

Crush 2023

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Presentation Abstracts

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Abstracts

Session 1

Under-vine cover cropping - findings and fallacies

Dr Thomas Lines, UA

In the management of vineyards, many growers follow long-held rules for long-held reasons. But rules are meant to be broken.

2 09:15 AM

Our recent research throughout South Australia, studying the effects of under-vine cover crops on grape vines, is demonstrating that cover cropping can be a highly productive and cost saving strategy.

Here we will pick and discuss the results from a number of recent trials, to reveal some truths, and discuss where research is lacking.

Improving wine yeast without the label: CRISPR-Cas9 production of non-GMO yeast with desirable winemaking characteristics

Mr Joseph Rossi, AWRI

Yeast are an integral part of the winemaking process and each strain will impart its own characteristics on the final product. However, not all yeast characteristics are desirable, such as excessive production of volatile acidity; while other characteristics can be difficult to achieve, such as varietal thiol production. At present, the ability to alter yeast characteristics in a way that does not result in the yeast being labelled as a GMO is limited to a few methodologies such as hybridisation, or mutagenesis and selection. While these methodologies have been successfully used in the past for the generation of commercially available industrial strains with improved winemaking properties, these techniques are also regarded as time-consuming and unpredictable. To overcome these limitations we have developed a more efficient and targeted non-GMO method for acquiring desirable traits in wine yeast using the CRISPR-Cas9 system. Through this system we were able to successfully modify yeast strains such that they either produced less VA during laboratory scale fermentations or had an improved ability to release varietal thiols. This work is an important step to efficiently develop non-GM wine yeast with a wide range of optimised, improved or oenological properties that can add value to the wine.

3 09:23 AM

The use of statistical methods to quantify the impact of climate change on grape and wine research

Mr German Puga, UA

4 09:31 AM

The aim of this presentation is to provide recommendations on how best to adapt the statistical frameworks that analyse the impact of climate change to wine-related outputs.

We focus on panel data methods, as they are usually preferred due to stronger identification properties than cross-sectional or time series methods. The first step in this type of exercise consists of estimating the impact of weather using panel data;

the second step consists of using the estimates from the first step to quantify the potential impact of climate change projections. We explain the challenges of using panel data methods to estimate the impact of weather and how to address those challenges. Further, using estimates of the (short-run) impact of weather to analyse the potential (long-run) impact of climate changes could often lead to biased estimates due to adaptation, climatic intensification, and general equilibrium effects, among other issues. We provide recommendations for addressing these issues. Last, we argue that for informing policies and adaptation strategies, statistical methods could be used together with other methods such as modern machine learning models, methods based on expert opinion, and bio-physical models.

LAMP assays for rapid detection of *Eutypa* and *Botryosphaeria dieback* pathogens

Dr Regina Baaijens, CSU

5 09:39 AM

Eutypa dieback (ED) and *Botryosphaeria dieback* (BD) are important grapevine trunk diseases causing dieback, cankers and eventually death of vines. These diseases can cause severe economic loss and have the potential to affect the wine industry if not managed effectively. Current diagnostics for ED and BD rely primarily on fungal isolations and PCR-based techniques. These methods are generally time-consuming, labour intensive or require highly skilled staff to perform the analysis. To overcome these limitations, we developed real-time loop-mediated isothermal amplification (LAMP) assays for rapid, economical and sensitive detection of ED and BD pathogens. The five species-specific and two genus-specific LAMP assays for detecting ED and BD pathogens, respectively, were highly specific and suitable for detecting and discriminating these fungal pathogens. A low cost and simple DNA extraction developed for LAMP was also found to be rapid and sensitive in detecting ED and BD pathogens from infected plant materials. These rapid DNA-based diagnostic tools, with high sensitivity, present an opportunity to diagnose and monitor infection in vineyards and nurseries in Australia. This may offer cost effective, simple and robust diagnostic tools in the diagnostic laboratories or low resource environments.

Up in smoke: The effect of barrel maturation on brandies made from smoke tainted fruit

Mr Hugh Holds, UA

6 09:47 AM

Climate change is leading to an increased risk of wildfires that pose a unique challenge to viticulture. Smoke, principally volatile phenols (VPs), can permeate the grape pericarp leading to a down-grading or rejection of fruit and a perceivable taint in resulting wines.

Notably, many whiskies are successfully produced and marketed in a "smoky" style. Distillation therefore offers the prospect of producing a saleable product from smoke-tainted grapes, whereby VPs may be considered less objectionable in a distilled wine product.

To test this, wines tainted by an Adelaide Hill's wildfire in 2020 were distilled and matured in replicate 28 L oak barrels for two years. Toasted vs charred oak

treatments were trialed and the resulting brandies profiled by GC-MS, hedonic assessment, and rate-all-that-apply (RATA) as a fast sensory method.

Results indicate that the distillation process decreases the chemical and sensory impacts of smoke taint compounds to negligible levels, while barrel maturation appears to be required to improve consumer acceptability of the distillates. This work suggests that brandies produced from smoke tainted fruit are likely to be accepted by consumers. The outcomes of this work could support valorisation of grapes that would have otherwise been wasted because of wildfire events near vineyards.

