



# Crush 2017

the grape and wine science symposium

13 and 14 November 2017

Adelaide, South Australia

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## Program and Abstracts

*\*Program subject to change*

# Program

Monday 13 November, 2017

Session 1 (Consumer, Sensory, Marketing)

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1	1:30 PM	<b>Welcome and official opening</b> Chris Ford, Crush 2017 Program Planning Committee Chair
2	1:40 PM	<b>Plenary (Keynote 1)</b> Keynote Speaker, Details to be advised
3	2:10 PM	<b><i>"I Like the Sound of That!" Wine descriptions influence consumers' expectations, liking, emotions and willingness to pay for Australian white wines</i></b> Lukas Danner, The University of Adelaide
4	2:20 PM	<b><i>Wine consumers' subjective responses to wine mouthfeel and understanding of wine body</i></b> Susan Bastian, The University of Adelaide
5	2:30 PM	<b><i>Key grape measures that predict sensory profiles of Cabernet Sauvignon wines</i></b> Jun Niimi, The University of Adelaide
6	2:40 PM	<b><i>Novel methodology for conducting wine alcohol sweetspotting trials</i></b> Duc-Truc Pham, School of AFW, The University of Adelaide
7	2:50 PM	<b><i>Using consumer perception to define New World fine wine</i></b> Marcell Kustos, The University of Adelaide
8	3:00 PM	<b><i>Using Canine Olfaction to Detect Brettanomyces</i></b> Sonja Needs, University of Melbourne
9	3:10 PM	<b><i>Probing the interactions between salivary proteins and wine tannins using surface analytical tools</i></b> Shyamsundar Muthuramalingam, Flinders University
10	3:20 PM	<b><i>Advance Australia Fair? Determining the country of origin associations for Australian wine in emerging and established markets</i></b> Roberta Crouch, The University of Adelaide
11	3:30 PM	<b>Afternoon Tea Break</b>

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# Program

Monday 13 November, 2017  
Session 2 (Winemaking & Technology)

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| 12 | 4:00 PM | <b><i>Strategies for effective sharing of research with Industry</i></b><br>Megan Hill, Department of Economic Development, Jobs, Transport and Resources   |
| 13 | 4:10 PM | <b><i>Gazing into a ferment's future</i></b><br>Tadro Abbott, The Australian Wine Research Institute  |
| 14 | 4:20 PM | <b><i>Engaging the user in app development: strategies for adoption of mobile tools in the vineyard</i></b><br>Lisa Given, Swinburne University of Technology   |
| 15 | 4:30 PM | <b><i>Taking yield forecasting into the digital age</i></b><br>Joanna Jones, Tasmanian Institute of Agriculture, University of Tasmania   |
| 16 | 4:40 PM | <b><i>Using smartphones to measure water stress in grapevines</i></b><br>Mickey Wang, South Australian Research and Development Institute (SARDI)   |
| 17 | 4:50 PM | <b><i>Developing a rapid technique to assess vine canopy nitrogen status</i></b><br>Harriet Walker, Tasmanian Institute of Agriculture, University of Tasmania  |
| 18 | 5:00 PM | <b><i>An integrated approach to achieving lower alcohol levels in wine</i></b><br>Renata Ristic, The University of Adelaide   |
| 19 | 5:10 PM | <b><i>Determination of chiral polyfunctional thiols in wine by stable isotope dilution analysis (SIDA) with chiral high performance liquid chromatography and tandem mass spectrometry (HPLC-MS/MS)</i></b><br>Liang Chen, The University of Adelaide |
| 20 | 5:20 PM | <b><i>Magnetic removal of haze-forming proteins from wines</i></b><br>Agnieszka Mierczynska-Vasilev, The Australian Wine Research Institute   |
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***Networking function (details to be advised)***

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Tuesday 14 November, 2017  
Session 3 (Viticulture)

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	9:00 AM	<b>Arrival and welcome</b>
21	9:10 AM	<b>Keynote Speaker</b> Greg Gambetta, Bordeaux Science Agro, Villenave d'Ornon, France
22	9:40 AM	<b>Managing winter drought. Effects on vine balance, wine composition and sensory traits</b> Marcos Bonada, South Australian Research and Development Institute (SARDI)
23	9:50 AM	<b>To what extent does vine balance actually drive fruit composition?</b> Everard Edwards, CSIRO Agriculture & Food
24	10:00 AM	<b>Does rootstock performance change with age?</b> Tim Pitt, South Australian Research and Development Institute (SARDI)
25	10:10 AM	<b>Active Canopy Cooling Strategies to Mitigate the Negative Effects of Heatwaves on Grapevines</b> Raquel Kallas, The University of Adelaide
26	10:20 AM	<b>Unravelling the genetics of sodium exclusion in North American Vitis species to improve grapevine rootstock breeding strategies</b> Jake Dunlevy, CSIRO Agriculture & Food
27	10:30 AM	<b>Changes to Australian winegrape day of year of maturity and viticultural climatic index values during El Niño-Southern Oscillation and Indian Ocean Dipole Events</b> Chelsea Jarvis, University of Melbourne
28	10:40 AM	<b>Using heterologous expression to functionally characterise proteins involved in sodium and chloride transport in grapevine</b> Sam Henderson, The University of Adelaide
29	10:50 AM	<b>Morning Tea</b>

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Tuesday 14 November, 2017  
Session 4 (Viticulture)

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30	11:20 AM	<b>Investigating the function of candidate genes for chloride homeostasis in grapevines</b> Yue Wu, The University of Adelaide
31	11:30 AM	<b>Practical strategies for management of grapevine trunk diseases.</b> Matthew Ayres, South Australian Research and Development Institute (SARDI)
32	11:40 AM	<b>What is the current status of fungicide resistance in Australian viticulture?</b> Suzanne McKay, South Australian Research and Development Institute (SARDI)
33	11:50 AM	<b>Hyperspectral imaging of Botrytis in Grapes</b> Bob Dambergs, The Australian Wine Research Institute

34	12:00 PM	<b>Using ATR-MIR to classify Chardonnay grapes according to GI and quality grade</b> Joanna Gambetta, Charles Sturt University
35	12:10 PM	<b>The role of rainfall and soil moisture in the susceptibility to and extent of infection by Eutypa lata in Shiraz grapevines in the Barossa Valley</b> Bruce Henderson, Agriculture, Food and Wine
36	12:20 PM	<b>Managing canopies to influence critical chemistry profiles in Sparkling Chardonnay wines</b> Fiona Kerslake, Tasmanian Institute of Agriculture, University of Tasmania
37	12:30 PM	<b>The effect of sunlight exposure on TDN development</b> Yevgeniya Grebneva, The Australian Wine Research Institute
38	12:40 PM	<b>Undervine cover cropping has yield and quality benefits</b> Chris Penfold, The University of Adelaide
39	12:50 PM	<b>Manipulation of ripening of Pinot Noir winegrapes with hormones and antitranspirants</b> Darren Fahey, NSW Department of Primary Industries
40	1:00 PM	<b>Which species of leafrollers (Lepidoptera: Tortricidae) are key insect pests in South Australian vineyards?</b> Mary Retallack, The University of Adelaide
41	1:10 PM	<b>The higher values of wine industry waste streams</b> Kieran Hirlam, The Australian Wine Research Institute
42	1:20 PM	<b>Lunch</b>
<b>Tuesday 14 November, 2017</b> <b>Session 5 (Winemaking)</b>		
43	2:10 PM	<b>Trends in Australian Winemaking Practice</b> Simon Nordestgaard, The Australian Wine Research Institute
44	2:30 PM	<b>The direct measurement of total volatile carbonyl compounds in wine.</b> Xinyi Zhang, Charles Sturt University
45	2:40 PM	<b>Airy thoughts on winemaking</b> Martin Day, The Australian Wine Research Institute
46	2:50 PM	<b>Controlling unripe characters using molecularly imprinted polymers</b> Chen Liang, The University of Adelaide
47	3:00 PM	<b>Filterability of copper sulfide in white, red and model wines</b> Nikolaos Kontoudakis, Charles Sturt University
48	3:10 PM	<b>Water into Wine – Managing wine alcohol levels with water and how it can influence wine quality</b> Olaf Schelezki, The University of Adelaide

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49 3:20 PM ***Modelling the changes in mass transfer and diffusion rates of phenolic compounds from fresh grape pomace under conditions simulating stages of red wine fermentation***  
Patrick Setford, The University of Adelaide

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50 3:30 PM ***Wild wine: metagenomic analysis of microbial communities during wine fermentation***  
Anthony Borneman, The Australian Wine Research Institute

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51 3:40 PM ***Afternoon Tea***

