THE UNIVERSITY of ADELAIDE

Annual Report 2021

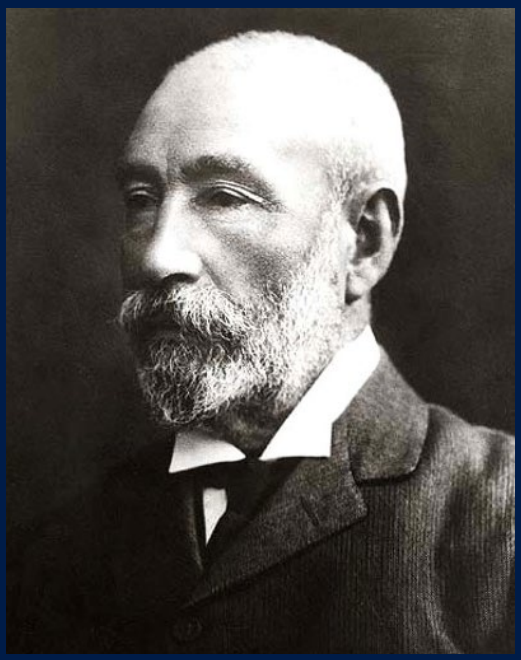
Waite Research Institute

make history.

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 fledgling colony of South Australia. 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 Smith & Co Ltd, Peter Waite embraced and developed innovative and contemporary farming practices.

Peter Waite gifted his homestead, Urrbrae House, and the surrounding property of 299 acres (121 ha) to The University of Adelaide in 1923 for agricultural education and research purposes. The Waite Agricultural Research Institute commenced operations on the site in 1924.



"I have been much influenced by the wonderful work our agriculturalists and pastoralists have accomplished hitherto in the 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 brought 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."

Peter Waite in explaining his gift

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Foreword / Deputy-Vice Chancellor (Research)

The University of Adelaide's six research institutes are its flagship research and innovation powerhouses, each one strategically aligned with an area of strength and depth of expertise. As part of this ecosystem, the Waite Research Institute (WRI) builds on the Waite Precinct's impressive legacy and history of delivering world-leading science and solutions in agriculture, food and wine.

The WRI brings together researchers from across the agriculture, food and wine spectrum, covering all three campuses (Waite, Roseworthy and North Terrace) and multiple Faculties and Schools. Working in areas as diverse as ag-tech, agri-economics and trade, consumer and sensory studies, plant breeding, soil ecology, wine and viticulture, agronomy, pests and disease, animal wellbeing and even space horticulture, WRI members are by the very nature of their disciplines engaged in addressing real-world challenges such as sustainable agriculture, the impacts of climate change on plants, and food security.

Under the leadership of Professor Matthew Gilliham, the WRI is pursuing multidisciplinary, large-scale research and innovation initiatives, many of them in conjunction with industry and government partners. The year 2021 saw the start of many new exciting projects, as well as ongoing, WRI-supported research projects coming to fruition, and producing exciting results.

The University of Adelaide's Agrifood and Wine FAME (Foci and Magnets for Excellence) Strategy, launched in March 2021, guides and informs WRI initiatives, and provides a platform that enables us to attract the best researchers and partners to deliver positive impacts for our State and Nation through research excellence and its translation.

This annual report provides just an overview of WRI activities, but is a great illustration of how our world-class fundamental and applied research is driving impact and improving outcomes for the vital agricultural sector.

Professor Anton Middelberg
Deputy Vice-Chancellor
and Vice-President (Research)

The Waite Research Institute at a glance

Plant Research Centre at Waite Campus

The Waite Research Institute is located at Waite Campus, but extends beyond just the location and the so-called Waite Precinct, which is the collective name for the co-located organisations, agencies and entities on site.

The Waite Research Institute is the modern successor to the original Waite Agricultural Research Institute, and is one of six Institutes of the University of Adelaide in areas of strength and strategic importance. The WRI is the flagship for Agricultural Research and Innovation at the University.

The Waite Research Institute was established in 2009 and has since been a University 'front door' for communication to, and interaction with, industry and the public in research and innovation programs in Agriculture, and central coordination point for internal activities.

The Waite Research Institute serves as the University's focal point for globally leading research in agriculture, food, wine, animal and natural resources science. Our goals are to:

- Explore and inform critical national and global issues and challenges such as Australian agriculture industry competitiveness, food security, sustainable intensification of agricultural production, food, nutrition and health, and adaptation to climate variability and change;
- Serve as an international model of research, development, industry application and teaching through the co-location of institutional partners, with capability in whole of value chain approaches from gene discovery to consumer needs; and
- Continue to evolve our high-quality education and training in agriculture, food and wine through undergraduate and postgraduate coursework and research degree programs.

In pursuing these aims, the WRI has invested in research leadership and Early-Career Research professional development, equipment purchases, small and large projects of strategic value, salary support for key research staff at various stages, large grant and Centre of Excellence bids and grant-writing support. The WRI also supports communication channels and hosts shared events with our partners, is host to a Waite precinct website and facilitates workshops, symposia and meetings that enhance collaborative research. Steady increases in the Waite's competitive research grant funding and industry collaborations, publication numbers and HDR completions have all occurred on the WRI's watch, and the Excellence in Research Australia rankings for all Waite-based disciplines remain above or well above world-class.

Over the years, the Waite Research Institute has successfully brought together researchers across the Waite, Roseworthy and North Terrace campuses for the pursuit of excellence in agricultural science through collaboration between the agencies and organisations housed on these locations, to unite the complementary R&D and industry-aligned support for SA's vibrant agriculture, food and wine sectors.

Waite Campus

Waite Campus is the largest concentration of agricultural research and teaching expertise 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 (AFW)
- Australian and New Zealand Council for the Care of Animals in Research and Teaching (ANZCCART)
- CSIRO (Agriculture and Food, Land and Water)
- South Australian Research and Development Institute (SARDI)
- Adelaide Glycomics
- Australian Wine Research Institute (AWRI)
- Australian Genome Research Facility (AGRF)
- Arris Pty Ltd
- Fight Food Waste Cooperative Research Centre
- Intergrain
- Urrbrae House Historic Precinct, including the Waite Arboretum
- Plant and Food Research Australia
- Terrestrial Ecosystem Research Network (TERN)
- ThincLab

In addition, the Waite hosts the following specialist research centres and breeding programs of national significance:

- Australian Plant Phenomics Facility (The Plant Accelerator)
- ARC Centre of Excellence in Plant Energy Biology (node)
- ARC Industrial Transformation Training Centre for Innovative Wine Production
- ARC Training Centre for Future Crops Development
- Centre of Crop and Environmental Development Solutions (CEADS)
- Wine Innovation Cluster (WIC)
- Research Consortium for Agricultural Product Development (RC-APD)
- Statistics for the Australian Grains Industry (SAGI)
- South Australian Genomics Centre (SAGC)
- The University of Adelaide/Shanghai Jiao Tong University Joint Lab for Plant Science and Breeding
- The Fertiliser Technology Research Centre
- The International Flavour Research Centre

Roseworthy Campus

The Roseworthy campus, 60km north of Adelaide, is the site of Australia's first agricultural college, established in 1883, and merged with the University of Adelaide in 1991. It has a history of excellence in dryland agriculture, natural resource management and animal science. Major University investment over the past 10 years has seen a renewed focus on animal and veterinary science. Specialist centres and facilities housed on Roseworthy campus include:

- The Davies Research Centre
- The Australian Centre for Antimicrobial Resistance Ecology
- Weatherbys Scientific Australia

North Terrace Campus

The North Terrace campus is the earliest permanent home of the University of Adelaide. This main campus, set in the heart of Adelaide is the site of most teaching and research facilities and the location of many of Waite Research Institute's collaborators.

