

Final Report Chapter 6: Project 4.3.1 AWRI Hunter Valley, Riverina and Tasmania Nodes

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Abstract

Australia is a geographically large and diverse country, with grape and wine producing regions situated in diverse climatic zones, and consequently, different regions express large differences in their Research, Development and Extension (RD&E) priorities. In addition, the extension and adoption messages for particular research outputs need to be tailored for the region concerned. For this reason, the AWRI established a network of regional nodes in order to address regional RD&E. priorities; the Riverina, Tasmania and Hunter Valley nodes being the subject of this report.

The report covers the period from 1 November 2013 to 30 June 2014. The work reported, comprising Outputs and Activities largely directed by the Grape and Wine Research and Development Corporation (GWRDC), focuses on extension and facilitated adoption of technologies which had been previously developed, and on extending existing AWRI flavour research projects via the Tasmania node. As such, this period represented a strong opportunity to extend work to a wider Australian wine industry audience, and a total of 30 workshops and seminars were staged across four states, with each event strongly attended by industry personnel. This achieved or exceeded the project's Output targets.

Executive Summary

Extensive capability building was performed by this project during the period from 1 November 2013 to 30 June 2014, although it is largely too early to assess the industry outcomes and their value.

A large number of industry personnel representing many of Australia's largest wine producers were provided with practical demonstration of two tools which can improve processing efficiency and therefore increase profitability; namely the AWRI Fermentation Simulator and the AWRI Refrigeration Demand Calculator. Seven regional Refrigeration Efficiency workshops were staged and a webinar was presented, which were attended by a total of 116 industry personnel representing 80 wineries. In addition, six regional Fermentation Simulator workshops and a webinar were staged, which were attended by a total of 89 industry personnel. Both the Fermentation Simulator and the AWRI Refrigeration Demand Calculator are available as free downloads from the AWRI website, and recordings of the two webinars are also available from the webinars page of the AWRI website.

With respect to the Fermentation Simulator, the tool was modified in two ways in response to industry feedback; firstly in respect of the ability to model ferments conducted with cool-climate grapes (i.e. low pH and high titratable acidity [TA]), and fermentations conducted with indigenous yeasts, both of which result in a longer 'lag time' before fermentation becomes fully established. These modifications allow wider applicability of the Ferment Simulator in industry. In addition a simplified 'Lite' version of the Fermentation Simulator was developed in response to feedback received mainly from smaller wineries, and a design brief for a mobile platform App. was developed in response to feedback from potential users that they would prefer a web-based interface. An Industry Adoption Plan to enhance future industry uptake of the Ferment Simulator was also developed.

An article describing use of both versions of the Ferment Simulator was also written and published in the November/December 2013 issue of *Wine and Viticulture Journal*.

In terms of assessing industry interest in the Ferment Simulator, between 28 October 2013 and 30 June 2014, 956 page-views of the AWRI website section covering the Ferment Simulator homepage, login page and the download page were recorded; including 80 unique page-views of the Ferment Simulator Download page. The AWRI website has recently been modified so that in future it will be possible to track the number of downloads of both the Fermentation Simulator and the Refrigeration Demand Calculator, in addition to the number of page-views.

The working prototype of the AWRI Refrigeration Demand Calculator was developed at the Riverina node using data accessed from three large wineries in the Riverina, and three medium-sized wineries in the Hunter Valley via the Riverina and Hunter Valley nodes.

Refrigeration is by far the largest user of electricity in the majority of wineries, and consequently, improving refrigeration efficiency will result in an immediate improvement to profitability. In response to this opportunity, the Refrigeration Demand Calculator was developed as a practical spreadsheet-based software tool, and was made available to all Australian wine producers as a free download from the AWRI website.

The purpose of the AWRI Refrigeration Demand Calculator is to allow wine producers to analyse, understand, and better manage their refrigeration demand with a view to reducing the amount of electricity used, and thus the amount of money spent on electricity. Wine producers are able to enter grape intake and production data to simulate refrigeration demand across the entire annual production cycle, and assess the impact of factors such as cellar storage, cold stabilisation temperatures, fermentation conditions, climate, brine temperature, tank size and insulation on refrigeration demand and energy costs.

The Refrigeration Demand Calculator was successfully validated with data from the 2014 vintage, and for one large winery which has a dedicated power meter on its refrigeration plant, the tool was able to estimate actual electricity used for refrigeration to with 5% of the actual usage.

Seven workshops which provided a practical demonstration of the AWRI Refrigeration Demand Calculator were planned, organised, promoted and presented in three states and also via a webinar, which is available for viewing on the AWRI website. The workshop content included information obtained from refrigeration benchmarking studies conducted with a number of wineries in two NSW wine regions. A total of 116 participants from 80 wineries attended the workshops.