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**Tuesday 14 November, 2017**  
**Session 6 (Winemaking)**

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52 4:10 PM ***Cyclodextrins and their polymers as novel additives and processing aids to remove volatile phenol off-odours in wine***  
Chao Dang, The University of Adelaide

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53 4:20 PM ***Selecting robust Australian malolactic bacteria for Australian wine conditions***  
Peter Costello, The Australian Wine Research Institute

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54 4:30 PM ***Transcriptome analysis of *Saccharomyces cerevisiae* and *Torulaspota delbrueckii* during wine-like fermentation***  
Federico Tondini, The University of Adelaide

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55 4:40 PM ***Saccharomyces interspecific hybridisation enhances the capacity for phenotypic improvements in wine yeast strain development.***  
Jennifer Bellon, The Australian Wine Research Institute

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56 4:50 PM ***Novel sparkling winemaking technologies and visualising yeast autolysis***  
Gail Gnoinski, Tasmanian Institute of Agriculture, University of Tasmania

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57 5:00 PM ***The other yeast - *Lachancea thermotolerans* diversity study***  
Ana Hranilovic, The University of Adelaide

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58 5:10 PM ***Soluble Protein and Amino Acid Content Affects the Foam Quality of Sparkling Wine***  
Kate Howell, University of Melbourne

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59 5:20 PM ***Official Closing***

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***Dinner at Carrick Hill (details to be advised)***

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# Abstracts

## 1 Welcome and official opening

**Presenter:** Chris Ford, Crush 2017 Program Planning Committee Chair

## 2 Plenary (Keynote 1)

**Presenter:** Keynote Speaker, Details to be advised

## 3 “I Like the Sound of That!” Wine descriptions influence consumers’ expectations, liking, emotions and willingness to pay for Australian white wines

**Presenter:** Dr Lukas Danner, The University of Adelaide

**Co-Authors:** T.E. Johnson, R. Ristic, H.L. Meiselman, S.E.P. Bastian

This study investigated how wine description information, typically presented on wine back-labels or wine company websites, influences consumers’ expected and informed liking, wine-evoked emotions and preparedness to pay for Australian white wines. Regular white wine consumers (n = 126) valued the same three commercially available white wines (mono-varietal Chardonnay, Riesling, Sauvignon Blanc) under three information levels;

- blind (no information provided),
- basic (sensory description of the wines)
- elaborate (sensory plus high wine quality and favourable winery information) and indicated their liking, wine-evoked emotions and willingness to pay.

Results showed that information level had a significant effect on all investigated variables. The elaborate information level evoked higher expectations before tasting the wines, plus resulted in higher liking ratings, elicitation of more intense positive and less intense negative emotions, and a substantial increase in willingness to pay compared to the blind condition, with the basic condition ranging in-between. Furthermore, if the liking rating after tasting the wines matched the expected liking or exceeded the expectations slightly, participants felt the most intense positive emotions and the least intense negative emotions. This highlights not only the importance of well-written and accurate wine descriptions, but also that information can influence consumers’ wine drinking experience.

## 4 Wine consumers’ subjective responses to wine mouthfeel and understanding of wine body

**Presenter:** Dr Susan Bastian, The University of Adelaide

**Co-Authors:** J. Niimi, L. Danner, L. Li, H. Bossan

Wine mouthfeel is considered important for wine quality by experts, while consumers understanding of mouthfeel and wine body is unknown. The first experiment used a 2 astringency level × 2 body level experimental design to determine the influence of intrinsic wine mouthfeel on consumers’ wine liking and emotions. The samples were base wine (control) with; added xanthan gum (for increased body), added grape seed extract (for increased astringency), and with both added. The consumer taste trial (n=112) indicated that wine with increased body did not influence wine liking and emotions; while increased astringency decreased liking and elicited more intense negative emotions. The second experiment examined consumers’ knowledge of wine body through an online survey (n=136). Consumers described wine body most frequently using words such as “flavour”, “fullness”, and “strength”. Wine body was therefore understood by consumers predominantly as a holistic multi-sensory perception of flavour. Wine flavour was indicated by consumers to be the most important factor driving purchase decisions followed by balance of flavours and wine body. It is crucial that wine professionals carefully communicate wine characteristics to consumers to prevent possible

misunderstandings such as the meaning of wine body and as a result better meet consumer expectations.

## **5 Key grape measures that predict sensory profiles of Cabernet Sauvignon wines**

**Presenter:** Dr Jun Niimi, The University of Adelaide

**Co-Authors:** O. Tomic, D. W. Jeffery, S. E. P. Bastian, T. Næs, P. K. Boss

Grape physical and chemical variables that lead to differences in wine sensory characteristics are poorly understood. This relationship was studied in Cabernet Sauvignon across three vintages. A total of 25 grape parcels were harvested per vintage from eight grape growing regions in South Australia. Twelve different sets of metabolomic measurements (X-Blocks) were made on the grapes including basic chemistry, volatile, and non-volatile compounds. These grape parcels were vinified identically each year and the 25 resulting wines per vintage were evaluated with descriptive analysis (Y) using a trained panel (n=10). Data was analysed with partial least squares with single X blocks, followed by sequential and orthogonalised partial least squares regression on multiple X blocks. Variation by vintage was large and resulted in different grape measures being used to model the same sensory attributes in each vintage. Grape measures related to colour were consistent contributors in models every vintage, possibly because of their comparatively larger discrimination than other grape chemical measures. Colour related measurements can be considered stable and less prone to vintage variation in comparison to the other chemical measures of the Cabernet Sauvignon grapes.

## **6 Novel methodology for conducting wine alcohol sweetspotting trials**

**Presenter:** Mr Duc-Truc Pham, School of AFW, The University of Adelaide

**Co-Authors:** V. Stockdale, D. Jeffery and K. Wilkinson

Warmer weather and changes to grape ripening dynamics have contributed to higher alcohol content in wine, which may increase alcohol hotness and is therefore considered as negatively impacting on wine quality. Winemakers, seeking to correct this trend, have sought various technological innovations to produce 'reduced alcohol wines' (RAW) and develop a sensory methodology to find the optimal ethanol content for RAW, known as the alcohol sweetspot. However, it is still unclear how optimal ethanol levels for RAW can be determined and whether or not the alcohol sweetspot phenomenon and sweetspotting methodology using sensory analysis can be scientifically validated. In this study, four new methods of presenting wine samples (i.e Row-Random, Row-Order, Circle-Random, Circle-Order ) for sweetspotting sensory trials have been investigated to explore the impact of bracket presentation type. Based on statistical analysis by one proportion test, the results suggested that the Circle-Order method could be the best option for alcohol sweetspotting trials. The findings of this study provide practical information for winemakers on the most useful approach to alcohol sweetspot testing and how to analyse the data when conducting their own evaluations of alcohol corrected wines.

## **7 Using consumer perception to define New World fine wine**

**Presenter:** Mr Marcell Kustos, The University of Adelaide

**Co-Authors:** S. Goodman, S. E. P. Bastian, DW Jeffery

Fine wines are often banded together based on provenance, that is, the region where they originate. Based on provenance, Old World countries have a significant advantage over New World counterparts such as Australia. Whilst in the Old World consumers rely on provenance to predict wine quality, the New World relies on brands and price points as extrinsic indicators of quality. However, an agreed definition of fine wine is absent to date. So to further the marketing in Australia and globally, of New World fine wines of provenance produced to meet the market's needs such as matching food with fine

wine, it is necessary to first understand current consumer perceptions of what constitutes a fine wine. In 2017, an online survey was conducted in both Australia and in the USA; the latter representing one of the largest export markets for Australian wine. In total, 700 responses were obtained. This presentation will report on the consumer definition of Australian fine wine, based on sensory attributes, grape variety, wine region, label information, and food pairing, and how that definition differs as a function of consumer wine involvement across two countries.

## **8 Using Canine Olfaction to Detect Brettanomyces**

**Presenter:** Ms Sonja Needs, University of Melbourne  
**Co-Authors:** A. Lacey, C. Barnes, K. Howell

Brettanomyces Bruxellensis (Brett) spoilage is a huge costs to the industry each year. Early detection and isolation of affected barrels is crucial to stop the yeast spreading. Laboratory analysis is time consuming and costly. Unless Brett is detected early in the barrel, little can be done to remedy the wine, and it is recommended barrel use is discontinued. We posed the idea that detection dogs could be used for fast, cheap and accurate identification of Brettanomyces in the winery. This study aimed to train 3 dogs to detect Brett, with trials to investigate their accuracy and perception threshold. Dogs were trained using operant conditioning to detect phenolic components responsible for signature Brett characteristics (4-ethyl phenol, 4-ethyl guaiacol and 4 ethyl catechol). The findings affirmed that dogs are indeed able to detect Brettanomyces phenolic components, in both ethanol and wine samples. These results provide a solid case for the viability of using a team of dogs to run through a winery and cost effectively and efficiently check barrels.

