THE UNIVERSITY of ADELAIDE

Waite Research Institute

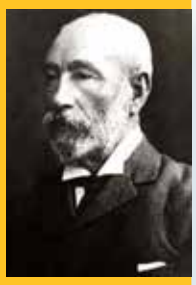
BIENNIAL REPORT 2011-12

The Peter Waite Legacy and Vision

Peter Waite was a visionary. The son of a Scottish farmer, he immigrated to Australia in 1859 and prospered in the fledging colony. Throughout his journey from the pastoral lands of the mid-north of South Australia to the boardroom of the "General and Commission Agent Company", later to become Elders Pty Ltd, Peter Waite embraced and developed innovative and contemporary farming practices.

Peter Waite gifted his homestead, Urrbrae House, and the surrounding property to The University of Adelaide in 1914. The property was handed over to the University in 1923.

In explaining his gift, Peter Waite wrote:



"I have been much influenced by the wonderful work our agriculturalists and pastoralists have accomplished hitherto in face of the very great odds they have had to meet. With comparatively little scientific training they have placed our wheat, wool and fruit in the highest estimation of the world: our sheep have been bought to such perfection that they are sought after not only by all our sister states, but South Africa.

Our agriculture machinery has been found good enough even for Americans to copy; and our farming methods have been accepted by other states as the most up-to date and practical for Australian conditions. We have now reached a point when it behoves us to call science to our aid to a greater extent than hitherto has been done, otherwise we cannot hope to keep in the forefront."

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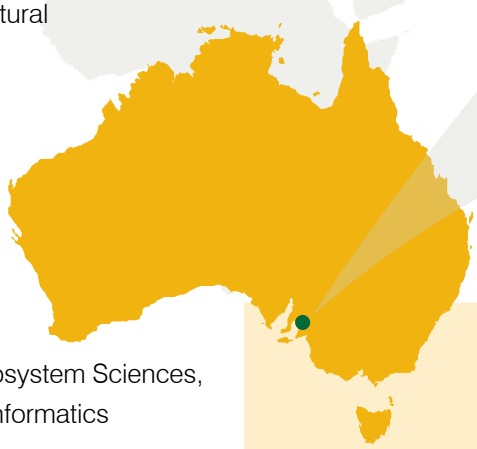
The Waite at a glance

The Waite Research Institute, an initiative of The University of Adelaide, was established to support collaboration between the Waite Campus partners to drive research for the benefit of Australia's agriculture, food and wine industries.

The Waite Campus is the largest agricultural research and teaching precinct in the Southern Hemisphere. Located in the south-eastern suburbs of Adelaide, South Australia, the Campus hosts:



- The University of Adelaide's School of Agriculture, Food and Wine
- CSIRO Divisions of Plant Industry, Ecosystem Sciences, Land and Water and Computational Informatics
- South Australian Research and Development Institute (SARDI)
- Australian Wine Research Institute (AWRI)
- Australian Genome Research Facility (AGRF)
- Australian Grain Technologies Pty Ltd (AGT)
- Arris Pty Ltd
- Urrbrae House Historic Precinct and Waite Arboretum

In addition, the Waite hosts the following specialist research centres of major significance;

- Australian Centre for Plant Functional Genomics
- Australian Plant Phenomics Facility (The Plant Accelerator)
- ARC Centre of Excellence in Plant Cell Walls
- ARC Centre of Excellence in Plant Energy Biology (node)
- FOODplus Research Centre
- Wine Innovation Cluster

12 world-class researcher organisations and centres

1100 research and technical staff

550 undergraduate students

295 postgraduate students

$100 million research income/expenditure per annum

$265 million of research and teaching infrastructure

80% Waite-developed cereal varieties comprise approximately 80% of southern Australian production

A consistent high-impact publication record

Recognised as delivering transformational and high-impact agricultural technologies and systems

'The Waite' is Australia's most recognised and respected agricultural research and teaching brand.

Over the last 88 years, the Waite Campus has developed through the pursuit of excellence in agricultural science and through collaboration between the co-located organisations to become:

- A global leader in agriculture, food, wine and natural resources science, exploring and informing critical national and global issues and challenges such as Australian agriculture industry competitiveness, food security, sustainable intensification of agricultural production, food, nutrition and health, advanced agricultural systems, and adaptation to climate variability and change;
- An international model of research, development, industry application and teaching through co-location of institutional partners, with capability in whole of value chain approaches from gene discovery to consumer needs;
- Renowned for high-quality education and training in agriculture, food and wine through undergraduate and postgraduate coursework and research degree programs;
- The centre of research capability for both grains and wine research within Australia.

Key Waite achievements 2011 - 2012

The Waite Research Institute supports the Waite Campus as a global leader in agricultural research, development and education addressing the global challenges that include food security and food production for healthier outcomes, climate change adaptation, resource limitations and land degradation.

NATIONAL EXCELLENCE – ERA RANKINGS

Excellence in Research for Australia (ERA) ranked all Waite-based research disciplines as at or above world standard in 2012:

- Plant biology;
- Soil science;
- Crop and pasture production;
- Horticultural production (includes wine-related activities);
- Nutrition and dietetics (includes food-related research).

RECENT FUNDING SUCCESSES

(* DENOTES DIRECT WRI INPUT/SUPPORT)

- Eight WIC collaborative projects were funded by the GWRDC in 2012, worth in excess of $9.5m.
- ARC Discovery Grant – Dr Matthew Gilliham; Prof Steve Tyerman; Dr Peter Ryan
  Gamma-aminobutyric acid-gated anion channels in plants
  Funding - $420,000, commencing 2013*
- ARC Discovery Grant – Prof Vladimir Jiranek, Prof Stephen Oliver
  Yeast cell-cell communication of overcrowding and nutrient limitation: novel signalling systems and their impact on fermentation
  Funding - $477,000, commencing 2013*
- ARC Discovery Grant – Prof Mike Wilkinson; Dr James Breen, Dr Thomas Higham, Dr Ron Pinhasi
  Reconstructing wheat evolution using ancient DNA
  Funding - $443,000, commencing 2013
- FOODplus – a Research Centre involving AFW staff Dr Jo Zhou and Prof Bob Gibson – has won the following NHMRC grant:
  - » Omega 3 fats to Reduce the Incidence of Prematurity: The ORIP Trial $4,021,840

MAJOR RESEARCH CENTRES AND INITIATIVES

- The launch of the ARC Centre of Excellence in Plant Cell Walls led by Professor Geoff Fincher in 2011
- A node of the ARC Centre of Excellence for Plant Energy Biology established in July 2011
- NHMRC Centre of Research Excellence - Foods for Future Australians
- The establishment of the Vineyard of the Future project to continuously monitor vine performance and berry development.

SCIENCE BREAKTHROUGHS IN HIGH-IMPACT PUBLICATIONS

International Barley Genome Sequencing Consortium, Mayer KF, Waugh R, Brown JW, Schulman A, Langridge P, Platzer M, Fincher GB, Muehlbauer GJ, Sato K, Close TJ, Wise RP, Stein N (2012) A physical, genetic and functional sequence assembly of the barley genome. ***Nature***, 491(7426):711-716.

This global collaborative project involved researchers from ACPFG and the ARC Centre of Excellence in Plant Cell Walls.

Munns RE, James RA, Xu B, Athman AN, Conn SJ, Jordans C, Byrt CS, Hare RA, Tyerman SD, Tester M, Plett D, Gilliham M (2012) Wheat grain yield on saline soils is improved by an ancestral Na+ transporter gene. ***Nature Biotechnology*** 30(4), 360-364.

This story was featured as one of the top 10 science stories from Australia and the world in 2012 by the Australian Science Media Centre, along with the Curiosity landing on Mars and the Higgs boson.

EXCELLENCE IN EDUCATION

- A 2012 Stephen Cole the Elder Award for Excellence in Teaching (Early Career) to Dr Kerry Wilkinson
- A 2012 Award for Excellence for Higher Degree by Research Supervision to Professor Eileen Scott
- A 2012 Faculty of Sciences Executive Dean's Award for Excellence in Teaching to Dr Chris Ford

HONOURS/AWARDS

- SA Scientist of the Year 2011 – Professor Peter Langridge, ACPFG
- SA 2012 Young Tall Poppy Awards - Dr Matthew Gilliham and Dr Kerry Wilkinson, both participants in the WRI's Research Leadership Development Program, were named SA Young Tall Poppies for 2012.
- Go8 Fellowship Award for Dr Matthew Gilliham – part of the Australia-China Young Researchers Exchange Program for 2012.
- Viticulture & Oenology 2012 Science and Innovation Award for Young People in Agriculture, Fisheries and Forestry – won by Dr Matthew Gilliham. Sponsored by the Grape and Wine Research and Development Corporation (GWRDC), the $22,000 award allows Dr Gilliham to draft the first sequence of a rootstock genome.

Our work in 2012 has led to better awareness of the large range of career opportunities that a degree in Agricultural Sciences can offer, reflecting a growing awareness of the need to look at new ways of feeding the world in the coming decades. Many young people are interested in being able to make a difference in global issues.

Director's Statement

The Waite Research Institute's (WRI) primary goal has been to add value to existing research in the areas of agriculture, food and wine on the Waite Campus and in the University more broadly. This was to be achieved by supporting novel activities that were new, collaborative, high-impact, large-scale and attractive to external funding agencies.

This Report highlights the WRI's key investments and outcomes in 2011 and 2012 following its official launch in late 2010. The WRI focussed on areas that were not being supported through other means but which had great potential to contribute to the future growth of the research on the Waite.

In 2011, high priority was given to long-term succession planning through the development and implementation of a Research Leadership Development Program (RLDP) supporting early- to mid-career researchers who demonstrated the potential to be the research leaders of the future. The objective was to increase the leadership skills and personal ambitions of the participants.

In 2012, the RLDP was followed by a more intensive "Step Up" program aimed at further developing the leadership behaviours and skills.The full benefits of these investments in individuals will take some time to be fully realised. However successes are already emerging. The RLDP concept has since been adopted by both the Environment Institute and the Institute for Mineral and Energy Resources.

The full benefits of these investments in individuals will take some time to be fully realised. However, successes are already emerging.

Major strategic investments have included the Vineyard of the Future (VoF) concept led by Professor Steve Tyerman, Wine Industry Chair of Viticulture, continuously monitoring the development and performance of vines within a highly-instrumented vineyard. The WRI has funded the establishment, instrumentation and support staff for this facility. The VoF has proved to be a timely investment and has attracted substantial support from the industry and the development of international replicates and collaborations with researchers from the Universities of La Rioja (Spain) and De Calca (Chile). The result will be an international network monitoring comparative vineyard performance in northern/ southern hemisphere and diverse climatic/soil type environments.

A major hurdle to developing collaborations is the availability of funds for travel to meet potential collaborators or to host meetings of partners. To address this, the WRI provided such funds. Applications are simple and decisions are made quickly with the input of the Institute's Science Advisory Committee.

To increase success in grant applications the WRI funded two grant writers to mentor staff in their development of applications. Two of the successful School of Agriculture, Food and Wine applications for ARC

Discovery grants in 2012 had input from the grant writer. One grant writer visited the Waite to deliver a master class on writing successful ARC grants.

To engage the public, the WRI established the Debate@TheWaite series; two teams debate current agricultural issues in a format that is both informative and entertaining. Organised in conjunction with the Royal Institution of Australia (RiAus), and held on the Waite Campus, they have been a major success with attendances averaging 150 with 50 per cent of attendees from outside the University. Topics have included "Increasing agricultural production is the only sure way to feed 9 billion people by 2050", "The future of the Australian wine industry will be based on technology, not tradition" and "Australian cities need Australian farmers".

The co-location of non-University research organisations such as CSIRO, the Australian Wine Research Institute, the South Australian Research and Development Institute and companies including Australia Grain Technologies is a unique aspect and strength of the Waite Campus. There are strong collaborative links between these organisations and many of the Campus facilities result from co-investment by these partners. In the belief that co-location still has much to offer, the WRI has championed the exploration of new opportunities through the establishment of the Waite Strategic Leadership Group with members drawn from the senior staff of all co-located partner organisations.

I stepped down as Director of the Waite Research Institute at the end of 2012 and the role has now been assumed by Professor Mike Wilkinson. It has been a pleasure to be the inaugural Director and I thank the University for giving me the opportunity. Of course, many of the achievements are the results of team work and I have been lucky to have a dedicated group of staff working with me as well as the support of the WRI Board, the WRI Science Advisory Committee and the advice of many colleagues. I thank all of those who have supported me in any way during my time as Director and I wish Mike Wilkinson even greater success in the coming years.

Professor Roger Leigh

December 2012

Director, Waite Research Institute from 2010-12

Professor Roger Leigh provided leadership during the critical formative years of the WRI, driving the twin objectives of supporting the School of Agriculture, Food & Wine, whilst encouraging a collaborative partnership culture with the other co-located partner insitutions on the Waite Campus.

Professor Leigh was also Head of the School of Agriculture, Food & Wine until March 2011.

WRI Structure & Governance

The Waite Research Institute (WRI) is one of five Institutes funded by The University of Adelaide. The Institutes bring together world-leading researchers with a multi-disciplinary focus to address state and national research priorities, providing a collaborative platform for research partnerships across the University and with other organisations.

The Waite Research Institute operated with a lean and transparent structure comprising an Advisory Board and a Science Advisory Committee (2012 onwards).

The WRI Board provides advice and support to the Director on the formulation of strategic directions and has general oversight of the management of the Institute. It also reviews the financial and operational performance of the Institute and provides an external perspective on the Institute's direction and activities.

Comprised of both external and internal members, the WRI Board met roughly quarterly throughout the first two years of the WRI's operations.

MISSION:

To deliver the science, education and innovation to transform Australian agriculture in global markets.

VISION: CONTINUED EXCELLENCE

"The University has all the elements of a global partnership at its Waite Campus, where research departments, research institutes and the R&D arms of government and business in the agricultural, food and wine field are co-located. In 2013, it will propose leverage of these organisations and selected international partners into a Waite consortium, which will likely become one of the most powerful concentrations of agriculture, food and wine research in the world."

The University of Adelaide Strategic Plan 2013-2023
"Beacon of Enlightenment"

WRI Board

EXTERNAL MEMBERS

Mr Perry Gunner
(Independent Chair)

Experienced primary producer and professional Board Director. Directorships have included Orlando Wines, ABB Grain, Freedom Foods Group, Viterra, Australian Vintage and Ausbulk.

Hon John Dawkins AO

Former Federal government member and Minister and experienced professional Board Director. Directorships have included Archer Exploration, TVET Australia, Sovereign Gold, M&C Saatchi Direct, Asgard Wealth Solutions and Elders Rural Bank.

Mr Graham Campbell

CEO & Managing Director, Nestlé Australia Ltd. Nestlé is the world's leading Nutrition, Health and Wellness company. It has had a presence in Australia since the 1880s and currently employs around 4000 people across Australia

Professor Alison Stewart

Distinguished Professor of Plant Pathology at Lincoln University, NZ and research leader of the Plant Disease Biocontrol Research Group.

INTERNAL MEMBERS

Professor Mike Brooks

Deputy Vice Chancellor (Research), The University of Adelaide

Professor Bob Hill

Executive Dean of Sciences, The University of Adelaide

Professor Roger Leigh

Director, WRI

WRI Staff

The WRI's small team of part-time staff brings together strengths in strategic planning, research leadership and project management, people development, science communication, research administration and financial reporting.

Professor Roger Leigh

Director (2010-12)

Professor Rob Lewis

Strategic Projects Manager

Dr Heather Bray

Community Engagement and Researcher Development Officer (2011-)

Ms Carolyn Gadd

WRI Executive Officer (2011-)

Mr Jason Dancer

Financial Accountant

Mrs Lisa Dancer

Administrative Officer (2011-)

Ms Chia Barlow

Executive Officer (2010-11)

Mr Alex Gardner,

Technical Officer (2010-11)

WRI Science Advisory Committee

The WRI's Science Advisory Committee (WRI SAC) was established in early 2012 to advise the WRI on scientific opportunities and assess funding requests based on their alignment with the WRI's strategic objectives, their quality, importance and scientific merit and the likely impact of their outcomes for the Waite.