Waite campus vineyard

WRI across the Campuses

20
world-class research organisations and centres

1700+
research and technical staff

1250+
undergraduate students

150+
postgraduate students
(AFW, VETSCI as per 10/2021)

$120 million
research income/expenditure per year

$350 million
research and teaching infrastructure

400+
research publications per annum

470+
WRI members

Internationally recognised for delivering transformational and high impact agricultural technologies and systems

WRI vision, goals, governance and operations

Vision

The Waite Research Institute supports research and innovation that builds capacity for Australia's agriculture, food and wine sectors. The WRI's broad vision is to drive the innovation to secure a sustainable future for Agriculture – by creating high-quality, nutritious and climate-resilient products. We do this in close partnership with agriculture, food and wine sectors across all of Australia. To achieve this vision, we will invest in outstanding researchers and advanced facilities across multiple scientific disciplines, in both new strategic initiatives and areas of established strength.

Goals

1. Research with impact in sustainable intensification of agriculture in a changing climate
2. Building large-scale initiatives across disciplines
3. Enhancing excellence through researcher development
4. Connecting researchers with industry

Governance and operations

In 2021 the WRI financial reporting was managed through the School of Agriculture, Food and Wine, in conjunction with the Office of the Deputy Vice-Chancellor (Research) (DVCR). The WRI assesses opportunities and reviews applications, making investment decisions based on the minimum 7:1 leverage requirement now established for all University Research Institutes.

Major Research Themes

- AgTech
- Animal Science and Livestock Wellbeing
- Crop Science
- Food Technology
- Sustainable Agriculture
- Wine and Viticulture

WRI Staff

Director
Professor Matthew Gilliham

Deputy Director
A/Professor Matthew Tucker

Operations and Research Manager
Dr Rebecca Vandeleur

Executive Officer
Dr Lieke van der Hulst

The WRI aims to support new opportunities:

- for building research excellence and capacity in our major research themes and which align with existing and emerging strengths in agriculture, food and wine;
- that have strategic value for the University as a whole and agricultural research specifically;
- that can demonstrate breadth of impact;
- that offer value for money through leveraging co-investment;
- that deliver tangible returns; and
- that foster great research- and industry relationships; as well as multi-disciplinary efforts to address important problems.

Director's overview

As 2021 continued to be a challenging time across the globe, it also slowly brought the return of face to face interactions and for WRI researchers a sustained focus which has resulted in outstanding work across a broad range of disciplines within the Agrifood and Wine sectors.

2021 saw exciting new ventures come to life, as well as further development of programs and projects that were underway. New ventures include five new ARC Discovery Projects that were awarded at the very end of the year, but also strategic and multidisciplinary bids leading to the start of the SA Drought and Innovation Hub, the Centre for Environmental Adaptation and Development (CEADS), the AGT-UoA Plant Breeding Academy, the ARC Industrial Transformation Training Centre for Future Crops Development and the International Flavour Research Centre this year.

Our research in space horticulture and synthetic biology with a significant involvement from WRI members from across the University of Adelaide also continued to gain momentum.

These developing research initiatives show how the WRI continues to perform a key enabling role, with support for its people through not only investment but also coaching and professional development. Furthermore, having attracted two new University of Adelaide funded Future Making Fellows in 2021 shows WRI's pull for new innovative research.

This year we were also fortunate to recruit two new excellent WRI staff members (and past graduates), Dr Rebecca Vandeleur and Dr Lieke van der Hulst as Operations and Research Manager and Executive Officer respectively.

Lastly, I would like to thank all our members for their ongoing efforts in 2021 – their continued perseverance and shared success has not gone unnoticed and has been, in my opinion, displayed tremendously at the WRI Showcase in December of 2021. It was great to be able to celebrate the research outputs and new research wins in an event where we could all gather and network without doing so on a screen. I hope you also enjoy reading about the many highlights and exciting new projects of 2021.

The WRI is always looking for new ways to engage and support activities within the University and to partner with external organisations, so please do not hesitate to get in touch with us to discuss your research endeavours if you are looking to explore new opportunities.

Professor Matthew Gilliham
Director, WRI

2021 in review

Waite Research Institute researchers continued to show their expertise in 2021 on a broad range of topics with a specific focus on sustainability and critical ongoing challenges in the agriculture, food and wine industries.

The WRI was involved with the development of the Agrifood and Wine FAME (Foci and Magnets for Excellence) Strategy in late 2020, with several projects receiving support in 2021 in the four key SA-based research missions of Dryland Agriculture, Value-Added Agrifoods, Supporting the Agrifood and Wine Value Chain, and Biosecurity and Livestock Wellbeing.

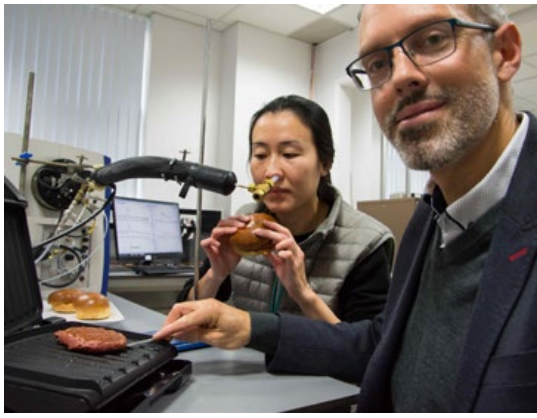
In line with these overarching research topics is the goal to improve drought resilience and preparedness on SA farms, which will be tackled by the newly established South Australian Drought Resilience Adoption and Innovation Hub (SA Drought Hub). The application for the SA Drought Hub was led by Dr Rhiannon Schilling and is one of eight in Australia, established by the Australian Federal Government. Each of the eight national hubs will bring together research and expertise that will support and facilitate effective testing and scaling up of new solutions into commercialisation and adoption. The SA Drought Hub will receive $8 million of funding over four years from the Australian Government's Future Drought Fund, with an additional $11.47 million of cash and in-kind support from the Hub's partners.

Last year also saw the launch of the International Flavour Research Centre, a collaboration between the University of Adelaide and the University of Nottingham, with industry partner v2food, a global leader in plant-based alternatives to meat. The new $2.5 million facility based at the Waite Campus, will expand the University of Nottingham's International Flavour Research Centre (IFRC), and bring together world-class scientists across flavour chemistry, food and agriculture, under the one roof, to take on the challenge of getting more sustainable, healthy, plant-based food into people's diet.

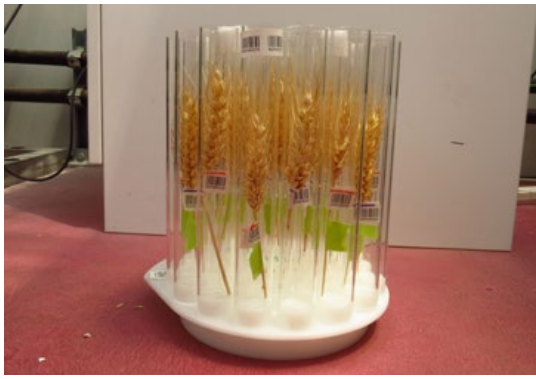
Waite campus researchers joined forces with the Australian National University (ANU) for the ARC Centre of Future Crops Development to launch in 2022. The Centre will build the workforce and foundations that will drive the translation of breakthroughs in advanced breeding, phenotyping and genetic technologies into higher yielding crops. $5 million in funding is coming from the Australian Research Council (ARC) for the new centre with the Australian National University (ANU) as administrating organisation; approximately $5 million will come from research and industry partners. WRI member A/Prof Stuart Roy was appointed as the Centre's Deputy Director – Industry.

