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Australian Grape and Wine Authority

# ASEV and Viticultural Research Collaboration



## TRAVEL REPORT to

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# ASEV and Viticultural Research Collaboration

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## 1. Abstract

This travel report details outputs from attendance at the 65th Amercian Society of Enology and Viticulture (ASEV) National Conference and 39th ASEV Eastern Section Annual meeting, held at Austin, Texas, from 23 to 27 June 2014. In addition to attending and giving a presentation (Walker et al. 2014) at the annual meeting, two symposia were attended. They were the 'Water Use Efficiency' Symposium and 'Winemaking for Challenging Environments Symposium'. An overview of each Symposium program is presented in this report, plus highlights of selected presentations from the main conference program.

Attendance at the meeting enabled networking with leading grape and wine rersearchers from the US and other countries. This included discussions with collaborators at UC Davis enabling existing collaborations to be progressed and new collaborations to be discussed.

## 2. Executive Summary

The annual ASEV meeting provides an opportunity to hear the latest research presentations on a wide range of topics in grape and wine science and the opportunity to network with leaders in this field. Two Symposia of high relevance to the Australian industry ('Water use Efficiency' and 'Winemaking for Challenging Environments') are included in the program. Water use efficiency is a major R&D goal in Australia where irrigated vineyards comprise over 90% of the total vineyard area and where water supplies may come under pressure, especially in times of drought. Salinity is also a concern in some production regions. Generally, these are the regions where the only water available for irrigation purposes is saline and often in limited quantity. Such situations require careful management to avoid build-up of salt levels in soil to unsustainable levels and the associated negative impacts on soil structure and water permeability.

From the plant perspective, much effort is being directed in Australia to identifying rootstocks with improved water use efficiency, drought tolerance and salt tolerance. The US rootstock breeding program at the University of California, Davis, led by

Professor Andy Walker, has similar interests and discussions were held to share information on research strategies and outcomes. Knowledge gained at the Symposium and Meeting will be beneficial in helping to develop strategies for improved management of scarce water supplies. The meeting also provided an opportunity to meet with a range of leading US researchers and invited international keynote speakers in grape and wine research and to share results and ideas. Existing collaborations were enhanced and new collaborations were discussed.

While there were many highlights from the meeting, some notable ones were hearing about the development of grapevine types with resistance to Pierce's disease, the development of a new microtensiometer for continuous monitoring of soil and plant water potentials and opportunities for application of the device in both R&D and commercial settings. Presenters also outlined exciting applications of neutron radiography, micro computed tomography and magnetic resonance imaging for studies of embolism and xylem vessel repair, and the application of a Satellite Irrigation Management Support (SIMS) in irrigation scheduling and management.

**3. Planned Outputs**

**A** Attend ASEV Meeting and Symposia.

**B** Meetings and discussions with Professor Andy Walker, Professor David Smart, Dr Kevin Fort, Professor Markus Keller, Professor Larry Williams, Dr Matthew Fidelibus, Dr Peter Cousins and Dr Nick Dokoozlian.

**C** Report written and submitted.

## 4. Report Against Outputs

### *4.1 Attend ASEV Meeting and Symposia*

The meeting including a familiarization tour of the Texas high plains wine region. Elevation of the region is around 3,000 to 4,100 feet above sea level. The environment includes long hot dry summer days, allowing the grapes to mature and ripen to desired sugar levels and cool evenings which assist to achieve desired acid levels. Currently there are over 4,000 planted acres. Climate can be variable, with some extended dry periods, hence most vineyards are irrigated with aquifer water. Grapes and wine have been produced in the region since the mid 1970's.

There is strong pest and disease pressure in the region, including Pierce's disease (*Xylella fastidiosa*) and cotton root rot (*Phymatotrichopsis omnivora*). Ozone sprays have been used to counter canopy-based pest and disease pressure and an ozone sprayer was demonstrated. The technology is called AgiOzein and was developed by Ernie Wilmink at Flat Creek Estate Winery.

### *4.2 Water Use Efficiency Symposium*

The Symposium Program included the following presentations:

*Salinity management in vineyards*
Donald Suarez
United States Department of Agriculture - Agricultural Research Service Salinity Laboratory, Riverside, California.