Monitoring avian diversity in vineyards using deep learning and automated acoustic recorders

Mr Callan Alexander, QUT

7 09:55 AM

Cost-effective methods for monitoring biodiversity at large spatial and temporal scales are essential to inform land managers, decision-makers, and global biodiversity accounting schemes. Monitoring potential biodiversity co-benefits for agricultural practitioners provides an opportunity to better understand and facilitate mutually beneficial outcomes. Acoustic monitoring provides an ideal framework for expanding the spatial and temporal scale of long-term biodiversity monitoring. It produces verifiable data that is less prone to bias, and allows for cost-effective, concurrent monitoring of multiple sites. Birds are an ideal indicator species for acoustic monitoring, as they are widespread, well-studied and highly vocal. However, there are significant challenges associated with using acoustic recorders for large-scale avian faunal monitoring, primarily associated with the substantial amounts of data collected. The objective of this research is to explore the application of large-scale acoustic monitoring within vineyards to quantify avian populations over time and guide land management choices. This will involve using automated data analysis methodologies with a focus on machine learning. The project will further explore the relationships between landscape factors and avian co-benefits, as well as determine the interactions between vineyard phenology and avian assemblages.

Innovative tea-flavored wine: Processing technology and mechanisms

Zijian Liang, UniMelb

8 10:03 AM

This research aimed to explore the prospects of three processing techniques (maceration, ultrasonication, PEF) in developing novel flavored wines with tea as flavoring materials, in an attempt to investigate physicochemical characteristics, volatile and phenolic profiles, functional and biological properties, and sensory attributes of resultant wines. Maceration with either green or black tea successfully modulated physicochemical properties (pH, titratable acidity, color) and phenolic profiles, increased total free phenolics and flavonoids (TPC, TFC) and free *in vitro* antioxidant (DPPH, FRAP, ABTS) activities of wine. Upon ultrasound application, the TPC, TFC, DPPH, FRAP, ABTS and volatile content of the Chardonnay wine infused with black tea were maximized under optimal conditions of ultrasound power 450.0 W and treatment time 22.6 min. Exposure to PEF allowed the green tea-infused Chardonnay wine to attain the maximum TPC, TFC, DPPH, FRAP, ABTS and volatile content under 1.3 kV/cm of electric field strength and 10 of pulse number. Catechin, caffeine and epicatechin gallate in tea-macerated wine, showed a good permeability across the Caco-2 cell. Tea-macerated Chardonnay wine displayed superior cellular antioxidant

power, cytoprotective effect, and altered the transcriptome of the cells. Prolonged bottle storage prominently modified multiple attributes of tea-macerated wine. This study potentially opens new wine markets.

Scan to learn more: A case study on enhancing wine authenticity, brand storytelling and sustainability through connected packaging

Ms Irma Dupuis, UON

9 10:11 AM

Increasingly stringent regulations and consumer demand for authenticity and sustainability have led wine producers to adopt connected packaging to provide better information about their products. However, the extent to which these technologies add value for consumers is unclear. This case study focuses on the Australian wine industry, examining the use of smart labels to understand consumer behaviour. Using Google Analytics augmented with Tag Manager, the study tracked consumer engagement with wine provenance and authenticity information after scanning smart labels, recording scrolling behaviour, time spent, and clicks. Results revealed that highly engaged consumers spent more time reading about brand storytelling, sustainability, and certifications. At the same time, first-time users tended to exit the page after viewing 40% of the information provided. This study offers insights into the potential of connected packaging and provides cost-effective methods for observing consumer interaction with smart labels. The study also offers managerial recommendations for industry professionals on utilizing data-rich technologies to improve marketing and communication for authenticity and provenance in the wine industry. Overall, this research sheds light on the emerging connected packaging category and its potential for enhancing consumer engagement and improving the visibility of sustainability practices in the wine industry.

Vineyard resting

Dr Paul Petrie, SARDI

10 10:19 AM

Grape growers and winemakers periodically encounter conditions when it is more economic not to produce a crop, or to 'rest' their vineyards, than to harvest fruit. These conditions may be due to reduced water allocations for irrigation and associated increases in growing costs or oversupply.

Methods for fruit removal to facilitate vineyard resting were trialled at two sites – Shiraz in the Riverland, SA and Chardonnay in the Riverina, NSW. Treatments included second pruning, and the application of calcium nitrate and/or ethephon. Ethephon was the most effective treatment – reducing yield to approximately 2t/ha (or 7% of the control) for the Shiraz. Three levels of irrigation were applied to better understand the interactions between crop load and potential water savings. When irrigation was reduced, vines with the crop manually removed recorded the highest stomatal conductance and lowest midday stem water potential.

Ethephon is likely to be a cost-effective option to reduce vineyard yield to close to zero, these vineyards would also have lower irrigation requirements. These techniques will likely provide alternative management options for growers that are

looking to minimise input costs when harvesting fruit is not economic. The return yield will be investigated during the 2024 vintage.