Late in the year the Australian Plant Breeding Academy was also started, through a partnership agreement between the School of Agriculture, Food and Wine and Australian Grain Technologies (AGT). The Academy will lead a new era in research and education, and will include the development of a new research program aligned with priority crops and traits to break new ground in plant breeding. The partnership with AGT will also see the appointment of a Breeding Research Fellow responsible for the Academy's breeding research portfolio, and the establishment of multiple PhD scholars in plant breeding, the first of which will commence in 2022.

Mr Rowan Ramsey MP, Dr Rhiannon Schilling and Deputy Vice-Chancellor and Vice-President (Research) Professor Anton Middelberg



Prof Ian Fisk with the 'MS-NOSE', a cutting-edge analytical tool that acts like an artificial nose, allowing real-time measurement of aromas while eating.



Grain in cassette to be deployed in our new GRDC funded X-Ray CT Scanner - Plant Accelerator

Awards, grants and publications

WRI members won awards and grants throughout 2021, which included external research funding, University of Adelaide internal funding and significant industry contracts.

Some highlights for 2021 include:

- Awarded and established ARC Linkage Grants for:
  - Prof Rachel Burton ($513,272): Pioneering seed solutions for the industrial hemp industry, as well as ($760,300): to establish agave as a sustainable, versatile and climate-proof Australian crop.
  - A/Prof Matthew Denton ($642,434): To identify and characterise soil bacteria that will allow the replacement of current agricultural fertilisers and increase Australian crop productivity.
  - Dr Iain Searle ($343,712): To develop a drought tolerant, high protein legume for arid Australia.
- ARC Discovery Grants awarded to:
  - Dr Michelle Phillipov ($390,979): Artisanal making and the future of small-scale local production.
  - A/Prof Alec Zuo and Prof Sarah Wheeler ($234,878): Impacts of changing water ownership and reforms on Australian water markets.
  - Prof Vincent Bulone ($621,200): Structure and metabolism of bioactive carbohydrates from brown algae.
  - Dr Tatiana Soares da Costa, with Prof Marilyn Anderson (La Trobe University) ($446,368): Re-purposing shelved 'antibiotics' in the search for new herbicides.
  - Emeritus Prof Stephen Tyerman and Dr Megan Shelden ($489,236): Finding the missing links in salt and water transport in plants.
- The ARC Future Fellowships awarded to Scott Boden ($816,950) to work on 'Deciphering the genetic regulation of inflorescence development in wheat'; and Jayakumar Bose ($802,000) for the project 'Targeting chloroplasts to enhance crop salt tolerance'.

Alison Gill

- Funding for Dr Tamara Jackson by the Australian Centre for International Agricultural Research (ACIAR) ($4.6M over 5 years) for her project 'Transforming smallholder food systems in the Eastern Gangetic Plain'.
- The Sandland Bequest funding awarded to a team which includes Prof Kerry Wilkinson and Dr Abel Santos, for the project 'Pesticide biosensor development and hybrid device integration for agricultural and environmental analytics' that aims to use expertise in the former Faculties of Sciences and ECMS to develop biosensors of industrial fungicides used in agriculture.

Ten 'Future Making Fellowships' were made available across the University of Adelaide Research Institutes in 2021, to attract and support early-career and mid-career researchers of outstanding research and calibre. The Waite Research Institute attracted Dr Stephanie Watts-Fawkes and Dr Tatiana Soares da Costa to start their projects under the Fellowships in 2021 and 2022 respectively.

PhD-candidate Alison Gill became an Agriculture, Food and Wine 2021 Fulbright recipient, allowing her to continue her research work on hemp agronomy at the University of California, Berkeley at the end of the year.

Dr Tina Bianco-Miotto was recognised for her impact on community in 2021 and was awarded the inaugural Eileen Scott Award for Excellence in Gender, Equity, Diversity and Inclusion.

During the graduation ceremonies, the University of Adelaide celebrated outstanding leaders and awarded Ms Pamela Dunsford, Emeritus Professor Geoffrey Fincher, Dr Stephen Jefferies and Emeritus Professor Peter Langridge with Honorary Doctorates.

WRI's 2021 publication awards (in the four WRI membership categories) based on citations and journal impact factor were announced at the WRI Research Showcase in December and awarded to: Prof Dabing Zhang (Research Leader), Dr Dimitra Capone (EMCR), Dr Victor Sadras (Industry) and Nasir Iqbal (Student).

Communications and engagement

Waite Research Institute communications relies on interactions with members through several social media platforms as well as the Waite website (thewaite.org). The Waite website is managed through the WRI with input from members across all partners. Aside from this, the website also serves as a platform for initial communication about the WRI with external stakeholders. All partner profiles on the website have been updated in 2021, and the site averages 2000 visitor sessions per month. Furthermore, notifications of over 10 events and seminars are listed on the site each month, which are received by over 700 members in a weekly e-mail update.

WRI also manages a University of Adelaide WRI website, as well as several social media accounts under @waiteresearch. The accounts relay research impact stories, news from campus, funding initiatives and student opportunities and are growing forms of communication with researchers and students alike - WRI Instagram account has grown with an overall increase of over 25% in followers and similar engagement growth over 2021.

Furthermore, one of our student Institute members, PhD candidate Natalia Caliani, was awarded a University of Adelaide Science Communications prize for capturing her research in a series of blog and social media posts shared by the University and Waite Research Institute through several channels. A group of Institute student members also represented WRI at the Faculty of Sciences booth at the Ingenuity event in October 2021, while a second group of students presented their research during the same event. WRI seminar series was conducted mostly online over the course of 2021, with more than 20 seminars being held, of which most are shared online on YouTube.

The WRI annual research Showcase was held at the National Wine Centre at the start of December 2021, and was attended by 160 people. The day comprised of industry talks by Caroline Rhodes of Primary Producers SA and George Georgiadis of the South Australian Spirit Producers' Association, as well as 24 research talks from across all of the WRI disciplines. The four different sessions were set up to reflect the FAME missions of Dryland Agriculture, Value-Added Agrifoods, Supporting the Agrifood and Wine Value Chain and Biosecurity and Livestock Wellbeing and were chaired by research leaders from WRI partners and the Head, School of Agriculture, Food and Wine.

WRI Social Media

George Georgiadis from the South Australian Spirits Producing Association and Never Never Distilling presenting at the Research Showcase

A selection of WRI projects funded in 2021

Parasitic Diseases Research Group

Dr Danny Wilson (School of Biological Sciences) and A/Prof Ryan O'Handley (School of Animal and Veterinary Sciences) and colleagues have formed the Parasitic Diseases Research Group (ParaDRG), part of the Australian Centre for Antimicrobial Resistance Ecology (ACARE). The purpose of the research group is to bring together research expertise to develop new drugs and vaccines to control parasitic diseases, with a specific focus on apicomplexan parasites. For the livestock industries globally, apicomplexan parasites, which include the coccidia, *Toxoplasma, Neospora, Babesia*, and *Cryptosporidium*, are amongst the most important production limiting pathogens and there is an urgent need to develop novel drugs and vaccines to control these diseases.