Dr Suarez noted that most guidelines for leaching recommendations consider average rootzone salinity, yet plants do not take up water uniformly with depth. He further noted that salt tolerance information is generally developed under conditions of uniform salinity, yet a more realistic consideration when evaluating field conditions is to calculate water uptake weighted salinity, with uptake greater near the surface, in proportion to the root distribution. This results in lower soil salinity values and lower

leaching requirements, especially when leaching fractions are relatively low. These root-weighted calculations are less likely to overestimate (a) crop water loss, (b) the need for leaching, and (c) yield loss.

*Use of reclaimed water for vineyard irrigation*
Michael McCarthy
South Australian Research and Development Institute, Australia

Dr McCarthy noted that for the Australian wine industry, the two most significant sources of recycled water are treated domestic water and winery wastewater. He also noted that environmental regulators require assurance that recycled water used in vineyards does not result in deleterious off-site impacts through surface run-off or accession to groundwater.

An example was presented of the use of recycled domestic waste water for vineyard irrigation purposes in the Mclaren Vale region, where approximately 5.4 GL of recycled water is supplied annually. A case study was presented that involved a Shiraz vineyard. It demonstrated no significant changes in vine growth, yield or nutrient status with the quality and volume of reclaimed water applied. Also, the study found that the concentrations of minor and major elements in wines made from the vines were similar to that of wines from vines irrigated with high quality water.

*Vineyard management with limited water*
Mark Battany
University of California Cooperative Extension, San Luis Obispo.

Dr Battany discussed ways to reduce water evaporation from vineyard soil. These include shallow tillage of the soil surface, which can reduce the rate of water conduction to the surface. The presentation noted that the proportion of irrigation water lost to soil water evaporation is high for newly planted vineyards, where frequent shallow irrigations generally occur. Drip irrigated vineyards on soils with poor infiltration can also have high evaporation losses. The presentation further noted that sub-surface drip can minimize evaporation losses. ‘Watering stakes’ present an alternative salinity management scenario, where a ‘spagetti’ (narrow

diameter poly) line connected to the main drip line directs irrigation water to a deeper depth in the soil. Dr Battany also noted the effectiveness of surface mulches. These include plastic and fabric films and organic mulches.

Dr Battany also discussed cover crops which provide a range of benefits to soil health, but also can transpire large amounts of water, which can be a negative and also a positive, for example, as a vine vigour control strategy. It was noted also that the timing of cover crop termination is important for maximizing soil storage of winter rainfall.

Finally, Dr Battany discussed a range of measurement tools available to growers to help them apply the right amount of irrigation.

*Drought and salinity tolerance in rootstocks*
Andrew Walker
University of California, Davis.

Dr Walker summarized some of the key characteristics of American Vitis species. For example, Riparia based rootstocks generally have shallow roots, are water sensitive, have low vigour and early maturity (Teleki 5C, 101-14, 16161C), whereas Rupestris based rootstocks have broadly distributed roots, are relatively drought tolerant, and have moderate to high vigor and mid season maturity (St. George, 1103 Paulsen, AXR#1). He further noted that Berlandieri based rootstocks have deeper roots, are drought tolerant, have higher vigor and delayed maturity (110 Richter, 140 Ruggeri, 420A and Kober 5BB).

Dr Walker's team have also been assessing rooting angles as a measure of drought tolerance. Rhizotrons have been used to monitor root development over time. Commercial rootstocks have been shown to perform to expectation with the root angle assay and the assay is now being used to assess hybrids from breeding.

Dr Walker has also characterized different types salt exclusion patterns for rootstock species, for example, *Vitis rupestris* and *Vitis berlandieri* have low leaf salt concentrations but high root salt concentrations*, Vitis girdiana* exhibits a double

exclusion phenotype with both leaves and roots having low salt concentrations, *Vitis vinifera* is generally the opposite with high leaf and root salt concentrations, *Vitis champini* is intermediate with leaves having moderate salt concentrations and roots with high concentrations, while a *Vitis rupestris type* is described as a hyper-accumulator with very high leaf salt accumulation and low root accumulation. It was noted that *Vitis doaniana* is also potentially a double excluder.

*Improving water use efficiency in grapevines: Agronomic and genetic opportunities*
Hipolito Medrano
University of the Balearic Islands, Spain.