## **9 Probing the interactions between salivary proteins and wine tannins using surface analytical tools**

**Presenter:** Mr Shyamsundar Muthuramalingam, Flinders University  
**Co-Authors:** P. Smith, J. Canals, N. Voelker, I. Köper

Astringency plays a crucial part in evaluating the flavour profile of the red wine. Astringency is described as drying, roughing and puckering of epithelium felt in the mouth because of interactions between polyphenolic compounds from wine and salivary proteins. The primary mechanism behind astringency is the loss of lubrication because of binding between tannins and salivary proteins. Studies on the binding mechanisms between polyphenols and salivary mucins are rare. This is surprising given the pre-eminent role of mucins in creating the viscoelasticity of saliva. Our hypothesis states, "The primary function of MG1, mucin protein is oral lubrication. When the Human whole saliva (HWS) reacts with wine polyphenols, the mucin protein forms insoluble complexes, which leads to the decrease in oral lubrication. Thus, an increased astringency will be perceived by the wine drinker". Hydrogen bonding and hydrophobic effect are the two main drivers behind the binding of wine tannin with mucin. These drivers of binding are tested in our research by varying pH and ethanol concentration of model wine respectively. Further to it, Quartz Crystal Microbalance with Dissipation experiments of HWS and its interaction with tannins in model wine highlighted the change in viscoelasticity of HWS film because of the interaction.

## **10 Advance Australia Fair? Determining the country of origin associations for Australian wine in emerging and established markets**

**Presenter:** Dr Roberta Crouch, The University of Adelaide  
**Co-Authors:**

The research presents a cross-national investigation (USA, UK, China, India, Vietnam, Indonesia and Korea) focussed on how consumer and retailer/importer perceptions of Australia and Australians influence their beliefs about Australian wine quality, buying behaviour and willingness to pay for Australian wine. Data analysis reveals that producers must leverage positive perceptions of Australia

and Australians (e.g. bold, exciting, reliable, sincere) whilst specifically avoiding the promotion of stereotypes related to the Australian landscape, flora and fauna and previous media campaigns. These attributes are found to be highly incongruent with the image of fine wine and work against improving the position of Australian fine wine in established and emerging international markets. Specifically, influencing consumers' likelihood to purchase Australian wines, the volume they purchase and the price paid.

## 11 Afternoon Tea Break

### 12 Strategies for effective sharing of research with Industry

**Presenter:** Ms Megan Hill, Department of Economic Development, Jobs, Transport and Resources

**Co-Authors:**

Who will be interested in your research outcomes, new method, tool or technology (i.e. 'innovation')? Why would they trial or purchase (i.e. 'adopt') and use it? Where will they look, and what information do they need when making a decision about something new? The 'Adoption of wine and grape R&D outputs: Who, what and why?' project posed and answered these questions using data collected from grape growers, winemakers and service providers through 81 interviews and 1066 surveys. Obviously, an innovation is not useful to everyone in industry. The key is to identify who it is useful to, and why. Climate, scale of business and 'business outlook' - whether a business is contracting, steady or expanding in size or production were found to strongly influence the research audience. Barriers to adoption depend on the perceived 'riskiness' of the innovation and the costs of adoption including staff training, problem solving and development of knowledge and skills. This talk presents the results of a comprehensive study that examined the drivers and barriers of adoption, and grape growers and winemakers need for, and use of, a range of sources of information to support their adoption of a range of research innovations.

### 13 Gazing into a ferment's future

**Presenter:** Mr Tadro Abbott, The Australian Wine Research Institute

**Co-Authors:**

The AWRI's new Ferment Simulator was released in beta in 2017 and has been through its first successful vintage. The new version brings the Ferment Simulator out of the realm of spreadsheets and into the WineCloud with a web app that allows wineries to access their ferments from any device with an internet connection. The Simulator allows the data to be collected, tracked and displayed on dashboards, as well as modelled to predict the future trajectory of the ferment. This gives winemakers an early warning of ferments that may race or become sluggish. The Ferment Simulator is free for all Australian winemakers. The session will provide an overview of the features available to winemakers and the learnings from the first vintage of operation.

### 14 Engaging the user in app development: strategies for adoption of mobile tools in the vineyard

**Presenter:** Prof Lisa Given, Swinburne University of Technology

**Co-Authors:** A. Deloire, P. Paschke

Wine scientists and industry organisations are increasingly creating mobile web applications ("apps") to support vineyard management and monitoring. While such tools are intended to improve wine industry practices, embedding user testing in the design of apps (which is standard in other industries) has not been implemented in the wine industry. User-focused design is essential for determining the need for new apps, the effectiveness of existing tools, and the need to optimise usability. This talk presents the results from an exploratory, interdisciplinary study drawing on information science theory and best practices, which examined vineyard managers' and grape growers' experiences with two apps: Fit Vine

and VitiCanopy. This study used hands-on exploration of user experience of the apps in the vineyard, to assess the usefulness of these tools from the users' perspective.

### **15 Taking yield forecasting into the digital age**

**Presenter:** Dr Joanna Jones, Tasmanian Institute of Agriculture, University of Tasmania  
**Co-Authors:** R. Dambergs, T. Rodemann & D. Close

The regulation of grapevine yield is a common goal for growers, viticulturists, winemakers, and sales teams alike, to allow for the strengthening of Australian grape and wine excellence. For this goal to become a reality, the ability to forecast yield sufficiently early in the season to allow manipulation of the growing system is essential. In addition to informing the regulation of yield, the inability to accurately forecast yield has substantial economic consequences relating to pre-harvest crop education, harvest planning, price negotiations, intake scheduling, tank space allocation, capital investment and development of marketing strategies. This study aims to develop an alternative method for estimating bud fruitfulness, without the need to destructively harvest buds and examine microscopically. Intact buds are scanned using NIR and then dissected microscopically to determine the number and size of inflorescence primordia present. The initial model shows promise for the use of NIR in yield forecasting. Presented here, PCA scores were used to discriminate between Pinot Noir and Chardonnay varieties (88% correct).

### **16 Using smartphones to measure water stress in grapevines**

**Presenter:** Mr Mickey Wang, South Australian Research and Development Institute (SARDI)  
**Co-Authors:** M.Skewes, P.Petrie, M.Whitty, S.Lam, S.Liu

Using a smartphone as a platform, develop a simple, cheap, reliable and readily available method to measure water stress levels in grapevines, to help growers to determine their irrigation strategy. We are using a phone attachable thermal camera to measure the temperature of grapevine canopies, as well as artificial wet and dry reference "leaves". The smartphone app uses this information to calculate the crop water stress index (CWSI) of the vines. CWSI gives values between zero and one, and growers can use it as a guide to manage water applications to the vineyard.

### **17 Developing a rapid technique to assess vine canopy nitrogen status**

**Presenter:** Miss Harriet Walker, Tasmanian Institute of Agriculture, University of Tasmania  
**Co-Authors:** J. Jones, N. Swarts & F. Kerslake

Nitrogen plays an important role in vine health, participating in important metabolic functions and ensuring adequate shoot development and bunch formation (AWRI 2010). Currently vine nutrient status in the vineyard is assessed using petiole sampling. Although petiole sampling can provide an accurate and instantaneous snapshot of leaf nutrient status, it is expensive and can require assistance to interpret. Therefore, a rapid and simpler nitrogen status estimating method would be of great benefit to the viticultural industry. Hand-held NDVI sensors such as the GreenSeeker, developed by Trimble, provide a rapid, non-destructive and cost-effective sensing system, which measures normalised difference vegetative index (NDVI) as an indication of plant health. Hand-held NDVI readings have previously been correlated with plant nitrogen content in field crops (Shaver et al. 2011; Tremblay et al. 2009), making its possible use in viticulture worth exploring. The following study was designed to explore an alternative method for estimating leaf nitrogen status in the vineyard by developing a calibration model using NDVI measurements obtained using the Greenseeker.

