plant energy biology
ARC CENTRE OF EXCELLENCE

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Australian Grape and Wine Authority

# Presentation of rootstock sodium exclusion findings at Salt and Water Stress in Plants, and IWPMB 2016



## FINAL REPORT to

AUSTRALIAN GRAPE AND WINE AUTHORITY

Project Number: **AGT 1520**

Principal Investigator: **Sam Henderson**

Research Organisation: **The University of Adelaide**

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# Abstract

The purpose of this report is to summarise the outcomes of a Wine Australia travel grant. Additional funding support was provided by the Australian Research Council Centre of Excellence in Plant Energy Biology. The main activities that were supported by this grant were participation in two international conferences and one national conference. At these meetings, data were presented that describe the genetic mapping and functional characterisation of genes involved in sodium exclusion in grapevine rootstocks. These data have been generated from a collaborative project between CSIRO Agriculture and the University of Adelaide. The participation in these meetings allowed for useful discussions and novel experimental ideas to be gained, which will assist the future development of this project and publication of our data. Highlights from the meetings are discussed, and any additional formats that were used to disseminate research findings are also mentioned.

## Executive summary


- A collaborative project between researchers at the University of Adelaide and CSIRO Agriculture is investigating sodium exclusion in *Vitis* species.

- Wine Australia provided travel support for participation and presentation of data at Salt and Water Stress in Plants, and the 17th International Workshop on Plant Membrane Biology in 2016.

- These meetings are two leading conference in their fields that promote discussion and the exchange of ideas among researchers.

- Participation enabled valuable insights to be gained from leading researchers in the field, and also provided an excellent professional development opportunity.

- Research findings were also presented to Australian audiences via the Australian Wine Industry Technical Conference in Adelaide, ComBio2017 in Brisbane, as well as internal seminars within the Centre of Excellence in Plant Energy Biology.

- Attendance at these meetings was beneficial and will expedite and enhance the preparation of a high quality manuscript that describes our research findings to date.

- Wine Australia is gratefully acknowledged for helping support this opportunity.

## Background

Developing genetic markers to accelerate breeding efforts aimed at generating superior grapevine rootstocks with enhanced abiotic stress tolerance is a high priority research area for Australian viticulture. Under a saline irrigation regime, the accumulation of ions in leaves and berries can inhibit grapevine growth and yield, and impart unfavourable sensory attributes to wines. The exclusion of these ions (for example sodium) from scions can be improved through the use of ion excluding rootstocks that reduce the translocation of charged solutes across the root cell membranes into the transpiration stream. A better understanding of the genetic determinants of the ion exclusion process in grapevine will help to achieve the aim of developing enhanced rootstocks that are well suited for Australia's harsh and changing environment.

A collaborative project between researchers at the University of Adelaide and CSIRO Agriculture is investigating sodium exclusion in *Vitis* species. Some of the data generated in the collaboration were recently presented at national and international meetings. Funding support was provided by Wine Australia. The conferences were GRC Salt and Water Stress in Plants, and the International Workshop on Plant Membrane Biology (IWPMB), which represent the two premier conferences in their fields. Participation in these meetings was beneficial for a number of reasons: for gaining advice on future experiments, for developing international contacts, assistance with interpretation of our results, and as a professional development opportunity for an early career researcher.

# Salt and Water Stress in Plants (29/5/2016 – 3/6/2016)

Salt and Water Stress in Plants is part of the Gordon Research Conference series and is held biennially. The conference was held in the Les Diablerets Conference Centre, Switzerland, in the spectacular alpine village of Les Diablerets, between 29 May and 3 June 2016 (Figure 1). The conference brought together over 150 delegates from around the world, from academia and private industry (Figure 2). To encourage participants to present the latest unpublished research findings, conference proceedings were not printed, and this led to some very novel posters and oral presentations. The 2016 edition of Salt and Water Stress in Plants had a particular emphasis on abiotic stress adaptation, crop yield and food security. The sessions entitled 'Yield Stability' and 'From Genes to Field' were particular meeting highlights, as the topics covered were closely aligned to the objectives of our work, which is breeding superior germplasm for harsh environments. In total, 97 posters were presented across two sessions. My poster received some interest, and useful comments and advice were received. A continuing theme throughout the presentations was the importance of root suberin deposition in salt and drought tolerance, as well as plant mineral nutrition. Research highlights included novel experiments using mutant plants to further define the role of suberin in the root endodermis. Data were presented describing mutant plants with abnormal suberin deposition, which clearly leads to poorer sodium exclusion from leaves. Conversely, in another presentation, mutant plants with enhanced suberin deposition showed improved drought tolerance. Finally, again in separate presentations, the hormonal and non-hormonal signalling events that lead to greater root suberin deposition under salinity stress, as well as putative protein kinases that might be involved in this process, are beginning to emerge. It was a privilege to attend this high calibre meeting in such a great location, and also a chance to experience some excellent Swiss wines, which are not exported to Australia.