WRI support is helping to establish the full lifecycle of *Toxoplasma gondii* parasites, which will provide the ability to test the efficacy of vaccines and drugs at all stages of parasite development, and enable scale up for commercial trials of developed therapeutics.

ARC Linkage project on soil ecological approach to increasing Australian crop productivity

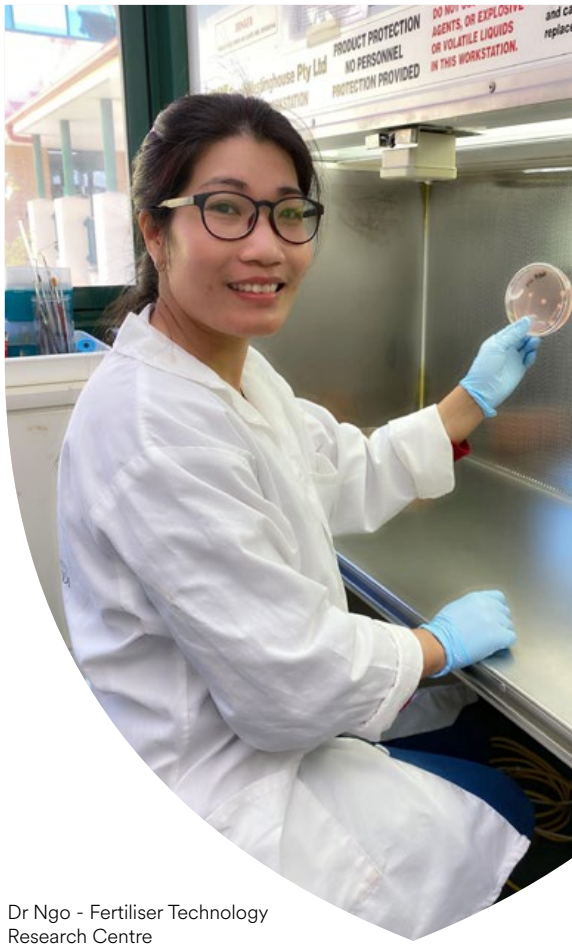
The WRI supported the ARC Linkage Project grant, along with New Edge Microbials and SAGIT, of A/Prof Matthew Denton and Prof Tim Cavagnaro to identify and characterise soil bacteria that will allow the replacement of current agricultural fertilisers and increase Australian crop productivity. Activities under this project included the planting of wheat seeds of a recent benchmark cultivar, Scepter, in the soils from our Australian soilbank, to be grown in a controlled environment room. Roots (endosphere) with attached rhizosphere soil were sampled for Plant Growth Promoting Bacteria (PGPB). Through this project 709 potential PGPB strains have been isolated from our soilbank and transferred to long term storage. 31 reference strains (30 strains from our previous collection, and one commercial strain) have been recovered and purified. All 740 strains are currently stored and a detailed database of the strains has been prepared.

Statistics for the Australian Grains Industry-South

SAGI-South has used WRI support to extend growers' field information with publicly available data on weather, climate and soil properties in the locations of trials and in the region. This data analytics development was supported with three publications on novel methodologies of ranked set sampling in statistical journals. SAGI-STH works in collaboration with colleagues from the Ohio State University, USA and the University of Canterbury, NZ.

Support for Fertiliser Technology Research Centre

With support from WRI, the Fertiliser Technology Research Centre is working with SARDI on developing new bio-mineral fertilisers incorporating known beneficial soil organisms. These fertilisers will be designed for developing countries or organic farming systems where use of synthetic fertilisers is either logistically difficult or cost prohibitive or not encouraged. Dr Thi Thanh Hue Ngo is using both chemical engineering and microbiological techniques to synthesise a number of different formulations that will be evaluated for physical, chemical and microbiological quality as well as agronomic efficiency.



Dr Ngo - Fertiliser Technology Research Centre

FAME Strategy Agrifood and Wine, Digi+

A large contingent of WRI researchers were successful in 2021 in securing backing through the FAME Agrifood and Wine Strategy as well as the FAME Digi+ Strategy internal funding scheme provided by the Deputy Vice-Chancellor (Research).

Project title	Applicants
Agrifood and Wine	
The development and deployment of an autonomous high-throughput field phenotyping platform for almond orchards	A/Prof Rini Akmeliawati, Dr Darren Plett
Novel business models for integrated water, food and energy production systems	Prof Holger Maier, Prof Sarah Wheeler
Video imaging and analysis for Animal Field Phenomics Facility	Prof Wayne Pitchford, Prof Simon Lucey
Beyond Vintage: Alternate uses of winery fermentation capacity for diversification and profit	Prof Vladimir Jiranek, Prof Robert Falconer
Advanced technologies to assess and report on the sustainability of farming landscapes ad resilient environments	Prof Andy Lowe, Dr Lingqiao Liu
Carbon valorisation: achieving a carbon neutral farming future	Prof Tim Cavagnaro, A/Prof Patrick O'Connor
Scaling up Space Agriculture	Prof Matthew Gilliham, Prof Volker Hessel
Early detection of subclinical mastitis using a novel in-line biosensor	A/Prof Kiro Petrovski, Dr Emilie Mas
A disruptive mobile roboticised tracking systems for pests and beneficial in vertebrates	Dr Jerome Buhl, Dr Tien-Fu Lu
Future vines: initiate	A/Prof Chris Ford, Prof Ian Reid
Optimising plant growth in simulated microgravity	Dr Philip Brewer, Prof Volker Hessel
Pesticide biosensors for viticulture and winemaking industries	Dr Fiona Whelan, Dr Abel Santos, Prof Kerry Wilkinson
Building traceability, transparency, and assurance (TTA) systems for agrifood and wine supply chains	Dr Armando Corsi, Prof Rachel Ankeny, A/Prof Sue Bastian
Healthy hens, healthy humans. Improving animal wellbeing and food safety of poultry by removing bacterial biofilms on chicken farms	Dr Andrea McWhorter, Dr Katharina Richter
Digi+	
An autonomous soil sampling and measurement system for transforming agricultural management and soil carbon stock assessment	A/Prof Luke Mosley, Dr Lei Chen

WRI activities and outcomes in 2021

The agriculture, food and wine sectors are facing challenges in a changing climate, growing world population and decline in natural resources.

The need for a circular economy in an economic, social and agricultural sense is growing, and research at the Waite Research Institute focuses on finding future-proof solutions for productive and profitable food and beverage production. To support this vision, the WRI research goals include sustainable development for agriculture in itself, but also for cross-disciplinary initiatives and social support of researchers, industry and community. WRI research is in this way aligned to the University of Adelaide and the FAME (Foci and Magnets for Excellence) Strategies for Agrifood and Wine and Digi+, where partnerships with government, business and the community are central to attracting the best researchers and partners to deliver industry transforming research outcomes for the complex social, technological and environmental challenges we face this day.

