof. David Lamb. They agreed to co-authorship and contributed immensely to the high quality of the contents. Tony Proffitt, Rob Bramley and David Lamb have each contributed chapters according to their specialist interests, knowledge and experience. The first draft of the book was circulated to the Editorial Reference Group and discussed at a meeting held in Mildura on 6th June 2005. A second draft was discussed in detail by the authors at a meeting held in Melbourne on 10th October 2005. A third draft was circulated to the Editorial Reference Group in early December 2005. The authors then reviewed all verbal and written feedback from the ERG and made appropriate changes. All members of the ERG who provided feedback are acknowledged in the book. A foreword was written by Jim Hardie (CRCV). A fourth draft was reviewed by the first 3 authors for technical detail and by the last author (Erika Winter) for style and consistency. To check compliance for the fulfilment of the project objectives, a fifth draft was also read by representatives of GWRDC and CRCV. A sixth draft was finally submitted to Winetitles on 22 June 2006.

**6. Results:**

Cooperation with Viticare: Questionnaire surveys conducted by the Viticare groups were analysed. Erika Winter visited a Viticare grower meeting. It was noted that there are a number of impediments to the adoption of Precision Viticulture for managing vineyard variability.

Communication: Outcomes from the surveys and information about the production of the book and its contents were presented in poster form at the GESCO conference held in Germany during August 2005, and at the International Cool Climate Symposium held in New Zealand during February 2006.

Final product: The 100 page book with 88 photographs, maps and aerial imagery will be published and printed by 'Winetitles'. The 'Contents' of the book are shown in Appendix 1.

**7. Outcome/Conclusion:**

- The project has achieved the objectives as modified and approved in year 2.
- The book discusses the various tools and technologies associated with Precision Viticulture and how someone interested in using them might make a start in adopting PV practices. Importantly, the book provides information about how spatial information should be acquired, delivered and used, thereby empowering a potential user with the questions that need to be asked of a service provider.
- The practical application of Precision Viticulture is a central theme to the book and a number of commercial case studies are presented.
- As far as the authors are aware, there is no similar book or other reference material available to wine producing countries of the world. This allows the Australian wine industry to show-case their advanced technology on the world-stage.

**8. Recommendations:**

- The CRCV should broadly publicise the availability of the book to all sectors of industry, including the education & training sector.

- A review of the book should occur in 12 months and possibly a revised edition be produced, depending on the progress of technology and its application to industry.

- Consideration be given to the development of a training program utilising the book as a main resource. This should be considered within the context of developing a new overall framework for delivery of training within the industry.

## Appendix 1:

## Contents of the book


**1. Introduction**

**2. Precision Viticulture**
**2.1 The Cyclical Process of Precision Viticulture**
**2.2 Vineyard Variability**
2.2.1 Spatial variability
2.2.2 Spatial variability in grape yield
2.2.3 Temporal variability in grape yield
2.2.4 Variability in grape quality
2.2.5 Measuring spatial variability in grape quality

**3. The Tools of Precision Viticulture**
**3.1 Global Positioning Systems**
3.1.1 GPS equipment
3.1.2 Accuracy of information
3.1.3 Obtaining differential corrections
3.1.4 Accessing GPS equipment and cost indicators
3.1.5 Making sense of GPS data
3.1.6 Generating a vineyard base map
**3.2 Geographical Information Systems and Data Management**
3.2.1 Accessing GIS
3.2.2 Data storage
3.2.3 Data management
3.2.4 Data presentation
3.2.5 Data interpolation, analysis and interpretation
**3.3 Remote Sensing**
3.3.1 Aerial photography
3.3.2 Infrared aerial photography
3.3.3 Digital imaging systems
3.3.4 Vegetation indices for remote sensing images
3.3.5 Image production
3.3.6 Airborne versus sattelite sensing
3.3.7 When to acquire imagery
3.3.8 Image calibration
3.3.9 Ground truthing imagery
**3.4 Yield Monitoring**
3.4.1Yield monitors
3.4.2 Yield map production
3.4.3 Ground truthing yield maps
**3.5 Soil Sensing**
3.5.1 Electromagnetic induction
3.5.2 Gamma-ray spectrometry
3.5.3 Ground-penetrating radar
**3.6 New and Emerging Technologies**
3.6.1 Canopy measures using side-looking sensors
3.6.2 Future developments

**4. Case Studies in Precision Viticulture**
**4.1 PV as a tool for selective harvesting**
4.1.1 Cabernet Sauvignon in Margaret River, Western Australia
4.1.2 Shiraz in Padthaway, South Australia
4.1.3 Riesling in the Clare Valley, South Australia
**4.2 PV as a tool for improved natural resource management**
4.2.1 Soil salinity in the Clare Valley, South Australia
**4.3 PV as a tool for improved application of inputs**
**4.3.1 Irrigation management in Margaret River, Western Australia**
4.3.2 Pruning in Margaret River, Western Australia
**4.4 PV as a tool for improved sampling**
4.4.1 Crop yield forecasting in McLaren Vale, South Australia
**4.5 PV as a tool for experimentation in whole blocks**
4.5.1 Whole-of-block experimentation in Langhorne Creek, South Australia