The assessment process is transparent and operates according to clear criteria and mechanisms. During 2012, the WRI SAC received and assessed 18 applications and awarded a total of $137,907 in funding to AFW researchers. (See Appendix 1 for details.)

Professor Roger Leigh

(Chair)
Director, WRI (2010-12)

Professor Mike Wilkinson

Head of School of Agriculture, Food and Wine

A/Professor Petra Marschner

Soils Research Group and Convenor, AFW Research Committee

Professor Steve Tyerman

Group Leader, Plant Physiology, Viticulture & Horticulture

Professor Diane Mather

Group Leader, Plant Breeding and Genetics, School of Agriculture, Food and Wine, The University of Adelaide

Professor Bob Gibson

Professor of Functional Food Science, School of Agriculture, Food and Wine, The University of Adelaide

Dr Chris Ford

Senior Lecturer in Oenology, School of Agriculture, Food & Wine, The University of Adelaide

Professor Simon Maddocks

Director Science Partnerships, SARDI

WRI Strategic Investment Framework

Through the Waite Research Institute and the School of Agriculture, Food & Wine, The University of Adelaide is committed to ensuring the Waite will continue to be a global leader in agricultural research, development and teaching, attracting international research and students.

The University of Adelaide's presence at the Waite Campus is primarily embodied in the School of Agriculture, Food & Wine (AFW). The Waite Research Institute works alongside and supports the School by developing and funding specific projects, such as the Vineyard of the Future, by building its general research capacity and by promoting the Waite's research outcomes and activities.

The Waite Research Institute has opperated according to a strategic and investment framework aimed at:

1. **Advancement of the University (AFW) research capabilities, income and outcomes**
2. **People Development and Attraction**
3. **Broader Waite Campus initiatives**
4. **Enhancing understanding of the Waite and its capabilities with the public and the broader scientific community**

These 'pillars' support the key research themes of the School of Agriculture, Food and Wine and the wider Waite Campus.

1 ADVANCEMENT OF THE UNIVERSITY'S, AND IN PARTICULAR THE SCHOOL OF AGRICULTURE, FOOD AND WINE'S RESEARCH CAPABILITIES, INCOME AND OUTCOMES

The WRI aimed to reach this objective by identifying, supporting and progressing activities that brought new, collaborative and large-scale activities to the Waite and to increase the number of successful grant applications for the School of Agriculture Food and Wine.

1.1 Salary contribution: Director, ARC Centre of Excellence in Plant Cell Walls

In 2010-12, the WRI provided salary support for Professor Geoff Fincher, inaugural Director of the ARC Centre of Excellence in Plant Cell Walls (PCW). This period included the establishment of the Centre, recruitment, international research linkages and a number of initial projects. Successes from PCW research are highlighted in the Research Stories section of this Report.

1.1 Vineyard of the Future

The WRI's biggest single investment in 2011-2012 has been in the 'Vineyard of the Future' project. A range of equipment, including a meteorological station, sap flow sensors, Infrared Gas Analyser (IRGA), Near Infrared Reflectance Spectroscope (NIRS) and cameras (Vis and IR) was purchased, tested and installed during 2011/2012. Visible cameras (Axis hi res PTZs) were installed to cover two directions over the Alverstoke vineyard on the Waite Campus and sap flow sensors where installed in vines that could be simultaneously imaged.

These cameras are programmed for time lapse photography, allowing imaging of canopy growth and fruit maturation. It is anticipated that a full season of development will be captured during the 2013-2014 vintage, monitoring canopy growth as well as leaf orientation and folding in response to heat waves and water stress. This will be combined with data from an application currently in a beta testing stage which measures canopy growth from under the vine while attached to either a hand held wand or ATV. This application is currently subject to a commercialisation process with ARI.

The Vineyard of the Future instrumentation has also been used during the past season to support a PhD project on the effects of cooling systems (microsprays and shading) during heat wave events. This project also used impedance spectroscopy to measure grape berry development and the onset of senescence. A paper is in preparation from this work. Dr Roberta De Bei, a postdoctoral fellow

working on the Vineyard of the Future project, is setting up the imaging systems for next year and is using the NIRS to measure carbohydrates and water stress in grapevines. This work has captured strong interest and financial support from Wynns Coonawarra (Treasury Wine Estates) and workshops are planned to facilitate commercialisation of the technique. The work was also reported from an industry perspective on the ABC Catalyst program.

1.2 Grant Writing Assistance

The WRI enlisted the services of an expert grant writer, Dr Tony Souter, in late 2010 to support the School of AFW's researchers in honing a range of new applications and revising 'near-miss' applications for funding.

In 2011-12, a total of 14 staff benefited from Tony's input, and the successful applications arising from this initiative include two of the three ARC Discovery grants awarded to AFW researchers in late 2012.

Feedback on Tony's expertise and assistance has been extremely positive, with all applicants agreeing their applications were significantly improved by engaging in this process. In addition, many of these staff have indicated this WRI-funded service is a valuable resource for the School's researchers.

For a full list of the publications arising from the School of Agriculture Food and Wine in 2011 and 2012, please see www.adelaide.edu.au/wri/science

2 PEOPLE DEVELOPMENT AND ATTRACTION

The WRI has supported initiatives to increase research capability by increasing the number of research students on campus and to develop future research leaders at the Waite.

2.1 Supporting the retention of undergraduate students at the Waite

The WRI has provided direct financial support to the School of Agriculture, Food and Wine's Waite scholars (undergraduate) program and the Honours program.

The Waite Scholars program, coordinated by Dr Jason Able and initiated in 2010, identified a select group of undergraduate students from relevant degrees (ie, those likely to enter a research degree in the School of Agriculture, Food and Wine) for mentoring and activities designed to increase awareness and interest in research. In addition, the Waite Scholars completed a summer internship within the School and received a scholarship from the Waite Research Institute.

There were 12 students in all between 2011 and 2013 that undertook summer internships with the School. The WRI contribution for each student was $1,500, matching their funding from the School of Agriculture Food and Wine.

Year	Student name	Program	Institution
2011/12	John Swincer	B.Sc	University of Adelaide
2011/12	Minh Tjien Nguyen	B.Sc (Biomedical Science)	University of Adelaide
2011/12	Yue (Crystal) Wu	B.VO	University of Adelaide
2011/12	Sijing Li	B.Sc (Viticulture)	University of Adelaide
2011/12	Michael Aldridge	B.Ag.Sci	University of Adelaide
2011/12	Luise Sigel	B.Ag.Sci	University of Adelaide
2012/13	Danrui Wu	B.Ag.Sci	University of Adelaide
2012/13	Ee Lin Tek	BN&FS	University of South Australia
2012/13	Ma Chao	B.Sc(Biotech)	University of Adelaide
2012/13	Lim Shin Huey	B.Ag.Sci	University of Adelaide
2012/13	Stefan Hasenohr	B.Sc	University of Adelaide
2012/13	Thy Nguyen	B. Vet.Bio	University of Adelaide

The WRI also provided $1,000 scholarships to the following Honours students in 2012:

Year	Student name	Project	Supervisor	Program
2012	Todd Storm	Treatment of Powdery mildew using milk and milk by-products, focusing on the impact on wine quality	Prof Eileen Scott	B.Sc
2012	Leon Talamini	An evaluation of calcium bentonite as a fining agent for wine	Dr Kerry Wilkinson	B.VO
2012	Alexandra Babynec	Management of eutypa dieback	Prof Eileen Scott	B.VO
2012	Naomi Verdonk	Wine marketing	A/Prof Johan Bruwer	B.Oen
2012	Poh Chong	Assessing varietal responses to P under controlled environment and field conditions	Dr Bill Bovill	B.Ag
2012-2013	Sijung Li	Flavour potential of oak battens prepared from decommissioned oak barrels	Dr Kerry Wilkinson	B.VO

2.2 Recruiting and supporting postgraduate students at the Waite

Postgraduate and Honours Information Night

On 4 August 2011, the Waite Campus hosted a postgraduate and honours information night. The evening included a welcome to the Campus, the School's 3 Minute Thesis finalists presented and the attendees were given a tour around the campus on a minibus hired for the event and provided with a sausage sizzle where they could mingle with current students and staff. The Research Groups of the School of Agriculture, Food and Wine, Research Centres and co-located partners had booths and provided information to prospective students in Lirra Lirra Cafe. The WRI sponsored the event with a contribution of $1,500 towards costs and the in-kind support of the special projects officer to assist with coordination of the event. More than 30 prospective students attended the event.

The WRI also sponsored a prize at the Annual Postgraduate Symposium for student participation ($250) which was won by Jessica Bovill in 2011.

Postgraduate Retreat

On 21 September 2012, the WRI ran a mini-retreat for final-year AFW postgraduate students immediately following the Annual Postgraduate Symposium. The purpose of the Retreat was to provide an experience that is unique (not covered in other workshops) and to inspire and motivate PhD students in the final stages of their PhD. The Retreat was held at the Balyana Conference Centre in Clapham and the students attended three workshops in rotation. These were:

- 'What is your brand?' with Karilyn Fazio. Karilyn is an organisational coach and has been working with the WRI's Research Leadership Development Program.
- 'Persuasive presentations' with David Griggs. David has also been working with the WRI's Research Leadership Development Program, running workshops on presentation skills. David focussed on overcoming nerves and developing an effective presentation style.
- 'Amplifying your science' with Mike Seyfang. Mike Seyfang is the social media consultant for the Faculty of Science and enables scientists to extend the reach of their work through social media.

Sixty students were invited to attend based on their candidature and 42 attended on the day. The event received positive feedback.

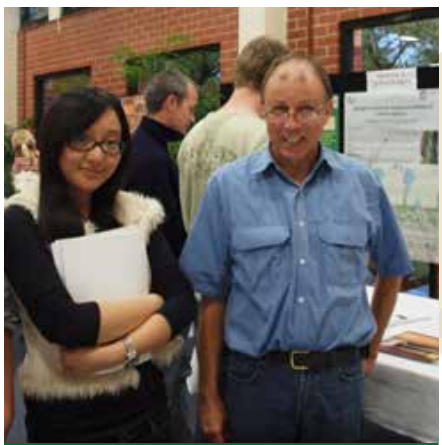
National Youth Science Forum

The WRI continued its support for attraction of students to the AFW's undergraduate courses through sponsorship and hosting of the annual National Youth Science Forum (NYSF) South Australian selection and orientation days. The NYSF seeks to nurture and encourage young Australians to be the next generation of leading scientists and engineers

supporting a sustainable future. The NYSF helps students moving into Year 12 who wish to follow careers in science, engineering and technology by introducing them to research and researchers, by encouraging the achievement of excellence in all their undertakings, and by helping to develop their communication and interpersonal skills. It also fosters discussion of and interest in major national and global issues and emphasises the importance of maintaining continuing active interests in sport, arts and music. The NYSF's mission is to provide community minded and science focused young Australians an opportunity for network development and insight into skills, careers and a lifetime of achievement in science, engineering and technology.

Each year the Waite days select 20 year 11 students (plus 2 reserves) from a pool nominated from schools around the state (in collaboration with their local Rotary Clubs and Rotary District 9520). Those selected attend "science camps" around Australia early in the following year.

WRI Director Professor Roger Leigh gave the 2012 Orientation



Dr Ian Dundas talks with an interested student at the Postgraduate and Honours Information Night in August 2011

Cohort 1 of the WRI Research Leadership Development Program with Executive coach Karilyn Fazio (third from left) and Prof Roger Leigh, Director WRI (centre).

Day introduction to the Waite and plenary science future and career presentation to the selected NYSF candidates and their families. The WRI's Professor Rob Lewis has also made similar presentations in previous years. The WRI's support of this event has resulted in a number of students taking up undergraduate studies with the School of AFW and progressing to postgraduate studies.

An extension of the WRI's contribution to the NYSF selection process was providing travel support to NYSF alumna Melissa Coventry and two of her colleagues to attend the 4th AC21 World Student Forum on Sustainable Rural Development, held in Bangkok, Thailand in May 2011.

2.3 The WRI Research Leadership Development Program

The WRI's Research Leadership Development Program has been one of the outstanding successes of the Waite Research Institute's first two years. Although the program grew from a desire to develop research leadership capacity at the Waite, professional development throughout all research career stages is one of the key needs identified by early-mid career researchers in the recent Career Support for Researchers report (ACOLA, 2012).[1]

The program addresses the Waite's unique needs, rather than create another generic leadership course similar to those at other institutions. From a list of a range of attributes of research leaders, we distilled four key areas of focus: developing a research/career vision; changing the work paradigm; harnessing ambition; and communicating with different audiences. In conjunction with Karilyn Fazio, an organisational coach from the Impetus Team, we developed a program to:

- Create a high-calibre pool of potential leaders and successors for the Waite Campus;
- Increase capability in the skills and practices required for successful research and grant making, particularly high-level coaching and communication skills, narrative and presentation skills;
- Increase strategic networking and relationship building skills, being mindful of managing energy levels;
- Develop self-awareness of strengths and development areas – creating strategies to be more resourceful and resilient.

[1]Toss Gascoigne and Associates & Econnect (2012) Career support for researchers: understanding needs and developing a best practice approach. Australian Council of Learned Academies Secretariat, Melbourne, viewed 31 Jul 2013, www.acolasecretariat.org.au/ACOLA/PDF/CareerSupportForResearchers.pdf

The program comprised two full days of workshops presented by Karilyn Fazio where the participants worked through several exercises individually, in small groups or as a whole group. The participants then undertook the challenging task of devising and pitching an ambitious research proposal (for example, a centre) to four judges, in a manner similar to the 'Dragon's Den' television program. Our judges notionally represented the Australian Research Council, the State Government, an industry investor and the Australian public. All of the participants then received a half-hour personal coaching session with Karilyn to identify areas for further development and strategies to help them develop.

The feedback on our first pilot program which commenced in July 2011 was overwhelmingly positive, and the WRI ran the program for a second cohort of researchers in 2012.

Recognising that a short program is only the beginning of professional development, the WRI has also supported a second phase for the first group of 10 researchers, which was researcher-led. Of the first group of 10 researchers, four elected to have ongoing personal coaching with Karilyn and the remaining six worked with Karilyn in small groups of three. Based on the feedback from the Dragon's Den, they also took part in a full-day Persuasive Presentations workshop with David Griggs (The Speaker's Studio), and a short workshop with Dr Jurgen Michaelis (Chief Executive, BioInnovation SA) on calculating and communicating return on investment.

A third cohort of 10 researchers will undertake the program in 2013, with further workshops planned for all participants.

3 BROADER WAITE CAMPUS INITIATIVES

This objective aims to pursue new and significant opportunities arising from the presence of multiple partners on the Waite Campus.

The WRI has taken an active facilitation and leadership role in the development of collaborative bids, proposals and activities. This has included coordinating and sponsoring a number of workshops and two retreats to identify and develop major new collaborations and initiatives building on the Waite partner institution capabilities and emerging opportunities. In particular the WRI convened two workshops of the Waite partners to explore the development of an Australian Institute for Food and Nutrition Research (AIFNR) aimed at linking agriculture, food, nutrition and health with the aim of increasing delivery of personal and community health solutions through food. This approach seeks the integration of bioscience and biomedicine to identify the physiological basis of the problem and solutions, increased community education on the benefits[2] and food products to deliver the required nutrients and preventative health attributes. It sought to integrate the activities on the Waite with the state's major new medical research initiative the South Australian Health and Medical Research Institute (SAHMRI).

The WRI also coordinated several high-level visits to the Waite Campus in 2011-12 on behalf of the wider Waite community. These included two successive Ministers for Science & Higher Education, the Chief Scientist of SA and a delegation of Latin American Ambassadors (see Appendix 5). These visits involved themed tours across the Campus with the cooperation of various Waite partners.

The WRI led the establishment of a Waite Communicators Network in late 2011. This group meets quarterly and has enabled active cooperation between marketing, communications, outreach and media personnel across the Waite in a constructive and non-competitive forum with the emphasis on commonalities, overlaps, joint activities and the sharing of relevant information to reduce the incidence of duplication and mixed messages. The common aim of members is to build the reputation and brand of the Waite.