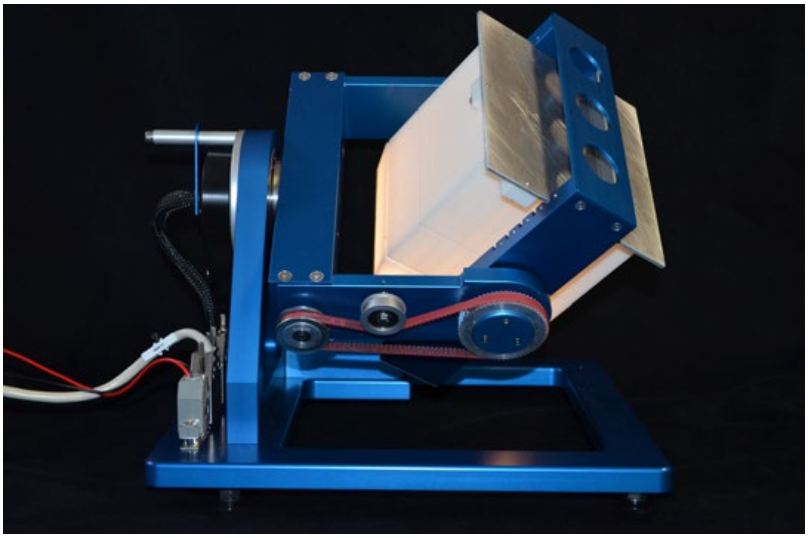
The Agrifood and Wine FAME and Digi+ Strategies were established in 2021, with the Research Missions of the former being Dryland Agriculture; Value-added Agrifoods; Supporting the Agrifood and Wine Value Chain; and Biosecurity and Livestock Wellbeing for Agrifood and Wine. The Digi+ strategy focuses on advances in digital technology to drive breakthroughs in, among others, food sustainability through the Research Missions of Critical Minerals; Quantum Technologies; Information Capability; Autonomous Systems; Energy Systems Transformation; and Space Industries.

A selection of research highlights from the 2021 projects within the FAME Strategy, and one Digi+ Strategy aligned with Waite Research Institute's focus on excellence in Agricultural research, is featured here.

Research with impact in sustainable intensification of agriculture in a changing climate

FAME and Digi+ projects started in 2021 with emphasis on research for the future, from Space Horticulture to improving animal wellbeing and food safety, and bringing further automation into agricultural management.

Researcher on crop plot at Waite Campus



Random Positioning Machine which simulates microgravity

The autonomous Trektor Platform on trial

Optimising plant growth in simulated microgravity – Philip Brewer, Volker Hessel

The original FAME project was focused on plants grown in simulated microgravity, in a Random Positioning Machine, under LED lighting. It was discovered that plant shoots and roots are extremely sensitive to growing towards and away from light in zero gravity. This outcome supported the possibility of growing plants in space. Furthermore, the work showed that dwarf Arabidopsis is able to develop normally in a zero-gravity environment, indicating the use of dwarf varieties in space to give opportunities for the development of space horticulture.

The project has expanded to identify how LED lighting affects human and plant well-being and performance in space as artificial light might impact both space agriculture and vertical farming on Earth. A simulated "space habitat" has been sourced to start the set up for an immersive vertical garden habitat. We think that in the future the "space habitat" will become an attractive facility for investors for research in the space and vertical farming manufacturing sectors, and will inspire further research and student engagement.

Healthy hens, healthy humans. Improving animal wellbeing and food safety of poultry by removing bacterial biofilms on chicken farms - Andrea McWhorter, Katharina Richter

Chicken meat and eggs can be carriers of several types of pathogens, causing harm to both humans and animals. Mitigating the presence of these pathogens in the food supply chain is of importance to public health. Several interventions have been designed to reduce bacterial load at multiple steps in the food supply chain, this project supports investigating these interventions and is performed in three separate aspects:

1. Controlling *Campylobacter* spp. on chicken meat using plasma activated water
2. Evaluating plasma activated water as a method for controlling Salmonella on egg farms
3. Isolation of environmental bacteria from a layer hen farm to evaluate both the capacity to form biofilms as well as the efficacy that different types of plasma activated water have on them.

All three parts of this project are set to be finished mid-2022, with ongoing research to follow to investigate what role multi-species bacterial biofilms play in the persistence of pathogenic and zoonotic bacterial strains – and subsequently the ability of plasma activated water to remove/reduce the biofilms.

An autonomous soil sampling and measurement system for transforming agricultural management and soil carbon stock assessment – Luke Mosley, Lei Chen

A/Prof. Luke Mosley (School of Agriculture, Food and Wine), Dr Lei Chen (School of Mechanical Engineering) and their team have commenced the work on the Digi+ FAME funded project on 'An autonomous soil sampling and measurement system for transforming agricultural management and soil carbon stock assessment'. Initial soil sampling concepts have been tested at the Waite Campus on the autonomous 'Trektor' platform and are proceeding to prototype build stage in the University of Adelaide Mechanical Engineering School. Low cost infra-red sensors have also been tested and show promising results when benchmarked against 'gold standard' laboratory instruments.

Building large-scale initiatives across disciplines

In 2021 the WRI continued to support initiatives that work across disciplines, updates from a selection of these is presented here.

ARC Training Centre for Future Crops Development

In 2021 the ARC Training Centre for Future Crops Development was established with partners ANU and NSW-DPI to train a new generation of researchers and leaders to build new capabilities for agriculture. The aim of the Centre is the development of socially responsible genetic and field technologies which result in higher-value and climate resilient crops. This will be achieved through the research areas of social and market shaping studies, synthetic biology (SynBio), crops targeting, traits targeting and increasing yield and grain quality.

Partnership negotiations for the Training Centre are still ongoing, with expected research activities to commence in July 2022 in the following 4 programs:

1. training a new generation of researchers and leaders to build capability for Australian agriculture
2. training in socio-economic considerations and opportunities for innovation, in alignment with community needs
3. training in genetic technologies and crop genome-engineering pipelines
   a. technological innovations in plant genome engineering
   b. SynBio applications to improve quality traits, yield and productivity of major Australian crop species
4. training and development in trait and field trial evaluation technologies.

Prior to the start of Training Centre activities, the Centre has leveraged a GRDC tender for proof of concept assessment of wheat genetic modifications and their impact on yield potential, for a total of $246,763, with work starting April 2022.

ARC Training Centre for Innovative Wine Production

2021 was the fourth year of the second iteration of the ARC Training Centre for Innovative Wine Production. This year saw the first of the Centre's PhD students complete their studies with Lira Souza Gonzaga qualifying for her degree and Pietro Previtali, Eva Sui and Colleen Szeto submitting their theses for examination. Each of these students have gained employment in the wine industry or academia with two joining Centre industry partner organisations.

A 2021 Centre highlight was a workshop in the Coonawarra wine region of South Australia. Centre PhD students and postdoctoral researchers presented their research to Coonawarra Vignerons and the local wine industry community. The trip provided an excellent opportunity for researchers to build networks and receive valuable industry specific feedback as well as discuss future collaborations, and was organised in collaboration with Centre industry partner Coonawarra Grape and Wine Incorporated.

The Centre's research was shared widely in 2021 with its researchers contributing to some 32 peer reviewed research articles, 1 book chapter and 6 conference papers.

One of these articles, which reported how crop load and plant water status can influence the ripening rate and aroma development of grape berries, featured on a supplementary cover of the *Journal of Agricultural and Food Chemistry* (Previtali et al, Journal of Agricultural and *Food Chemistry*, Vol. 69, Issue 27). This research generated significant interest with subsequent media releases, radio interviews and news stories. Centre researchers also presented their research through some 40 local, national and international talks, including 12 presentations at the national Crush Symposium, a conference specifically for wine science researchers.

Statistics for the Australian Grains Industry – Southern Region (SAGI-STH)

The SAGI-STH project has been extended for another year to continue its excellent support of the research investment in the region and to work closely with the grains industry on embedding statistics and data analytics in their R&D and Extension. The team is looking after thirty research projects representing a multi-million dollar investment (>$25M) by GRDC, ranging from breeding to on-farm experimentation, with another extension until January 2023 to be negotiated in 2022. The project is maintaining a large footprint in the Southern grains growing region through project work and professional development workshops for growers. The community of practice developed over many years is supported with monthly webinars and now includes more than 300 participants, with about 40 participants joining monthly.