The AWRI Refrigeration Demand Calculator is available to industry as an unlocked Excel file (compatible with Office 2007 onwards) and the source code is also unlocked, allowing wine producers to interface directly with internal systems for automatic data acquisition if desired. An associated *User Guide* and example spreadsheet were also developed and made available to industry via the AWRI website.

In response to industry demand expressed via the AWRI Hunter Valley node, a new workshop with industry-wide applicability titled *Working smarter not harder - making the most of your smart phone and tablet* was developed. The workshop focused on realising the potential of smart phones and tablets as tools for improving vineyard management and efficiency; recognising that smart phones and tablets have rapidly transformed the way in which information and data can be obtained, collected and stored. These technologies facilitate access to substantial resources and systems that grapegrowers can use to improve the management of their vineyards, and their overall productivity and efficiency. A practical hands-on workshop was developed and presented nine times across three states, and was attended by a total of 131 industry personnel.

In relation to the industry impact of the *Working smarter not harder - making the most of your smart phone and tablet* workshops, participants almost unanimously indicated that they had found the workshops useful, and had gained new knowledge which they could immediately apply in their businesses.

The Hunter Valley node also responded to an industry need for increased winemaking extension delivery throughout NSW, by staging a series of six practical winemaking workshops in NSW and the ACT. The intended outcome of these activities was to better equip winemakers to improve their winemaking and processing efficiency through application of research outputs.

The content chosen by each region varied widely, and included tasting and discussions of wines fermented with indigenous yeasts; practical understanding and management of phenolics in red wines; the avoidance of potential off-flavours from sources such as bushfire smoke and *Brettanomyces*; and tastings and discussion of 2014 vintage wines with which winemakers had experimented with novel winemaking techniques, and of wines which had not progressed as anticipated. The workshops were attended by a total of 164 wine industry personnel indicating there is a strong demand for this type of activity.

Work conducted by the AWRI Tasmania node during this period, was an extension of the existing Investment Agreement Project 3.1.1, *Identification and origin of volatile compounds responsible for important wine sensory attributes*. Tasmania is recognised as an important production area for very high quality Chardonnay grapes and wines, with the area under vine increasing rapidly. Two commercially important attributes of the grapes and wines relate to degrees of 'tropical fruit' and 'stone fruit' sensory characters. 'Tropical fruit' characters in wine are known to originate from thiols and thiol precursors in the grapes, but the origin of 'stone fruit' character in white wines remains unknown. Initial data suggested that Tasmanian Chardonnay can exhibit particularly high levels of tropical thiols, and anecdotally, can also be very high in 'stone fruit' character. As such Tasmanian Chardonnay represents an ideal fruit source to study, in order to expand the scope of Project 3.1.1.

Under the project reported here, the concentrations of 'tropical' thiols, and the likely target compounds responsible for 'stone fruit' aroma were examined in Tasmanian Chardonnay grapes and wines. The aim was to quantify the concentrations of the compounds and the precursor compounds responsible for these attributes in grapes and wines, with a view to later possibly being able to predict the strength of these characters in finished wine from objective measures of grapes.

The intended outcome of these activities is that winemakers and grapegrowers will be able to more accurately target commercially relevant grape and wine style attributes by understanding the concentrations of tropical thiols responsible for 'tropical fruit' characters in Chardonnay grapes and wines from different parts of Tasmania, and the origin of 'stone fruit' characters in white wines. Collaboration with the University of Tasmania School of Chemistry in Hobart allowed access to analytical equipment and methods which are not available at the AWRI in Adelaide.

In addition to the funding from GWRDC, industry support for the activities reported here is gratefully acknowledged. In-kind contributions were received from Keith Tulloch Wines in the Hunter Valley (free office space); TIA (the Tasmanian Institute of Agriculture) (free office space and facilitation of collaborations with the University of Tasmania School of Chemistry); the Riverina Institute of TAFE (50% subsidy on office space and a

degree of administrative support); and, The Hunter Valley Wine and Tourism Association ($10,000 pro-rata cash contribution for the period covered by this report).

Background

The speed at which new R&D outputs are adopted by industry is a key competitive advantage for the Australian wine industry, and thus for also maximising the value of Australia's levy investment in RD&E. Regional wine producing areas of Australia have different research and development priorities which reflect their individual winemaking and viticultural challenges and requirements. Australia is a geographically large and diverse country, with grape and wine producing regions situated in diverse climatic zones. To a large extent, the climate of each region dictates the type of wine produced, and the type of wine businesses which have become established in each region, with consequent large differences in regional RD&E priorities. In addition, the extension and adoption messages for particular research outputs need to be tailored for the region concerned. Examples of this are the understanding of colour and tannin interactions in red wines, which might differ between hot and cooler regions with regard to the same grape variety, or differ between regions due to the predominant grape varieties being grown.