Investment in shared infrastructure and seed funding of proposals and projects that result in shared or collaborative activity has also been a feature of the WRI's activities in 2011-12.

[2]Benefits: include direct to individual through increased lifelong health and longevity as well as society through reduced treatment costs.

3.1 Facilitating large-scale collaborative research activities

The WRI facilitated a Waite visit and discussions with the CSIRO Executive Team in September 2011 to reinforce the significance of the Waite in the context of CSIRO's new global precinct policy. This has resulted in CSIRO seeking closer interactions with the Waite in national programs and enhanced and strengthened the long-standing partnership between CSIRO and The University of Adelaide.

Through the Waite Strategic Leadership Group, the WRI has championed and taken leadership in discussion with the Waite partners on the future direction of and opportunities for the Waite collective, particularly in light of the approaching Waite Centenary. These discussions have resulted in a reaffirmation of the Waite's brand and co-location culture as well as identification of potential opportunities to pursue. These include the pending national Soil Plant Interactions program, the Waite Communicators network and reinforcement of the Waite's standing in the Grains National RD&E Strategy.

3.2 Establishing and fostering linkages with other significant international agricultural research organisations

The WRI supported a visit by Professor Roger Leigh to the John Innes Centre, recognised as one of the world's premier agricultural research institutions, to discuss potential for collaborative initiatives with the Waite Campus. Similar discussions were held in 2011 and 2012 with Plant & Food Research in New Zealand. A number of other international collaborations and alliances were fostered by individual AFW researchers with travel support from the WRI during 2011-12. See Appendix 1 for a full list of recipients of WRI funding and outcomes.

3.3 Investment in shared infrastructure

Waite node of Adelaide Microscopy

In 2012, the WRI, along with the School of AFW, ACPFG and the ARC Centre of Excellence in Plant Cell Walls, agreed to co-fund and support the staffing of a Waite node of Adelaide Microscopy. The long-standing need for this facility on the Waite Campus was acknowledged by the Deputy Vice-Chancellor (Research), whose generous support also enabled this initiative to go ahead. The Waite node of Adelaide Microscopy opened for business in January 2013.

Membrane Transporter Expression Facility

During 2012, the WRI (through its Science Advisory Committee) approved support for upgrading of the Membrane Transporter Expression Facility, which is available for common and shared use by all Waite partner organisations.

3.4 Building the Campus Community

Peter Waite Day is an informal campus community-building exercise held to coincide with the anniversary of Peter Waite's birthday, 9 May each year. Held at the Lirra Lirra Café and lawns, the event features a Bocce tournament and is open to staff from across the Waite Campus organisations.

Peter Waite's generous bequest to The University of Adelaide for the purpose of agricultural research and the legacy embodied in the Campus are celebrated and remembered on this occasion each year, and these events have been enjoyed by all who attended in beautiful autumn weather.

4 ENHANCING UNDERSTANDING OF THE WAITE AND ITS CAPABILITIES WITH THE PUBLIC AND THE BROADER SCIENTIFIC COMMUNITY

Community engagement has been one of the key areas of activity for the Waite Research Institute in 2011-2012, with a view to increasing awareness of the Waite as a world-leading agricultural research centre, and the understanding of the benefits of our research in the community. The main activities were the Debate@The Waite series and establishing a social media presence.

4.1 Debate@The Waite – enhancing the public's engagement with agricultural science

The Debate@The Waite is a public event series which aims to engage the broader community in agricultural issues. The debate format provides an ideal vehicle for engagement because many agricultural issues are complex and involve both scientific and social aspects. The debates are based on traditional Oxford rules, consisting of two teams that argue for or against a proposition with the audience voting to decide the winning team.

In 2011-2012, the WRI organised and ran five debates. Each debate included speakers from the School of Agriculture, Food and Wine, other faculties at The University of Adelaide and representatives from industry. The topics were:

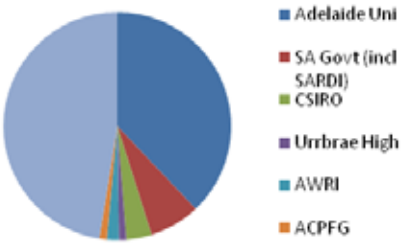
- Increasing agricultural production is the only sure way to feel 9 billion people by 2050;
- Agriculture should be exempt from greenhouse gas reduction schemes;
- The future of the Australian wine industry will be based on technology, not tradition;
- Australian cities need Australian farmers;
- Every Australian child should be taught Agriculture at school;

Overall, 463 unique visitors attended these debates, at an average of 157 registrations for each event. Based on an analysis of the email addresses provided by the registrants, just over half (53%) of the registrations came from The University of Adelaide or the Waite Campus (including Urrbrae Agricultural High School) and 47% from the broader community.

All but one of the debates were moderated by the Director of the Royal Institution of Australia (RiAus), Dr Paul Willis (pictured above at the inaugural event in August 2011). The WRI values its partnership with the RiAus in engaging the community in issues in agriculture.

Dr Paul Willis, moderator of the Debate@The Waite series

> In 2011-2012 the WRI debated, tweeted and blogged with over a thousand people in South Australia and beyond.



4.2 Social Media

Social media refers to a group of internet-based applications that allow the creation and exchange of content among users. The use of social media by both the general public and organisations has been increasing rapidly in recent years. The most common applications used by Australians include Facebook, LinkedIn and Twitter.

The WRI has maintained a Facebook page, Twitter profile and WordPress blog since its launch in 2010, as well as a YouTube channel (for video sharing) and Flickr profile (photo sharing). A Waite Research Institute LinkedIn group was started in May 2012. Each of the main platforms has a slightly different demographic profile. Likes on the WRI Facebook page mostly come from current and past students, Waite Campus staff and interested people from Australia

Summary of WRI community engagement interactions (numbers current at end January 2013)

463 Debate@The Waite total unique attendance

157 Debate@The Waite average registrations

770 Twitter followers

171 Facebook likes

43 LinkedIn group members

104 Total number of blog posts

4,063 Blog visitors in 2011

6,968 Blog visitors in 2012

14,161 WRI website – unique page views in 2011

19,495 WRI website – unique page views in 2012

and overseas. The WRI LinkedIn group is largely Waite Campus staff but is increasing to include people who do business with the Waite Campus. Twitter is our largest platform and includes a broad range of people, including scientists and science communicators, agricultural producers, journalists, politicians and the broader public.

The WRI blog is the foundation of our social media communications. Information on all of the debates and other events, news (such as awards and conferences) and research stories is posted on the blog with links to relevant websites and staff pages. These posts are then replicated on the Facebook page and LinkedIn group and also sent out through Twitter. Opportunistic updates are also made on each of the platforms, depending on the content and the target audience.

One of our biggest successes has been the combination of Twitter and the Debate@The Waite. Each debate has been 'live-tweeted', with one tweet every few minutes during the debate, summarising the main points of each speaker. To allow people to follow the debate we have been using the hashtag #AgChatOz, a link to the social media group of the same name which runs regular organised discussions for those interested in agriculture. The WRI acknowledges the support of AgChatOz in engaging with those who are unable to attend the debates in person.

4.3 Conference sponsorship

The WRI co-sponsored a number of scientific conferences and other events related to agriculture held in Adelaide and at the Waite Campus in 2011-12. The key criteria for sponsorship support were that these events must attract national and international researchers to the Waite, and/or raise the profile of the Waite and the WRI. The total amount of conference sponsorship provided by the WRI to the end of 2012 was $25,000.

The events supported by the WRI in 2011-12 were:

August 2011	The Crawford Fund Parliamentary Conference, Canberra. *The supermarket revolution in food: good, bad or ugly for the world's farmers, consumers and retailers?*
September 2011	The 15th Australian Barley Technical Symposium. Adelaide
September 2011	Crush 2011 – the grape and wine science symposium. Waite Campus, Adelaide
November 2011	Agriculture Institute Forum, Waite Campus, Adelaide. *Producing more food with fewer resources.*
February 2012	A National Forum on Food Security. Adelaide
October 2012	Natural Resources in Demand – Global and Local Perspectives. Waite Campus, Adelaide
November 2012	Crush 2012 – the grape and wine science symposium. Waite Campus, Adelaide

WRI and the Waite partnerships

The Waite Research Institute keeps alive the vision of Peter Waite by supporting the collective interests of the Waite Campus organisations. We do this by facilitating collaborative activity and communications, sponsoring and organising campus-community building exercises like Peter Waite Day and supporting collaborative initiatives such as conferences and workshops that bring the Waite organisations together or bring other scientists from the national and international arena to the Waite.

The Waite partnerships are an integral and valuable part of the Campus and its collegiate culture. The major achievements and contributions of the Waite organisations in 2011-12 are listed here.

The WRI's most significant partner on the Waite Campus is The University of Adelaide's School of Agriculture, Food and Wine.

THE SCHOOL OF AGRICULTURE, FOOD & WINE (AFW)

http://www.adelaide.edu.au/afw

LOCATION: Building 20, Hartley Grove, Waite Campus Urrbrae

One of five Schools within the Faculty of Sciences at The University of Adelaide, AFW is a world-class concentration of scientific research, education and product-conferring capability, the centrepiece of the Southern Hemisphere's largest collection of expertise in plant genomics, crop improvement, sustainable agriculture, dry land farming, horticulture, viticulture, oenology, wine business and food and health. The School currently comprises 45 academic staff, 165 research postgraduate students, 130 coursework postgraduate students, 550 undergraduates, and 380 externally registered students.

The School is organised into the following research themes:

- Farming Systems
- Food & Nutrition
- Plant Breeding & Genetics
- Plant Protection
- Plant Physiology, Viticulture & Horticulture
- Soil Science
- Wine Science

Highlights in 2011-2012

The School of Agriculture, Food & Wine received $19m over seven years from the Australian Research Council in 2010/11 to establish the new national Centre of Excellence in Plant Cell Walls. Significant funding of $4.5m over three years was also received from the Australia-India Strategic Research Fund for chickpea research. The Adelaide node of the ARC Centre of Excellence for Plant Energy Biology was also established at the Waite during this period.

Staff of the School and its Centres took out numerous honours and awards in 2011-12, including Professor Peter Langridge as SA's 2011 Scientist of the Year, Professor Geoff Fincher's 2011 BioinnovationSA Industry Leader Award, Professor Mike McLaughlin's 2011 International Plant Nutrition Institute (IPNI) Science Award and Professor Bob Gibson's Alexander Leaf Distinguished Scientist Award for Lifetime Achievement. Younger researchers also did well, with success for Dr Kerry Wilkinson and Dr Matt Gilliham at the SA Tall Poppy Awards, and Matt Gilliham's DAFF Science and Innovation Award, both in 2012.

Major publication success also flowed, with Professor Peter Langridge's involvement in no less than three *Nature* papers and Dr Matt Gilliham's *Nature Biotechnology* paper.

The School of Agriculture, Food and Wine houses a number of specialist research centres and entities.

FOODPLUS RESEARCH CENTRE

www.adelaide.edu.au/foodplus

LOCATION: Waite Main Building, Waite Road, Waite Campus, Urrbrae

FOODplus, a unit within the School of Agriculture, Food and Wine and joint venture of the Women's and Children's Health Research Institute and The University of Adelaide, undertakes research in food and nutrition as it relates to human health. It plays a key role in setting the national agenda in relation to Food and Nutrition. FOODplus identifies agricultural products that subscribe to the FOODplus mission and develops opportunities to leverage those products. Research focuses on translating nutrition research into food products with health outcomes and economic relationships with industry and coal-face agriculture.

Highlights 2011-2012

In 2011, the FOODplus goup was awarded a NHMRC "Centre of Research Excellence in Food for Future Australians" five-year grant of $2.5m.

Its Director, Professor Bob Gibson was awarded the Alexander Leaf 'Distinguished Scientist Award for Lifetime Achievement' by the International Society for the Study of Fatty Acids and Lipids in May, 2012.

A number of significant publications in prestigious and high-impact journals during this period included a paper on the incidence of maternal depression and neurodevelopmental outcomes in children in the largest ever trial of DHA on pregnant women, published in the *Journal of the American Medical Association* (JAMA), and a paper that showed that junk food feeding in pregnant rats alters the food choices and neural reward pathway of the offspring such that it is more likely for the offspring to consume more fatty foods in later life in the *FASEB Journal*.

In addition, Dr ShaoJia (Jo) Zhou was awarded $4.1m by the NHMRC in 2012 to conduct the ORIP randomized controlled trial to determine if long-chain polyunsaturated fatty acids from fish oil can reduce the incidence of pre-term birth using 5,500 pregnant women.

AUSTRALIAN CENTRE FOR PLANT FUNCTIONAL GENOMICS (ACPFG)

www.acpfg.com.au

LOCATION: Plant Genomics Centre, Hartley Grove, Waite Campus, Urrbrae

The Australian Centre for Plant Functional Genomics (ACPFG) is one of the largest cereal crop genomics research facilities in the southern hemisphere, employing more than 100 research scientists and staff. ACPFG was a key initiator of major projects at the Waite Campus including The Plant Accelerator®, ARC Centre of Excellence in Plant Cell Walls and AGRF. ACPFG has research nodes at The University of Adelaide, The University of Melbourne, The University of Queensland, and The University of South Australia. ACPFG is a joint investment by the Australian Research Council, Grains Research and Development Corporation, South Australian Government and The Universities of Adelaide, Melbourne, Queensland and South Australia.

Highlights 2011-2012

In 2011, ACPFG established a new transgenic field testing site in Western Australia to examine the performance of transgenic lines under saline conditions, with a plan to expand to further WA Government-established field sites in 2013.

In 2012 ACPFG substantially increased their collaborations with two of the most significant international seed companies, DuPont and DowAgroSciences.

In addition, ACPFG expanded into chickpea genomics research with an Australian India Strategic Research Fund award to work with international partners.

ARC CENTRE OF EXCELLENCE IN PLANT CELL WALLS (PCW)

http://www.plantcellwalls.org.au

LOCATION: Level 4, WIC Building, cnr Paratoo Road and Hartley Grove, Waite Campus, Urrbrae

The ARC Centre of Excellence in Plant Cell Walls, a collaboration between the Universities of Adelaide, Melbourne and Queensland, in partnership with SA State Government and seven international institutions, is hosted by The University of Adelaide at its Waite Campus and has nodes at both Melbourne and Queensland Universities. The CoE seeks to advance fundamental scientific understanding of plant cell wall biology, which will subsequently find applications in sustainable biomass production for food security, human health and energy biomass conversion.

Highlights 2011-2012

2011 saw the establishment of the ARC Centre of Excellence for Plant Cell Walls with the official launch on 16 August. By the end of 2012, the Centre had refined its research programs and attracted close to 90 high-quality staff and postgraduate students, 40 of whom are at the Waite node.

Partner investigators from seven institutions in Europe and the USA have visited the Centre's laboratories to progress and develop new projects. One of the first joint publications with international partner investigators was the publication of the barley scaffold genome sequence in the prestigious journal *Nature* in December 2012 and the Centre has attracted additional national and international funding for collaborative projects.

AUSTRALIAN PLANT PHENOMICS FACILITY (APPF) - THE PLANT ACCELERATOR®

www.plantphenomics.org.au

LOCATION: Hartley Grove, Waite Campus, Urrbrae

The Plant Accelerator®, a national facility established under the Commonwealth National Collaborative Research Infrastructure Scheme (NCRIS), is a world-leading plant phenomics facility offering state-of-the-art plant growth environments and the latest technology in high throughput plant imaging for the repeated measurements of the physical attributes (phenotype) of plants automatically and non-destructively. The services enable academic and commercial plant scientists to better understand the factors controlling the performance of particular crops, factors including the genetic make-up of the plants, the soil conditions, chemical and nutrient treatments, and environmental stresses. This facilitates an acceleration of crops improvement - generating crops that are more productive, disease tolerant and viable in marginal conditions.

The APPF has two nodes; The Plant Accelerator® at the Waite and The High Resolution Plant Phenomics Centre involving CSIRO Plant Industry and the Australian National University in Canberra.