Abstracts

Session 2

Fungicide resistance in Australian vineyards

Dr Ismail Ismail, SARDAI

13 11:15 AM

The grapevine diseases powdery mildew (*Erysiphe necator*), downy mildew (*Plasmopara viticola*) and Botrytis bunch rot (*Botrytis cinerea*) are significant diseases in Australia and worldwide. Fungicides are vital tools in controlling these diseases, however fungicide resistance is an increasingly problematic issue facing the grapevine industry. All three pathogens showed varying levels of reduced sensitivity to most of the fungicide groups tested, with resistance confirmed for fungicides from gp 13 for *E.necator*, gps 9, 12 and 17 for *B. cinerea* and gps 4 and 11 for *P.viticola*. Techniques have been refined for improved monitoring of fungicide resistance with development of a mini-greenhouse system to maintain and test isolates, rotorod spore traps to monitor for resistance, an in-field qPCR detection pipeline and next generation sequencing to detect resistance mutations. For *E.necator*, there were strong relationships between phenotyping and genotyping for gp 11(Qols), but not for gp 3 (DMIs). The mutants H242R/Y (gp7,SDHI,*E.necator*) and G1105S (gp40, CAA, *P.viticola*) were not detected, but reduced sensitivity was recorded for both. Continued monitoring is crucial to managing and minimising fungicide resistance in Australia and future research aims to further develop protocols for in-field and high-throughput testing.

Polysulfides and the appearance of 'reduced' wine aromas

Ms Yu Hou, UA

14 11:23 AM

The role of polysulfides in the development of wine aromas has gained increasing attention in recent years, particularly due to their potential contribution to sulfidic off-odours in bottled wine. Reducing conditions during winemaking and post-fermentation can encourage off-flavours to develop, which can lead to consumer dissatisfaction and profit loss.

This PhD project aims to investigate the formation and breakdown of polysulfides by quantifying various species in wine and other beverages, with the goal of providing insights that can assist the industry in minimising sulfidic faults and ensuring consistent wine quality. By evaluating the conditions that contribute to the presence and degradation of polysulfides, this research can contribute to the development of effective strategies for preventing the recurrence of sulfide-related odours in bottled wine, thereby decreasing the negative economic impact and improving consumer enjoyment of wines, regardless of closure type. The project's findings may also assist industry practices and facilitate the development of remedial methods for managing the presence of polysulfides in wine, ultimately enhancing the quality and

reputation of Australian wines in the global market.

Interactions of different grapevine trunk disease (GTD) pathogens within vines

Ms Dyanah Amorio, CSU

15 11:31 AM

Recent studies in Australia utilising microbial profiling demonstrated that the pathogens associated with two significant GTDs, Botryosphaeria dieback (BD) and Petri disease (PD), were present together in individual vines, with PD pathogens being the most abundant. The incidence and impact of PD has not been comprehensively studied in Australia, although considered a serious disease in Europe. This study aims to elucidate the interactions between these GTD pathogen groups *in vitro* and *in vivo*, and to understand the mechanism behind these interactions. The *in vitro* interactions between these groups were investigated by dual inoculation and assessed for fungal growth and hyphal interactions. The formation of a dark-pigmented margin and inhibition zone between the pathogen groups occurred on artificial media. A significant reduction in the average fungal growth of the PD pathogen *Phaeoacremonium aleophilum* was observed when paired with the BD pathogen *Neofusicoccum parvum*. These obvious morphological changes *in vitro* revealed specific interactions between BD and PD pathogens, which now need to be examined *in vivo*. Investigating the interaction of GTD pathogens further will provide critical data to assist in understanding disease epidemiology, forming the basis of improved management strategies.

Broadening your winemaking yeast portfolio – looking for new fermentation superstars

Miss Natalia Caliani, UA

16 11:39 AM

Non-*Saccharomyces* yeasts are gaining worldwide interest because of their potential to improve wine quality. Currently, only a handful of commercial non-*Saccharomyces* strains are available for winemakers to choose from, and this project seeks to broaden their portfolio. Any new yeast isolate should be tolerant to the most common wine stressors, such as pH, ethanol, and sulfur dioxide (SO₂), an antimicrobial and antioxidant. Their fermentation performance and desirable secondary metabolites are also critical selection criteria.

In this study, an indigenous yeast library containing 480 single colonies isolated from the Chalmers Merbein vineyard (Victoria, Australia) was added to 200 single colonies isolated from the Yalumba Pewsey Vale vineyard (SA, Australia). They were identified using internal transcribed spacer (ITS) sequencing. Nineteen of the Chalmers isolates were chosen to assess their ethanol and SO₂ tolerance, using YPD agar spiked with increasing concentrations of both stressors. Only thirteen isolates showed some degree of tolerance. Their sugar consumption was evaluated in a chemically defined grape juice medium (CDGJM), adding twelve Pewsey Vale isolates to the screening. Lastly, their SO₂ tolerance was evaluated using CDGJM spiked with 20, 35, 50, and 65 ppm using an automated fermentation platform.