## 18 An integrated approach to achieving lower alcohol levels in wine

**Presenter:** Dr Renata Ristic, The University of Adelaide

**Co-Authors:** O. J. Schelezki, A. Hranilovic, S. Li, D.-T. Pham, D. Wollan, K. A. Bindon, D. W. Jeffery, V. Jiranek, K. L. Wilkinson

Warmer environmental conditions and/or prolonged ripening times due to winery congestion have contributed to the production of increasingly higher alcohol content wines. These wines can exhibit diminished varietal aroma and flavour characters, together with notable 'hotness' and 'overripe fruit' notes, which are considered detrimental to wine quality. Concurrently, there is increased consumer demand for lighter-bodied wine styles, and therefore, interest from industry in strategies that achieve lower wine alcohol levels, without compromising quality. Existing technologies enable the partial dealcoholisation of wine, but perceived drawbacks associated with quality and processing costs necessitate further investigation into alternative and innovative techniques, which are both economically feasible and environmentally sustainable. Research undertaken within the (ARC TC-IWP) focuses on correction of wine alcohol levels through an integrated whole-of-production-chain approach and series of complementary studies. The composition and aroma/flavour profiles of wines from trials involving:

- (i) sequential harvest and blending regimes,
- (ii) the use of *Saccharomyces* and non-*Saccharomyces* yeast strains,
- (iii) the addition of commercial wine additives (i.e. maceration enzymes, mannoproteins and tannins), and
- (iv) reverse osmosis/evaporative perstraction treatment, were studied. The potential for each of these approaches, applied either individually or in combination, to achieve lower alcohol levels in wine will be presented.

## 19 Determination of chiral polyfunctional thiols in wine by stable isotope dilution analysis (SIDA) with chiral high performance liquid chromatography and tandem mass spectrometry (HPLC-MS/MS)

**Presenter:** Mr Liang Chen, The University of Adelaide

**Co-Authors:** D. L. Capone, D. W. Jeffery

Polyfunctional thiols are potent sulfur compounds with exceedingly low sensory thresholds that result in striking effects on wine aroma. Among them, 3-sulfanyl-1-hexanol (3SH) and its acetate 3-sulfanylhexyl acetate (3SHA), both present as pairs of enantiomers with different odour thresholds and qualities, are of particular importance because of their more abundant and ubiquitous presence in a range of varieties. The reactivity and ultra-trace occurrence of these thiols in wine poses challenges for their accurate measurement, and their chiral nature means that comprehensive profiles of the enantiomers of 3SH and 3SHA in wine are limited. We have derived a novel chiral SIDA method for the determination of enantiomers of 3SH and 3SHA in wine. The method uses deuterium labelled internal standards, a polysaccharide-based chiral HPLC column, and MS/MS detection of thiol derivatives. The method was fully validated in four wine matrices and showed excellent performance. To our knowledge, this is the first SIDA based method capable of accurately determining both of these thiol enantiomers in a single run in the food and beverage field. The new method was applied to a small survey of commercial wines, thus revealing the quantitative profiles of the enantiomers of 3SH and 3SHA in wines.

## 20 Magnetic removal of haze-forming proteins from wines

**Presenter:** Dr Agnieszka Mierczynska-Vasilev, The Australian Wine Research Institute  
**Co-Authors:** P. A. Smith

Bentonite fining to remove haze-forming proteins is a key step in the production of white and rosé wines, but has some drawbacks including wine losses and waste disposal issues. In this work a novel technology for the rapid, selective, magnetic removal of pathogenesis-related proteins from wine was developed. The surface of magnetic nanoparticles was functionalised with acrylic acid plasma polymer to selectively bind and remove pathogenesis-related proteins from wine, leading to protein stabilised wine. The particles and bound proteins were then able to be removed from the wine using a magnet. The analysis showed that the acrylic acid coated magnetic nanoparticles effectively removed proteins and did not significantly change the phenolic composition of the wines, and there was no loss of wine which is a serious issue with the current bentonite based practices. This new technology may become an alternative to conventional bentonite treatment. Furthermore, such rapid separation technology for the binding and removal of proteins could benefit other areas such as diagnostics, water treatment, biotechnology and therapeutics.

## 21 Keynote Speaker

**Presenter:** Greg Gambetta, Bordeaux Science Agro, Villenave d'Ornon, France

## 22 Managing winter drought. Effects on vine balance, wine composition and sensory traits

**Presenter:** Dr Marcos Bonada, South Australian Research and Development Institute (SARDI)  
**Co-Authors:** P. Petrie, E. Edwards & M. McCarthy

Australian winegrowing regions are expected to experience a warmer and dryer winters due to climate change. In most premium regions production rely on a full soil profile at the being of spring to supply water for canopy growth and development into summer. Reduced rainfall during winter will result in a greater proportion of seasons where the vines start the season without a full soil profile. This study investigates the effects of winter rainfall exclusion and rainfall replacement options on vine balance and berry and wine quality parameters. Results from seasons 2015/16 and 2016/17 showed the negative effects of a dry soil profile in spring have on vine growth and yield. Consistently on both seasons, even when the soil water was maintained during winter using irrigation (drip or sprinkler), yield was reduced compared to the control vines exposed to natural rain. Topping up the soil profile in spring (as opposed to attempting to maintain it throughout winter) resulted in the lowest yield and excessive canopy growth, which impacted negatively in wine phenolic composition and sensory attributes. Reduced winter rain (second decile) improved wine sensory attributes but significantly reduced yield by a 40% in the first season.

## 23 To what extent does vine balance actually drive fruit composition?

**Presenter:** Dr Everard Edwards, CSIRO Agriculture & Food  
**Co-Authors:** J. Smith, A. Walker, C. Barril, A. Boettcher, D. Foster, J. Gouot. B. Holzapfel

Vine balance is a concept describing the relationship between carbon assimilation (usually estimated using a measure of vine vigour, e.g. pruning weight) and its utilisation for fruit production (usually estimated using harvest yield). It is commonly considered that composition of the berry, and resulting wine, is strongly affected by vine balance. To test this, various canopy and crop load manipulations were used to alter vine balance and replicated in three contrasting viticultural regions of Australia over three seasons. Fruit were sampled throughout maturation, until harvest, when small lot wines were made from each field replicate. The fruit samples were analysed for maturity, basic composition and the expression of key genes that regulate anthocyanin and tannin formation. Changing vine balance affected

the maturation rate, but had a less consistent effect on fruit composition. Overall, there was no conclusive evidence that the changes in vine balance achieved had a direct effect on fruit composition.

#### **24 Does rootstock performance change with age?**

**Presenter:** Mr Tim Pitt, South Australian Research and Development Institute (SARDI)

**Co-Authors:** M. Skewes, P. Nicholas, R. Stevens, M. McCarthy, P. Petrie

Rootstock selections are often based on overseas research or from field trials that were evaluated when the vines were relatively young. Australian information about the performance of rootstock/scion combinations beyond their first 10 years is scarce. This raises the question; what happens to rootstock properties as vines age beyond their first decade? SARDI has an extensive network of historic rootstock comparison trials (24+ years in age) distributed throughout South Australia's major wine producing regions. Since 2010, many of these historic trial sites have been revisited to investigate the stability of rootstock/scion performance over time. Investigations identified that yield performance of grafted vines can change with age. For example, in the Riverland, yield from 23 year old Cabernet Sauvignon on Teleki-5C, J17-48 and K51-40 declined relative to vines grafted to 101-14, 1103-Paulsen and Ramsey. Investigations also highlighted age related deterioration of salt exclusion properties for vines grafted to Teleki-5C and K51-40 relative to other rootstock genotypes and water stress investigations on mature vines showed Ramsey and 110-Richter as being more tolerant to lethal water stress than 1103 Paulsen and 140 Ruggeri. At some sites mature grafted vines out yielded those on own roots but retained equivalent juice phenolics and maturity components.

#### **25 Active Canopy Cooling Strategies to Mitigate the Negative Effects of Heatwaves on Grapevines**

**Presenter:** Ms. Raquel Kallas, The University of Adelaide

**Co-Authors:** V. Pagay

Climate models predict higher growing season temperatures and increased frequency and duration of heatwaves in premium winegrape growing regions across Australia. Strategies that promote active canopy cooling via evaporation and convection were investigated for their potential to mitigate the negative effects of heatwaves on grapevine physiology and wine quality. Two trials were conducted – an “in canopy cooling” (ICC) trial and an “under canopy cooling” (UCC) trial. Three treatments were compared to a conventional drip line control: in canopy misters (ICM), under canopy sprinklers (UCS), and supplemental irrigation (SI) on Sauvignon blanc in the Riverland region of South Australia. UCS and SI treatments significantly increased gas exchange and water use efficiency compared to the control during heatwaves. Internal canopy air temperatures were 1 – 5°C cooler than the control in UCS and SI, respectively. ICM internal canopy temperatures and leaf surface temperatures were cooler than the control by up to 4.6°C and 12.3°C, respectively. Preliminary results show that the treatments promote canopy cooling.