**5. Getting started with Precision Viticulture**

**6. References**

**7. Acronyms and Definitions**

**Appendix 2:**

**Communication:**

1. A poster highlighting this project has been presented at two conferences:
Title: 'Promoting the Adoption of Precision Viticulture'
Authors: T. Proffitt[1], R. Bramley[2,6], D. Lamb[3,6], E. Winter[4,6], G. Dunn[5] and S. Robinson[6]
*[1]AHA Viticulture, Dunsborough; [2]CSIRO Sustainable Ecosystems, Adelaide; [3] University of New England, Armidale; [4]GrapeLinks, Melbourne, [5]DPI Victoria, Tatura; [6] CRCV, Adelaide.*
*- Proceedings GESCO conference 2005, Geisenheim, Germany. ISBN 3-93472-19*
*- Proceedings International Cool Climate Symposium 2006, Auckland, New Zealand (In press).*

2. CRCV Press release.
New book will help grapegrowers and winemakers better manage vineyard variability by implementing Precision Viticulture technologies.

3. Further communication activities will enhance the uptake of the book. These activities will be undertaken by GWRDC and CRCV, the publisher Winetitles and other industry media once the book is available for purchase.

**Appendix 3:**

**Intellectual Property and Royalties:**

The book is the IP arising from the project. The material presented in this book derives from Precision Viticulture research and development undertaken by CSIRO, The University of New England, AHA Viticulture and the Cooperative Research Centre for Viticulture (CRCV) in partnership with industry collaborators. CSIRO, UNE and AHA have assigned the rights to their materials to the CRCV, subject to having the right to use their own data, figures, tables, formulae and outputs of scientific instruments. Because the target audience and likely demand for the book is limited, the CRCV provided a financial contribution towards production costs and also waived the right to royalties in order to make the publication commercially viable for Winetitles.

**Appendix 4:**

**References:** Refer to the acknowledgement and reference sections of the book.

**Appendix 5:**

**Staff**

Dr. Erika Winter, GrapeLinks, Melbourne, VIC
Dr. Tony Proffitt, AHA Viticulture, Dunsborough, WA
Dr. Rob Bramley, CSIRO Sustainable Ecosystems, Adelaide, SA (in kind)
Assoc. Prof. David Lamb, Univ. of New England, Armidale, NSW (in kind)

**Appendix 6:**

**Other contributors**

The material presented in this book derives from Precision Viticulture research and development undertaken by CSIRO, The University of New England, AHA Viticulture and the Cooperative Research Centre for Viticulture (CRCV) in partnership with industry collaborators. The latter have been many and varied, but we are especially grateful to many of the staff and management of Southcorp Wines (now Foster's Wine Estates), AHA Viticulture and Vasse Felix for their enthusiastic adoption of Precision Viticulture, and growers such as Colin Peterson (Peterson's Wines) for allowing unfettered access to their vineyards and staff resources. Richard Hamilton, Colin Hinze, John Matz and Bruce Pearse also deserve special mention. Much of the progress made in the research would not have been made without the contributions of Susie Williams, Dean Lanyon, Kerstin Panten, Jackie Ouzman, John Louis, Gary McKenzie, Allan Mitchell, Graham Hyde and Andrew Hall. We are most grateful to these friends and colleagues; their input has been valued greatly. During the production stages, drafts of this book were commented upon by the Editorial Reference Group consisting of members of research organisations (Dr. Jim Hardie, CRCV; Peter Mansfield, CRCV; Tony Clancy, GWRDC; Dr. Dean Lanyon, CSIRO, SA; Dr. Andrew Hall, Charles Sturt University, NSW; Dr. Greg Dunn, University of Melbourne, VIC; John Whiting, DPI, VIC), practitioners (Bruce Pearse, Vasse Felix, WA; Dr. Richard Hamilton, Foster's Wine Estates, SA; Colin Hinze, Taylor's Wines, SA; Grant Yates, Foster's Wine Estates, SA; Bob Kennedy, Beyond Broke, NSW), and service providers (Dr. Frank Honey and Andrew Malcolm, SpecTerra Services, WA; Tom Wisdom, Selwyn Viticultural Services, WA; Terry Evans, SARDI, SA; Dr. Bernd Kleinlagel, Advanced Technology Viticulture, SA; Dr. Rohan Rainbow, Southern precision Agriculture Association, SA).

**Appendix 7: CRCV Budget reconciliation**

**Appendix 8: CRCV Attachment Project Summary & Impact Form**

**Appendix 9: CRCV Attachment CRCV Annual Report Requirement**