17 11:47 AM

The Impact of high temperature on root knot nematode resistance in grapevine rootstocks

Dr Harley Smith, CSIRO

Root knot nematode is a major pest of Australian viticulture, which is managed in part through the usage of root knot nematode resistant rootstocks. In tomato, experimental studies show that root knot nematode resistance mediated by *Meloidogyne incognita-1 (Mi-1)* can breakdown when soil temperatures exceed 28°C. As soil temperatures often exceed 30°C in hot wine grape growing climates, we evaluated the impact of high temperature on root knot nematode resistance in commercial rootstocks and CSIRO breeding material using glasshouse and in vitro screening systems. Results from our study show that root knot nematode resistance breaks down in a subset of commercial rootstocks at 32°C. In these resistant rootstocks, localized cell necrosis induced by root knot nematode infection at 25°C diminishes when screening was performed at 32°C. Therefore, results from our study demonstrate that breeding new rootstocks that maintain resistance at high soil temperature is an essential selection-criteria for hot conditions, as well as for a changing climate.

Novel wine microbes and their influence on wine sensory attributes

Dr Jin Zhang, UA

18 11:55 PM

The indigenous microbial population is sometimes relied upon solely by winemakers to conduct wine fermentation and can result in unique and complex wines. Modern winemaking techniques, however, often utilise pure, purposefully selected cultures, typically *Saccharomyces cerevisiae* and *Oenococcus oeni*. These are chosen for their rapid fermentation properties and reduced risk of the production of undesirable aromas, often leading to consistent wine processing and characteristics. Recently, the demand for microbes with disparate and novel capabilities has increased. As such, this project aims to identify new strains from diverse environmental sources with enhanced or novel fermentation properties. We have assembled a collection of over 500 isolates (containing >50 species of yeast and bacteria), bio-prospected from plants, insects and active fermentations and analysed each for novel capabilities. For instance, yeast strains were identified that are capable of enhancing the release of glycosylated aromatic precursors in white wines, some that can degrade acetic acid, and also some that can inhibit the growth of the common spoilage organism *Brettanomyces*. Bacterial strains better able to efficiently complete malolactic fermentation in the presence of high sulfur dioxide were also identified. Further investigation is to explore and validate strain performances in a wide array of fermentation conditions.

The genetic variability of grapevine Pinot gris virus (GPGV) in Australia

Miss Kamalpreet Kaur, AgVIC

19 12:03 PM

Grapevine Pinot gris virus was found in Australia in 2016, but the impact on the production of nursery material and fruit in Australia is unknown. This study investigated the prevalence and genetic diversity of GPGV in Australia. GPGV was detected by reverse transcription-polymerase chain reaction (RT-PCR) in a range of rootstock, table and wine grape varieties from New South Wales, South Australia, and Victoria and 473/2171 (21.8%) samples were infected. Genomes of 32 Australian GPGV isolates were sequenced and

many of the isolates shared high nucleotide homology. Phylogenetic and haplotype analyses demonstrated that there were four distinct clades amongst the 32 Australian GPGV isolates and that there were likely to have been at least five separate introductions of the virus into Australia. Recombination and haplotype analysis indicate the emergence of new GPGV strains after introduction into Australia. When compared with 168 overseas GPGV isolates, the analyses suggest that the most likely origin of Australian GPGV isolates is from Europe. There was no correlation between specific GPGV genotypes and symptoms such as leaf mottling, leaf deformation, and shoot stunting, which were observed in some vineyards, and the virus was frequently found in symptomless grapevines.

Interaction of rootstock and soil microbiome on grapevine stress response and grape metabolites in Vitis vinifera L cv. Pinot noir

Mr Yipeng Chen, UniMelb

20 12:11 PM

Rootstocks are commonly used to improve grape quality and production through management of disease and abiotic stresses. Majority of previous studies focused on Shiraz and Cabernet Sauvignon scions. There is a need to investigate the influence of rootstocks on performance of Pinot noir, which is likely different from other varieties due to scion-root interaction. This four-year PhD project investigated the impacts of 14 selected rootstocks on physiology, berry composition, wine quality, root exudate and soil microbiome of Pinot noir MV6 scion in Mornington Peninsula. This study for the first time correlated grapevine nutrients uptake with roots and leaves hormones, where petiole potassium and magnesium was positively correlated to indole-3-acetic acid and salicylic acid in leaves. Clear differences were observed in berry pH and wine aroma profile. Selected rootstock such as 3309C showed significantly lower pH and stronger fruity aroma intensity compared to own-roots. Wine phenolic composition, notably anthoxanthins and stilbenes, were different among scions grafted to different rootstocks, especially in those grafted to 3309C and C114. Rootstocks, notably Schwarzmann and Merbein 5489 affected rhizosphere microbiome, which is attributed to root exudates such as quercetin and epicatechin. The present study supports rootstock selection for quality pinot noir production in Australia.

Remediation of smoke tainted wine using molecularly imprinted polymers

Mr Yiming Huo, UA

21 12:19 PM

In recent years, vineyards around the world have been exposed to smoke from wildfires. Wines made from smoke-affected grapes often exhibit unpleasant smoky, ashy characters, due to the presence of smoke-derived volatile compounds, including volatile phenols, which can occur in both free and glycosylated forms. Strategies for remediating smoke-tainted wine typically involve the addition of adsorbent materials such as activated carbon (either directly or in combination with nanofiltration) to remove smoke taint compounds. However, these treatments can simultaneously remove wine constituents responsible for desirable aroma, flavour and colour attributes.