These regional needs are recognised in the National Primary Industries RD&E Framework Wine Sector Strategy (September 2009), which calls for national 'R', regional 'D' and local 'E'. Formation of regional nodes of activity in a number of Australia's grapegrowing and winemaking regions allowed regionally-relevant D priorities to be identified, and tailored RD&E solutions to be provided. It has been demonstrated that research, development and extension activities which target specific regional priorities, as well as active facilitation of technology adoption, could be effectively and efficiently delivered through the AWRI regional nodes, especially in regions where obvious gaps in development and extension support for the industry were identified.

The AWRI established four regional nodes, in the Riverina, the Hunter Valley, Tasmania and Victoria, through which research, development and extension activities have successfully addressed regional priorities, and technology adoption has been facilitated. After South Australia, which has 46.9% of Australia's wine grape plantings (ABS Vineyard Estimates), the States with the next two largest areas under vine are NSW (27.2%) and Victoria (16.9%). The Riverina node is located within the Big Rivers zone of NSW, which accounts for 69.8% of that State's area under vine. The addition of the Hunter Valley node (which services the Hunter Valley and Central Ranges zones with links into Mudgee, Orange and Cowra etc.) means that zones comprising more than 93% of NSW's area under vine were directly served by AWRI nodes. Greater Victoria is well served by the node located in Port Melbourne, and while Tasmania has only a small proportion of Australia's wine producing area it is expanding rapidly. In addition, its geographical isolation, relatively large number of small producers and importance as the nation's premier sparkling wine production region combine to justify the location of a node. The Tasmanian industry was also pro-active in establishing the node, and the state continued to contribute 50% of the salary and operation budget for the node, in addition to substantial in-kind support including office and laboratory space, up to the cessation of funding for this project on 30 June 2014.

The nodes also facilitate two-way interaction and flow of information between the regions and both research providers and funding bodies. As with all other AWRI staff involved in RD&E, node staff are engaged in industry-engagement and extension activities as well as directing enquiries received from grapegrowers and winemakers to the appropriate bodies, or to the appropriate AWRI staff member.

Australia has a global reputation as a technologically advanced wine producer, and the speed at which new knowledge and technologies have been adopted has been an important factor in developing Australia's technologically advanced status. This project was designed to ensure that Australia maintains its technological advantage in the world wine market, by remaining a leader in rapid adoption of novel research outputs. The strategy was to build the capabilities of Australia's wine producers in regional Australia, and to actively facilitate the development and adoption of new technologies by those regional producers.

Summary of aims and expected outcomes

Hunter Valley

a.AWRI Fermentation Simulator – investigate barriers to adoption

This project sought to investigate barriers to adoption of the AWRI Ferment Simulator encountered by wine producers in the Hunter Valley, and, in conjunction with the AWRI Riverina Node, through development and delivery of extension activities to encourage uptake.

Outcome: Increased uptake of use of the Fermentation Simulator.

b. Development of new half-day workshop for grape growers; *Working smarter not harder - making the most of your smart phone and tablet*

Smart phones and tablets have rapidly transformed the way in which information and data can be obtained, collected and stored. These technologies facilitate access to substantial resources and systems that grapegrowers can use to improve the management of their vineyards, and their overall productivity and efficiency.

A practical hands-on workshop was to be developed that supports growers to integrate the use of smart phones and tablets into the management of their businesses.

Outcome: Improved vineyard management productivity and efficiency through increased use of smart phones and tablets.

c. Increased winemaking extension delivery throughout NSW and beyond

The project aimed to stage additional workshops to those delivered through the Investment Agreement Project 4.1.1, in five regions of NSW and one in the ACT. The first half of these workshops sought to utilise largely existing AWRI content relating to winemaking practice, combined and modified as necessary according to the technical issues each region wished to address. The second half of the workshop was to comprise content related to refrigeration efficiency as described in the Riverina Node schedule.

Outcome: Winemakers better equipped to improve their winemaking and processing efficiency through application of research outputs.

Riverina

a. Winery Refrigeration Efficiency workshops

This project recognises that refrigeration is a major use of electricity in wineries and that many winery refrigeration systems are inefficient and could be improved.

This project sought to provide wine producers with the knowledge and the skills necessary to benchmark and improve their own refrigeration systems, leading to improved energy efficiency and reduced spending on electricity.