SAGI-STH continues research at the interface of statistics and machine learning in plant phenotypic and genotypic applications. Two papers in this area have been accepted for publication in 2021, with one of them in a highly ranked journal *GigaScience*.

Two young statisticians in the Hub were successful in getting a small Yitpi grant for collecting data stories to highlight Waite research. Furthermore, the group attracted an Oracle infrastructure grant worth of $140K credit for cloud computing.

The Biometry Hub presents monthly seminars, StatsPD@Waite, to promote data science and statistics in agriculture, soil and plant research. The group hosts undergraduate, postgraduate and research internships for non-data scientists to develop and strengthen their data skills. Two Honours students successfully graduated from the group (AgScience/Biometry) in 2021.

Research Consortium for Agricultural Product Development

The Research Consortium for Agricultural Product Development (RC-APD) is a $10.9 million (including cash and in-kind), four-year program funded by the Government of South Australia launched in 2019. It brings together nine South Australian-based companies from the agriculture and food sector, and nine national and international academic institutions and industry partners to develop high-value products from agricultural waste.

The research activities of the RC-APD are undertaken in three cross-disciplinary programs across the campuses and faculties of the University of Adelaide and the University of South Australia, in conjunction with industry partners.

In 2021, the RC-APD has continued its excellent work in areas such as the analysis of waste streams from agricultural and food waste to identify new bioactives; the determination of specific biological activities; the development of prototypes of commercial products with health benefits, cosmetics and packaging materials, among many others. The outcomes of the ongoing input in 2021 resulted in:

- Three published research articles in *Green Chemistry, Foods* and the *International Journal of Molecular Sciences*.
- Site visits to Industry Partners Coopers Brewery, Ashton Valley Fresh and SA Mushrooms to build knowledge, gain operational insight, and advance commercialisation opportunities.
- The support of five PhD students and four new undergraduate students and the engagement of three additional post-doctoral scientists.
- A nomination was successful for Professor Vincent Bulone as Researcher of the Year Award at the 2021 AUSVEG *SA Vegetable Industry Awards for Excellence* in recognition of his ongoing development of high-value products from agricultural waste and leadership in securing significant research funds and resources.
- The contribution to the Waite Research Institute Showcase day with two presentations in the session on Value-Added Agrifoods.

Furthermore in 2021, Consortium Director Vincent Bulone secured an ARC Discovery Project grant ($621,200) for a project titled Structure and metabolism of bioactive carbohydrates from brown algae. Prof Bulone is also the Scientific Director of the Cooperative Research Centre Fight Food Waste; his involvement adds to the synergies between the two initiatives.

Enhancing excellence through researcher development

The WRI invests heavily in the development of their researchers through support, with a strong focus on early and mid-career researchers (ECMRs). A Peer Mentoring for Grant and Fellowship Success program for EMCRs was supported by the WRI in 2021. The program offered a facilitated, structured, peer-mentoring program over three months for ECMRs to either observe or have the chance to finish a substantially crafted grant, fellowship or other written application. The program gave participants the opportunity to work on publication metrics, peer mentoring and collaborative/networking opportunities over the course of three sessions throughout the year and attracted a total of 20 EMCRs from within the University of Adelaide, SARDI and AWRI with a mix of food, wine, agriculture backgrounds, as well as biological sciences and public health.

Several of the participants applied for small grants, Future Making Fellowships and ARC Discovery Early Career Researcher Awards (DECRA).

The WRI has also supported grant writing through connecting with an independent grant editor. In 2021 support was provided for 2 Future Fellowship applications, 6 DECRAs, 8 ARC Discovery Projects, 1 ARC Linkage Project and 1 Centre of Excellence. Outcomes of most of these applications are due in 2022.

Further support for EMCRs was given in the form of a scheme to promote them as honours supervisors. Student scholarships were made available in 2021 for students choosing an ECMR as supervisor, which helped Dr Thomas Lines and Dr James Cowley to attract honours students. The honours support scheme also aided in setting up collaborative projects between ECMRs from different research groups.

The WRI also supported the postgraduate student symposium, organised by the Postgraduate Association for Waite Students, in September, which gave current PhD researchers a podium to present their current research work. The two-day symposium was a great success with ample interaction between peers as well as support by supervisors and other research staff and finished with awarding four student researchers with prizes for their presented work.

Researcher development includes the support for Women of Waite, which included help for multiple events over the year. The Women's Day Breakfast Event in March and the speaker event with Julie Piantadosi from Total Coaching Academy later in the year were well attended and overall viewed as a good way of connecting across campus partners.

Prize winners postgraduate symposium

Connecting researchers with industry

The WRI believes that strong connections between industry and research provide significant benefits for development of both parties. As 2021 was still bound by many COVID restrictions, visits to the Waite campus were kept at a minimum for most of the year.

Two visits did stand out, with ABC's Landline in the first half of the year coming to campus to interview WRI's Prof Gilliham and A/Prof Tucker as well as CSIRO's Dr Ian Dry for a discussion on the potential for utilising GM plants for agriculture on Earth and beyond. Late in the year, Shadow Minister Zoe Bettison visited the campus together with newly appointed Deputy Vice-Chancellor (External Engagement) Dr Jessica Gallagher and Pro Vice-Chancellor (International) Prof Jacqueline Lo, and met with A/Prof Bettina Berger for a visit to the Plant Accelerator, A/Prof Paul Grbin to visit the Winery, Dr Mark Krstic from the AWRI and University's Prof Matthew Gilliham, A/Prof Matt Tucker, Prof Jason Able and A/Prof Chris Ford to discuss the future of agricultural research and the return of international students to campus. The visit was well enjoyed by all and provided a good introduction to the Waite campus for Dr Gallagher.

2021 also saw a slow return to events occurring either face to face or in hybrid models and WRI supported the Australian Society of Plant Scientists Conference in November at the National Wine Centre in Adelaide. The national conference covered diverse aspects of plant biology from across Australia and included the ASPS annual general meeting.

University of Adelaide's Research Tuesdays Events were done in a hybrid format throughout 2021 as well, with WRI Deputy Director A/Prof Matthew Tucker presenting on GM crops in October. The event was well attended both online as well as face to face on the North Terrace campus.

Furthermore, academia and regional wine expertise was brought together through a Memorandum of Understanding between the University of Adelaide and the Barossa Grape and Wine Association. Under the agreement, plans include the development of executive short courses, so those already working in the industry can develop new skills to further their businesses and careers. Mutual collaboration will also allow the leveraging of knowledge with existing and future suppliers, which may assist in research project and grant applications, including the development of externally funded projects. An initial meeting was organised through an Open Day at the Barossa Campus where Agriculture, Food and Wine research was presented to local industry, followed by a networking event.

The wine industry mentor program provides another level of communication between academia and industry, with the successful program attracting mentors such as Cassandra Collins, Sue Bastian, Chris Ford and Kerry Wilkinson, as well as mentees from Agriculture, Food and Wine groups across Waite Campus.

WRI partners

University partners

AFW

The School of Agriculture, Food and Wine (AFW) is one of twelve schools within the University of Adelaide Faculty of Sciences, Engineering and Technology. The school 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 comprises more than 70 academic and research staff, and several hundred postgraduate and undergraduate students move through the School's suite of degrees each year.