Dr Medrano noted that for every 125 ml glass of wine 120 litres of water was used mostly to produce the fruit in the vineyard, and noted that the water footprint issue is an inconvenient label for the wine industry. Dr Medrano discussed ways to improve water use efficiency covering (1) agronomic methods and (2) genetic and biotechnological methods. Significant variation in measures of water use efficiency was noted between grapevine varieties. Regarding the latter, improving carbon dioxide diffusion through mesophyll and engineering Rubisco (a key enzyme involved in the photosynthetic process) were possibilities.

*Role of xylem structure and function in water relations*
Andrew McElrone
University of California, Davis.

Dr McElrone outlined a range of technologies such as neutron radiography, magnetic resonance imaging and micro computed tomography for studying the efficiency of xylem transport, cavitation and embolism repair. The studies included comparisons between *V. riparia* and *V. champinii* with regard to repair of embolised vessels, with greater repair observed in *V. riparia*. The studies also included xylem function in berries around veraison, where reduced conductivity was observed post veraison.

*A microtensiometer for continuous monitoring of soil and plant water potentials*
Alan Lakso and Vinay Pagay
Cornell University, New York and Oregon State University, Corvallis.

Dr Lakso and Dr Pagay outlined that stem water potential is probably the best integrator of water stress within the vine under varying conditions, and the need to be able to continuously monitor the water potential in the trunk of the vine. They have developed and tested a microtensiometer that has the same basic principle as a soil tensiometer that is able to continuously monitor water potential in soils and plants. The microtensimeters have been shown to operate accurately and stably to water potential tensions of -200 bars, which is a 100 fold increase over current tensiometers. Dr Lakso and Dr Pagay also noted while developments so far are very promising, further development work is required, and that it may up to two years before commercial release.

*Irrigation scheduling in eastern North America*
Andy Reynolds
Brock University, Canada

This presentation covered all aspects of irrigation scheduling including the Penman-Monteith equation, use of crop coefficients, accounting for rainfall, dripper spacing and time of irrigation, soil water storage capacity and calculation of irrigation timing (interval between irrigations). Irrigation efficiency was discussed in relation to soil moisture, water relations, berry composition and sensory impact. Dr Reynolds also noted that Partial rootzone drying has been examined and found to be efficacious in dry seasons.

*Learning from research and adapting technology towards efficient vineyard water management*
Mark Greenspan
Advanced Viticulture, California.

Dr Greenspan provided a detailed overview of soil based irrigation scheduling which is used to determine how much water should be applied and when it should be applied. He also outlined how plant based sensors are crucially important for providing feedback to adjust the irrigation schedule, i.e. the interval between irrigations. Some case studies were presented to demonstrate the key points.

### *4.3 Winemaking for Challenging Environments Symposium*

*Premise for Challenging Environments*
Sara Spayd
North Carolina State University, Raleigh

Challenging climates were described as hot, cold or warm at the wrong time, cool at the wrong time and too little precipitation or available water at the wrong time in the annual grapevine cycle, and in particular during phenological pathway from bud initiation, through flowering, fruit set, veraison to berry ripening . Dr Spayd noted that the issue is generally how to make the best of a challenging situation, what steps to take to improve must and wine quality in the winery, for example, managing green flavours, phenols, acid-pH balance, and variety development for challenging climates, involving fruit/wine quality and cold hardiness, including for Pierces disease.

*Dealing with environmental challenges in the vineyard: Delivering the best product to the winemaker*
Ed Hellman
Texas A&M AgriLife Extension and Texas Tech University, Lubbock

Dr Hellman expanded on the challenges summarizing them as insufficient or excessive sunlight, insufficient or excessive water, insufficient or excessive heat, cold weather including dormant freeze, spring frost or fall frost, and also including water quality challenges, excessive wind, humidity hail and herbicide drift. For each type of challenge, management options such as site selection, vineyard design and within-season practices were discussed as ways to counter the challenge. Dr Hellman noted the importance of adjusting the degree of implementation depending on the specific circumstance.