This study sought to evaluate molecularly imprinted polymers (MIPs) as a novel adsorbent developed specifically to target the removal of smoke-derived volatile phenols from wine. In a preliminary trial, MIP addition removed 40-50% of the volatile phenols present in a smoke-tainted Pinot Noir wine, demonstrated by gas chromatography-mass spectrometry analysis of wine before and after treatment. In a subsequent trial, smoke-tainted Chardonnay, rosé and Cabernet Sauvignon wines passed through a column packed with MIPs, and the extent of remediation was evaluated by comparing the colour, volatile phenol composition and sensory profiles of wines, before and after treatment.

A combined ultrafiltration/heat/protease treatment for protein stabilisation of white wine

Dr Eva Sui, AWRI

22 12.27 PM

Ultrafiltration (UF) was evaluated as an innovative approach for achieving white wine stabilization, providing an alternative method to the traditional removal of wine proteins via bentonite fining. Unfined Sauvignon Blanc wine (50 L) was fractionated in triplicate by UF, generating a stable permeate fraction (40 L, 80% volume) and a protein-enriched retentate fraction (10 L, 20% volume). Stabilization treatments comprising heat or heat with protease (Aspergillopepsin enzyme mixture) and/or bentonite addition were subsequently applied to retentate before treated retentate was recombined with permeate. Protein stability of recombined wine was significantly improved when retentate was heated with protease addition, with 59% of protein being removed. The quantity of bentonite required to achieve protein stability of recombined wine was therefore reduced by 72%, compared to conventional fining of wine alone. Wine quality ratings (by an expert panel) and sensory profiling (by the Rate-All-That-Apply method) revealed that the sensory properties of the wines from the combined UF/heat/protease treatment were comparable to those of conventional bentonite-fined control wine. Compositional analysis confirmed key wine aroma compounds were retained, and oxidative characters were not introduced by the combined treatments. These results are encouraging and indicate the potential for UF to facilitate novel stabilisation and fining strategies.

Abstracts

Session 3

Evaluating the risk of infection by grapevine trunk disease pathogens in spring

Dr Mark Sosnowski, SARDI

26 02:30 PM

Grapevine trunk diseases (GTDs) are caused primarily by spore infection of winter pruning wounds. Spring shoot thinning also creates wounds and is undertaken to improve airflow, increase sunlight exposure, maintain crop yield, and to reduce pruning wounds in the following winter. Hail events also occur during spring, causing severe damage to developing green shoots. Spore trapping in vineyards has detected GTD pathogens throughout spring and summer in association with rainfall. A shadehouse trial was established on Shiraz vines grown in pots. In spring, green shoots were either cut with secateurs leaving a smooth wound, or the whole shoot was torn off from the lignified cane, leaving a rough 'socket' wound. Wounds were inoculated with spores of GTD pathogens and in the following winter wounds were assessed for presence or absence of the pathogens. In addition, canes were collected from two Barossa Valley vineyards affected by a severe hail event in the previous spring, with hail damage wounds assessed for pathogens. Pathogens were recovered from 62 to 91% of inoculated shoot thinning wounds, and up to 5% of naturally infected hail damage wounds. Ongoing research will evaluate the risk of infection in the vineyard under natural conditions following shoot thinning activities.

Activated carbon fabric: A promising strategy for mitigation of smoke taint in the vineyard

Miss Tingting Shi, UA

27 02:38 PM

Activated carbon has proven to be capable of ameliorating smoke tainted wine, removing the smoke-derived volatile phenols thought to be responsible for smoky, ashy characters. 'Proof-of-concept' studies have recently demonstrated the potential for activated carbon fabric (ACF) to mitigate smoke contamination of grapes in the vineyard. Post-harvest smoke exposure of grapes yielded wine with elevated volatile phenols, however, the composition of wine made from grapes enclosed in activated carbon fabric during smoke exposure was comparable to that of control wine. Furthermore, whereas wine made with smoke-exposed grapes exhibited diminished fruit intensity and pronounced smoke characters, the sensory profiles of wines corresponding to ACF treatments could not be differentiated from that of control wine.

Applying ACF to individual bunches of grapes is clearly not feasible in commercial vineyards, therefore, field trials involving the application of activated carbon fabric to

the fruit zone of grapevines were undertaken. The (black) ACF caused premature senescence of covered leaves, but did not affect ripening. Wine chemical and sensory analysis again confirmed fruit covered by ACF was protected from smoke contamination. Several shortcomings need to be addressed before this mitigation strategy can be implemented in commercial vineyards, but results are highly promising.

Changes in Cu fractions and riboflavin concentration in white wines: Impacts of oxygen and bottle colour during short-term light exposure

Miss Isara Vongluangam, CSU

28 02:46 PM

Riboflavin is a critical initiator of photochemical reactions in wine leading to the accumulation of volatile sulfur compounds. Cu(II) organic acids (fraction I) and Cu(I) thiol species (fraction II) can repress reductive aroma, but the influence of these Cu fractions and the relative rate of change for riboflavin and Cu fractions during light exposure are unknown. Chardonnay treated with 0.5 mg/L riboflavin, 0.3 mg/L Cu and different concentrations of oxygen (10 and 0.5 mg/L) stored in Flint bottles was analysed for changes in Cu fractions (colorimetry) and riboflavin (ultrahigh-performance liquid chromatography). The wine was also investigated using other coloured bottles (Arctic blue, French green, Antique green, and Amber) at the lower oxygen concentration. Results showed in Flint bottled wine with low oxygen, light exposure decreased Cu fractions I and II at a rate faster than for riboflavin. Alternatively, high oxygen led to increases in Cu fractions I and II, but rapid loss of riboflavin. The darker bottles slowed the changes of Cu fractions and riboflavin from hours (i.e., Flint) to weeks/months (i.e., Amber). This study showed light accelerated the removal of protective Cu fractions, and wine bottle colour could influence the rate of decline to some extent.