Figure 1: The Les Diablerets Conference Centre in the Swiss Alps was the site of Salt and Water Stress in Plants 2016.



Figure 2: Participants in Salt and Water Stress in Plants 2016 in Les Diablerets.

## IWMBP 2016 (5/6/2016 – 10/6/2016)

IWPMB is considered the premier international conference for science related to plant membranes, and is highly relevant to our research into the uptake and transport of sodium in grapevine which must cross cell membranes to accumulate and cause toxicity. The first IWPMB was held in 1968 and has since been held triennially. The 17$^{th}$ IWPMB (2016) was held in Annapolis, USA, which is the capital of the state of Maryland. With its brick-paved streets, historic buildings and attractive harbour, Annapolis was an excellent location for the meeting. Over 230 participants gathered to hear presentations and view posters from the approximately 160 submitted abstracts. Two separate sessions on abiotic interactions ensured that plant abiotic stress and salinity tolerance were well covered. Some research highlights included updates on the plant osmosensor OSCA1, the evolution of ABA signalling in plants, the role of mechanosensitive channels in oscillatory perception, and the role of aquaporins in controlling plant gas exchange. Furthermore, a fascinating report on the crystal structure of an ammonia-permeable aquaporin from *Arabidopsis thaliana* (TIP2;1) was presented. A session entitled 'future perspectives' was thought provoking. Other highlights included numerous oral presentations about NRT1/PTR Family (NPF) proteins, describing structural insights, mechanisms of regulation, and substrate specificity. Insights into various methodologies used to study this family of plant transporter were gained, which will be valuable for additional grapevine projects that are ongoing at the University of Adelaide. The schedule also included two 'Networking lunches' for postdocs and students, which were a good opportunity to meet with research leaders and discuss ideas. Overall, this was an excellent meeting that was well organised.

## Dissemination of research findings to Australian audiences

### ComBio2016

ComBio2016 was held at the Brisbane Convention Centre from 3 - 7 October 2016. ComBio2016 incorporates the annual meetings of three societies, the Australian Society for Biochemistry and Molecular Biology (ASBMB), the Australian Society of Plant Scientists (ASPS) and the Australia and New Zealand Society for Cell and Developmental Biology (ANZSCDB). As such, there is a great diversity and depth of scientific material on offer. It was interesting to discuss with researchers in the mammalian field about venom peptides as novel blockers of sodium transporters and the potential application of these

compounds as therapeutics for pain and stroke. Many of the assay techniques used in such studies are analogous to the methods used for characterising plant cation transporters. There may also be some structural similarity between plant and mammalian sodium transporters that could be of interest for future research on plant salt tolerance. The ASPS sessions entitled 'Abiotic Stress and Climate Change', and 'Plant Water Relations' were applicable to our research on grapevine salinity tolerance. Furthermore, the session 'Plant Nutrient Acquisition and Efficiency' contained numerous examples of plant membrane transport that were novel and interesting. An opportunity to chair this session was also useful for professional development. This conference provided an opportunity to present research and disseminate knowledge to an Australian audience. Our poster was on display from 5 - 7 October, and presented in the 'Plant Cell and Developmental Biology and Genetics' session on 6 October. The dinners of the ASPS, at the Queensland University of Technology, and ComBio at Rydges Rooftop both showcased stunning views of the Brisbane River and of the city, and also provided a good networking opportunity.

**Additional presentations**

Our research findings were also presented in May 2016 at the ARC Centre of Excellence in Plant Energy Biology annual retreat at La Trobe University, as an oral presentation, with experts in the field in attendance as audience members. Some valuable feedback was obtained during the question time. Furthermore, a poster entitled 'Characterising a potential genetic marker, VviNPF2.1, for grapevine salt exclusion' (presenting author Yue Wu, University of Adelaide) was presented at the Australian Wine Industry Technical Conference (AWITC) in Adelaide during July 2016. Homologs of these transporters in the model plant species *Arabidopsis thaliana* have putative sodium dependency (Li *et al*, 2016), and are therefore interesting to study from the perspective of plant abiotic stress tolerance. Finally, we are in the advanced stages of preparing a manuscript for submission to a peer-review scientific journal.

# References

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