#### **26 Unravelling the genetics of sodium exclusion in North American Vitis species to improve grapevine rootstock breeding strategies**

**Presenter:** Dr Jake Dunlevy, CSIRO Agriculture & Food

**Co-Authors:** S. W. Henderson, D. H. Blackmore, R. R. Walker, E. J. Edwards, M. Gilliam and A. R. Walker

Initially exploited for their conferred resistance to phylloxera, rootstocks derived from wild North American Vitis species can also confer other beneficial traits including nematode resistance and increased drought and salinity tolerance. Most rootstocks used in Australia were bred in either Europe or the USA and are therefore not always ideally suited to Australian conditions. The aim of CSIRO's rootstock breeding program is to utilize marker-assisted selection to combine key traits in new rootstock genotypes specifically suited to Australian vineyards. Soil salinity is an important issue to the Australian wine industry, particularly in areas that face a diminishing and/or expensive supply of high quality irrigation water. When grown on saline soils traditional winegrape cultivars can suffer from decreased growth and yield, and reduced berry quality due to high accumulation of damaging sodium and chloride

ions. Fortunately, some rootstocks are able to limit the translocation and accumulation of these ions leading to increased salt tolerance. Here we present the identification of a QTL and underlying gene associated with the majority of variation in sodium exclusion in a complex interspecific rootstock family. The characterization and genetic nature of four unique alleles, their species of origin, and implications for breeding work will be discussed.

## **27 Changes to Australian winegrape day of year of maturity and viticultural climatic index values during El Niño-Southern Oscillation and Indian Ocean Dipole Events**

**Presenter:** Ms Chelsea Jarvis, University of Melbourne

**Co-Authors:** E. Barlow, R. Darbyshire, R. Eckard, I. Goodwin

Grapevine growth and development are intimately linked with growing season weather conditions. El Niño-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD), which can occur independently or in tandem (ENSOIOD), affect seasonal weather patterns for Australia and have the potential to influence southern hemisphere winegrape production due to the peak of these events occurring during the austral spring and summer. Grape maturity data was collected and analysed in conjunction with gridded historical climate data. Deviation from mean viticultural climatic index values during ENSOIOD and IOD events indicated that temperatures were impacted, especially maximum temperatures. The greatest deviation from mean day of grape maturity were found when La Niña and IOD positive and LN and IOD negative events occurred together. During these events, significantly dry, hot conditions or cool, wet conditions, respectively, occurred, suggesting that the IOD overrides the ENSO signal. ENSO events for all categories had the least amount of significant results.

## **28 Using heterologous expression to functionally characterise proteins involved in sodium and chloride transport in grapevine**

**Presenter:** Dr Sam Henderson, The University of Adelaide

**Co-Authors:** J. D. Dunlevy, Y. Wu, D. H. Blackmore, R. R. Walker, A. R. Walker, M. Gilliam

Genetic mapping, and comparison of whole root transcriptomes, has revealed a number of candidate genes that are likely to control sodium and chloride exclusion in grapevine rootstocks. These traits are important for grapevine salt tolerance in the field, and for producing superior wines that contain low salt concentrations. Here we present detailed functional data for proteins encoded by two candidate genes for “salt exclusion” (HKT1;1 and CCC) using heterologous expression systems. Expression of GFP-tagged proteins in tobacco (*Nicotiana benthamina*) leaves, has been used to determine the subcellular localisation of the proteins. Furthermore, expression in yeast (*Saccharomyces cerevisiae*) and *Xenopus laevis* oocytes has been used to determine the substrate specificity for both proteins. The power of heterologous expression is highlighted by the analysis of HKT1;1 allelic variants and site-directed mutants, where key amino acid residues were identified that determine the sodium transport capacity of the protein. These findings correlate with the sodium exclusion capacity of grapevine hybrids, where the presence of “faster” HKT1;1 variants in the plant genome enhances leaf sodium exclusion under saline irrigation.

## **29 Morning Tea**

## **30 Investigating the function of candidate genes for chloride homeostasis in grapevines**

**Presenter:** Ms Yue Wu, The University of Adelaide

**Co-Authors:** S.W. Henderson, R. R. Walker, A.R. Walker, M. Gilliam

Salinity is a serious challenge facing Australian viticulture and winemaking, and is caused by high [sodium] and [chloride] in soils and irrigation water. *Vitis vinifera* is moderately sensitive to salinity, especially to Cl<sup>-</sup>. Excessive Cl<sup>-</sup> reduces vine water uptake, causes plant growth inhibition, leaf burn and vine death. High Cl<sup>-</sup> concentrations in berries leads to wines with salty, soapy tastes, and wines that

exceed legal [Cl<sup>-</sup>] limits. These challenges can be minimised using rootstocks with a high Cl<sup>-</sup> exclusion capacity, but further investigations are required to uncover the genetic mechanisms controlling this process. Genes in the Nitrate/peptide-transporter-family VviNPF2.1 and VviNPF2.2, the Aluminium-activated-malate-transporter family VviALMT2 and VviALMT8, were more highly expressed in the good excluder 140-Ruggeri than in the poor excluder K51-40. VviNPF2.1, VviNPF2.2 and VviALMT2 have been identified to be plasma membrane localised and are possibly Cl<sup>-</sup> and NO<sub>3</sub><sup>-</sup> permeable. Further experiments will elucidate whether these candidate genes play critical roles in Cl<sup>-</sup>-exclusion, and may help to develop genetic markers for breeding.

### **31 Practical strategies for management of grapevine trunk diseases.**

**Presenter:** Matthew Ayres, South Australian Research and Development Institute (SARDI)  
**Co-Authors:** R. Billones-Baaijens, S. Savocchia, M. Sosnowski

Eutypa and Botryosphaeria dieback are grapevine trunk diseases (GTDs) caused by fungal pathogens that infect pruning wounds, leading to vine decline and eventual vine death. Practical strategies for management of GTDs have been developed as a result of recent research. Molecular tools were developed to detect inoculum from spore traps, showing that spore dispersal patterns vary according to climate, highlighting the influence of rain on inoculum production. Pruning wounds were shown to be highly susceptible to infection for the first two weeks, and application of fungicides to pruning wounds within 6 days of infection provided protection for up to 3 weeks. Remedial surgery controlled botryosphaeria dieback on own-rooted vines, with further work required to improve regeneration of scion material on reworked grafted vines. Cultivar susceptibility to dieback varied, with potential for tolerance identified in some germplasm, clones and rootstocks. Increased water stress generally decreased the susceptibility of canes to colonisation by trunk disease pathogens, suggesting that drought and deficit irrigation practices are not likely to contribute to the increased prevalence of grapevine trunk disease in Australian vineyards. These outcomes provide new information that is leading to adoption of improved strategies for managing trunk diseases in diverse climates of Australia.

### **32 What is the current status of fungicide resistance in Australian viticulture?**

**Presenter:** Dr Suzanne McKay, South Australian Research and Development Institute (SARDI)  
**Co-Authors:** S. Savocchia, L. Harper, F. Lopez, A. Borneman, M. Herderich and B.H. Hall

Powdery mildew, downy mildew and Botrytis bunch rot caused by Erysiphe necator, Plasmopara viticola and Botrytis cinerea respectively, are the three most important foliar diseases in Australian vineyards. These diseases result in high economic impact from management costs and reduced income. Fungicide resistant populations add to the cost due to reduced fungicide efficacy and failure of spray programs to manage disease. Several hundred isolates of E. necator, P. viticola and B. cinerea were established from samples obtained over 3 years from vineyards in the main viticultural regions of Australia. To determine the incidence and severity of fungicide resistance in Australia the isolates were tested for sensitivity to a range of commonly used fungicides. Representative isolates were genotyped for the presence of known mutations conferring resistance to specific fungicides. The incidence and severity of resistance of E. necator to Quinone outside Inhibitors (QoI) and Demethylation Inhibitors, P. viticola to QoIs and Phenylamides, and B. cinerea to five fungicide groups will be presented. The implications of the results will be discussed in terms of disease management strategies and sustainability of the Australian viticultural industry.

### **33 Hyperspectral imaging of Botrytis in Grapes**

**Presenter:** Dr Bob Dambergs, The Australian Wine Research Institute  
**Co-Authors:** P. Petrie

This study describes the use of hyperspectral imaging of grapes, over the wavelength range 400 to 1000 nm, covering visible and Near Infrared ranges. This spectral information contained in each pixel of the spectral hypercube was used to create false colour overlays to identify clean and infected grapes. This can be done with simple RGB images for white grapes but more complex spectral information is required to detect botrytis in red grapes.