Cumulative effects of shoot thinning on reproductive performance of Semillon

Dr Eva (Xiaoyi) Wang, UA

29 02:54 PM

Shoot thinning is often used to decrease shoot density and leaf area to maintain a balance between vegetative growth and yield. The carry-over effects of shoot thinning on reproductive performance have not been fully investigated. For three years, shoot thinning was applied to Semillon vines. Canopy architecture was captured at five key growing stages and bud fruitfulness was assessed at dormancy. Reproductive parameters were assessed in the following seasons. Results showed that the open canopy led by shoot thinning improved bud fruitfulness. The effect was further reflected on the size of inflorescence. Shoot thinning increased bunch weight due to an increase in berry number and weight. The increase in bunch weight was even greater in the succeeding season, suggesting a cumulative effect of shoot thinning. When the treatment was not adopted in the third season, residual effects on inflorescence architecture and berry number were detected on previously thinned vines while vegetative growth was not influenced. Our results indicate that the effect of canopy manipulation has a carry-over effect

in the following season when modifying the source-sink relationship. When estimating production potential growers should take the effects into consideration when deciding on appropriate vineyard management to reach desired yield goals.

Limiting magnesium availability as a potential method to control *Brettanomyces* spoilage in wine

Miss Yanina Giordano, UA

The wine industry is still struggling with spoilage caused by *Brettanomyces* yeasts. The spoilage potential of this species was further enhanced by its tolerance to SO₂. Thus, it is critical to developing new strategies to manage this spoilage yeast.

This study investigated the effect of mineral concentration on *Brettanomyces* metabolism under winemaking conditions.

30 03:02 PM

This research assessed *Brettanomyces* sensitivity to magnesium (Mg²⁺) limitation. Mg²⁺ dependence was investigated by culturing *Brettanomyces* in the presence of diminishing concentrations of Mg²⁺ in defined media.

While 1 mg/L of Mg²⁺ was shown to support the normal growth of *Brettanomyces*, concentrations below 0.5 mg/L, significantly limited the ability of *Brettanomyces* to grow, while 0.1 mg/L of Mg²⁺ was unable to support proliferation. Long-term Mg²⁺ deficiency resulted in permanent reduction to viability.

A pilot trial is underway to assess the effectiveness of electro dialysis technology in removing Mg²⁺ from wine to prevent *Brettanomyces* yeast development. Success in preventing *Brettanomyces* growth could lead to commercial-scale treatment and provide winemakers with valuable technology for managing spoilage.

Malolactic fermentation performance, diacetyl formation and sensory impacts of *Oenococcus oeni*

Dr Peter Costello, AWRI

31 03:10 PM

Despite considerable improvements in the control of malolactic fermentation (MLF), Australian winemakers still experience stuck or sluggish MLF, particularly in limiting wine conditions including white and sparkling base wines. In these cases, knowledge of factors influencing yeast and malolactic bacteria strain compatibility, such as the amount of SO₂ a yeast strain produces, become vital for successful MLF. Here, we show that the choice of co-inoculation *S. cerevisiae* strain significantly affects *O. oeni* survival, MLF performance and, additionally, sensory properties of Chardonnay at pilot-scale. In support of previous findings, bacterial survival could be uncoupled from SO₂-production by yeast, whereby alleviation of bacterial inhibition by certain SO₂-producing yeast strains correlated with early, transient formation of acetaldehyde. Furthermore, the co-inoculation yeast strain significantly influenced the concentration of diacetyl, an important flavour compound imparting buttery sensory attributes, and typically associated with lactic acid bacteria metabolism. Although diacetyl was undetected in wines co-inoculated with non-SO₂-producing yeast strains, comparatively higher concentrations (1.0-4.9 mg/L) occurred in wines co-inoculated with high-SO₂-producing yeast strains. Sensory evaluation revealed that wines co-

inoculated with high SO₂-producing yeast strains also had higher citation frequency for attributes including *butter*.

Abstracts

Session 4

All in the mouth; saliva composition, microbiome and perception of wine flavour

A/Prof Kate Howell, UniMelb

34 04:05 PM

The preferences of consumers for flavours and aromas in wine are varied and due to inherent factors such as cultural background, wine education and personal taste. Saliva composition could provide an explanation as to why wine tasters express different preferences for wine. To test this hypothesis, experienced wine tasters were asked to evaluate wine to acquire free description-based and perceived intensity data. Saliva enzymes were measured, protein composition profiling by quantitative proteomics and bacterial diversity was estimated using amplicon sequencing of 16S rRNA genes. Saliva was spiked into wine to measure the impact on the wine volatile release. The wine tasters showed differences in wine flavour perception, which was supported differences in volatile release from the addition of saliva and aligned with statistically significant variations in the concentrations of specific proteins (proline-rich proteins (PRPs) and lipocalin-1 (LCN-1)). Significant correlations between perceived intensities of wine attributes and PRPs and LCN-1 were observed. Microbial diversity varied amongst the consumers, with enrichment in flavonoid pathways seen in some participants. Our results provide a basis to understand preference for wine based on interactions between aroma compounds and salivary proteins and could be used to suggest foods or beverages to particular consumer groups.