*Snake oil or Alchemy-techniques to salvage a vintage in the winery*
Misha Kwasniewski
University of Missouri, Columbia

Compositional challenges were observed to include managing excessive pH, loss of acids, excessive soluble solids (sugar), off aromas, including unwanted varietal characters, colour bleaching, must nutrition, diseased fruit, and wine stability. Dr Kwasniewski further noted a range of biological challenges that include managing unwanted microbes and managing the desired microbes. Some potential interventions were outlined, such as mechanical, including thermovinification and flash cooling, or chemical such as enzymatic treatments or additives (nutrients, tannins, fining agents, filtering aids and mannoproteins). These and other processes such as addition of esters, oak treatment and blending options were discussed in detail.

*Origin of green flavours in wine and their management*
Justin Scheiner
Texas A&M AgriLife Extension, College Station

Dr Schneiner noted that green, herbaceous flavours are undesirable in most wines. Methoxypyrazines are the main contributor of green flavour in wine. Other sources of green flavours include the green leaf volatiles and certain thiols associated with Sauvignon Blanc. He further noted that methoxypyrazines are mostly associated with certain Bordeaux varieties, such as Cabernet Sauvignon, Merlot, Cabernet Franc, Carmenare, Sauvignon Blanc and also Semillon. The methoxypyrazines in wines were noted to derive from grapes, with 95% from skin, 4% from seeds and <1% from pulp. The presentation outlined interventions that include fining (bentonite / charcoal), thermovinification, Tetra Paks, odourant binding proteins, flash extraction and silicone fining. Potential vineyard interventions were noted to include leaf removal treatments, pre-veraison, to reduce cluster shading, which is known to be associated with higher concentrations. Dr Schneiner further highlighted that green leaf volatiles are responsible for crushed grass and fresh cut grass aroma and that Sauvignon Blanc may have higher concentrations than other varieties. In addition, he also noted that concentrations decrease with grape maturity and during fermentation.

*Managing acidity and pH in wine*

Roger Boulton
University of California, Davis.

Dr Boulton outlined the acids of juices and wines, the main ones being tartaric acid, described as the stable backbone of juice and wine acidity, with stability depending on solubility of its salts, and malic acid, which can be degraded to lactic acid in malolactic fermentation, and forms soluble salts. He then defined pH, titratable acidity and the concept of potassium-proton swapping by plasma membrane ATPase, including the inter-relationship between potassium content and pH. Three situations of possible unusual TA and pH values in challenging environments were considered. First was high TA (>8 g/L) and low pH (pH <3.3), generally associated with high tartaric and malic acid and low potassium to tartaric plus malic acid ratio. He outlined that deacidification in this case is with the calcium carbonate double salt method. Second was low acid (TA<6 g/L) and high pH (pH >3.8), generally associated with low tartaric acid and malic acid and high potassium to tartaric plus malic acid ratio. He noted that in this case, tartaric acid is added to increase TA, and that this results in dissociation to release $H^+$, and later, precipitation of potassium hydrogen tartarate. Third was high acid (TA>10 g/L) and high pH (ph>3.8), generally associated with high tartaric and malic acid and high potassium to tartaric plus malic acid ratio. Dr Boulton pointed out that in this case, more extensive deacidification with calcium carbonate is done to lower the titratable acidity and malic acid concentration, followed by addition of tartaric acid and encouragement of potassium hydrogen tartarate precipitation during and after fermentation.

*Malolactic fermentation under low pH conditions*

Thomas Henick-Kling
Washington State University, Richland

Dr Henick Kling noted that malolactic acid fermentation is an important tool to develop the desired, ripe flavor characteristics in wine and to balance and integrate the acididty into the wine texture. He outlined advantages such as enhancement of ripe fruit flavours by release of aroma compounds from their glucose linked form, and from compounds contributed from lactic acid bacteria metabolism that positively

contribute to desired flavours. Of the challenges, he noted that high acidity and low pH in under-ripe grapes and also that grapes with a high microbial load made it difficult to conduct malolactic fermentation. He further outlined some of the winemaking tools to assist successful malolactic fermentations.

*Colour and Phenolic issues*
Anna Katherine Mansfield
Cornell University, New York

Dr Mansfield noted that colour and tannin structure are arguably the most important quality indicators of red wines, and that deficiencies can occur in in cool and cold climate growing regions. She further noted that monomeric anthocyanins, important for colour stability and density, and influenced by a range of factors including cultivar, and polymeric proanthocyanidins (condensed tannins) that affect mouthfeel, aging capacity and perceived wine structure, are thought to contribute to colour stability by combining to form polymeric pigments. Methods used to ameliorate deficiencies in colour and tannin structure were discussed, including cold soak, extended maceration and additions of enzymes or enological tannins.