The School is organised into three departments and incorporates several research disciplines, including:

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

The School of Agriculture, Food and Wine also encompasses the following specialist research centres and entities:

Australian Plant Phenomics Facility (APPF) – The Plant Accelerator

The Australian Plant Phenomics Facility (APPF) is a distributed network of national research infrastructure platforms offering open access to state-of-the-art plant phenomics technologies, tools and expertise not available at this scale or breadth in the public sector anywhere else in the world.

The Plant Accelerator is a national facility established under the Commonwealth National Collaborative Research Infrastructure Scheme (NCRIS). It 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 crop improvement – generating crops that are more productive, disease tolerant and viable in marginal conditions.

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

Plant Energy Biology (PEB)

The University of Adelaide established a node of the ARC Centre of Excellence in Plant Energy Biology in 2011. The current version of the centre began in 2014 with Professor Steve Tyerman and Professor Matthew Gilliham as Chief Investigators with Professor Rachel Burton becoming a Chief Investigator in 2018. The Centre comprises The University of Western Australia, Australian National University, The University of Adelaide and La Trobe University, eleven Chief Investigators and 130 internationally competitive staff and students. PEB was funded primarily through the Australian Research Council ($26 million) and $14 million from the partner universities to fund the Centre through to the end of 2021.

The research focus of the Centre is to better understand the way in which plants capture, convert and use energy in response to environmental change. The long-term goal is to enhance energy efficiency to improve sustainable productivity of plants. At the Adelaide node the aim is to improve the efficiency of plant energy use by manipulating the transport properties of gatekeeper cells for water, carboxylates, phosphate and salt.

ARC Training Centre for Innovative Wine Production

Based at the University of Adelaide's Waite Campus, research projects within the multi-partner ARC Training Centre for Innovative Wine Production fall into two broad themes: Responding to Challenges and Increasing Profitability. Research spans the winemaking process investigating aspects of viticultural management, oenology including wine microbiology, wine chemistry and sensory science and winery process optimisation. Incorporating 13 partners, the Centre represents a unique and exciting training opportunity for PhD and postdoctoral researchers to work closely with leading research centres and Australian and International companies from the wine and food sector.

The Centre, administered by the University of Adelaide, has been made possible through $4.4 million in competitive funding from the Australian Research Council, with an additional $11.6 million in cash and in-kind support from university, research and industry partners including AGRF, Availer, AWRI, Chalmers Wines Australia, Coonawarra Grape and Wine Inc., CSIRO, Charles Sturt University, E. & J. Gallo Winery, Lallemand Australia, the NSW Department of Primary Industries, Pernod Ricard Winemakers, VA Filtration (SA) and Wine Australia.

ARC Training Centre for Future Crops Development

The ARC Training Centre for Future Crops Development is an international collaboration to transform Australian Agri-Tech and global food security. Research foci of the Centre are synthetic biology, crops targeting, traits targeting and increasing yield and grain quality to work towards the aim of developing higher-value and climate resilient crops, using new SynBio (genomic) techniques to target key traits for improving yield in the harsh Australian environment.

The Centre is a collaborative effort to transform industry with 20 local and international partners from across the research, industry and commercial agri-tech sectors.

Partners include the Australian National University, CSIRO and the NSW Department of Primary Industries.

Wine Innovation Cluster (WIC)

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 encompasses ~70% of Australia's national wine R&D capability, and was established in recognition of the fact that enhanced coordination and integration is necessary to build the quality outcomes needed by the wine and grape growing industries to meet future challenges. 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 35 collaborative projects that have attracted more than $27m in external funding; strong industry partnerships on many of them attest to their relevance.

University partners at the North Terrace and Roseworthy campuses include:

The Centre for Global Food and Resources (GFAR)

The University of Adelaide's Centre for Global Food and Resources (GFAR) has a global reputation for creating and applying knowledge on secure and resilient global food and resource systems.

Working with Australian primary producers and agribusiness and resource professionals, through a unique mix of business fundamentals, practical experience and global connections. With world-leading agricultural and wine research and training facilities extending to campuses located at Waite and Roseworthy, GFAR conducts innovative interdisciplinary research, using a whole of systems approach, addressing economic, policy, agribusiness and social issues affecting global food systems. In addition, we connect relevant partners ranging from industry organisations and enterprises to government institutions and policy makers. Its networks extend across the globe with strong research partnerships with agricultural, food, health and environmental scientists, as well as industry, government and NGOs, with the aim of achieving healthy, resilient and productive communities and landscapes that are food, water and resource secure.

School of Animal and Veterinary Sciences and the Davies Research Centre

The School of Animal and Veterinary Sciences (SAVS) has international leaders in animal behaviour, biology, population health, infectious diseases, reproduction, livestock and equine health research.

The Davies Research Centre is conducting world-class research, knowledge transfer and delivery of applications to build the sustainability of the red meat industry. Ruminant animal experts explore the interactions between genetics, physiology, management and the natural environment to improve animal productivity, welfare and the quality of the resulting food for consumers.

With key links to the beef, sheep, pork and poultry industries, the Roseworthy campus research environment fosters collaboration and partnerships for delivering evidence-based outcomes in a 1671 hectare farm setting and modern laboratories. Co-located partners include PIRSA-SARDI, Weatherbys Scientific Australia and Zoos SA.

ThincLab.

ThincLab

ThincLab Waite is Adelaide's first agtech, food innovation and wine focused incubator. ThincLab supports start-ups in the agri, food and wine sectors. It provides a nexus for start-ups, mentors, investors, agribusiness, corporates and academics to connect and collaborate.

Members of ThincLab Waite benefit from a range of services to support their start-up, including:

- a global network of industry experts and our dedicated AgTech Expert in Residence,
- access to the ThincLab programs (ThincSTART, ThinkSCALE and ThincGROWTH) and our ThincSprint, and
- access to ThincLab masterclasses and networking opportunities.

Non-University partners

The Waite and Roseworthy campuses of the University of Adelaide are unique in the number of non-University research partners co-located there. 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. All have added greatly to the richness of the research environment, co-investing in buildings and other infrastructure and forming effective collaborative relationships with each other.

CSIRO

CSIRO, Australia's national science agency, aims to solve the country's greatest challenges through innovative science and technology. CSIRO works with industry, government and the research community to address challenges including food security and quality; clean energy and resources; health and wellbeing; resilient and valuable environments; innovative industries; and a secure Australia and region. CSIRO's research at the Waite Campus provides innovation for Australia's agricultural, land, water and minerals sectors.

CSIRO's agriculture research applies world class multidisciplinary science, technology and facilities, relevant IP and global networks across the value chain to create healthier, trusted, safer and more sustainable food and fibre for the future. At the Waite Campus focus is on integrated agricultural systems, wine grapes and horticulture, genomic science for crop performance, and soil carbon and nutrient cycling. CSIRO's land and water research provides the science to underpin Australia's economic, social and environmental prosperity. CSIRO's research at the Waite Campus focuses on environmental resilience, environmental toxicology, managing water ecosystems, water in the resources sector, economics, productivity and sustainability. CSIRO's mineral resources works closely with industry partners to unlock the value of Australia's natural resource base and delivers a more productive, lower cost, socially and environmentally responsible global minerals industry.

PIRSA-SARDI

SARDI, a Division of the South Australian Department of Primary Industries and Regions (PIRSA), is the SA Government's principal research institute for primary industries creating opportunities to ensure the agriculture, food, aquatic and bioscience industries are internationally competitive and ecologically sustainable. SARDI focusses on food safety and innovation, production systems and productivity enhancement, water utilisation and climate adaptation, product integrity, plant breeding, molecular diagnostics, market access, supplier competitiveness and biosecurity. SARDI research divisions are aquatic sciences, livestock and farming systems, and sustainable systems. SARDI has more than 300 scientific, technical and support staff and has management responsibility for 12 research centres across South Australia.