### **34 Using ATR-MIR to classify Chardonnay grapes according to GI and quality grade**

**Presenter:** Ms. Joanna Gambetta, Charles Sturt University  
**Co-Authors:** D.W. Jeffery, S.E.P. Bastian, D. Cozzolino

The quality of any wine depends in part on the composition and quality of the grapes used to produce it. As such it is important to have objective methods capable of classifying grapes according to quality, and if possible, rapid methods that require little to no sample preparation. Preliminary work was undertaken to develop a rapid method using attenuated total reflection (ATR) mid-infrared (MIR) spectroscopy to classify Chardonnay grapes according to geographic origin and industry-allocated quality grade. Models were developed using partial least squares discriminant analysis of the fingerprint region of the MIR spectra (1500-800 cm<sup>-1</sup>), which were capable of correctly classifying Chardonnay grapes according to quality with a 83% and 79% success rate for the 2014 and 2016 vintages, respectively. Classification according to region of origin had an overall success rate of 83% in 2014 and 81% in 2016. Qualitative prediction models for total soluble solids and titratable acidity were also developed using partial least squares analysis and the fingerprint region of the MIR spectra. We have demonstrated the potential use of ATR-MIR as a rapid tool to classify samples according to their geographical origins and quality grades.

### **35 The role of rainfall and soil moisture in the susceptibility to and extent of infection by *Eutypa lata* in Shiraz grapevines in the Barossa Valley**

**Presenter:** Mr Bruce Henderson, Agriculture, Food and Wine  
**Co-Authors:** M. Sosnowski, M. McCarthy and E. Scott

*Eutypa dieback* caused by *Eutypa lata* is a major trunk disease of grapevines. *E. lata* has over 80 host species. Rainfall events of 2 mm are sufficient for ascospore production leading to infection of woody tissue at the surface of wounds. There is currently no cure. Colonisation of canes by *E. lata* has been reduced in vines under moisture stress. The microbiota found on pruning cuts in apricot trees have been reported to be different with exposure to or protection from rainfall. Two experiments are in progress to investigate the effects of winter drought and rainfall on susceptibility to and the rate of progress of infection by *E. lata* in grapevines. Preliminary results indicate that very low soil moisture levels over winter in the Barossa Valley may not affect either susceptibility to infection its extent of progress. Fungi were isolated from the surface of wounds exposed to or protected from rainfall following pruning. The most frequently occurring species observed have been identified. *Epicoccum nigrum* appeared more frequently on the cut surfaces exposed to rainfall, whereas *Alternaria alternata* and *Cladosporium herbarum* were found to be more common on wounds protected from rainfall. The implications of this result will be discussed.

### **36 Managing canopies to influence critical chemistry profiles in Sparkling Chardonnay wines**

**Presenter:** Dr Fiona Kerlake, Tasmanian Institute of Agriculture, University of Tasmania

**Co-Authors:** J. Jones, R. Dambergs, P. Smith, D. Close

The effect of pruning method was investigated on field-grown grapevines (*Vitis vinifera* L. cv. Chardonnay) during the 2010 growing season in southern Tasmania, Australia. Vines were cane or spur pruned by hand to 20 nodes per vine at winter pruning. Spur pruned vines had denser canopies earlier in the season, with both treatments similar at harvest time. Field replicates were made into wine replicates with 10 kg ferments to produce base wines which were tiraged and kept on lees for 5.5 years at 15 C before being disgorged and tasted by an expert panel of sparkling winemakers and analysed for spectral phenolic fingerprints, polysaccharides, proteins and volatiles. Distinct treatment related clustering was observed from wine composition analysis. Compounds relating to mouthfeel and texture were influenced by the pruning treatments applied.

### **37 The effect of sunlight exposure on TDN development**

**Presenter:** Ms. Yevgeniya Grebneva, The Australian Wine Research Institute

**Co-Authors:** J. Hixson, C. Black, M. Krstic, M. Herderich

The kerosene-like character of bottle-aged Riesling wines is due to the presence of the volatile compound 1,1,6-trimethyl-1,2-dihydronaphthalene (TDN). TDN, a carotenoid-derived metabolite, is largely absent from grape berries and juice in its free form, but arises from non-volatile glycosylated precursors during winemaking or bottle storage. Due to increasing temperatures and sunlight exposure there exists the possibility of TDN accumulating in young Riesling wines, developing aged character earlier and sometimes overwhelming the attractive floral and fruity characters. However, the conditions that cause higher concentrations of TDN in Riesling have not yet been completely defined. This study involved application of viticultural treatments including cluster-zone leaf removal, bunch shading, application of inorganic and organic sunblock products in two commercial vineyards in South Australia. It was possible to study the impact of sunlight, shade and an approximate 2 °C difference in temperature on the formation of TDN in Riesling grapes and wines. Results obtained in this study show that the concentration of total TDN altered substantially during the final stages of maturity. Furthermore, it was shown that TDN levels were significantly different between the treatments applied.

### **38 Undervine cover cropping has yield and quality benefits**

**Presenter:** Mr. Chris Penfold, The University of Adelaide

**Co-Authors:** J Howie, M. Weckert

Conventional management of the undervine zone of most vineyards involves the regular removal of vegetation with herbicides. However, for an industry which has pride in its environmental credentials, this soil management practice in the zone of the vineyard with the greatest concentration of vine roots, needs to be addressed. A Wine Australia funded trial investigating the potential of growing desirable species undervine began in 2014. Fruit yields in 2016 and 2017 from treatments with sown pasture legume species have been consistently as good or better than the herbicide controls at the Nuriootpa and Langhorne Creek sites. Sensory assessment of wine originating from the Nuriootpa site showed the herbicide control to produce the least preferred product. The projects continuation will aim to identify the soil processes involved, and the potential to provide producers with a long term sustainable management practice for this important area of the vineyard floor.

### **39 Manipulation of ripening of Pinot Noir winegrapes with hormones and antitranspirants**

**Presenter:** Mr Darren Fahey, NSW Department of Primary Industries

Co-Authors:

Due to a changing climatic conditions over recent vintages several regions have experienced a compression of harvests resulting in higher pH and lower than desirable natural acid levels due to logistics within wineries a key issue across industry. This trial will study the effect of hormones and antitranspirants to manipulate ripening of Pinot Noir winegrapes across both a cool and warm wine growing region of NSW. Hormone treatments were applied at Agronomic and berry quality data will be reported.

### **40 Which species of leafrollers (Lepidoptera: Tortricidae) are key insect pests in South Australian vineyards?**

**Presenter:** Ms Mary Retallack, The University of Adelaide

Co-Authors: D.A. MacKay, L.J. Thomson, M.A. Keller

Background and aims: Light brown apple moth (LBAM), *Epiphyas postvittana* (Lepidoptera: Tortricidae) is regarded as the key insect pest in Australian vineyards. Recent observations suggest that leafroller species other than *E. postvittana* may be causing damage in grapevines. Methods and results: A study of tortricids was undertaken in Adelaide Hills and McLaren Vale vineyards. 407 larvae of Tortricidae were collected from grapevine canopies. Molecular techniques were used to identify species. The mean prevalence of *E. postvittana* per sample was 92.3% in 2014/15 and 96.6% in 2015/16. Larval *Acropolitis rudisana* and *Merophyas divulsana* were found in the grapevine canopy for the first time at much lower densities. Conclusion: The presence of leafroller species *A. rudisana* and *M. divulsana* on grapevines indicates these species of Tortricidae may be present in a vineyard. Significance of the study: This study confirms that *E. postvittana* is the most common tortricid pest in South Australian vineyards and the importance of using molecular methods to determine the species of Tortricidae at the larval stage with confidence.

### **41 The higher values of wine industry waste streams**

**Presenter:** Mr Kieran Hirlam, The Australian Wine Research Institute

Co-Authors: J. Hixson

Currently, most waste streams from the wine industry are utilised for low value applications including land remediation, animal feed or dumped to landfill. The low value utilisation arises as most producers have few other options available as individually the significant costs of looking at high value waste transformation technologies and alternative supply chains are beyond reach. There are examples of successful waste transformation business models within the Australian Wine Industry, for example Tarac Technologies, however there remains opportunities for industry to capitalise on higher value transformation opportunities to generate additional revenue streams through supply to existing markets. There are a vast number of distinct wine industry waste streams, each being compositionally unique. Current investigations have separated the different streams into vineyard-derived and winery-derived and assessed their current uses, average compositional values, approximate quantities and potential re-use applications. Potential reuse pathways can range from the exploitation of the entire waste product (bioprocessing applications), or through isolation, extraction and/or purification of specific compound classes. Reusability of wine industry waste streams can increase the industries sustainability image, whilst additionally opening avenues for added revenue through access to higher valued markets.