Highlights 2011-2012

The Plant Accelerator® had new growth chambers and walk-in rooms along with tri-generation plant facilities installed during 2011. The tri-generation facilities will reduce the running costs and decrease the carbon footprint of the operation. Worth a total of $4m, these additions were funded by the Australian Government's Super Science Initiative / Education Investment Fund.

In 2012, further Australian Government Collaborative Research Infrastructure Scheme (CRIS) funding worth $1.7m was announced for operating costs of The Plant Accelerator® in 2013-2014.

This facility ran tours for several thousand visitors from all over the world in 2011-12.

ARC CENTRE OF EXCELLENCE IN PLANT ENERGY BIOLOGY (ADELAIDE NODE)

The University of Adelaide became a node of the ARC Centre of Excellence in Plant Energy Biology (PEB) in 2011, with Professor Steve Tyerman becoming a Chief Investigator in the Centre in July of that year.

The Centre comprises The University of Western Australia, Australian National University and The University of Adelaide, seven Chief Investigators and over 110 internationally competitive staff and students. It is funded primarily through the Australian Research Council ($12.5m (2005) + $9.8m (2011-2013)) and $13.7m from the partner universities to fund the Centre through to 2013.

The research focus of the Centre is on the metabolic reactions that allow plants to use energy from the sun to produce the oxygen we breathe, the food we eat and remove waste carbon dioxide from the atmosphere. The long-term goal is to comprehend this system well enough to not only understand how plants function at a cellular level, but to be able to design optimal energy metabolism for particular functions (for example, starch, sugar or biofuel production), or in response to harsh environmental conditions.

Highlights 2011-2012

In the period July 2011 to December 2012, PEB Adelaide node had a number of successes, including the launch of Professor Steve Tyerman's co-authored book, *The Grapevine*, and Dr Matt Gilliham's publication successes. The announcement of the *Nature Biotechnology* paper triggered widespread national interest, with senior author, Waite Campus researcher Dr Matt Gilliham featured in both city and regional newspapers and radio. The work also featured in Scientific American's Guest Blog when the printed journal was circulated in April 2012. The story was featured as one of the top 10 science stories from Australia and the world in 2012 by the Australian Science Media Centre, along with the Curiosity landing on Mars and the Higgs boson.

The School of Agriculture, Food & Wine is a partner in the Wine Innovation Cluster (WIC), which brings together four of the leading R&D providers in the wine and grape sector.

wineinnovationcluster.com
Synergy in grape & wine research

THE WINE INNOVATION CLUSTER

www.wineinnovationcluster.com

LOCATION: Wine Innovation Central Building, Cnr Hartley Grove and Paratoo Road, Waite Campus, Urrbrae

The WIC is a virtual entity and partnership of four leading Australian grape and wine research agencies. Based on the Waite Campus, the WIC strives to build collaboration and create synergies in research and development across the co-located partner organisations for the benefit of Australia's multi-billion dollar wine industry.

The WIC represents critical mass in terms of national wine R&D capability; a 2009 audit showed that approximately 60 per cent of the total is located at the Waite Campus and incorporated in the WIC. The WIC was established in recognition of the fact that enhanced coordination and integration of R&D is necessary to build the quality outcomes and effective delivery needed by the wine and grape growing industries to meet the challenges of the future.

Collectively, the WIC partners cover the entire grape and wine research, development and extension spectrum and the WIC is continuously exploring opportunities for collaborative research projects. Since it was established in 2008, the WIC partners have worked on more than 24 collaborative projects that have attracted more than $10m external funding; strong industry partnerships on many of them attest to their relevance.

Highlights 2011-2012

The WIC organised and hosted two highly successful national symposia on grape and wine science in September 2011 and November 2012. These 'Crush' events were held at the Waite Campus and attacted 180 and 140 researchers, higher degree students and industry representatives respectively.

During this period the WIC also made significant progress in developing a more systematic, transparent and monitored approach to discussing and submitting joint EOIs/applications for grant funding, enhanced communication across the partner organisations and worked more closely with industry partners on specific field trials and projects.

The WIC has also been busy creating opportunities for greater engagement with the GWRDC and industry bodies to ensure alignment of research priorities. In 2012, 50 per cent of the total grant applications from across the Waite-based partner organisations in two of the GWRDC's priority funding areas were joint WIC proposals. With several of these applications funded, the WIC is going from strength to strength, and in late 2012 applied for an ARC-funded Industrial Transformation Training Centre in wine, to be based at the Waite Campus.

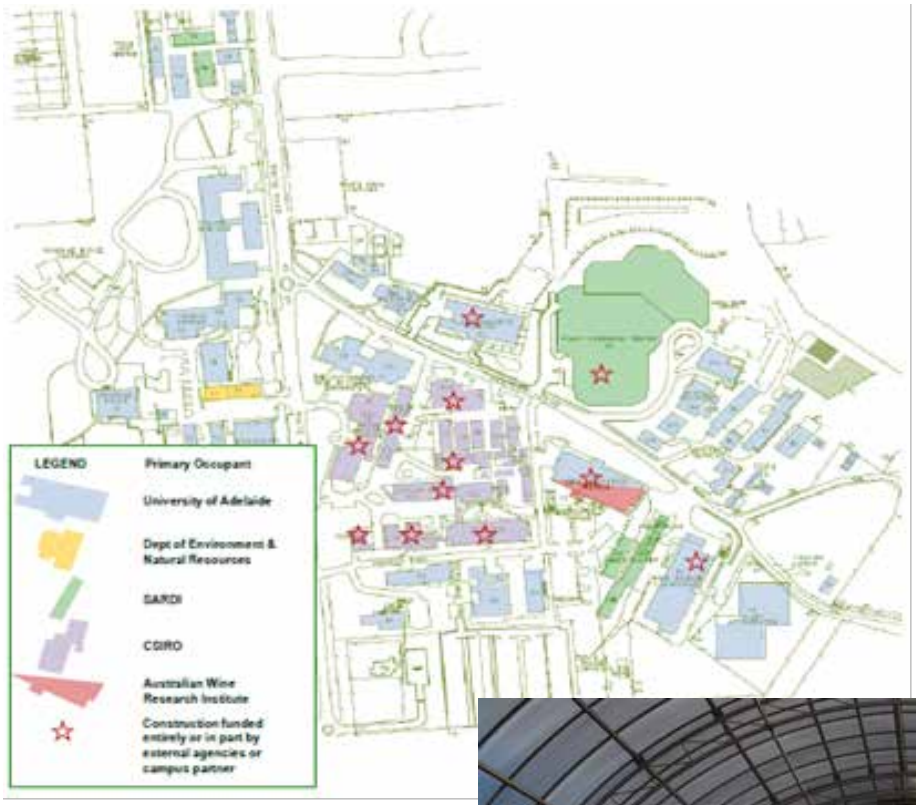
NON-UNIVERSITY PARTNERS

The Waite Campus is unique in the number of non-University research partners located on it.

These partners include Federal and State government agencies as well as national research centres and industry-funded organisations such as the Australian Wine Research Institute. Some partners have been on the campus for many decades but, irrespective of their period of residency, all have added greatly to the richness of the research environment. They have invested in buildings and other infrastructure and have formed effective collaborative relationships with each other.

The Wine Innovation Cluster is a recent example of the latter but there are also numerous bilateral links. The co-location model that epitomises the Waite Campus is universally admired and has helped maintain the reputation of the campus, and therefore The University of Adelaide, as the leading academic agricultural research institution in Australia.

The co-location of several R&D organisations and shared infrastructure is one of the unique features and strengths of the Waite Campus.



COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION (CSIRO)

www.csiro.au

LOCATION: Prescott, Taylor, Cornish and WIC West buildings, Waite Campus, Urrbrae

CSIRO has parts of four divisions based at the Waite Campus - Ecosystem Sciences, Land and Water, Computational Informatics and Plant Industry. CSIRO conducts agricultural research to help improve the profitability and sustainability of Australian farms, the quality and yield of Australian grain, horticultural and fibre crops and Australia's food production and farming systems to ensure food and fibre are delivered to Australians on a sustainable basis.

Highlights 2011-2012

CSIRO's Waite-based researchers support the agricultural, environmental, sustainability and natural resource management sectors through key research themes.

The development of innovative solutions to Australia's land and water management challenges occurs through research areas that include groundwater and surface water hydrology, soil and landscape science, contaminant chemistry and ecotoxicology, catchment biogeochemistry and aquatic ecology, water reuse and environmental process engineering, natural resource management policy and economics, and identification of opportunities and policy options for improving the use of land and water resources. Most of this work contributes to the Water for a Healthy Country Flagship.

CSIRO plant science on the Waite Campus aims to improve the performance of horticultural crops across the production, processing and marketing chain by developing improved genetic material from molecular and conventional breeding, and by generating better plant management techniques.

An important Waite focus is research for the Australian grape and wine industry, targeting aspects such as fruit quality (berry colour and flavour), disease control, flowering and fruit set and improved rootstocks.

A CSIRO team led by Dr Chris Davies established the crystal structure of an Indole-3-Acetic Amido Synthetase from grapevine involved in auxin (plant hormone) homeostasis. This significant science achievement, involving collaboration between scientists in CSIRO Plant Industry at the Waite Campus and CSIRO Materials Science and Engineering (Melbourne), was published in *Plant Cell* 24: 4525-4538.

CSIRO Plant Industry at the Waite is also playing a critical role in understanding how plants resist attack by fungal and oomycete pathogens. The introduction of durable and effective resistance genes into grapevines will lead to increases in productivity and quality through a reduction in the dependence on chemical inputs for disease control.

CSIRO farming systems research at the Waite is focused on the biophysical performance of farming systems and agricultural land with the aim of identifying management solutions that improve production along with environmental and economic performance. This research integrates expertise in field experimentation, plant-soil sciences, ecology, soil microbiology, simulation modelling, spatial technologies and bio-economics and contributes to the Sustainable Agriculture Flagship.

CSIRO's Computational Informatics is creating a capability hub in key research areas including next generation data analytics, autonomous robotics, complex systems modelling, and decision making under uncertainty. Computational Informatics aims to transform information and decision making to enhance productivity, foster collaboration and deliver impact through services across a range of sectors.

AUSTRALIAN WINE RESEARCH INSTITUTE (AWRI)

www.awri.com.au

LOCATION: Levels 2 & 3, Wine Innovation Central Building, cnr Paratoo Road & Hartley Grove, Waite Campus, Urrbrae

The Australian Wine Research Institute, incorporated in 1955, has contributed substantially to the success of the Australian wine sector since then, striving to deliver value to Australian grape and wine producers with world-class research and development, as well as integrated

information and knowledge extension, education and commercial services activities. Priorities for research, development, extension and commercial services are driven by the Australian grape and wine sector. AWRI's staff aim for fundamental understanding and direct industry application and are specialists in traditional and cutting edge disciplines such as: winemaking, sensory science, organic and analytical chemistry, chemical engineering and life cycle analysis, mass spectrometry and spectroscopy, bioinformatics and chemometrics, biochemistry, molecular biology, metabolomics and systems biology, microbiology, fermentation management, and knowledge and information management.

Highlights 2011-2012

Breakthrough in Brett. In a 'world first', the genetic blueprint of the predominant *Dekkera (Brettanomyces) bruxellensis* strain found in Australian wineries has been determined. This brings 'Brett' research and the winemakers' battle against barnyard-like taints in their wine into a new era. It will enable the search for genes that confer tolerance to sulfite and the ability to grow in (and spoil) wine. We can now learn what makes this yeast so resilient and identify 'chinks in its armour' to future-proof winemakers' control strategies against strains with increased SO2 tolerance.

Fight against downy mildew. The seasonal conditions and shortages of chemicals put a lot of pressure on the grape sector. The AWRI played an important role in alleviating the stress on growers through the dissemination of information on control strategies. Ten eBulletins or agrochemical updates were issued. Visits were made to regions in NSW and SA to appreciate better the difficulties being faced. Emergency use permits for agrochemicals were obtained from the APVMA. Special efforts were made to inform and engage stakeholders about the potential use of phosphorous acid for the control of downy mildew. Strategies for botrytis control in the vineyard and laccase in the winery were delivered in presentations held in Mudgee, Orange and Canberra.

Measuring wine style. In a world first, scientists fully developed the concept of measuring wine style using a simple spectral scan. Multiple samples of wines made from the synonymous Pinot Grigio / Pinot Gris grape variety were scanned to take their 'fingerprints', and information obtained from the scans was then calibrated against expert taster's ratings of the Grigio-ness or Gris-ness of the wines' style. Using the calibration, the style of other Pinot Grigio and Pinot Gris wines can now be measured simply by scanning them, without the need for tasting. All Australian wine producers now have access to this technology via a labelling device called the PinotG Style Spectrum, which informs customers of the style of the wine inside the bottle before they purchase or consume it. The concept has also been shown to work for Chardonnay wines.

Bound flavour and aroma compounds released in the mouth. As part of the AWRI's studies into smoke taint, a non-volatile glycoside (sugar molecules joined to aroma compounds) fraction isolated from smoke-affected grapes was found to give smoky flavour when tasted. This shows that these compounds, which were previously regarded as flavourless, can be broken down during the short time of tasting to release flavour. This research has been extended to evaluate desirable flavours in wines and how it relates to both intensity and persistence of fruity flavour when wines are tasted.

Government of South Australia

SARDI RESEARCH AND DEVELOPMENT

SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE (SARDI)

www.sardi.sa.gov.au

LOCATION: Plant Research Centre, 2b Hartley Grove, Waite Campus, Urrbrae

SARDI, a division of the South Australian Department of Primary Industries and Regions (PIRSA), is the SA Government's principal research and development institute focused on primary and food industries, creating opportunities to ensure the agriculture, food, aquatic and bioscience industries are internationally competitive and ecologically sustainable. SARDI focuses on Aquaculture, Animal Reproduction, Animal Welfare, Low Rainfall Farming Systems, Plant and Soil Health, Water Resources, Fisheries Management, Marine Ecosystems, Food Safety

and Innovation and Climate Adaptation. SARDI has 400 scientific, technical and support staff across 13 Regional Research facilities in South Australia. Headquartered on the Waite Campus, SARDI Waite based scientists deliver innovative solutions to: manage pest and diseases in grains and horticultural crops; address biosecurity and food safety as it impacts on the food supply chain and export market access; sustainably utilise natural resources in the context of premium food and wine production; and develop risk and adaptation strategies which underpin economic growth in a variable and changing climate.

Highlights 2011-2012

In 2012, SARDI celebrated 20 years of delivering innovative research to boost the productivity, quality and biosecurity of South Australia's agriculture and food industries.

Among many achievements, SARDI developed a molecular marker specific to the naturally occurring genes for tolerance to cereal cyst nematode disease in oats, a disease which can cause up to 80 per cent yield loss in this most CCN susceptible cereal crop. The newly released SARDI oat variety – Wombat – has both resistance and tolerance to this significant disease.

Meanwhile, SARDI Molecular Diagnostics has developed a suite of DNA-based diagnostic tests to help the Australian potato processing industry overcome losses of more than $80m in quality rejections and reduced yields.

Building on 20 years of strong industry, commercial and academic collaborations, SARDI has strengthened its leadership of research and development in fishing and aquaculture, food safety, grains, viticulture, pork, poultry, climate adaptation and animal welfare.

AUSTRALIAN GRAIN TECHNOLOGIES PTY LTD (AGT)

www.ausgraintech.com

LOCATION: Level 1, WIC Building, Waite Campus, Urrbrae

Australian Grain Technologies Pty Ltd (AGT) is Australia's largest wheat breeding company. AGT was established in June 2002 as part of a national initiative to re-focus and re-position Australia's wheat breeding efforts in a rapidly changing, highly competitive, global economy. The original shareholders of AGT were the Grains Research and Development Corporation (GRDC), the South Australian Research and Development Institute (SARDI), and The University of Adelaide (UA). AGT began by consolidating more than 100 years of wheat breeding activities formerly managed by UA at both the Waite and Roseworthy Campuses with those undertaken by the Victoria Department of Agriculture (now Department of Primary Industries) at Horsham, establishing major breeding operations at Roseworthy in South Australia and Horsham in Victoria. In 2003 AGT took over the management and operations of the National Triticale Improvement Program (NTIP) funded by GRDC and formerly conducted under the auspices of UA. In 2005, AGT merged with SunPrime Seeds Pty Ltd. In 2007, the formal establishment of a major breeding operation in Western Australia was created in the form of a partnership between AGT and the Council of Grain Grower Organisation (COGGO). In July 2008, Vilmorin & Cie, a wholly owned subsidiary of Limagrain Holdings of France purchased a 25% shareholding in AGT. In 2009, the University of Sydney and GrainCorp Limited sold their shareholdings to the GRDC and Vilmorin & Cie.