*New possibilities: Hope for Pierce's disease regions?*
Andrew Walker
University of California, Davis

Dr Walker outlined breeding of grape varieties resistant to Pierce's disease (PD) as one of a number of methods to control the disease. His group established that *V. arizonica/candicans* b43-17 has single gene resistance to PD and that it is homozygous and that all progeny from crosses to b43-17 are resistant. A marker for *PdR1* has been used to select resistant types from an extensive breeding program that has involved crosses with 8 vinifera parents. He noted that there are currently 13 PD resistant wine grape selections and three PD resistant rootstocks at FPS. Field testing, including winemaking is being conducted. Dr Walker outlined that the next phase of the program will be to characterize, map and stack new resistance sources. He noted also that physical mapping of PdR1 has identified 5 candidate resistance gene (s).

### *4.4 Main Conference Presentations*

Main conference presentations covered a wide range of disciplines. Just a small number are highlighted covering work on salt and drought tolerance in rootstocks, responses to deficit irrigation, irrigation scheduling, grape ripening and composition.

*Kevin Fort, Andy Walker, Joaquin Fraga and Daniele Grossi (UC Davis)* presentated a paper on 'Rapid recovery from drought stress in deeply rooted *Vitis* rootstocks'. The involved a comparison between two deep-rooted rootstocks, 110 Richter and Ramsey with two shallow-rooted more fibrous rootstocks, 101-14 and Riparia Gloire. The deep rooted rootstocks had more new root growth and faster recovery of stomatal conductance after rewatering.

*Cecilia Osorio and Andy Walker (UC Davis)* reported on a study that examined anatomical and morphological features to study the drought tolerance mechanisms utilized by seven grape rootstocks. The study involved three drought tolerant rootstocks (Ramsey, 140 Ruggeri and 110 Richter) and four drought susceptible rootstocks (101-14, 5C, 420A and Riparia Gloire). They found that the drought tolerant rootstocks had significantly deeper rooting angles and higher root biomass than the drought susceptible cultivars under well watered conditions. The presentation also reported that drought tolerant cultivars maintained similar root biomass under well-watered and drought conditions, whereas drought susceptible cultivars significantly increased root biomass when stressed. It was further found that drought tolerant cultivars produced a greater number of vessels with smaller diameters when exposed to drought.

*Mark Matthews (UC Davis)* presentated an alternative definition for the end of berry ripening. His study found that late onset of cell death in berry mesocarp begins approximately 110 days after anthesis. He was able to develop a model of xylem flux, phloem flux and total sugar per berry from analyses of berry growth, water relations and total soluble solids. He outlined that for Cabernet Sauvignon, the model indicated that sugar accumulation ceases approximately 110 days after flowering and that phloem influx ceases soon after.

*Jim Harbertson, Richard Larsen and Maria Mireles (Washington State University)* produced wines with ethanol concentrations between 11.8 and 16.2 % (v/v) ethanol, and found that only wines with 16.2% (v/v) ethanol had a significant impact on tannin extraction from seeds. The study also found that wines made from over ripe fruit had significantly greater wine tannins than wines made from other harvests.

*Daniel Pap, Summaira Riaz, Alan Tensher and Rong Hu (UC Davis*) found that major powdery mildew disease resistance loci in the wild Chinese species, Vitis piasezkii, were located on chromosomes 9 and 19.

*Erin Troxell (Hochschule Geisenheim university) Brent Sams, Luis Sanchez and Nick Dokoozlian (E&J Gallo)* found that in a Petite Sirah vineyard, areas with the highest yield and lowest fruit quality had higher potassium uptake at bloom and more shoots per vine.