The Australian Wine Research Institute (AWRI)

The Australian Wine Research Institute (AWRI) is the Australian grape and wine industry's own research organisation. It supports a sustainable and successful grape and wine industry through world class research, practical solutions and knowledge transfer. Established in 1955, the AWRI is governed by an industry-led, skills-based Board and is a member of the Wine Innovation Cluster located at the Waite Research Precinct in Adelaide. The AWRI's activities are guided by its mission and values, an industry-endorsed research, development and extension plan and an internal business plan. AWRI Commercial Services is the commercial arm of the organisation and provides advanced analytical and consulting services on a fee-paying basis.

The AWRI supports grapegrowers and winemakers by:

- Undertaking strategic and applied research based on the priorities of Australia's grapegrowers and winemakers
- Providing a helpdesk service to answer queries from producers and conducting problem-solving investigations
- Presenting roadshow workshops and seminars in Australian wine regions
- Delivering technical information via the John Fornachon Memorial Library, the AWRI website and regular email bulletins
- Producing publications including an Annual Report, AWRI Technical Review and the Agrochemicals 'Dog Book'
- Conducting events including the triennial Australian Wine Industry Technical Conference, the Advanced Wine Assessment Course and Research to Practice modules
- Providing NATA-accredited analysis and assistance with wine export
- Supervising postgraduate students and providing lectures to undergraduate students.

Australian Genome Research Facility (AGRF)

AGRF is a not-for-profit organisation, committed to quality and innovation. We actively seek to partner and share our knowledge and expertise in genomics. Through our national network, AGRF provides access to innovative and leading technologies, enabling genomics in the biomedical, agricultural and environmental sectors. From single gene analysis to whole genome sequencing, AGRF provides a full range of genomic capabilities and services with complementary bioinformatics across the entire biological spectrum, to academia, healthcare and commercial industries. AGRF's vision is to help make the world a better and more sustainable place through the use of genomics. AGRF's purpose is to partner with the genomics community to make profound improvements to people's lives by delivering a world-class, innovative, and integrated capability. To achieve this, AGRF is an active collaborator on a number of Waite researcher grants that demonstrate collaborative partnerships, transfer of skills, knowledge and ideas to help secure commercial and wider benefits of research.

Arris

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

Fight Food Waste Ltd

Fight Food Waste Ltd is a registered charity that was established in 2018 and has a vision of An Australia without food waste. The company incorporates two divisions - the Fight Food Waste Cooperative Research Centre (FFW CRC) and Stop Food Waste Australia (SFWA). The 2018-funded FFW CRC is an $120 million, 10-year organisation funded through the Australian Government's Cooperative Research Centre Program, industry partners, state governments and tertiary institutions. Stop Food Waste Australia commenced in January 2021 as the National Food Waste Governance Entity that is the lead agency in delivering the National Food Waste Strategy. It will receive $4 million in seed funding between January 2021 and June 2024 from the Australian Government Department of Agriculture, Water and the Environment.

The Fight Food Waste Cooperative Research Centre brings together 50 industry and 10 research partners, with combined resources of $64 million cash and $57 million in-kind contributions. The FFW CRC receives core funding from the Australian Government Department of Industry, Science, Energy and Resources CRC Program and is currently funded until 2028. Stop Food Waste Australia is a powerful partnership of 20 organisations who operate along the farm-to-fork food supply chain that are committed to reducing Australia's food waste by half by 2030. It currently receives seed funding from the Australian Government Department of Agriculture, Water and the Environment.

Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

Plant and Food Research Australia

Plant and Food Research is a New Zealand Government-owned Crown Research Institute, with staff situated at sites across Australia; at Waite, co-located at QUT in Brisbane, and in Melbourne. Research is conducted globally with a network of scientific collaborators, international development projects, and in-market support for customers' international activities. Plant and Food Research's mission is to create the world's most sustainable food systems by providing answers to complex biological questions. Plant and Food research designs innovative products and technologies in research areas of future plants, fish and foods; and sustainable, resilient food supply.

Financial statement 2021

Expenditure	
WRI areas of activity	
Researcher Development	$ 82,234
Large Scale Initiatives (or Science and Capacity Building)	$ 188,599
Connecting with Industry	$ 13,137
Research with Impact	$ 63,600
Sub total	**$ 347,570**
Salary and Admin	$ 455,511
Total	**$ 803,081**

Income (to members of the WRI)	
Category 1	$ 27,927,582
Category 2	$ 4,733,961
Category 3	$ 12,863,550
Category 4	$ 1,562,615
Other (NCRIS)	$ 3,155,990
Total	**$ 50,243,698**

Publications in 2021

3 Books

400+ Journal Articles

12 Book Chapters

10 Conference Papers

To view or download the full list of WRI publications for the 2021 calendar year, go to adelaide.edu.au/waite-research-institute/about#publications

The Waite Research Institute supports research and innovation that builds capacity for Australia's agriculture, food and wine sectors.

List of relevant acronyms

ACARE	Australian Centre for Antimicrobial Resistance Ecology
AFW	The University of Adelaide's School of Agriculture, Food and Wine
AGRF	Australian Genome Research Facility
AGT	Australian Grain Technologies
ANZCCART	Australian and New Zealand Council for the Care of Animals in Research and Teaching
ARC	Australian Research Council
APPF	Australian Plant Phenomics Facility (The Plant Accelerator)
AWRI	Australian Wine Research Institute
CEADS	Centre for Environmental Adaptation and Development
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ECMS	The University of Adelaide's Faculty of Engineering, Computer and Mathematical Sciences
EMCR	Early/Mid-Career Researcher
FAME	Focus and Magnets for Excellence (UA Strategies)
FFW	CRC Fight Food Waste Cooperative Research Centre
GFAR	The University of Adelaide's Centre for Global Food and Resources
GRDC	Grains Research and Development Corporation
HDR	Higher Degree by Research
HIA	Horticulture Innovation Australia
LIEF	Large Infrastructure and Equipment Funding
NCRIS	National Collaborative Research Infrastructure Strategy
NRM	Natural Resource Management
ParaDRG	Parasitic Diseases Research Group
PEB	ARC Centre of Excellence in Plant Energy Biology
PIRSA	Department of Primary Industries and Regions South Australia
RC-APD	The Research Consortium for Agricultural Product Development
SAGC	South Australian Genomics Centre
SAGI-STH	Statistics for the Australian Grains Industry – Southern Region
SAGIT	South Australian Grains Industry Trust
SAHMRI	South Australian Health and Medical Research Institute
SARDI	South Australian Research and Development Institute
SAVS	The University of Adelaide's School of Animal and Veterinary Sciences
SFWA	Stop Food Waste Australia
SJTU	Shanghai Jiao Tong University
TC-IWP	Training Centre for Innovative Wine Production
TERN	Terrestrial Ecosystem Research Network
UA	The University of Adelaide
WA	Wine Australia
WIC	Wine Innovation Cluster
WRI	Waite Research Institute

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Kaurna acknowledgement
We acknowledge and pay our respects to the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide's campuses at North Terrace, Waite, and Roseworthy are built. We acknowledge the deep feelings of attachment and relationship of the Kaurna people to country and we respect and value their past, present and ongoing connection to the land and cultural beliefs. The University continues to develop respectful and reciprocal relationships with all Indigenous peoples in Australia, and with other Indigenous peoples throughout the world.