AGT's success depends on its ability to meet the current and future needs of the Australian grains industry and the demands of growers and their markets. With comprehensive wheat breeding operations based in each of Australia's four major wheat production zones, it is a national enterprise based at the Roseworthy and Waite campuses.

AGT is an independent company with governance oversight by a Board.

Highlights 2011-2012

Australian Grain Technologies (AGT) is Australia's market leading wheat breeding company providing long term benefits to wheat producers through the delivery of varieties with improved grain yield, quality and disease resistance attributes. AGT holds the largest market share with more than 30% of the Australian wheat crop sown to AGT varieties.

In 2007, AGT introduced Seed Sharing to the Australian market. This innovative system provides a legal avenue for farmers to trade seed of new varieties to one another. Seed Sharing has been strongly embraced and supported

by growers in recent years, ensuring that new AGT varieties with superior performance have been adopted rapidly and the economic benefit these varieties are broadly disseminated in the shortest possible timeframe.

AGT is also at the forefront of breeding R&D and the application of new selection technologies in its breeding programs. AGT utilises cutting edge technologies such as molecular markers, controlled environments, summer nurseries and statistical tools to increase rates of genetic gain in its breeding programs. The combination of these technologies has led to the release of the highest yielding milling wheats in the southern and western zones (Mace) and the northern zone (Suntop). AGT is also the only Australian wheat breeding company to have delivered two gene Clearfield® wheats to the market. These varieties allow wheat producers to control "in crop" weeds using the imidazolinone herbicide "Intervix".

AUSTRALIAN GENOME RESEARCH FACILITY (AGRF)

www.agrf.org.au

LOCATION: Plant Genomics Centre, Hartley Grove, Waite Campus

AGRF, a not-for-profit incorporated company established under the Commonwealth Major National Research Facility (MNRF) Program, is Australia's largest provider of genomics services and solutions. AGRF has laboratories in Brisbane, Sydney, Melbourne and Adelaide. The Adelaide node is the national centre servicing the agriculture and related industries and provides a full range of applied genomics, array fabrication, bioinformatics, epigenomics and structural genomics, gene expression, genotyping, nucleic acid extraction, plant growth and stress research techniques, sequencing and next-generation sequencing services and long-term storage facilities.

Highlights 2011-2012

Genetic ID Validation

The Waite based node specialises in the development of techniques for and the validation of the genetic identity of resources. It developed diagnostic genetic ID databases for species as diverse as olives, almonds, grapevine and jujube. These databases are vital for breeders' validation of germplasm and varieties and to ensure product integrity in the market. The databases are available as a service to the research, community and industry sectors.

Emerging Genomic Technologies and Platform Assessment

Access to emerging state of the art technologies/ platforms is vital for the Australian genomics communities' international relevance and competitiveness. A major role of AGRF is the sourcing, validation and subsequent provision of emerging genomic technologies and platforms to the Australian research, clinical and industry sectors. AGRF is currently assessing the rapidly evolving high-throughput next and third (single molecule) generation platforms. AGRF purchased and assessed two Ion Torrent (now called PGM) desktop next generation sequencers. These were provided to the local Waite community at a substantially discounted rate to encourage researchers to use the technology and explore novel ways they could utilise NGS in their research programs. The lead AGRF scientist, Paul Gooding, has been regularly placed in the top ten in the world for data quality and output from the PGM instrument by LifeTech, one of the major genomics platform/instrumentation development and manufacturing companies.

Bioplatforms Australia (BPA) Framework Datasets

AGRF is a key participant in the development of Framework genomic data sets for Australia. These are coordinated through Bioplatforms Australia (BPA). BPA is a Commonwealth government strategic funding organisation to provide scientific infrastructure and research services in the specialist fields of genomics, proteomics, metabolomics and bioinformatics. The BPA Framework data sets of direct interest to the Waite include Wheat and Soil Biodiversity.

The Soil Biodiversity Framework dataset program is providing a meta-genomics mapping of soil communities and organisms from a variety of farming and

environmental cross-sectional environments and habitats. Dr John Stephen, Agriculture Node Manager provided significant input into the design and delivery of this project. The node's role is the main lab for sample preparation and genetic material extraction including the use of a new Aurora extraction system for the recalcitrant samples.

Other collaborators on this program include scientists from the National Parks (DPN); Western Australian Department of Environment and Conservation (DECWA); Department of Primary Industries (DPI) in Victoria; several universities and research and development corporations and CSIRO are going to undertake a project to map Australia's soil biodiversity. The project also includes support from the Science and Industry Endowment Fund (SIEF) as part of a larger project looking at developing innovative tools and approaches in economics.

This large project will form a fundamental reference dataset for soil biologists nationally.

arris agricultural & environmental

arris marketing communications

arris water treatment & technology

ARRIS PTY LTD

www.arris.com.au

Location: Hartley Grove, Waite Campus, Urrbrae

Arris is an innovative Australian consulting and communications company, providing services in three distinct areas: agricultural and environmental services, water management and marketing communications. The Arris team has a unique mix of qualifications and experience in science, water, agriculture, communications, event management, education and training, graphic design, web design and computer technologies and provides services for a diverse range of clients.

Arris has been located at the Waite Campus for more than 10 years. This location allows us to provide our clients with a full range of services, as well as access to some of the world's leading researchers and organisations.

Highlights 2011-2012

The past 18 months have been an exciting time of growth and development for Arris, with a water business integrated into the Arris brand.

The Arris environmental team has been working on brine management, environmental studies and development approvals for the Sundrop Farms solar powered glasshouse project.

Arris' water team has built an ion exchange pilot treatment plant for the treatment of coal seam gas associated water for WestSide Corporation in Queensland.

The communications team has spent the last nine months working in-house with the Department of Environment, Water and Natural Resources, delivering specialist communication services for their Water Knowledge Projects – this involved the development and implementation of a communications strategy, the design and development of communications tools and targeted stakeholder engagement.

Arris has been working with Space Down Under, installing and trialling the use of modified water treatment solids (WTS) as a structural soil enhancer. Space Down Under has patented the use of modified water treatment solids (WTS) as a structural soil enhancer and is achieving excellent feedback and results.

Arris is delivering a project for the Biodiversity Fund, which involves the revegetation of a semi-arid environment on the Central Eyre Peninsula, with an emphasis on establishment success and the monitoring and measurement of carbon sequestration.

Arris installed a wastewater treatment and reuse system at a mining campsite for use by 5-8 people in South Australia. Arris works with Hydroscape to supply domestic Fuji Clean systems for on-site and decentralised wastewater treatment applications. Arris designs, obtains regulatory approvals, instals, operates and maintains these systems, which are suitable for mining camps and re-locatable construction facilities.

Research stories from the Waite

VITICULTURE AND WINE

Genome is key to future proofing 'Brett' management

Dr Chris Curtin, Dr Anthony Borneman, Dr Paul Henschke, Peter Godden, Dr Paul Chambers and Prof Isak Pretorius (AWRI)

'Brett' character is the most significant microbial spoilage issue faced by winemakers in Australia over the past two decades. The 'medicinal' and 'metallic' character is caused by a wild yeast species, *Dekkera (Brettanomyces) bruxellensis*, that occurs naturally on grape skins.

Throughout the early 2000s, the Australian Wine Research Institute (AWRI) developed a nationwide 'Brett' control strategy. This comprehensive strategy involved improving oak barrel hygiene and low doses of sulphites in combination with pH management. To future-proof this widely-adopted control strategy, AWRI researchers took a proactive approach to tackling potential sulphite resistance. Genome sequencing of the three major strains of *D. bruxellensis* found in Australian wineries was initiated to crack the yeast's genetic code and identify its weak spots.

Assembly of the whole genome sequence for the AWRI 1499 strain was completed in 2011. This strain is one of the most common in Australia and has a relatively high level of sulphite tolerance.

Sequencing the 'Brett' genome meant that the potential for an emergence of a 'super' strain resistant to sulphite treatment can be investigated. The most important gene responsible for sulphite tolerance in 'Brett' has already been identified by the team.

This world-first has provided immediate insight into the genes that may facilitate survival of 'Brett' in wine. Researchers can now improve control strategies further by investigating factors that influence 'Brett' spoilage.

This research is funded by the Grape and Wine Development Corporation (GWRDC) with matched funding from the Australian Government.

Rootstocks to combat saline irrigation water

Dr Rob Walker, Dr Mandy Walker, Peter Clingeleffer and Deidre Blackmore (CSIRO Plant Industry); Dr Matt Gilliham and Sam Henderson (The University of Adelaide); and Dr Leigh Francis and Dr Helen Holt (AWRI).

Highly saline irrigation water can lead to high soil salinity and reduced vine health and wine quality in some grape growing regions of Australia. Rootstocks that can exclude salt may mitigate the effects of saline irrigation water and reduce sodium and chloride levels in wines. Previous studies of rootstocks under saline conditions have assessed scion yield, grape and wine composition, pH, titratable acidity and sodium and chloride concentrations, but not the effects of rootstock on wine sensory properties.

Working in collaboration with researchers from CSIRO Plant Industry, AWRI researchers examined wine from selected rootstocks to investigate the effects of saline irrigation water on the sensory properties of wines and University of Adelaide researchers investigated the mechanisms of salt exclusion.

Chloride and sodium exclusion mechanisms in grapevine rootstocks were examined in glasshouse and laboratory studies. Roots of good and poor chloride excluders had similar rates of unidirectional influx of chloride into

roots but good chloride excluders, like the 140 Ruggeri rootstock, restricted chloride entry to the shoots. It also appears that more than one gene is involved with sodium and chloride transport. Candidate chloride transporter genes were assessed and ongoing research will determine any links to chloride exclusion.

The fermentation process had a greater affect on chloride concentrations than sodium concentrations. In Chardonnay, chloride and sodium concentrations increased by 1.4 and 1.1 times respectively in wine compared to grape juice. In Shiraz, chloride and sodium concentrations increased by a magnitude of 2.2 and 1.25 respectively.

Grape growers and winemakers will be able to make more informed rootstock choices as a result of this research and benefit from reduced rejection of fruit and wine by winemakers and domestic or international markets.

This research is funded by the Grape and Wine Research and Development Corporation (GWRDC) with in-kind contributions from the agencies.

Making up for predicted lack of winter rainfall

Dr Michael McCarthy (SARDI) and Dr Everard Edwards (CSIRO Plant Industry)

Climate change projections predict lower winter and spring rainfall and greater rainfall variability. Vines entering the growing season with dry root systems are not able to develop large enough canopies to produce good yields or high quality fruit. In the past, growers have tried to adjust for low winter rainfall by drip irrigating before budburst, but a considerable amount of water is needed to have any effect. Grape growers need to know if drip irrigation will be able to supplement reduced and variable rainfall or if they need to invest in alternative irrigation methods, such as micro-sprinklers.

A three-year research collaboration between SARDI and CSIRO Plant Industry is assessing the effects of drip irrigation systems and micro-sprinkler systems on root growth. During winter, grapevines will be covered with clear plastic shelters to exclude all winter rainfall. Winter and spring rainfall will be simulated with drip irrigation, to partially wet the root zone, or with micro-sprinklers to completely wet the root zone. The shelters, which have no ends or sides, will be removed at budburst so vines experience normal growing conditions.

At different stages of the season, the effect of variable water availability on grapevine roots will be measured, along with the impacts on vine storage reserves, root zone water content and climate indices. The researchers will also look at the options for managing the salt that builds up in the soil profile in the absence of leaching winter rainfall.

This research is working to secure the future of Australia's wine regions by ensuring grape growers are able to remain economically sustainable in a changing climate.

This research is funded by GWRDC with matched funding from the Australian Government.

Yeast and bacteria by design – directing evolution to enhance winemaking

Prof Vladimir Jiranek, Dr Michelle Walker (The University of Adelaide) and group.

Yeast and bacteria are essential to winemaking and must be able to thrive in challenging conditions to achieve good fermentation. Juices can often be high in sugar or acid and wines can be high in alcohol, which can limit these organisms in the primary (yeast) and malolactic (bacteria) fermentations. Existing commercial strains don't always cope with these challenges and isolating more strains from wineries is unlikely to yield rapid improvements for winemakers.

With these new analytical methods, the AWRI has been able to provide advice to grape growers and winemakers on harvesting after a smoke event.

Markedly improved yeast strains have been generated by this research group using the non-recombinant directed evolution technique. Directed evolution imitates the mutation, selection and amplification processes of evolution in the laboratory, where genes coding for proteins or enzymes of interest are mutated to ultimately create a large number of variant strains of the organism. These are then screened for the desired characteristics.

Using this technique, desirable attributes can be enhanced, undesirable characteristics diminished or many desirable attributes combined into a single strain. Once generated, the strains undergo extensive laboratory trials and pilot studies to determine their oenological properties, in particularly their impact on sensory qualities.

The research team is building on their success to further improve yeast strains as well as extend the technique to lactic acid bacteria. Their goal is to create a collection of yeast and bacteria that are better able to effect fermentation, despite the challenges of the winemaking process. Armed with the knowledge of which genes and processes have changed to yield the improvement, the group will be able to advise winemakers on fermentation management practices and nutritional supplements.

This four-year project is expected to start to yield prototype strains within two years. These will be trialled with the help of industry partner Lallemand and local wineries.

Funded by the Grape and Wine Research and Development Corporation (GWRDC).

New methods to identify grapes tainted by bushfire smoke

Dr Yoji Hayasaka, Mango Parker, Gayle Baldock, Kevin Pardon, Dr Cory Black, Dr Markus Herderich, Dr Leigh Francis, Dr Christine Mayr (AWRI)

Wine produced from grapes exposed to smoke often has an 'ashy' aftertaste or lingering ash flavour and can be downgraded or unsaleable. It is not possible to stop the uptake of smoke compounds or fully remove smoke-derived compounds from affected grapes or wines.

Harvesting earlier could deliver a lower alcohol wine that consumers like as much as, or even prefer to, a fuller style wine.

With increasing incidence of bushfires near wine grape growing regions, the AWRI has been developing strategies to detect and measure smoke exposure. Two analytical methods have been developed to assess smoke exposure in grapes and wine. The methods measure the volatile phenols in bushfire smoke and identify the many metabolites of these volatile phenols (phenolic glycosides) formed in grapes following smoke exposure. This research showed that phenolic glycosides are partially responsible for negative sensory characters of smoke-tainted wine. Volatile phenol concentrations also have an influence.

Phenolic glycoside concentrations are good markers for the intensity and duration of smoke exposure and the potential for smoke taint to develop in wine. The relative intensity of smoke exposure can even be determined in samples where the concentration of volatile phenols is very low or where negative sensory characters are not obvious early in the winemaking process. The natural abundance of many free and bound smoke compounds was also measured, so that grapes not affected by smoke can also be identified.

With these new analytical methods, the AWRI has been able to provide advice to grape growers and winemakers on harvesting after a smoke event.

This research is funded by the Grape and Wine Research and Development Corporation (GWRDC) with matched funding from the Australian Government.

Less alcohol, not less taste

Dr Chris Curtin, Dr Cristian Varela, Dr Darius Kutyna (AWRI)

The wine industry is actively seeking technologies and processes for producing lower alcohol content wines for health, economic and quality reasons. The AWRI has taken an integrated approach, incorporating viticultural practices, fermentation and winemaking strategies as well as post-fermentation practices and processing technologies, to address this challenge.