Ultrafiltration technology for efficient winemaking

Miss Stephanie Angela, UA

35 04:13 PM

Ultrafiltration is a pressure-driven, membrane-based separation process that fractionates liquids, nominally based on size exclusion. Depending on the molecular weight cut-off specifications of the membrane, smaller molecules pass through the membrane into the 'permeate' fraction, while larger molecules are retained and concentrated in the 'retentate' fraction; albeit, feed composition, flow rate and applied pressure also influence separation outcomes. This study sought to investigate novel winemaking applications of ultrafiltration. The primary objective was to establish to what extent ultrafiltration might be used to manage phenolic compounds associated with astringency and/or bitterness in white wine. However, trials involving the addition of retentate to (i) fermenting red grape must, (ii) de-alcoholised wine, and (iii) permeate, were also undertaken, to determine the potential for retentate to enhance wine colour stability, flavour intensity and/or mouthfeel properties. Whereas colour enhancements were not apparent, likely due to the inherent effects of dilution, differences in wine flavour and mouthfeel were perceived via sensory profiling using the Rate-All-That-Apply method. Findings will enable the wine industry to make informed decisions regarding the suitability of ultrafiltration technology as an innovative approach to improving wine quality and process efficiency, and therefore profitability.

LoRaWAN soil sensors for vineyard monitoring

Mr Wen-Hsiang(Denny) Hsieh, AWRI

36 04:21 PM

One communications protocol for IoT devices in the agricultural sector that is commonly used is LoRaWAN (Long-Range Wide-Area Network). Reasons reported for this include its long range, low cost and low power use and therefore long battery life. In a recent project studying different under-vine weeding management techniques, LoRaWAN soil sensors (specifically Farm21 FS11 sensors) were utilised to monitor soil moisture.

Several challenges with the sensors were experienced, including poor signal strength and short battery life apparently due to interference from the vine canopy. Several actions were taken in an attempt to improve performance, including installation of a higher gain antenna and an additional off-grid gateway in the middle of the vineyard that was powered by a solar-battery system. Signal strength was measured under the different circumstances including at different stages of the vineyard growth cycle. A sensor using the 4G/LTE network instead of LoRaWAN was also trialled.

While the modifications made resulted in some small improvements in performance of the LoRaWAN sensors, there remained major issues that may make them unsuitable in many Australian vineyards. Sensors using their own 4G/LTE connections could be the best approach despite the added expense.

Can secateurs be contaminated by GTD pathogens from infected cane?

Mr Colin Starkey, CSU

37 04:29 PM

Grapevine trunk diseases (GTDs) such as Eutypa dieback (ED) and Botryosphaeria dieback (BD) cause significant yield reduction in Australian vineyards. The causal pathogens infect primarily through pruning wounds resulting in cankers, dieback and eventually death of vines. In recent years, the demand for organic and biodynamic wines has increased significantly. With no control strategies in place, the development of alternative plant protection strategies to manage GTDs for organic and/or biodynamic systems is essential. The contamination of pruning equipment, such as secateurs, has long thought not to be a source of spread for GTDs. In this research, the potential for contamination between inoculated canes (*Neofusicoccum luteum*) and secateurs was assessed. Preliminary results indicated that there is of the potential for contamination between canes and secateurs, with 30% of the agar plates tested positive to *N. luteum* when the contaminated secateurs were cut through the sterile agar. Therefore, it is feasible for a level of contamination to occur from contaminated vines to secateurs. Further research will be conducted to identify if contamination is spread onto clean canes and a more comprehensive study to identify other possible pathogen transference will be conducted.

The 1000 grapevine genomes project: Cataloguing Australia's grapevine germplasm

Dr Christopher Ward, AWRI

38 04:37 PM

Grapevine cultivars can be unequivocally typed by both physical differences (ampelography) and genetic tests. However due to their very similar characteristics, the identification of clones within a cultivar relies on the accurate tracing of supply

records to the point of origin. Such records are not always available or reliable, particularly for older accessions. Whole genome sequencing (WGS) provides the most highly detailed methodology for defining grapevine cultivars and more importantly, this can be extended to differentiating clones within those cultivars. The AWRI has developed a world-first clonal sequencing methodology that combines the latest next-generation genome sequencing technologies, high-performance computing and customised bioinformatics tools. This technique has been successfully used to define clonal variation across 1000 accessions of 20 different cultivars obtained from nurseries and vineyards throughout Australia.

To aid in the phylogenetic analysis and identification of intra-cultivar somatic mutations, long-read reference genomes were produced for several cultivars, including Shiraz, Grenache and Sauvignon Blanc. These reference genomes were also used to detect unique structural variations that may be important drivers of the phenotypic differences observed between these cultivars.