Outcome: Improved refrigeration efficiency leading to reduced electricity use.

b. Refrigeration Efficiency – model refrigeration use and develop a monitoring tool

In addition to addressing the need to assist wine producers to improve their refrigeration efficiency described above, the project sought to concurrently develop a practical prototype software tool to assist wine producers to increase their refrigeration efficiency and reduce operating costs.

Outcome: A prototype software tool for analysis of demand-side refrigeration.

c. AWRI Fermentation Simulator – extension and investigate barriers to adoption

The AWRI has developed a workable fermentation simulator in Excel format based on the records of thousands of fermentations of grapes grown in warm to hot grapegrowing regions. The simulator is a powerful and unique tool for optimising fermentation management, avoiding slow and stuck fermentations, and for smoothing electricity use in refrigeration, thus allowing avoidance of punitive electricity tariffs. The simulator was introduced to industry through a variety of extension events, but industry uptake was been slow.

This project sought to investigate barriers to adoption encountered by wine producers in the Riverina and Hunter Valley, and take action to encourage uptake.

Outcome: Improved fermentation management through increased uptake of use of the AWRI Fermentation Simulator.

d. Fermentation simulator expanded to include cool climate (low pH/high TA) and indigenous yeast fermentations

The underlying fermentation simulation model did not accommodate fermentations conducted with fruit grown in cool climates with low pH and high TA, or fermentations conducted with indigenous yeast. This raised a possibility of failure of robustness of the model.

Outcome: Broader applicability and functionality of the fermentation simulator.

Tasmania

Tasmania is recognised as an important production area for very high quality Chardonnay grapes and wines, with the area under vine increasing rapidly. Two commercially important attributes of the grapes and wines relate to degrees

of 'tropical fruit' and 'stone fruit' sensory characters. 'Tropical fruit' characters in wine are known to originate from thiols and thiol precursors in the grapes, but the origin of 'stone fruit' character in white wines remains unknown.

Initial data suggest that Tasmanian Chardonnay can exhibit particularly high levels of tropical thiols, and anecdotally, can also be very high in 'stone fruit' character. As such Tasmanian Chardonnay represents an ideal fruit source to study, in order to expand the existing GWRDC-funded AWRI project 3.1.1, *Identification and origin of volatile compounds responsible for important wine sensory attributes*. This project sought to examine the concentrations of 'tropical' thiols, and the likely target compounds responsible for 'stone fruit' aroma, in Tasmanian Chardonnay. The aim was to quantify the concentrations of the compounds and the precursor compounds responsible for these attributes in grapes and wines; and to possibly predict the strength of these characters in finished wine from objective measures of the grapes.

Outcome: Winemakers and grapegrowers more accurately able to target commercially relevant grape and wine style attributes by; understanding the concentrations of tropical thiols responsible for 'tropical fruit' characters in Chardonnay grapes and wines from different parts of Tasmania; and, the origin of 'stone fruit' characters in white wines.

Objectives

Hunter

The objective of this project is to raise awareness and facilitate uptake of research outcomes, assist producers to understand the practical value of the outcomes, and assist producers to overcome potential barriers to adoption particularly of technologies relating to refrigeration efficiency and fermentation modelling, in order to benefit their business. This will be achieved by extending research outcomes to encourage adoption and adaption by industry personnel.

Riverina

The objectives of this project are to raise awareness, facilitate uptake, and understand the barriers to adoption of research outcomes, specifically in the areas of increasing refrigeration efficiency and fermentation modelling to achieve optimal fermentation outcomes.

Tasmania

To allow winemakers and grapegrowers to more accurately target commercially relevant grape and wine style attributes by understanding the concentrations of tropical thiols responsible for 'tropical fruit' characters in Chardonnay grapes and wines from different parts of Tasmania, and the origin of 'stone fruit' characters in white wines.

Method

AWRI Fermentation Simulator – investigate and address barriers to adoption

Hunter Output a; Riverina Output c1; Riverina Output c2

The AWRI had previously developed a workable fermentation simulator in Excel format. The simulator had previously been introduced to industry through a variety of extension events, but industry uptake had been slow.

Barriers to adoption of the Ferment Simulator were addressed by a number of methods:

An on-line *Survey Monkey* survey was widely distributed to industry via an AWRI *eBulletin*, and also to a targeted group of potential direct-users of the Simulator via the *Inter Winery Analysis Group*.

Direct survey interviews were conducted with wine producers in the Hunter Valley and Riverina, and during the 2014 vintage node staff worked one-to-one with a number of producers of differing size, in order to gain first-hand knowledge of how the Ferment Simulator is used in various winery settings, and to gain an understanding of potential practical barriers to its adoption.