In a sequential harvest trial, AWRI researchers picked Cabernet Sauvignon grapes at five maturities to deliver wines with alcohol contents ranging from 11.8% v/v to 15.5% v/v. Delaying harvest can produce grapes with a fuller flavour and reduced green characters responsible for vegetal or herbaceous characters in wines. Consumer preference did not change with maturity – consumers liked wines with 13.6% v/v alcohol as much as wines with up to 15.5% v/v alcohol. Harvesting earlier could deliver a lower alcohol wine that consumers like as much as, or even prefer to, a fuller style wine.

Another option for producing reduced alcohol wines is to generate wine yeasts that produce less alcohol from the same amount of sugar. This would allow flavour-ripe grapes to be harvested and used to produce lower alcohol content wines. The AWRI is tackling this technical challenge in two ways. Yeast metabolism has been genetically modified (GM) so that they produce less ethanol. The AWRI's best GM prototype strains produce up to 2% v/v less alcohol in Chardonnay and have been modified to minimise any impact on the aroma profile of the wine. Some strains have been modified with non-GM approaches and achieve similar ethanol yields, but further optimisation is needed to reduce sensory defects.

This research is funded by the Grape and Wine Research and Development Corporation (GWRDC) with matched funding from the Australian Government.

FOOD FOR HEALTH AND WELLBEING

Waite analytical expertise used to track iodine status of women

Dr Jo Zhou and Dao Hoa Anh Huynh (The University of Adelaide) and Lyndon Palmer (Waite Analytical Services)

Iodine is essential for synthesising thyroid hormones that are needed for normal development of a baby's brain and nervous system, both before and after birth. During pregnancy and breastfeeding, babies are almost entirely dependent on their mothers to supply these thyroid hormones. It is vital that pregnant and breastfeeding women get sufficient iodine.

The iodine status of pregnant and lactating women in South Australia is being investigated in a collaborative research project run through the Women's and Children's Health Research Institute (WCHRI) at the Women's and Children's Hospital in Adelaide. As part of this project, Dr Jo Zhou from the University of Adelaide's FOODplus group is principal investigator of a clinical trial called 'Pregnancy Iodine and Neurodevelopment in Kids' (PINK). This is the first study of this type since iodine fortification of commercially-produced bread in Australia became mandatory in 2009.

To measure iodine levels in breast milk, the research team enlisted the help of local experts in measuring trace elements in biological materials – the Waite Analytical Service (WAS). Over the past year, Lyndon Palmer, WAS, has worked with Dr Zhou and PhD student Dao Hoa Anh Huynh to develop a robust method to collect, store, extract and analyse iodine levels in breast milk from over 750 Adelaide women.

This work will help to determine if the iodine intake of pregnant and lactating women in South Australia is sufficient and investigate the relationship between a mother's iodine status and the neurodevelopmental outcomes of their children.

This research is funded by the National Health and Medical Research Council (NHMRC).

Essential fats in chicken and eggs – improving health and market value

Prof Bob Gibson, Dr Sue Bastian and Dr John Carragher (FOODplus Research Centre, The University of Adelaide), Lilik Kartikasari (Sebelas Maret University, Indonesia), Dr Bob Hughes and Dr Mark Geier (The University of Adelaide and SARDI), Prof Maria Makrides (The University of Adelaide and WCHRI), and Prof James House (University of Manitoba, Canada)

Low-cost, sustainable, flaxseed oil diets can be used to improve the nutritional value of chicken meat and eggs.

Omega 3 (n-3) fatty acids are essential for many processes in the human body. Our bodies cannot manufacture long-chain omega 3 fatty acids; we need to obtain them through our diet. Improving omega 3 fatty acid levels in chicken meat and eggs has the potential to improve human health and increase their market value.

In a highly successful collaboration between FOODplus, the University of Adelaide's School of Animal and Veterinary Science, SARDI's poultry nutrition group and the University of Manitoba, Canada, researchers have investigated using vegetable oils in chicken feed to increase omega 3 fatty acid levels in meat and eggs.

By adding different amounts of vegetable oils to otherwise identical feed, the researchers were able to manipulate levels of dietary linoleic acid (LA) and alpha linolenic acid (ALA). The meat from chickens fed a diet low in LA and high in ALA had 3–4 times more n-3 long chain polyunsaturated fatty acids (i.e. eicosapentaenoic acid, EPA; docosahexaenoic acid, DHA) than meat from chickens on the standard diet. Levels in eggs doubled compared to those laid by chickens on the standard diet. Increases in total n-3 polyunsaturated fatty acids (ALA, EPA, DHA and docosapentaenoic acid, DPA) were even greater – 9-fold in meat and 10-fold in eggs.

This research demonstrated that low-cost, sustainable, flaxseed oil diets can be used to improve the nutritional value of chicken meat and eggs. This was achieved without compromising chicken growth rates, feed conversion ratios, mortality rates or the sensory aspects of chicken products.

This Constellation SA-Manitoba Initiative funded study was managed locally by the Department of Education, Employment, Science and Technology (DFEEST).

International collaboration develops 'super spaghetti'

A/Prof Rachel Burton and Prof Geoff Fincher (PCW, The University of Adelaide)

Researchers from the University of Adelaide are collaborating with Italian colleagues to produce a 'super' spaghetti that is beginning to excite scientists, nutritionists and food manufacturers around the world.

The super spaghetti has a range of potential health benefits for consumers, including reducing the risk of heart disease and colorectal cancer according to A/Prof Rachel Burton, Program Leader with the Australian Research Council (ARC) Centre of Excellence in Plant Cell Walls.

A/Prof Burton leads two projects investigating key aspects of cell walls in durum wheat – the wheat commonly used to make pasta. In collaboration with the University of Bari, Italy, the relationship between wheat growth and starch and dietary fibre levels will be investigated with the aim of improving fibre levels in pasta. The roles played by the two major components of dietary fibre – arabinoxylans and beta-glucans – in the quality of pasta and bread dough will also be examined in conjunction with the University of Molise, Italy.

The super spaghetti has a range of potential health benefits for consumers, including reducing the risk of heart disease and colorectal cancer.

These projects highlight one of the great strengths of the Centre of Excellence – bringing together complementary expertise and resources from around the world to produce meaningful research outcomes for industries and communities worldwide. As part of this highly successful collaboration, the Centre of Excellence is currently hosting a PhD student from the University of Bari. Australian researchers have also been hosted in Italy and further visits are planned.

With Italians consuming approximately 27 kilograms of pasta per person each year, compared to four kilograms per person in Australia, there are many potential economic benefits of producing higher quality wheat and pasta products. South Australian durum wheat growers could have greater access to Italy's competitive wheat market and South Australian and Italian pasta manufacturers could develop niche markets for specialist pasta products with added health properties.

Funding for the South Australian component of the projects is provided by the SA State Government, Department of Premier and Cabinet and the ARC Centre of Excellence in Plant Cell Walls.

New guide promotes nutritional value of seafood

Dr Andreas Kiermeier and Dr Cath McLeod (SARDI)

A scarcity of nutritional data for key Australian seafood species such as yellowtail kingfish, wild banana prawns and Pacific oysters prompted the Australian Seafood Cooperative Research Centre to develop the Super Seafood guide.

Researchers from SARDI's Food Safety and Innovation science program collected data for the guide, which is the first major update in more than 10 years. Comprehensive laboratory testing of wild and farmed Australian seafood used more advanced testing methods than previous studies, providing robust baseline data for the commercially-traded seafood species. DNA profiling was used to identify each fish species and the levels of energy, protein, fat, sodium, fatty acids, vitamins and minerals were measured. All of the assessed species contained health-promoting fatty acids and several species also had high quantities of nutritionally important vitamins and minerals.

SARDI's Food Safety and Innovation science program works to support public health and the economic development of agri-food industries through robust research. The Super Seafood guide will help producers and manufacturers substantiate product label claims, including nutritional panel information and health claims, and promote the benefits of seafood as part of a balanced diet.

This research was funded by the Australian Seafood Cooperative Research Centre.

CROP INNOVATION FOR FOOD SECURITY

The root of plant performance

Dr Chun Y Huang (ACFPG), Dr Alan McKay (SARDI) and Dr Hadyn Kuchel (AGT)

Root architecture – the spatial configuration of roots – has a major influence on a plant's ability to access water and nutrients. Crop roots need to compete against roots of other species (weeds) as well as those of the same species. Understanding these interactions is essential to maximising crop yield and productivity.

Traditionally, scientists have relied on soil sampling and the laborious process of separating, drying and weighing roots to quantify root growth. The high cost and inaccuracy of this method has hampered past efforts to study root architecture. Plants are also destroyed in the process, making long-term studies of an individual plant's root architecture impossible.

The possibility of using molecular techniques to study root architecture is being explored in a collaborative research project which includes researchers from the Australian Centre for Plant Functional Genomics (ACFPG), South Australian Research and Development Institute and Australian (SARDI) Grain Technologies (AGT). The research teams are also working with statisticians from the University of Adelaide and New South Wales Department of Primary Industries.

The research team has developed quantitative DNA tests

to study the root distribution of crops in the field. The tests measure the DNA concentrations of live cells associated with plant roots in soil samples taken from different locations within the soil profile. Using this technique, researchers can now estimate the root distribution of barley, wheat and canola crops. Wheat root distribution studies have shown that modern genotypes vary in their root distribution and response to drought – this could have implications for variety selection in different cropping areas.

This method has enormous potential to improve studies on root architecture in the field as it enables non-destructive measurement of living root systems. The technology also has wider applications for scientists interested in studying root systems, including crop physiologists, plant breeders and agronomists as well as pathologists and nematologists studying soilborne diseases.

This research is funded by the Grains Research and Development Corporation (GRDC) and the South Australian Grain Industry Trust (SAGIT).

Tackling barley disease from all angles

A/Prof Amanda Able (The University of Adelaide) and Dr Hugh Wallwork (SARDI)

Net form net blotch (NFNB) is a damaging disease of barley that has recently emerged as a particular threat to growers across South Australia, resulting in a loss of more than $100m per year to Australian cereal crops. Several new strains of the pathogen have appeared over the past six years and previously resistant barley varieties are now susceptible. This has significantly increased the difficulty of breeding improved resistant varieties.

Symptoms of net form net blotch in barley in the field

Researchers from the University of Adelaide and SARDI are tackling the disease with a collaborative research program. Dr Wallwork and the SARDI team are monitoring the pathogen (Pyrenophora teres f. teres) across South Australia, collecting isolates and testing the highly variable pathogen under controlled environment conditions. The University of Adelaide team led by A/Prof Amanda Able is studying the pathogen's toxins. By comparing the protein profile produced by isolates of varying virulence and/or aggressiveness, the researchers have been able to identify a group of toxins that influence how the host and the pathogen interact. The group was the first to report the production of host-specific proteinaceous toxins by P. teres which appear to cause different levels of NFNB-like symptoms on different barley varieties.

The combined research efforts will help the team determine whether the toxins can be used as a reliable selection tool for developing NFNB-resistant barley varieties.

This research is funded by The Grains Research and Development Corporation (GRDC).

Predicting the effects of climate change on grapevines

A/Prof Victor Sadras and Martin Moran (SARDI); Dr Paul Petrie (Treasury Wine Estates)

In the face of predictions of increased climate variability, grape growers and winemakers need variety-dependent tools for forecasting in-season ripening as well as viticultural practices to mitigate heat damage. Experimental results can be inconclusive or misleading when controlled environments are used to assess the effects of temperature on vine physiology, berry composition and wine attributes or climatically different regions are compared.

SARDI scientists A/Prof Victor Sadras and Martin Moran are working with Dr Paul Petrie from Treasury Wine Estates to develop a robust system for manipulating temperatures under vineyard conditions to help future irrigation, harvest, transport and winery schedule planning.

Large-scale, automated, open-top chambers were developed to elevate temperatures approximately 2°C above ambient, mimicking projected temperature increases for Australia. The complex system combined passive and active heating to reproduce daily and

seasonal cycles of temperature and vapour pressure deficit as well as maintain exposure to natural light.

Sensitive stages of grapevine development began earlier when temperatures were elevated. This meant that subsequent developmental stages occurred in cooler conditions than normal, reducing the warming effects. The effects of temperature on berry maturity were smaller than expected (three days earlier per degree Celsius) and effects on yield were irregular. Elevated temperatures appeared to deplete starch in trunks and produce larger and more open stomata, increasing leaf transpiration and photosynthesis per unit of leaf area. Responses in pH and titrable acidity were highly variety-dependent.

Accurate assessments of the effects of temperature on vine performance, berry and wine attributes will help the industry to adopt practices and technology to adapt to and mitigate the effects of climate change.

This research is funded by the Grape and Wine Research and Development Corporation (GWRDC) with matched funding from the Australian Government.

Potential for break crops to unlock phosphorus supplies in Australian soils

Prof Annie McNeill and Dr Ashlea Doolette (The University of Adelaide)

Approximately $10b worth of phosphorus is fixed in Australia's agricultural soils and is unavailable to crops. The grains industry is looking for biological options to unlock more of this phosphorus and improve fertiliser application efficiency in the future.

Using break crops, such as legumes or broadleaf crops, in a cereal cropping system can decrease cereal pathogens. Legumes also add vital nitrogen to the soil but the impact of break crops on soil phosphorus is not well understood.

This research could help growers to put a 'phosphorus supply' value on particular rotation choices – significantly adding to existing knowledge on disease break and nitrogen benefits.

The phosphorus benefit of a range of break crops and soil types is being investigated in a project led by Professor Annie McNeill, School of Agriculture, Food and Wine. As part of the project, Dr Ashlea Doolette is looking at crop rotation options to make phosphorus more available in grain-growing regions across Australia. Initial results show that wheat crops following a legume break had consistently higher yields. Phosphorus intake was greater after some legume crops compared to cereal or canola break crops.

Researchers are still working to understand the mechanisms behind these responses. Legumes may be influencing phosphorus release from the soil by solubilising phosphorus in the root zone and making it more available to crops. There may also be substantial phosphorus input from dead roots and shoots left behind by break crops. Ongoing research is comparing sites with sufficient and deficient phosphorus supplies.

This research could help growers to put a 'phosphorus supply' value on particular rotation choices – significantly adding to existing knowledge on disease break and nitrogen benefits.

This research is funded by The Grains Research and Development Corporation (GRDC).

Tracking phosphorus to improve pasture productivity

Dr Ron Smernik, Prof Mike McLaughlin and Dr Tim McLaren (The University of Adelaide); Caroline Johnston (CSIRO Land and Water); Dr Therese McBeath (CSIRO Ecosystems Science); Dr Richard Simpson (CSIRO Plant Industry); Dr Chris Guppy (University of New England).

Phosphorus is a key driver of production in improved pasture grazing systems with long-term experiments demonstrating the close relationship between phosphorus inputs and profitability. In grazed pastures, phosphorus moves continuously between the soil, plants and animals. Fertiliser phosphorus can become tied up in the soil and leach, especially in sandy soils, or run off soils if there is heavy rain soon after application. Phosphorus is also lost when animals or animal products leave the system.

A collaborative project between CSIRO Land and Water and Meat and Livestock Australia is investigating a range

of aspects surrounding phosphorus transfer, pooling in soils and flux. This $1.3m project is led by School of Agriculture, Food and Wine researchers Dr Ron Smernik and Professor Mike McLaughlin, with Dr Tim McLaren as Research Fellow.

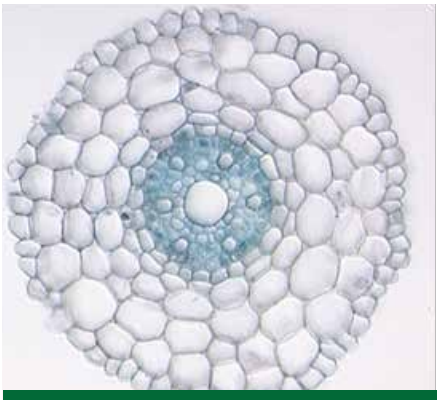
Fertiliser management strategies are being trialled to manipulate the movement of phosphorus into plants and minimise transfer to phosphorus pools in the soil.