### **42 Lunch**

#### 43 Trends in Australian Winemaking Practice

**Presenter:** Dr Simon Nordestgaard, The Australian Wine Research Institute

**Co-Authors:** S. Nordestgaard, G. Cowey, M. Essling, E. Wilkes

Data from a large-scale survey of Australian winemaking practices will be presented. The survey received more than 220 responses from Australian wineries of all sizes, covering more than 70% of the Australian crush. The presentation will include data on the prevalence of YAN measurements, flotation for juice clarification, yeast choices for red and white fermentations, sequential- vs. co-inoculation for malolactic fermentation, cross-flow filtration for lees reprocessing, CMC for wine cold stabilisation and other topics as time permits.

#### 44 The direct measurement of total volatile carbonyl compounds in wine.

**Presenter:** Xinyi Zhang, Charles Sturt University

**Co-Authors:** N. Kontoudakis, K. Šulkje, G. Antalick, J. Blackman, A. C. Clark

This work provides a novel method for the direct quantification of total volatile carbonyl compounds in wine. The method allows determination of the total carbonyl compound concentrations after releasing the hydrogen sulfide-bound fraction into with p-quinone treatment of wine. The total carbonyl concentration was then extracted via solid phase extraction and derivatised on the extraction cartridge. The derivatised sample extracts were analysed by gas chromatography – mass spectrometry (GC-QQQ-MS) with segmented mass transitions. The method was validated for usage in red and white wines. Compared to other methods, the method allows direct measurement of the total carbonyl concentrations rather than calculation of the approximate concentration based on hydrogen sulphite-dissociation constants and free carbonyl measurements.

#### 45 Airy thoughts on winemaking

**Presenter:** Dr Martin Day, The Australian Wine Research Institute

**Co-Authors:** A. Barker, M. Bekker, J. McRae, R. Kolouchova, S. Kassara, W. Pearson, S. Schmidt, P. A. Smith

Winemaking techniques traditionally-taught in the New World tend to exclude oxygen from most stages of the process. Oxygen, however, can be considered not only as a yeast nutrient, or a remedy to reductive sulfide aromas but more subtly to modulate style. After several years of research into both red and white wines, the importance of oxygen exposure, and particularly its timing and dose, is now being understood. From passive exposure at crushing in white grape to active aeration during fermentation of Chardonnay or Shiraz this talk will bring together how the fear of oxygen can be overcome to deliver better wines more efficiently.

#### 46 Controlling unripe characters using molecularly imprinted polymers

**Presenter:** Ms Chen Liang, The University of Adelaide

**Co-Authors:** D.W. Jeffery, D.K. Taylor

Methoxypyrazines (MPs) are known to be responsible for green characters such as vegetative and capsicum-like flavours in grapes and wines. Early harvest grapes may contain higher concentrations of MPs that lead to wines with 'unripe' characters. MPs present in grapes at harvest are largely unaffected by winemaking procedures, so methods for removing excessive MPs post-harvest are warranted. This project involves synthesis of molecularly imprinted polymers (MIPs) to specifically remove MPs from wines. The target molecules are used as templates during polymer synthesis, whereupon removal of the template liberates cavities that selectively recognise and bind target molecules. However, the specific binding is highly solvent-dependent. Different combinations of solvents, monomers and templates have

been trialled and MIPs with modest selectivity for 3-isobutyl-2-methoxypyrazine (IBMP) have been developed. Microwave synthesis was adopted as well as the conventional thermal synthesis. Furthermore, an innovation of this project involves MIPs made into magnetic forms by addition of iron-oxide nanoparticles. This will aid in separation of polymers by applying an external magnetic field.

#### **47 Filterability of copper sulfide in white, red and model wines**

**Presenter:** Dr Nikolaos Kontoudakis, Charles Sturt University

**Co-Authors:** A. Guo, M. E. Smith, G. R. Scollary, P. A. Smith, E. N. Wilkes, A. C. Clark

The presence of copper sulfide in wines is undesirable as it is a potential reservoir of hydrogen sulfide, associated with aromas of rotten egg and sewage. The filterability of copper sulfide in white, red and model wines was investigated in the present work. The in situ formed copper sulfide in model wine systems was efficiently removed by filtration through 0.45 and 0.2  $\mu\text{m}$  pore size membrane filters immediately after the preparation of the solution. For red and white wines, and surprising even for model wines with 1 %(v/v) of added white wine, the copper sulfide couldn't be efficiently removed via membrane filtration. That fact, in combination with particle size studies, showed that the removal by membrane filtration in the model wine was by adsorption rather than retention of particles greater than 0.45  $\mu\text{m}$ . It was found that wine macromolecules, such as proteins, polysaccharides and to a lesser extent red wine polyphenols, were preventing the adsorption of copper sulfide on the membrane filtration media.

#### **48 Water into Wine – Managing wine alcohol levels with water and how it can influence wine quality**

**Presenter:** Olaf Schelezki, The University of Adelaide

**Co-Authors:** K. Bindon, P. Smith, P. Boss, D. Jeffery

Regulation changes in Australia were recently adopted that allow winemakers to add water to dilute high must sugar concentrations, addressing the need for a solution to manage rising wine alcohol levels. However, the best way to achieve this while maintaining wine style and quality has barely been addressed. Our study employed comprehensive grape and wine chemical analyses and sensory assessments to understand the consequences of pre-fermentative changes in must composition on the quality of Cabernet Sauvignon and Shiraz wines under different vintage conditions. Targeting different alcohol levels, water was incorporated in two ways: a) substitution of defined proportions of run-off juice, maintaining a constant ratio of grape solids and liquid phase; b) addition of specific volumes of water and effectively diluting the must. Quality parameters such as tannin concentrations and colour measurements did not change significantly in the wines following the substitution treatments. Differences in polysaccharide and tannin composition indicated variability in extraction according to the applied volume change. Additionally, the experimental setup allows further insight into the extraction behaviour of tannins and polysaccharides, as well as in the wine volatile compositions, which could support decision making to match water additions with desired wine styles.

#### **49 Modelling the changes in mass transfer and diffusion rates of phenolic compounds from fresh grape pomace under conditions simulating stages of red wine fermentation**

**Presenter:** Mr Patrick Setford, The University of Adelaide

**Co-Authors:** D. W. Jeffery, P. R. Grbin, R. A. Muhlack

The overall quality of red wine is influenced markedly by various phenolic compounds that are extracted from grape solids during maceration. The ability to predict the extraction rates and control the concentrations of important wine quality compounds at various stages of the winemaking process would therefore be of great benefit to winemakers seeking to improve the quality or maintain the consistency of their product. The objective of this study was to determine the diffusion and mass transfer coefficients of malvidin-3-glucoside and catechin from pre-fermentative grape solids using process conditions that simulate various stages of the red winemaking process. Merlot berries harvested from the Coombe Vineyard (Urrbrae SA) were manually destemmed and pressed to remove the majority of juice. Using a 23 full factorial design, maceration was undertaken in model juice/wine solutions at different temperatures (0, 10 and 20 °C) and with varying solvent concentrations that simulate stages of fermentation. Samples collected throughout the extraction process were analysed by HPLC to quantify the concentrations of malvidin-3-glucoside and catechin and generate extraction curves. A model was generated that described the change in extraction kinetics over a range of conditions simulating that which occurs during an active ferment with continuously changing ethanol concentrations.

#### **50 Wild wine: metagenomic analysis of microbial communities during wine fermentation**

**Presenter:** Dr Anthony Borneman, The Australian Wine Research Institute

**Co-Authors:** K. Cuijvers, P. Sternes and A.R. Borneman

Wine is a complex beverage, comprising thousands of metabolites that are produced by yeasts and bacteria acting on grape must. To ensure reliable fermentation, most wines are produced by inoculating must with commercial strains of *Saccharomyces cerevisiae*. However, there is a growing trend towards the historical practice of uninoculated or 'wild' fermentations, in which only those yeasts and bacteria that are naturally associated with the grapes or winery are used. Wild ferments show a far more complex progression of microbial species than inoculated wines and differences in these resident microflora between vineyards and wineries may therefore have a key role in defining regional expression of wine characteristics. In order to map the microflora of spontaneous fermentation, metagenomic techniques are being used to monitor the progression of microbial species in large numbers of wild fermentations from across the major winemaking areas of Australia. Notable differences between regions, vineyards and wineries were apparent and these can be broadly defined by the resulting microbial composition of the wild ferments.