As a result of industry feedback received from the surveys:

- A modified 'Lite' version of the Ferment Simulator was developed with small wineries in mind, with a simplified user interface and basic fermentation simulation capability.
- The functionality of the Ferment Simulator was also enhanced to accommodate indigenous yeast ferments and 'cool climate' ferments of juices with very low pH and high TA. To achieve this, fermentation records

were sourced from a number of collaborating wineries, particularly via the AWRI/TIA Tasmania node, and changes were made to the Ferment Simulator source codes which were shown to accurately predict the fermentation trajectories for the newly added fermentation categories.

Both versions of the Fermentation Simulator were made available to industry personnel as free downloads from the AWRI website.

User Guides for both versions of the Ferment Simulator, and a full tank farm case study were developed, and made available to industry personnel as free downloads from the AWRI website.

An article describing use of both versions of the Ferment Simulator was also written and published in the November/December 2013 issue of *Wine and Viticulture Journal*.

Workshops which provided a hands-on demonstration of both versions of the Ferment Simulator were developed, organised, promoted and presented in six regions and via a webinar, and a recording of the webinar was made available for viewing on the AWRI website.

A detailed Design Brief for a mobile platform App. of the Ferment Simulator was developed.

An Industry Adoption Plan to enhance future industry uptake of the Ferment Simulator was developed.

Development and delivery of a new half-day workshop for grape growers; *Working smarter not harder - making the most of your smart phone and tablet*

Hunter Output b; Hunter Output c2

Industry feedback was sought via the AWRI Hunter Valley node regarding priorities for new extension content.

A regionally expressed priority was making new 'smart' technology platforms more accessible to grapegrowers.

Content for a new workshop titled *Working smarter not harder - making the most of your smart phone and tablet* was developed in collaboration with a number of leading viticulturists and vineyard managers who had already incorporated the use of such technologies into the way they do business.

Nine workshops were planned, organised, promoted and presented in three states, in conjunction with major wine companies, grower groups and regional associations.

New content shared by participants in the workshops was used to expand the original presentation.

Increased winemaking extension delivery throughout NSW and beyond, via the AWRI Hunter Valley Node

Hunter Output c1

A series of six practical winemaking workshops were developed, organised, promoted and presented through NSW and the ACT.

The content for each workshop was developed following extensive collaboration with regional winemakers' associations.

Refrigeration Efficiency – model refrigeration use and develop a monitoring tool; develop and present workshops

Riverina Output a; Riverina Output b; Hunter Output c1

A practical prototype software tool, the AWRI Refrigeration Demand Calculator, was completed.

The tool was validated using data from the 2014 vintage.

Case studies of refrigeration use were conducted with a number of wineries.

Information from the case studies was incorporated into the development of a new Refrigeration Efficiency workshop (which incorporated material from a pre-existing *Research to Practice* module).

Seven workshops which provided a practical demonstration of the AWRI Refrigeration Demand Calculator were planned, organised, promoted and presented in three states and also via a webinar.

A recording of the webinar was made available for viewing on the AWRI website.

The Calculator was made available to industry as a free download from the AWRI website.

An associated *User Guide* and example spreadsheet were also developed and made available to industry via the AWRI website.

Investigate likely target compounds responsible for stone fruit aroma in white wine.

Provide industry with information related to the concentrations of 'tropical' thiols and their precursors in Tasmanian Chardonnay grapes and wines.

Tasmania Output a, Tasmania Output b, Tasmania Output c

Extensive industry consultation was conducted to select 30 Tasmanian commercial Chardonnay wines which might exhibit 'apricot/peach/nectarine' stone fruit characters.

A winemaker panel was convened in Tasmania to rate the Tasmanian commercial Chardonnay wines for 'apricot/peach/nectarine' stone fruit characters.

Wines were selected based on data from the tasting for *comprehensive multidimensional GCxGC time of flight MS analysis*.

Extensive industry consultation was conducted to select eight Chardonnay vineyards which were considered to express high levels of 'tropical' fruit characters.

Extensive industry liaison was conducted to ensure that fruit from selected vineyards was processed in accordance with a consistent protocol.

The logistics of shipping stainless steel kegs to Tasmania from Adelaide; having them filled with the processed juice at the selected wineries; and the shipping of the filled kegs back to Adelaide in refrigerated condition, were planned and managed.

Analysis of the juices and resulting wines for thiol and thiol-precursor concentrations was performed under the GWRDC-funded AWRI project 3.1.1, *Identification and origin of volatile compounds responsible for important wine sensory attributes*.

Results and Discussion

All contracted Outputs and Activities were achieved by the relevant Target Date.

Improving refrigeration efficiency to reduce electricity use

Riverina Output a: Wineries in NSW and ACT better understand how to improve their refrigeration efficiency.

Riverina Output b: A practical software tool for heat and energy balance analysis of winery operations.