The team are investigating annual rates of fertiliser phosphorus transfer to plant shoots and roots as well as to inorganic and organic phosphorus pools in the soil and how transfer might vary with different soil or pasture types and climates. Fertiliser management strategies are being trialled to manipulate the movement of phosphorus into plants and minimise transfer to phosphorus pools in the soil. The team are also exploring technologies that will release phosphorus from organic and inorganic pools by studying the chemical nature of soil organic phosphorus (phytate or macromolecular phosphorus). This research will help minimise accumulation of this stable phosphorus form in fertilised pastures and increase availability to plants.

This research is funded by Meat and Livestock Australia.

Ancient varieties hold secret to adaptation

Research led by Dr Matthew Gilliham (The University of Adelaide) and Professor Rana Munns (CSIRO Plant Industry, Canberra). For full author list and citation see www.nature.com/nbt/journal/v30/n4/full/nbt.2120.html



Location of the gene encoding for the ancestral sodium transporter in cells (stained blue) surrounding the xylem of modern durum wheat roots. (A. Athman, University of Adelaide)]

Almost 70 per cent of Australia's prime wheat growing regions are susceptible to salinity. Salinity impacts have been estimated to decrease the value of Australia's wheat crop by $1.3b. The genetic diversity that helps crops cope with harsh environmental conditions, like salinity and drought, has been lost over thousands of years of selecting varieties with the best yield and quality characteristics. So, in the search for genes for salt tolerance, researchers looked back to the ancestors and wild relatives of wheat.

The research initiated by CSIRO concentrated on Triticum monococcum, a domesticated variety of einkorn wheat. This ancient variety still grows in some parts of the world today and is able to grow in salty soil.

Using a range of molecular and physiological tests the team, including researchers from the School of Agriculture, Food and Wine, CSIRO, ARC Centre for Plant Energy Biology and ACFPG, were able to identify a sodium transporter gene TmHKT1;5-A. The gene prevents sodium from entering plant shoots by filtering it out at the root level. The build-up of sodium in root cells has little effect on the plant's cellular metabolism, growth and development. This gene was introduced into durum wheat lines (by traditional breeding methods) with a resulting increase in grain yield.

The CSIRO was the first to show that sodium exclusion genes increase grain yield in the field. A durum wheat line which is salt tolerant under commercial farming conditions has now been released to farmers but researchers aren't stopping there. Other genes with the potential to further improve salt tolerance have been identified and research is continuing to harness more of the hidden potential in these ancient varieties.

This research was funded by the Grains Research and Development Corporation (GRDC) and the Australian Research Council (ARC).

Mapping of barley genome to accelerate barley research

Prof Peter Langridge and Dr Bujun Shi (ACFPG); Prof Geoff Fincher (PCW, The University of Adelaide)

Barley breeders and scientists now have a new weapon to help them accelerate research and improve barley quality and tolerance to diseases, pests, heat and drought. The International Barley Sequencing Consortium (IBSC) has now completely mapped the barley genome.

Durum field (photo: Richard James, CSIRO)

Barley is the second most important crop in Australian agriculture and the fourth most important cereal crop in the world. Together with wheat and rye, barley provides about 30 per cent of all the calories consumed worldwide.

Australian research leaders Prof Peter Langridge, Australian Centre for Functional Plant Genomics (ACFPG) and Prof Geoff Fincher, Director ARC Centre of Excellence in Plant Cell Walls, School of Agriculture, Food and Wine and their teams were an integral part of this major step forward for agricultural science and industry. The ISBC was formed in 2006 and is a collaboration of more than 70 scientists from 22 research institutions across the world.

The barley genome is almost twice the size of the human genome. It contains a large proportion of closely related sequences that are difficult to piece together, making sequencing a major challenge for the ISBC. Sequencing the genome helps scientists to understand where and when genes are switched on in different tissues and at different stages of development. Regions of the genome that carry genes important in disease resistance have also been described, greatly improving our knowledge of the crop's immune system.

Barley is very closely related to Australia's most important crop – wheat. Mapping of the barley genome will have a major impact on wheat research. Global improvements in wheat production will be key to ensuring food security worldwide.

Funding support for the Australian component of the sequencing project was provided by the ARC, GRDC and South Australian Government.

Rathjen reflects on relationships in retirement

Reflecting on 40 years in agricultural research, Professor Tony Rathjen highlighted the enormous role that farmers have played in his research career. Never confined to an office or laboratory all day, Professor Rathjen highlighted the importance of developing personal relationships with farmers in understanding the cropping environment, practices and processes. Being able to tap into their astute and unusual observations was invaluable to his hands-on research approach.

Professor Rathjen began lecturing in plant breeding at the University in 1965 after obtaining his agricultural science degree at The University of Adelaide and PhD at Cambridge. In an illustrious career firmly-grounded by his strong relationships with industry, Professor Rathjen has released more than 20 wheat varieties. Working on soft wheats in the 1980s he released Molineaux, the first variety resistant to cereal cyst nematode (CCN). In the late 1990s he released Yitpi, a bread variety widely used across SA and Vic., with a combination of CCN resistance and boron tolerance.

Professor Rathjen has also been instrumental in establishing a strong durum industry in SA. Tjilkuri, a durum variety with improved resistance to crown rot was released in 2010. Varieties from Professor Rathjen's program are still being released today.

Never confined to an office or laboratory all day, Professor Rathjen highlighted the importance of developing personal relationships with farmers in understanding the cropping environment, practices and processes. Being able to tap into their astute and unusual observations was invaluable.

Professor Rathjen's hands on approach to research also extended to his teaching. He incorporated primary production tours into courses to give students a first-hand understanding of the agricultural industry and environment.

Thanks to the success of his varieties, Professor Rathjen was able to set up the Yitpi foundation, which encourages and promotes crop science research and education. The foundation also supports the study of Australian aboriginal culture, particularly land use and linguistics.

Although officially 'retired', Professor Rathjen remains active in a number of industry areas and will no doubt continue to make positive and lasting contributions to industry and society.

Spores of Phytophthora cinnamomi

MANAGING OUR NATURAL RESOURCES

Understanding the potential impacts of a devastating disease

Kueh Kiong Hook, Suzanne McKay, Evelina Facelli, Jose Facelli, Amanda Able and Eileen Scott (The University of Adelaide); Renate Velzeboer (Department of Environment, Water and Natural Resources)

Phytophthora dieback is an important disease of horticultural crops globally, resulting in a loss of millions of dollars per year to Australian horticulture. The disease was first identified in South Australia in 1969 and was then found extensively in native vegetation in the Mt Lofty Ranges, Fleurieu Peninsula and Kangaroo Island. Large areas of native vegetation have also been affected in WA, Tas., Qld and Vic. causing local extinction of some species and threatening the survival of highly endangered species such as the Wollemi Pine in NSW.

Phytophthora dieback is mainly caused by the soilborne fungus Phytophthora cinnamomi. The root rot caused by the disease restricts water uptake and infected plants may die during southern Australia's hot dry summers.

Managing Phytophthora dieback has been difficult in SA because little was known about the susceptibility of native species. Hygiene methods used to minimise disease spread, such as car wash-down facilities or restricting access, are no longer effective once an area is infected.

A research team led by the School of Agriculture, Food and Wine has conducted the first detailed study of the susceptibility of SA's vulnerable native flora to Phytophthora dieback. Thirty of the 37 native flora species tested were found to be susceptible. Eight of the 15 threatened, rare or locally endangered species tested were either moderately or highly susceptible. Significant populations of at least four of the susceptible threatened species are located close to Phytophthora-infested areas, suspected infested areas or areas conducive for the pathogen.

This research will help to set protection and conservation priorities for native vegetation in SA and minimise the impact of this potentially devastating disease on our vulnerable native flora.

This research was funded by the Australian Research Council, with financial and in-kind support from the Department of Environment, Water and Natural Resources, SA Water, Adelaide Hills Council, Adelaide and Mount Lofty Ranges NRM Board, City of Tea Tree Gully Council, Department of Planning, Transport and Infrastructure, Forestry SA, Primary Industries and Resources South Australia Forestry and SA Murray Darling Basin NRM Board.

This research will help to set protection and conservation priorities for native vegetation in SA.

Human and plant factors contributing to glyphosate resistance

A/Prof Chris Preston (The University of Adelaide)

Glyphosate is one of the most commonly used herbicides in agricultural, public and domestic settings. Fifty per cent of annual ryegrass and fleabane samples collected from roadsides and other non-agricultural areas of SA, NSW and WA were found to be resistant to glyphosate

in a recent survey led by A/Prof Christopher Preston, School of Agriculture, Food and Wine. If not managed well, resistant weeds like annual ryegrass and fleabane in non-agricultural areas can impact on agricultural users of glyphosate.

Surveys on herbicide use were also conducted with local government and national parks workers in Qld. Glyphosate was the most frequently used herbicide, with 86 per cent of respondents applying it more than once and 10 per cent using it at least nine times per year. Twenty-nine per cent of respondents reported that their organisation had used glyphosate for more than 15 years and 49 per cent said reported no formal record keeping on herbicide efficacy.

Glyphosate resistant roadside weeds can become problems in agricultural areas

The information on herbicide use strategies and resistance helped researchers understand which industry sectors and regions are most at risk of encouraging glyphosate resistant weeds. Failing to keep herbicide use records and policies of individual organisations that limited the chemicals that could be used contributed to high risk ratings.

Fifty per cent of annual ryegrass and fleabane samples collected from roadsides and other non-agricultural areas of SA, NSW and WA were found to be resistant to glyphosate.

This research has improved our understanding of both the human and plant factors that contribute to glyphosate-resistance risk in non-agricultural areas. It highlights the need for best management practice guidelines to strongly communicate the use of alternative tactics for species at high risk of developing resistance. Multiple control options should be identified and preserved for these high risk species.

This research is funded by the Rural Industries Research and Development Corporation (RIRDC) and the Australian Government's National Weeds and Productivity Research Program.

New tool to assist in future land-use planning

Prof Wayne Meyer (The University of Adelaide) and Dr Brett Bryan (CSIRO)

Future impacts of climate change, the carbon economy and energy policy has created uncertainty for many land-use managers. The interactions between these factors are complex and communities that want to take a proactive approach need 'climate-ready' or 'carbon-ready' plans.

Prof Wayne Meyer, Chair of Natural Resource Sciences at The University of Adelaide and Dr Brett Bryan, CSIRO Ecosystem Science, have developed Landscape Futures Analysis, a rigorous, multi-featured, science-based planning tool that helps natural resource management (NRM) bodies to examine future scenarios with a series of 'what if' questions.

The tool is computer based and highly interactive. Users choose baseline data on climate, agricultural commodity prices, production costs and carbon prices from the tool and it models interactions between different landscape elements – for example, combining climate change models with models of wheat production or species vulnerability. Options, not 'answers', are generated through an iterative process where scientific data and scenarios combine to help users make difficult, proactive and collaborative decisions for their community. Maps demonstrate the effects of alternate scenarios on different

locations to help communities connect with and visualise the information.

The researchers have collaborated closely with regional NRM bodies and other interested parties to develop the Landscape Futures Analysis Tool (www.lfat.org.au). The tool has improved awareness and understanding of climate change and its likely consequences; provided clarity and confidence through better understanding of risks and opportunities; and increased the planning capacity of communities through engagement with researchers, industry and administrative agencies.

Landscape Futures Analysis is helping communities to not only adapt but thrive in a changing future, by maintaining functioning ecosystems, sustaining livelihoods and building informed, confident and proud communities.

Landscape Futures Analysis is helping communities to not only adapt but thrive in a changing future, by maintaining functioning ecosystems, sustaining livelihoods and building informed, confident and proud communities.

This research is funded by the SA Premiers Science and Research Fund and the National Climate Change Adaptation Research Facility.

Native bees have potential to lower pollination costs in lucerne

Dr Katja Hogendoorn and A/Prof Mike Keller (The University of Adelaide)

Inadequate pollination is thought to be a major factor limiting productivity of lucerne in Australia. Lucerne crops are completely reliant on bees visiting to trip the sexual column in flowers, release pollen and allow pollination and seed set. Some lucerne growers pay to have managed bee hives placed on their properties but many growers rely solely on feral honeybees and native bees.

Feral honeybee populations are under threat from invasion by an exotic mite Varroa destructor. Although not yet in Australia, the mite is present in our near neighbours, New Zealand and Papua New Guinea. It has the potential to decimate feral honeybee populations and eliminate the free pollination services they provide. Dr Katja Hogendoorn and Associate Professor Mike Keller, School of Agriculture, Food and Wine, investigated the ability of native bees species to pollinate lucerne in captivity. Native bees are not susceptible to Varroa mite and harnessing their pollination services could substantially reduce pollination costs for growers.

Common native resin bees (Megachile nigrovittata) and Nomia bees (Lipotriches flavoviridis) were efficient pollinators of lucerne. In greenhouse experiments, M. nigrovittata pollinated 48 per cent of flowers. Small, ground nesting nomiine bees were also an important pollinator of lucerne, tripping 32 times more flowers per minute than honeybees.

The blue-banded bee (Amegilla murrayensis). (photo: Katja Hogendoorn).

Common blue-banded bees (Amegilla cingulata) did not pollinate lucerne as their long tongues meant they could reach the nectar without tripping the flowers.

Promoting effective native pollinators could increase the productivity and resilience of the lucerne industry. Further research is needed into lucerne management practices and nesting structures that encourage the survival and growth of native bee populations in cropping areas.

This research is funded by the Rural Industries Research and Development Corporation (RIRDC).

The WRI and the Waite's Future

"The Waite" is the campus brand that has represented excellence in research and teaching for more than 90 years.

2013 marks the centenary of the Peter Waite's letter of intent to bequest the land on which the Waite sits to the University and The Waite will celebrate its centenary of delivery in 2024. It is therefore appropriate to consider the directions and capabilities required for the positioning the Waite for the next 100 years, building on its historic excellence and contribution.

As highlighted in this report, the WRI has contributed strongly to the Waite legacy over the last two years under the leadership of Professor Roger Leigh. I have the honour and privilege of following Roger in this role.

Building on Roger's legacy, the WRI drafted new Strategic and Operational Plans in January 2013 to better reflect the new priorities outlined in the University's Strategic Plan (Beacon of Enlightenment) and those of the School of Agriculture, Food and Wine following its 2012/13 review, whilst complementing those of the co-located partners. In keeping with the founding principles of the WRI, the 2013 Operational Plan incorporated stretch KPIs that focus only on outputs that are directly attributable to WRI's activities and investments. No indirect claims were to be made for outcomes that may have occurred in the absence of WRI funding or activity.

The WRI's key performance indicators and budgets are all embedded in the broad goals of:

1 IMPROVING THE QUALITY OF WAITE SCIENCE

2 ENHANCING THE REPUTATION OF THE WAITE AS "WORLD LEADING"

3 INCREASING STUDENT INTEREST IN AGRICULTURE DEGREES

4 INCREASING AND ENHANCING COLLABORATION ACROSS THE WAITE

5 DEVELOPING WAITE PEOPLE FOR THE FUTURE

In this way, the WRI will provide unequivocal information on the value proposition to the University from its investment in terms of outputs that will impact on the University's core business and/or its international standing.

Agriculture is critical to Australia's future economic resilience and competitiveness but is highly dependent on continuing innovation and development. The Waite is the largest and most significant provider of agricultural research and training

Professor Mike Wilkinson

Director, Waite Research Institute and Head, School of Agriculture, Food and Wine

The University of Adelaide

throughout Australia and so its future research performance is of huge national importance. Equally, the Waite has the potential to provide the global lead in the drive to address the grand challenge of feeding future generations in the face of climate change and an increasing world population

To achieve these we are positioning the Waite to:

- Intensify cooperative efforts with co-located partner institutions to deliver research and teaching outcomes that address the major contemporary issues as they emerge;
- Extend its operational focus to address the challenges of:
  - » Global food security;
  - » Food and nutrition for better health;
  - » Research-led solutions to maintain the international competitiveness of key agricultural sectors such as grains and wine;
  - » Farming in a carbon constrained and climate change future;
  - » Agriculture in the environment

and its role in biodiversity;

- » Global food trade, markets and policy;
- » Production and value/supply chain efficiencies;
- » Future consumer and society expectations from food;
- » Rural and regional community resilience in response to changing agricultural demands and challenges;

- Attract, develop and retain internationally prominent researchers and teachers to provide global research and teaching leadership to equip future generations to meet these challenges;
- Invest in and exploit state-of-the-art equipment and buildings to ensure research environments are fit to meet the challenges set;
- Further advance the global stature of the Waite brand and the research and teaching that underpins it.