Do bacteriophage influence malolactic fermentation?

Miss Zhecun Xu, UA

39 04:45 PM

Many factors affecting wine fermentation, and the microorganisms involved, have been described. Reports of the impact of oenophage, the bacteriophage infecting *Oenococcus*, are rare. These viruses have been isolated from wines but their influence on winemaking is unknown. Their presence may in fact be a 'double-edged sword' for winemakers; whilst some suggest they may be a causal agent of protracted malolactic fermentation, they may also be considered an alternative to sulfur dioxide for prevention of microbial wine spoilage. Therefore, this project seeks to further understand the prevalence, biodiversity and impact of oenophage in winemaking. We detected prophage among almost all of the 100 *O. oeni* collected from Australian and Chinese wineries, their integrase/prophage-like sequences were highly homologous to published sequences, and many strains harboured multiple prophages. A preliminary analysis of phage impact on L-malic acid degradation in a defined medium has so far revealed no effect. However, this topic will be explored at greater depth, i.e. testing the effect of phage on MLF in red and white wine with a combination of stressors. These findings will highlight the impacts of bacteriophage in winemaking and guide fermentation management.

A winegrape phenology model for Australia

Dr Dane Thomas, SARDI

40 04:53 PM

Operational, tactical and strategic decisions including timing of pesticide applications to ensure withholding periods are met or managing preparations for harvest require an understanding of crop development. A phenology model describes this development using weather information. We found that winegrape models developed in other continents performed poorly in Australia. We have developed and tested a phenology model that relates local temperature observations and historical dates for development from budburst to harvest in Australia. Phenological data from southern Australia were used covering 10 varieties, although most observations are of Chardonnay, Cabernet Sauvignon and Shiraz. Our model is superior to overseas

models but is not perfect. Models performed better when the influence of both low and high temperatures on progressing grape development were limited. Models commencing on a specific day (e.g. 1st August) predict dates of budburst, flowering and veraison more accurately with an error (measured as RMSE) of roughly 5 to 10 days compared to date of harvest with an RMSE of 10 to 14 days. Similarly, models that commence on the day of an earlier EL stage (e.g. Budburst) predict flowering and veraison more accurately than harvest. Predicting the period between veraison and harvest is generally poor.

Defining the genomic heritage of salt tolerant rootstocks

Mr Andres Zhou-Tsang, UA

41 05:01 PM

Soil salinity is a widespread condition that impacts grape production and winemaking, certain rootstock varieties are proficient salt excluders and can protect grapevines against high salinity, however the available range is limited and needs to be expanded through breeding. Here we have constructed the reference genome assemblies of salt excluding rootstock varieties 140 Ruggeri and Dogridge, which documents their entire genetic information. Due to the hybrid origin of these rootstock varieties, their genomic heritage has been determined by matching these genomes to their parental species. Furthermore, a whole genome comparison was made with varieties of lesser salt exclusion capability, Richter 110 and K51-40, to outline unique genomic components in 140 Ruggeri and Dogridge in where their genetic basis of salt exclusion could be located. The genomic data generated in this study can guide marker discovery to improve future breeding designs of resilient rootstocks, not limited to salt exclusion, but applicable to any other trait of interest.

How do under vine living mulches affect nutrition, yield, and fruit quality in cool climate vineyards?

Ms Pippa French, TIA

42 05:09 PM

Under vine cover crops in vineyards can reduce management intensity, improve soil quality, and add nutrients to the soil. Nitrogen, the nutrient required by vines in the highest quantity, can be supplied by the decaying plant matter of leguminous cover crops, potentially reducing or eliminating the need for synthetic N fertiliser. However, water use by cover crops reduces water availability which can limit nutrient supply, particularly if it occurs at the beginning of the season. This study investigated the effects of two living mulch mixtures on yield, vigour and fruit quality on Chardonnay vines in Southern Tasmania. The trial was conducted on two contrasting topsoils to better understand the role of soil in mediating the effects of living mulches on vines.

Biochar in Australian vineyards

43 05:17 PM

Dr Vinay Pagay, UA

In the context of climate change, biochar is a promising material to sequester carbon in vineyards. Between 2021-2022, a field trial was conducted in Langhorne Creek, SA. Biochar was produced on-site and buried at 60 cm over which Cabernet Sauvignon grapevines were planted. Biochar was applied at the following rates (w/v basis): 0%, 3%, 5%, 10% and 20%, with and without compost. Soil and vine performance was assessed over the two seasons. Biochar with compost was found to be beneficial to the soil and vegetation at nearly every level, but potentially detrimental at high levels (20%). Soil moisture infiltration increased with the addition of biochar and compost. Microbial diversity was enhanced under the biochar and compost treatments, and was greater in the char layer than the surface layer. Biochar also improved vine water status and intrinsic water use efficiency. Intermediate levels of char (10%) stimulated the most growth of undervine vegetation compared to the other groups, whereas the 20%-compost resulted in low vegetation biomass. Together, our results suggest that, for enhanced vine performance, biochar should be applied in the range of 5-10% (w/v) and in conjunction with compost to maintain a constant C/N ratio in the soil.

Crush 2023 is supported and coordinated by contribution from the following:

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