Hunter Output c1: Extension of information on improved winemaking practices (Deliver one-day workshops in six regions (five in NSW and one in Canberra District). Half of the workshop will focus on refrigeration efficiency).

Under this project a new process optimisation tool, the AWRI Refrigeration Demand Calculator was finalised and launched, after initial development work had been conducted by the AWRI Riverina Node during the previous two years.

Refrigeration is by far the largest user of electricity in the majority of wineries, and consequently, improving refrigeration efficiency will result in an immediate improvement to profitability. In response to this opportunity, the Refrigeration Demand Calculator was developed as a practical spreadsheet-based software tool, and was made available to all Australian wine producers as a free download from the AWRI website.

The purpose of the AWRI Refrigeration Demand Calculator is to allow wine producers to analyse, understand, and better manage their refrigeration demand with a view to reducing the amount of electricity used, and thus the amount of money spent on electricity. The Calculator was developed using data accessed from three large wineries in the Riverina, and three medium-sized wineries in the Hunter Valley via the AWRI Riverina and Hunter Valley nodes. Wine producers are able to enter grape intake and production data to simulate refrigeration demand across the entire annual production cycle, and assess the impact of factors such as cellar storage, cold stabilisation temperatures, fermentation conditions, climate, brine temperature, tank size and insulation on refrigeration demand and energy costs.

The Refrigeration Demand Calculator was successfully validated with data from the 2014 vintage, and for one large very large winery which has a dedicated power meter on its refrigeration plant, the tool was able to estimate actual electricity used for refrigeration to with 5% of the actual usage.

Seven workshops which provided a practical demonstration of the AWRI Refrigeration Demand Calculator were planned, organised, promoted and presented in three states and also via a webinar, which is available for viewing on the AWRI website. The workshop content included information obtained from refrigeration benchmarking studies conducted with a number of wineries in two NSW wine regions. A total of 116 participants from 80 wineries attended the workshops.

The AWRI Refrigeration Demand Calculator is available to industry as a free download from the AWRI website, as an unlocked Excel file (compatible with Office 2007 onwards) and the source code is also unlocked, allowing wine producers to interface directly with internal systems for automatic data acquisition if desired. An associated *User Guide* and example spreadsheet were also developed and made available to industry via the AWRI website.

Adding to the functionality of the AWRI Ferment Simulator; understanding barriers to its adoption; and extension activities to facilitate its uptake by wine producers

Hunter Output a: Report on adoption barriers of the AWRI Fermentation Simulator for small to medium sized wineries.

Riverina Output c1: Report on adoption barriers for the AWRI Fermentation Simulator and pathway solutions.

Riverina Output c2: Extension of information on the AWRI Fermentation Simulator to at least 48 wineries in six regions, and a webinar delivered to whole of industry. Extension pack for AWRI Fermentation Simulator prepared.

Riverina Output c3: AWRI Fermentation Simulator modified to overcome indentified barriers to adoption. Subject to anecdotal evidence to be tested under Output c1, the modification activities are likely to include: Simplified version of the Fermentation Simulator Developed, to be offered alongside the full version; Fermentation Simulator with enhanced ability to model fermentations conducted with indigenous yeast; Fermentation Simulator with enhanced ability to model fermentations conducted with fruit from cool climates.

Riverina Output c4: Article related to the two versions of the simulator and its use, published in a non-peer reviewed industry journal.

The AWRI Ferment Simulator, which was developed by the AWRI Riverina node, was released during the previous year. The tool, the 'Full' and 'Lite' versions of which are available as a free downloads from the AWRI website, allows winemakers to track ferment trajectory, and accounts for conditions such as temperature, yeast, wine type, nutrient levels, agitation regime and tank size. The calculator can also be used to monitor refrigeration and electricity demand and predict problem ferment behaviour early so that corrective action can be taken. A 'what if' analysis function allows alternative fermentation management strategies to be evaluated.

During the current project, in response to feedback received from industry, the functionality of the Ferment Simulator was enhanced to accommodate indigenous yeast ferments and 'cool climate' ferments of juices with very low pH and high TA. Fermentation records were sourced from a number of collaborating wineries, particularly via the AWRI/TIA Tasmania node, and changes were made to the Ferment Simulator source codes which were shown to accurately predict the fermentation trajectories for the newly added fermentation categories.