*Joaquin Fraga, Kevin Fort and Andy Walker (UC Davis)* examed a rhizotron /rootbox assay for assessing root architecture of the grape rootstocks Ramsey and Riparia Gloire. They traced root system development weekly, measured root girths and destructively harvested the plants after 4 weeks. They found that Ramsey was consistently more deeply rooted, while Riparia Gloire roots were more shallow with a higher density of root counts in the upper half of the rhizotron

*Forrest Melton, Martin Mendez, Lee Johnson, Christopher Lund, Kirk Post, Alberto Guzman, Andrew Morgan, Melissah Ball and Jenna Rodriquez (E&J Gallo)* described development and deployment of a prototype system called Satellite Irrigation management Support (SIMS) for irrigation scheduling and management support in California. The system utilizes the NASA Terrestrial Observation and Prediction System to map crop canopy development and basal crop coefficients for multiple crop types in the Central Valley at the scale of individual fields. They also reported that the GIS and remote sensing group at E&J Gallo are implementing a system based on satellite imagery from the Landsat platform to assist irrigation scheduling across different growing regions via web based decision support system and web services.

*Yun Zhang and Markus Keller (Washington State University)* examined berry transpiration and xylem backflow during berry development and found that transpiration increased initially in berries during the developmental period from around 6 ºBrix to around 13 ºBrix and then declined with further ripening. They observed that in order to fulfill requirements for berry sugar accumulation, phloem inflow was in excess of berry requirement, with the excess disposed of as xylem backflow.

*Kevin Usher, Pat Bowen, Carl Bogdanoff and Margaret Cliff (Pacific Agri-Food Research Centre (Canada)* reported their work on methoxypyrazines, which they described as nitrogen-containing compounds that produce vegetative aromas in wine grapes. They found that high rates of nitrogen application at bud break and berry set resulted in high levels of IBMP throughout berry development.

*Kendra Baumgartner, Renaud Travadon, Mark Lubell, Vicken Hillis, Jonathan Kaplan and Monica Cooper (USDA and UC Davis)* discussed measures for preventative management of trunk diseases, such as delayed pruning, double pruning, and hand painting applications of the protectant thiophanate-methyl, which were shown to decrease pruning wound infections by 25-75%.

### *4.5 Meetings and Discussions with Key Scientists*

*Rootstocks – salt and drought tolerance*

These discussions were with Professor Andy Walker and Dr Kevin Fort. Information was shared on current status of rootstock research at Davis and Waite. This included populations under investigation for segregation of the chloride exclusion trait, physiology of the trait, excluders versus ‘double excluders’ and what is known about sodium exclusion in grapevine.

*Berry development and adaptation to biotic and abiotic stresses*

These discussions were held with Professors David Smart and Markus Keller.

*Grapevine scion and rootstock breeding*

Current status of research to develop better grapevine scion varieties was discussed with Dr Peter Cousins.

*General viticulture*

A wide range of discussions were held, including with Dr Matt Fidelibus, Dr Keith Striegler, Dr Andrew McElrone, Professor Roger Boulton, Professor Jim Kennedy, Professor Alan Lakso, and with Dr Jorge (Pata) Pena (INTA, Mendoza).

## 5. Outcomes

### 5.1. Knowledge

There were many highlights around new knowledge presented at the meeting; to name just a few is difficult, but they include the following:

- Significant advances towards development of grapevine types with resistance to Pierce's disease, with a number of promising selections now undergoing field testing.

- Significant advances towards development of a new microtensiometer for continuous monitoring of soil and plant water potentials. The technology has potential in both R&D and commercial applications.

- Exciting new knowledge obtained in relation to embolism and xylem vessel repair from technologies including neutron radiography, micro computed tomography and magnetic resonance imaging, and in relation to irrigation

scheduling and management, application of Satellite Irrigation Management Support (SIMS) that utilizes the NASA Terrestrial Observation and Prediction System to map crop canopy development and basal crop coefficients for multiple crop types in the Central Valley at the scale of individual fields.

### 5.2. Collaboration

- Existing collaborations were enhanced through discussions and sharing of information and also exploring opportunitirs to enhance the collaborations going forward.

- Some potential new collaborations were discussed, and ways to facilitate such collaborations, including for example, sabatticals and short visits between key laboratories.

## 6. Reference

Walker, R.R., Gong, H., Henderson, S., Gilliham, M. and Walker, A. (2014) Salt exclusion in grapevines. Abstract ASEV 65$^{th}$ meeting, p.71.

## 7. Appendix: Budget reconciliation

Submitted separately to AGWA