#### **51 Afternoon Tea**

#### **52 Cyclodextrins and their polymers as novel additives and processing aids to remove volatile phenol off-odours in wine**

**Presenter:** Mr Chao Dang, The University of Adelaide

**Co-Authors:** D. Taylor, DT. Pham.

Cyclodextrins oligosaccharides have been widely used to modify aromas, flavours, tastes and mouth-feel of food and beverage products. This is mainly due to "encapsulation" of the guest molecule by cyclodextrin's ring cavity. Volatile phenols, such as 4-ethylphenol, 4-ethylguaiacol, guaiacol, 4-vinylphenol and 4-methylphenol, can derive from spoilage microbes and smoke, and can cause off-odours in wine. Three cyclodextrins ( $\alpha$ -,  $\beta$ -, and  $\gamma$ -) and their polymers were studied to remove volatile

phenol related off-odours. Static headspace GC-MS was used to measure the retention of the volatile phenol compounds by cyclodextrins in wine. An SPME extraction method was developed to isolate the internal standards from the reacting matrix due to cyclodextrin reaction with the standards. Imprinted and non-imprinted cyclodextrin polymers were produced using toluene 2,4-diisocyanate (TDI), epichlorohydrin (EP) and chitosan (CS) as monomers to treat the permeate portion of the wine sample after reverse osmosis. Results showed that cyclodextrin additions can significantly lower the concentration of selected volatile phenols in the headspace, while bringing changes to palate characters of the wine and loss of other aromas due to encapsulation effect. Cyclodextrin polymers showed the ability to remove selected volatile phenol compounds from the permeate, with imprinted polymers showing more selectivity than non-imprinted polymers.

### **53 Selecting robust Australian malolactic bacteria for Australian wine conditions**

**Presenter:** Dr Peter Costello, The Australian Wine Research Institute

**Co-Authors:** E. Bartowsky, P. Chambers, C. Jordans, S. Schmidt

Over recent decades, developments in the control of malolactic fermentation (MLF) have been facilitated through increased knowledge of the many factors that govern MLF, and wider availability of commercial malolactic bacterial starter cultures. However, MLF can often remain problematic, particularly in difficult to harsh wine conditions. To assist in overcoming this problem, another important factor which, to date, has received little attention is the large genetic diversity that exists amongst *Oenococcus oeni*. Since such diversity will affect a range of important phenotypic traits and stress tolerances, exploration of MLF performance of genetically diverse Australian isolates of *O. oeni* would therefore be a pertinent approach to identify unique robust strains suited to Australian wine conditions. In this study, a robotic system was utilised to phenotypically profile large numbers of genetically diverse isolates of *O. oeni*, sourced from Australian wine regions, for MLF performance and tolerance to wine stress factors. Using miniaturized wine fermentations in 96-well microplates, various combinations of bacteria strain/stress factors were screened for tolerances to alcohol, low pH and low temperature in red and white test wines. Potential stress-tolerant strains were further tested for MLF performance in lab- and winery-scale trials.

### **54 Transcriptome analysis of *Saccharomyces cerevisiae* and *Torulaspota delbrueckii* during wine-like fermentation**

**Presenter:** Mr Federico Tondini, The University of Adelaide

**Co-Authors:** V. Jiranek

During spontaneous or “uninoculaed” wine fermentations, the species of microorganism that tend to be predominant towards the end of fermentation are yeast *Saccharomyces cerevisiae*. However, other microorganisms (both yeast and bacteria) have been found to be involved in the process. One example is the yeast *Torulaspota delbrueckii*. It has interesting oenological traits and has been used occasionally during winemaking together with *Saccharomyces cerevisiae*, to modulate wine sensory attributes. The mechanisms behind the physiological differences that exist between *Saccharomyces* and *Torulaspota* were investigated using Next Generation Sequencing technology and analysed by assembling RNA transcriptomes. Results highlight the genomic and transcriptional differences influencing biosynthetic pathways of flavour and aroma compounds such as esters, glycerol and acetic acid.

### **55 *Saccharomyces* interspecific hybridisation enhances the capacity for phenotypic improvements in wine yeast strain development.**

**Presenter:** Ms Jennifer Bellon, The Australian Wine Research Institute

**Co-Authors:** M. Solomon, S. Schmidt

Yeast strain development is a crucial step in providing fermentation-based food and beverage industries with robust yeast capable of facing challenging environments. Whilst *Saccharomyces cerevisiae* is the power house for many beverage industries, non-*S. cerevisiae* strains can make valuable contributions in wine production. The combination of diverse metabolites from spontaneous fermentations can deliver complexity to wine profiles. However, many non-*S. cerevisiae* species have low tolerances to high ethanol levels and fermentations can have unpredictable results. Our strategy to increase the impact of non-*S. cerevisiae* contributions in wine is to generate interspecific hybrids between a robust *S. cerevisiae* strain and a second *Saccharomyces* species (i.e. *Saccharomyces uvarum*, *Saccharomyces mikatae* and *Saccharomyces arboricola*). The hybrid strains developed have robust fermentation properties and, relative to the *S. cerevisiae* parent, produce wines with different concentrations of metabolites that are considered desirable in wine. We have used natural yeast breeding techniques to introduce targeted improvements in important, wine-relevant traits ranging from low temperature fermentation and novel flavor profiles to reduced levels of volatile acidity in high-sugar musts. In addition, *Saccharomyces* interspecific hybrids have the capacity for genetic tractability and may become an important yeast model in future research for establishing relationships between phenotype and genotype.

### **56 Novel sparkling winemaking technologies and visualising yeast autolysis**

**Presenter:** Mrs Gail Gnoinski, Tasmanian Institute of Agriculture, University of Tasmania

**Co-Authors:** F.L. Kerslake, R.G. Dambergs, S. Schmidt, D.C. Close

Sparkling wines produced by the Methode traditionnelle benefit from autolysis of yeast and lengthy ageing on lees, yet the mechanisms of autolysis are not well understood. Novel techniques to break down yeast cells and accelerate the autolytic process are being evaluated, and cell level damage using scanning electron microscopy (SEM) visualized. A sacrificial culture was prepared from commercially available wine yeast for secondary fermentation of sparkling wine. A reference sub-sample was collected as benchmark and novel technologies (enzymes, ultrasound or microwave) applied to remaining sub-samples. Effects of the technologies were visualised using SEM and show that yeast cells exhibit subtle morphological impact for enzyme treatments, cavitation features for ultrasound and elongated, pitted cell surfaces following microwave application. At six months bottle age wines showed differences for autolytic character and in sensory appraisal by sparkling winemakers, wines were judged 'more autolytic' than control wines.

### **57 The other yeast - *Lachancea thermotolerans* diversity study**

**Presenter:** Ms Ana Hranilovic, The University of Adelaide

**Co-Authors:** W. Albertin, M. Bely, I. Masneuf-Pomarede, P. Boss, P. Grbin, V. Jiranek

The yeast *Lachancea thermotolerans* (formerly *Kluyveromyces thermotolerans*) is a species with remarkable, yet underexplored, biotechnological potential. It occupies diverse ecological niches worldwide, including plant material, soil, insects, and horticultural crops, in particular grapes. In wine fermentations, *L. thermotolerans* association with *Saccharomyces cerevisiae* can lead to wine acidification, lower ethanol content and increased aromatic complexity. To gain an insight in the species' population diversity and structure, 172 *L. thermotolerans* isolates were sourced from a range of natural and anthropic habitats covering a large geographic span. These were analysed using a set of 14 microsatellite markers. The resultant clustering revealed that the evolution of *L. thermotolerans* has been shaped by the geographical localisation, anthropisation and flux between different ecosystems. Genetic proximity of isolates originating from anthropic environments, in particular grapes and wine, is suggestive of domestication events within the species. The observed clustering was further validated by

several means, including population structure analysis, F-statistics, Mantel's test and the analysis of molecular variance (AMOVA). Further support for the genetic clustering was provided via plate-based assays testing growth on several substrates and physicochemical conditions. This was followed by an in-depth phenotypical characterisation of isolates in an oenological context.

#### **58 Soluble Protein and Amino Acid Content Affects the Foam Quality of Sparkling Wine**

**Presenter:** Dr Kate Howell, University of Melbourne

**Co-Authors:** BC. Condé, E. Bouchard, JA Culbert, KL. Wilkinson, S. Fuentes

Proteins and amino acids are known to influence the foam characteristics of sparkling wines. However, it is unclear to what extent they promote foam formation and/or stability. This study investigated the effect of protein content and amino acid composition on the foaming properties of 28 sparkling white wines, made by different production methods. Foam volume and stability were determined using a robotic pourer and computer vision algorithms. Modifications were applied to the protein determination method involving the use of yeast invertase as a standard in order to improve quantification accuracy. The protein content was found to be significantly correlated to parameters representative of foam stability, as were the amino acids arginine, asparagine, histidine, and tyrosine. Additionally, the production method was found to influence the foam collar height, which favored foaming in Méthode Traditionnelle wines, over other production methods. Understanding the contributions of key wine constituents on the visual and mouthfeel parameters of sparkling wine will enable more efficient production of high quality wines.

#### **59 Official Closing**