While feedback from wineries which have used the AWRI Ferment Simulator has been overwhelmingly positive, the AWRI wishes to understand the process within wine companies which leads to such technologies being adopted, in order to remove any potential barriers to adoption. A number of initiatives were implemented, including direct survey interviews with wine producers in the Hunter Valley and Riverina; working one-on-one with targeted wine producers during vintage to gain first-hand knowledge of how the Ferment Simulator is used in a winery setting; and an online survey which was widely distributed across the industry via an AWRI *eBulletin* and the Interwinery Analysis Group. Consistent results were obtained through each survey method, and while respondents saw great value in the tool and found that it performed its intended functions well, there were three other key findings: that there was a perception amongst small wineries in particular that the tool may be overly complicated; that 60% of respondents said that they would be more likely to adopt the tool if they had attended a seminar or workshop on how to download and use it; and, wine producers of all sizes indicated that they would prefer a more user-friendly web-based interface which was compatible with mobile devices. As a result of this industry feedback, a 'Lite' version of the Ferment Simulator was developed with small wineries in mind, with a simplified user interface and basic fermentation simulation capability. In addition, a detailed Design Brief for a mobile platform App was developed, although it should be noted that funding was not available to develop the App itself. An Industry Adoption Plan was also developed, although it should be further noted that funding is not available to implement the Adoption Plan.

Workshops which provided a hands-on demonstration of both versions of the Ferment Simulator were also presented in six regions and via a webinar; and the webinar was made available for viewing on the AWRI website. The workshops were attended by a total of 89 industry personnel from approximately 60 wineries. User guides for both versions of the Ferment Simulator and a full tank farm case study were also developed, and an article describing use

of both versions of the Ferment Simulator was published in the November/December 2013 issue of *Wine and Viticulture Journal*.

Helping growers to work smarter, not harder

Hunter Output b: Content for a new workshop related to growers integrating the use of smart phones and tablets into their businesses.

Hunter Output c2: Extension of information on integrating the use of smart phones and tablets into viticultural businesses.

The AWRI Hunter Valley node addressed a regionally expressed priority of making new 'smart' technology platforms more accessible to grapegrowers, by developing and presenting a workshop titled *Working smarter not harder - making the most of your smart phone and tablet*. The workshop was developed in collaboration with a number of leading viticulturists and vineyard managers who have already incorporated the use of such technologies into the way they do business. Nine workshops were planned, organised, promoted and presented in three states, in conjunction with major wine companies, grower groups and regional associations, and were attended by 113 industry personnel. The workshop was designed to facilitate maximum audience interaction, recognising that the field is growing and changing so rapidly that few, if any individuals, can claim to know all there is to know on this subject at any point in time. Consequently, the content of the workshop has grown with the contribution made by members of each audience, with a large amount of useful information having been shared by attendees at each event.

Addressing regional winemaking issues in NSW

Hunter Output c1: Extension of information on improved winemaking practices.

The AWRI staged a series of six practical winemaking workshops through NSW and the ACT which were attended by a total of 164 wine industry personnel. The content chosen by each region varied widely, and included tasting and discussions of wines fermented with indigenous yeasts; practical understanding and management of phenolics in red wines; the avoidance of potential off-flavours from sources such as bushfire smoke and *Brettanomyces*; and tastings and discussion of 2014 vintage wines with which winemakers had experimented with novel winemaking techniques, and of wines which had not progressed as anticipated.

Tasmanian Chardonnay from stone fruit to tropical fruit: identifying flavour compounds which are of commercial importance

Tasmania Output a: Data indentifying likely target compounds responsible for stone fruit aroma in white wine.

Tasmania Output b: Data on the concentrations of 'tropical' thiols and their precursors in Tasmanian Chardonnay grapes and wines.

Tasmania Output c: Wine industry better understands precursors of stonefruit aroma and thiols in Tasmanian Chardonnay grapes and wines.

The AWRI/TIA Tasmania node was heavily involved in designing and implementing the Tasmanian investigations into stone fruit and tropical fruit characters being pursued by Investment Agreement Project 3.1.1. In the hunt for the chemical origins of 'white stone fruit' and 'peach', node staff worked with Tasmanian industry members to select a broad range of 30 wines and to stage a tasting (noting that the Activity required a tasting of 30 wines, the tasting proceeding with 29 wines, a 30th wine not arriving in time for the tasting); so as to identify wines that were either high or low in those characters. Excellent agreement was found between members of the experienced tasting panel that these two attributes were independent of each other, and wines were selected for further study based on being either high or low in one or other of the attributes, with a very small number of wines being considered high or low in both attributes.

Studies with the University of Tasmania/TIA used comprehensive multidimensional gas-chromatography mass spectrometry for the separation of closely similar compounds to compare the volatile fingerprints of high stone fruit and low stone fruit wines.