There are particular opportunities now that biological sciences are maturing to a level where "Big Science" is transitioning to become "Big and Integrated Science", requiring large-scale facilities and multi-disciplinary teams that have been common in the physical sciences for many years. As such, biology is well placed to benefit from investment in large centralised research programs that generate the critical mass necessary for significant breakthroughs to occur. We are now entering a post-genomic era, where germplasm and its genetic diversity need to be revealed by combining genomics with other technologies, in particular phenomics, bioinformatics, epigenetics, mechanistic modelling and novel farming systems. These include remote sensing and other technologies that can be deployed to continuously monitor and understand crop responses to the environment and how these determine outcomes both for yield and quality. These technologies can be deployed for broad acre crops as well as more specialised high-value horticultural crops and grapevines, and also to monitor subsequent processing e.g. winemaking.

In summary, we are intent on progressing from a world-class research and teaching precinct to a world-leading one. That is a major change. We are already changing the way that we address this in terms of embracing new, emerging fields, raising the ambition of individual scientists and we are going to be the first to make sure that it's translated.

With my Waite colleagues and co-located partner institutions I look forward to the next exciting era in the Waite's history to deliver on the post-centenary vision and make a leading contribution to Australia's agricultural science, industry and economy.

Professor Mike Wilkinson

Director, Waite Research Institute and Head, School of Agriculture, Food and Wine, The University of Adelaide

January 2013

Appendices

APPENDIX 1

WRI-funded Proposals and Outcomes in 2012

Project/Proposal title	Recipient	Outcomes
Contribution to the salary of the Director, ARC Centre of Excellence in Plant Cell Walls	Prof Geoff Fincher	The establishment of the Centre, with all initial KPIs and targets met
Vineyard of the Future – establishment, equipment , technical support costs	Prof Steve Tyerman	A fully operational, continuously monitored vineyard, international collaboration, potential industry co-funding
Additional lab work and support (in conjunction with grant writer assistance) to enhance a revised ARC Discovery application	Prof Vladimir Jiranek	A successful ARC Discovery application, worth $477K over 3 years, announced in November 2012
Support of a post- conference workshop on 'Strategies for statistical consulting in Australian Universities'	Dr Olena Kravchuk	A successful workshop with professionally produced written materials
Travel to gain support from UK retailers for an ARC Linkage project, plus French yeast collaborator visits	Prof Vladimir Jiranek	$15K secured from Sainsburys for the ARC Industrial Transformation Training Centre bid (awarded $2.4m in early 2013); good progress on a joint project with Lallemand in France.
Travel support for Zurich lab work and international workshop	Dr Ashlea Doolette	Collaboration with eminent scientists at ETH, enhanced skills and capacity building for the Waite
Travel support for Vineyard of the Future collaborative links/scoping visit to Spain	Prof Steve Tyerman	The establishment of a four-way global partnership on the VoF project
Travel support for US collaborator linkage visits following conference	Dr David Jeffery and Dr Kerry Wilkinson	Enhanced collaboration with Constellation Brands, Gallo and UC Davis; joint projects pending
Travel support for Cambridge lab work	Ms Sandra Schmoeckel	A manuscript submitted to the peer-reviewed journal FEBS letters and an enhanced PhD thesis, to be completed by the end of 2013
Membrane Transporter Expression Facility	Dr Matt Gilliham Prof Steve Tyerman	Expanded capacity of the Xenopus oocyte system allowing greater throughput and more proteins being screened each week
Travel support for collaborator visits in Germany & Canada	Prof Dennis Taylor	Developed collaborative linkages with UBC and two German institutes; presentations and meetings highlighting Waite capability; joint projects pending
Waite node of Adelaide Microscopy - 25% of staffing costs for 1 year	Stuart Matthews (on behalf of the School of AFW)	Adelaide Microscopy's Waite Node opened in January 2013

APPENDIX 1 (CONTINUED)

WRI-funded Proposals and Outcomes in 2012

Project/Proposal title	Recipient	Outcomes
China delegation travel support	A/Prof Mike Keller	Development of reciprocal/exchange arrangements and collaboration with China's Northwest Agriculture & Forestry University
Almond sequencing collaboration/ international consortium	Dr Michelle Wirthensohn	Involvement in an international almond sequencing consortium, five Australian cultivars to be sequenced, a PhD student project on the mapping of the genome
Travel support for international flavourist expert Leslie Norris to visit the Waite	Ms Yaelle Saltman Dr Sue Bastian	PhD project progress, training/capacity building for Waite researchers in related food and wine areas, workshops with industry partners and the GWRDC
Travel support for visits to the John Innes Centre	Prof Roger Leigh	Insights into the success and culture of the JIC (ongoing)

Appendices

APPENDIX 2

WRI Key Institute Members

(Active AFW researchers and academic staff in 2010-12)

Able, Amanda Jane
Able, Jason Alan
Ajiboye, Abraham Babasola
Asenstorfer, Robert Ernst
Bastian, Susan Elaine
Baumann, Ute
Berger, Bettina
Betts, Natalie Sonia
Borysyuk, Mykola (Nikolai)
Boutsalis, Peter
Bruwer, Johan de Wet
Burton, Rachel Anita
Byrt, Caitlin Siobhan
Chalmers, Kenneth
Chiasson, David
Clarke, Stephen James
Coleman, Desmond Francis
Collins, Cassandra
Collins, Helen Marie
Collins, Nicholas Charles
Coventry, Stewart John
Cozzolino, Daniel
Croxford, Adam Earl
Cu, Thi Thu Suong
De Bei, Roberta
de Oliveira Santos Garcia, Melissa
Dechorgnat, Julie
Degryse, Jozefien Louisa Elvire
Delaporte, Kate Louise
Denton, Matthew Damian
Doolette, Ashlea Louise
Dundas, Ian Stewart
Eagles, Howard Alan
Eckermann, Paul Joseph
Eglinton, Jason Konrad
Eini Gandomani, Omid
Eliby, Serik
Fincher, Geoffrey Bruce
Fleet, Benjamin James
Fleury, Delphine Laurinda
Ford, Caroline Sarah
Ford, Christopher Michael
Fox, Rebecca
Franco Garcia, Alexandre
Fuentes, Sigfredo
Garajova, Sona
Gardner, Jennifer Margaret
Garnett, Trevor Paul
Gibson, Robert Alan
Gill, Gurjeet Singh
Gilliham, Matthew
Godfrey, Dale
Gogel, Beverley Joy
Grant, Cameron Douglas
Grbin, Paul Ramon
Harris, Paul
Hayes, Julie Ellen
Heath, Timothy James
Hogendoorn, Katja
Hrmova, Maria
Huang, Chunyuan
Jacobs, Andrew Keith
Jeffery, David William
Jiranek, Vladimir
Johns, Craig Michael
Kaiser, Brent Norman
Keller, Michael Anthony
Khoo, Kelvin Han Ping
Koopman, Darren John
Kovalchuk, Nataliya
Kravchuk, Olena
Langridge, Peter
Langridge-Reimold, Ursula Julie
Leigh, Roger Allen
Lewis, Rober Keer
Li, Chi Man Elton
Li, Ming
Liccioli, Tommaso
Little, Alan
Lopato, Sergiy
Loveys, Beth Rachel
Luang, Sukanya (Jeab)
Lyons, Graham Henry
Malone, Jenna Moira
March, Timothy John
Marschner, Petra
Mason, Sean David
Mather, Diane Elizabeth
Mayo, Gwenda Mary
McDonald, Glenn Keith
McLaughlin, Michael John
McLaren, Timothy
McNeill, Ann Marie
Melino, Vanessa
Morran, Sarah
Morris, Christina
Mrva, Kolumbina
Muhlhausler, Beverly Sara
Nuberg, Ian Kinloch
Okada, Takashi
Okamoto, Mamoru
Ovchinnikova, Evgenia
Parent, Boris Jean Augustin
Paull, Jeffrey Gordon
Penfold, Christopher Morant
Phillips, Alison Louise
Plett, Darren Craig
Preston, Christopher
Ramesh, Sunita
Randles, John Wesley
Rathjen, Anthony John
Rengasamy, Pichu
Riggs, Gavin James Alexander
Riggs, Karina
Ristic, Renata
Rodriguez Lopez, Carlos Marcelino
Roumeliotis, Sophia
Roy, Stuart John
Rutley, David Lewis
Schultz, Carolyn Jane
Schwerdt, Julian
Scott, Eileen Sandra
Sefton, Mark Aidan
Setia, Raj Kumar
Shahinnia, Fahimeh
Shi, Bu-jun
Shirley, Neil John
Singh, Rohan Ranjit
Skouroumounis, George Kyriakos
Smernik, Ronald Josef
Sornaraj, Pradeep
Suchecki, Radoslaw
Stringer, Randy
Sundstrom, Joanna Faye
Sutton, Timothy John
Sweetman, Crystal
Taylor, Dennis Kenwyn
Taylor, Julian Daniel
Tester, Mark Alfred
Tilbrook, Joanne
Timmins, William (Andy)
Tricker, Penelope Jane
Tu, Wei-Chun
Tucker, Elise
Tucker, Matthew Robert
Tyerman, Stephen Donald
Umberger, Wendy Jeanne
Valente, Peter
Van Zanten, Robert
Vandeleur, Rebecca Kay
Vassos, Elysia Joanne
Verbyla, Arunas Petras
Walker, Michelle Elisabeth
Washington, Jennifer Marie
Watson-Haigh, Nathan
Whitford, Ryan
Wilkinson, Kerry Leigh
Wilkinson, Michael James
Wirthensohn, Michelle Gabrielle
Yang, Nannan
Zhang, Qisen

APPENDIX 3

Notable Waite Visitors and Seminar Speakers in 2011 - 2012

2011

Waite Distinguished Guest Lecture Series	
Distinguished Guest Lecture, February 2011	Emeritus Professor Ulrich Zimmermann, Universität Würzburg and ZIM Plant Technology i.G., Henningsdorf at Berlin, Germany
The inaugural Peter Waite Lecture, February 2011	Professor Geoff Fincher, ARC Centre of Excellence in Plant Cell Walls, The University of Adelaide
The Robyn van Heeswijck Lecture, March 2011	Dr Brendan Choat, University of Western Sydney, Hawkesbury Institute for the Environment
The AR Hickinbotham Lecture, May 2011	Dr Brian Loveys, CSIRO Plant Industry & University of Adelaide
The Harold Woolhouse Lecture, August 2011	Dr José A. Feijó, University of Lisbon, Portugal and Instituto Gulbenkian de Ciência, Portugal
The inaugural JA Prescott Lecture, October 2011	Dr Glyn Bengough, Principal Research Scientist, The James Hutton Institute

ACPFG Seminar Series – a representative list of visiting speakers
A/Prof Nikolay Borisjuk, Thomas Jefferson University, Mar 2011
Prof Elsbeth Walker, University of Massachusetts, Jun 2011
Prof John Cushman, University of Nevada, Jul 2011
Dr Fred van Eeuwyjk, Wageningen University, Jul 2011
Prof Jim Whelan, University of Western Australia
Prof Ray Rose, University of Newcastle, Sep 2011
Prof Allan Downie, John Innes Centre, Nov 2011

Visiting delegations, groups and individuals
Emeritus Professor Ulrich Zimmermann, Universität Würzburg and ZIM Plant Technology i.G., Henningsdorf at Berlin, Germany
Dr José A. Feijó, University of Lisbon, Portugal
Dr Glyn Bengough, Principal Research Scientist, The James Hutton Institute
Dr Brendan Choat, University of Western Sydney
SA Minister for Science, Hon Jay Weatherill, and SA Chief Scientist, Professor Don Bursill
Professor Yerko Moreno, Vice-Rector, University of Talca, Chile
A delegation of 8 Latin American Ambassadors to Australia
The CSIRO Executive Team (national)

APPENDIX 3

Notable Waite Visitors and Seminar Speakers in 2011 & 2012

2012

Waite Distinguished Guest Lecture Series	
The JA Prescott Lecture, January 2012	Professor Ismail Cakmak, Sabanci University, Istanbul, Turkey
The Keith Finlay Lecture, July 2012	Professor Ed Buckler, Institute for Genomic Diversity, USDA-ARS, Cornell University, USA
The Robyn van Heeswijck Lecture, September 2012	Associate Professor Seth DeBolt, University of Kentucky, USA
The Harold Woolhouse Lecture, October 2012	Professor Dale Sanders FRS, John Innes Centre, Norwich, UK

ACPFG Seminar Series – a representative list of visiting speakers
Dr Stephan Scholten, University of Hamburg, Jan 2012
A/Prof Justin Borevitz, Australian National University, Feb 2012
Dr Marc Albertson, Pioneer, Feb 2012
Dr Stephan Arndt, University of Melbourne, May 2012
Dr Josh Mylne, University of Queensland, May 2012
Dr Xavier Sirault, CSIRO Canberra, Jun 2012
Dr Connie Darmanin, CSIRO Melbourne , Jun 2012
Prof Kenji Omasa, University of Tokyo, Aug 2012
Dr Zhonghua Chen, University of Western Sydney, Aug 2012
Dr Ryo Fujimoto, Niigata University, Japan, Sep 2012
Dr Viktor Korzun, KWS, Einbeck, Germany, Oct 2012

Visiting delegations, groups and individuals
Dr Stephan Arndt, University of Melbourne
Professor Ismail Cakmak, Sabanci University, Istanbul, Turkey
Professor Ed Buckler, Institute for Genomic Diversity, USDA-ARS, Cornell University, USA
Associate Professor Seth DeBolt, University of Kentucky, USA
Professor Dale Sanders FRS, John Innes Centre, Norwich, UK
The Grape and Wine Research and Development Corporation Board (WIC-coordinated)
The Queensland Wine Industry Association
The University of Adelaide Council
SA Minister for Science, Hon Tom Kenyon, and SA Chief Scientist, Professor Don Bursill
A delegation of 25 Chinese University presidents
Invest in SA group – Department of Manufacturing, Innovation, Trade, Resources & Employment

APPENDIX 4

2011 & 2012 Expenditure

WRI Year End Expenditure - December 2011 & 2012	2011 Actual	2012 Actual
	$	$
Infrastructure	200,840	0
Marketing & Promotion	37,959	44,912
Science & Capacity Building	201,086	293,694
Staffing & Administration	350,044	394,306
Total Expenditure	**789,929**	**850,793**

APPENDIX 5

2011 & 2012 Income (School of Agriculture, Food and Wine)

WRI Members Research Income 2011 & 2012	2011	2012
	$	$
Category 1	20,009,065	18,149,162
Category 2	2,988,877	3,021,522
Category 3	3,558,374	6,751,507
Category 4	29,628	17,188
Total Research Income	**26,585,944**	**27,939,379**

(Based on the WRI Members List, appendix 2)

APPENDIX 6

List of Relevant Acronyms

ACPFG	Australian Centre for Plant Functional Genomics
AFW	The University of Adelaide's School of Agriculture, Food & Wine
AGRF	Australian Genome Research Facility
AGT	Australian Grain Technologies
ARC	Australian Research Council
APPF	Australian Plant Phenomics Facility (The Plant Accelerator)
AWRI	Australian Wine Research Institute
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DENR	Department of Environment & Natural Resources
EIF	Education Investment Fund
GRDC	Grains Research & Development Corporation
GWRDC	Grape and Wine Research and Development Corporation
HAL	Horticulture Australia Limited
LIEF	Large Infrastructure & Equipment Funding
PCW	ARC Centre of Excellence in Plant Cell Walls
PEB	ARC Centre of Excellence in Plant Energy Biology
PIRSA	Department of Primary Industries & Regions South Australia
PISC	Primary Industries Standing Committee
RIRDC	Rural Industries Research and Development Corporation
SARDI	South Australian Research & Development Institute
UA	The University of Adelaide
WIC	Wine Innovation Cluster
WRI	Waite Research Institute

Waite Research Institute

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