Tasmania node staff also worked with the local industry and conducted sensory assessment to identify vineyards which tend to produce wines which are high in tropical fruit characters, and worked with wine companies to ensure that juice from eight Tasmanian vineyards was processed consistently in accordance with a strict protocol and shipped refrigerated to Adelaide, to be fermented under identical conditions to the other twelve batches of juice which form part of this national study. This work formed part of a broader winemaking study conducted on a set of 20 Chardonnay grape lots sourced from cool and warm climate vineyards, from New South Wales, Victoria, Western

Australia, South Australia, in addition to the Tasmanian samples, which will allow an assessment of the relationship between thiol precursors in grapes, the concentration of free thiols in wine, and wine sensory properties.

Outcome and Conclusion

It is too early to assess or quantify the industry outcomes of this project in relation to the AWRI Fermentation Simulator and Refrigeration Demand Calculator, although several contacts with the AWRI were made by participants following the various workshops, seeking access to the presentations and to each of the tools.

Between 28 October 2013 and 30 June 2014, 956 page-views of the AWRI website section covering the Ferment Simulator homepage, login page and the download page were recorded; including 80 unique page-views of the Ferment Simulator Downloads page. The AWRI website has recently been modified so that it is now possible to track the number of downloads of the two tools, in addition to the number of page-views.

It is considered that the *Working smarter not harder - making the most of your smart phone and tablet* workshop has had an immediate positive impact on the uptake of the targeted technologies by most if not all of the industry personnel who attended the workshops, as participants almost unanimously indicated that they had found the workshops useful, and had gained new knowledge.

The work on identifying the chemical origins of 'stone fruit' in white wines, and the concentrations of tropical thiols in Chardonnay grapes and wines, has been progressed by the work performed by the Tasmania node, and through the collaboration with the University of Tasmania has allowed access to analytical techniques not available at the AWRI.

Recommendations

It is recommended that further work is conducted supporting the implementation of the Design Brief developed for an AWRI Ferment Simulator mobile platform App, as the surveys conducted strongly indicated that respondents would be more likely to use the tool with a web-based interface. It is also recommended that actions outlined in the Adoption Plan developed for the AWRI Ferment Simulator are implemented. In addition it is recommended that this brief be extended to include the AWRI Refrigeration Calculator.

The *Working smarter not harder - making the most of your smart phone and tablet* is also considered to have broad applicability across the industry, and it is recommended that its presentation to a wide industry audience in all states be continued.

Register of presentations

Hunter Output c1

Riverina Output a

Refrigeration Efficiency workshops. Target 8 in total: 5 in NSW and Canberra, 2 in Tasmania (exchanged with Victoria); at least 56 wineries represented in total, plus 1 webinar

Griffith 3 April 2014	26 attendees; 8 wineries
Mudgee 21 May 2014	5 attendees; 5 wineries
Canberra 6 June 2014	18 attendees; 15 wineries
North-east Victoria 13 June 2014	10 attendees; 9 wineries
Webinar 24 June2014	12 attendees; 12 wineries
Lower and Upper Hunter Valley 25 June 2014	10 attendees; 8 wineries
Mornington 26 June 2014	11 attendees; 7 wineries
Orange 30 June 2014	24 attendees; 16 wineries
Totals	**116 attendees 80 wineries represented**

Hunter Output c1

Extension of information on improved winemaking (workshops). Target 6 in total; 5 in NSW, 1 in Canberra

Lower Hunter Valley 13 November 2013	57 attendees
Upper Hunter Valley 21 November 2013	22 attendees
Griffith 3 April 2014	26 attendees
Mudgee 9 April 2014	17 attendees
Canberra 6 June 2014	18 attendees
Orange 30 June 2014	24 attendees
Total	**164 attendees**

Riverina Output c2

Ferment Simulator workshops. Target 6 in total, plus 1 webinar

Barossa 14 April 2014	5 attendees
McLaren Vale 15 April 2014	5 attendees
Clare 13 December 2013	40 attendees
Coonawarra 4 June 2014	6 attendees
North-east Victoria 13 June 2014	10 attendees
Webinar 26 June 2014 (AM)	12 attendees
Mornington 26 June 2014 (PM)	11 attendees
Total	**89 attendees**

Hunter Output c2

Smart phones and tablets workshop. Target up to 10 regions

McLaren Vale 15 January 2014	14 attendees
Barossa 16 January 2104	14 attendees
Hobart 20 January 2014	12 attendees
Launceston 21 January 2014	10 attendees
Griffith 4 April 2014	10 attendees
Mudgee 21 May 2014	8 attendees
Hunter Valley 27 May 2014	17 attendees
Riverland 16 June 2014	22 attendees
Orange 30 June 2014	24 attendees
Total	**131 attendees**

Publications

Muhlack, R., Scrimgeour, N., Wilkes, E., Godden, P., Johnson, D. Optimising fermentation through simulation. *Wine Vitic. J.* 28 (6): 38, 40-43; 2013.