THE UNIVERSITY of ADELAIDE

Honours Projects 2023

School of Agriculture, Food and Wine

make history.

Welcome to the School of Agriculture, Food and Wine

Message from the Head of School
Professor Jason A. Able

We are delighted that you are considering to choose an Honours project with us. The University of Adelaide is Australia's foremost university for teaching and research in agriculture and wine, and we are increasingly recognised in food and nutritional sciences. Annually, the School is competitively awarded in excess of $30M in research income and our staff publish over 300 journal articles (many of which appear in top ranking journals). These two metrics alone place the School as one of the top two research strengths of the University of Adelaide.

The School takes great pride in the quality and performance of its research and educational programs. Its facilities are state-of-the-art in many areas and we strive to provide a research environment of the highest international standard. In addition, we benefit from interactions with partner organisations on the Waite Campus including (but not limited to): South Australian Research & Development Institute (SARDI), the Australian Wine Research Institute (AWRI) and the Commonwealth Scientific & Industrial Research Organisation (CSIRO).

Undertaking an Honours degree is an exciting phase in your career development. Indeed, it is our expectation that many of you will make (or contribute to) important discoveries that will influence others in your chosen domain. Beyond Honours, many of you will no doubt also go on to undertake an MSc or PhD, given the rich and rewarding experiences you have during your Honours year.

The School aims to offer a supportive and vibrant research environment and we are committed to helping you develop your skills as a researcher. As such, projects supervised by Early- and Mid-Career Researchers (EMCRs) may be eligible for a $5000 student scholarship, funded by the Mortlock Bequest. These projects are titled EMCR-led Honours Project Scheme in this document. Additional scholarships for students supervised by more senior academics are also available from the School of Agriculture, Food and Wine and are based on academic merit. Details about scholarships can be obtained from the supervisors whose email addresses are listed in each of the project summaries. Links to researcher profiles to find out more about the supervisors are also included in this document.

We hope that you will identify a project that suits your interests and subsequently embark upon a journey that is the start of a wonderful, long and prosperous research career that is exciting, challenging and rewarding.

Best wishes as you start your journey of discovery with us.

Sincerely,

Jason

EMCR led Honours Project Scheme

Project title: Turning failed antibiotics into herbicides to fight weeds

Project supervisors:

Dr Tatiana Soares da Costa – Head of the Herbicide and Antibiotic Innovation Lab with the Waite Research Institute. Her area of expertise is in biochemistry, with a focus on developing new herbicide and antibiotics to tackle the rise in resistance that is threatening our global food security and health.

Dr Jenna Malone – Senior Research Fellow with the School of Agriculture, Food and Wine Weed Science group. She works on understanding and management of herbicide resistant weeds, with a focus on the evolution and inheritance of molecular resistance mechanisms.

Project description:

Weeds have been at war with food crops for many years. They battle with crops for resources, such as food, water and sunlight, reducing the quality and size of our harvests. For decades, we have used herbicides to control weeds and they have become an essential tool in agriculture to ensure food supply. Unfortunately, our current herbicides are failing as weeds have become resistant to their effects. Herbicide resistant weeds have now invaded over 40% of cropping land in Australia and they are costing our farmers over $5 billion every year. To make matters worse, very few new herbicides have entered the market in the past 40 years.

This project aims to tackle herbicide resistance by re-purposing failed antibiotics as new herbicide candidates that are less prone to developing resistance. The Soares da Costa Lab has discovered similarities between weeds and superbugs, and the project will leverage our knowledge of antibiotic resistance in superbugs to tackle herbicide resistance in weeds.

The Honours project will integrate innovative approaches in biochemistry, molecular biology and plant biology to identify and characterise compounds with herbicidal activity that have different mechanisms of action to herbicides in the market. Techniques that will be used in this project include protein expression and purification, enzyme kinetics, X-ray crystallography/docking, plant growth assays and compound application/spraying. The project is expected to make significant long-term contributions towards food security by discovering new tools for effective weed management.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further information: tatiana.soaresdacosta@adelaide.edu.au; jenna.malone@adelaide.edu.au

EMCR led Honours Project Scheme

Project title: Investigating the nitrogen and phosphorus requirements of psyllium (*Plantago ovata*), an emerging food and pharmaceutical crop

Project supervisors:

For this project you will work with Dr James Cowley and Dr Matthias Salomon, two postdoctoral researchers who have expertise in the food and health aspects of *Plantago* and soil nutrition and AMF, respectively, as well as Professor Rachel Burton, Head of the Department of Food Science. The work will also be conducted in collaboration with the Frank Wise Institute for Tropical Agriculture in Kununurra, Western Australia and there is scope to visit the institute during the project.



Project description:

Plantago ovata or psyllium, is an emerging crop species in Australia. It is the source of psyllium husk, a dietary fibre-rich material used as health supplements and in the production of gluten-free food. Almost all psyllium is grown in India, however, production beyond small-holder producers is rare and little is known about its nutrient requirements which are needed to expand to larger scale production, with almost no research into growth performance related to Australian soils.

In this project you will conduct greenhouse experiments to learn about the nitrogen and phosphorus requirements of *P. ovata*. A dose-response experiment of a range of nitrogen concentrations will help guide us in identifying the optimal N application for farmers. You will also test the response of *P. ovata* to soil phosphorus with and without arbuscular mycorrhizae (AMF) present. AMF are symbiotic fungi that supply difficult-to-capture nutrients like phosphorus to the plant, but little is known about their importance for *P. ovata*. You will determine the effect that these treatments have on biomass production, photosynthesis, seed yield, seed quality, and psyllium husk quality.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further information

Email: james.cowley@adelaide.edu.au; matthias.salomon@adelaide.edu.au

EMCR led Honours Project Scheme

Project title: Could Covid-style PCR tests be used to screen for herbicide resistance?

Project supervisors:

Dr Jenna Malone is a Senior Research Fellow with the School of Agriculture, Food and Wine, Weed Science Research group. She works on understanding and management of herbicide resistant weeds, with a focus on the evolution and inheritance of molecular resistance mechanisms.
https://researchers.adelaide.edu.au/profile/jenna.malone

Dr Peter Boutsalis is a researcher with the Weeds Science Research group whose work focuses on conducting random weed surveys to monitor for changes in herbicide resistance. He also runs Plant Science Consulting, an Adelaide based company specialising in herbicide resistance testing.
https://researchers.adelaide.edu.au/profile/peter.boutsalis

Project description:

While the dangers and implications of antibiotic resistance to human health are well known and publicised, far less attention has been given the increasing problem of resistance to the pesticides and herbicides vital to global food production systems.

Weeds present one of the largest costs to agriculture, causing greater losses to crop yield than both pest and pathogens combined, and costing Australian grain growers over $5 billion every year in yield losses and management costs. Herbicides are by far the most effective weed control tools and therefore the most widely used weed management practice of growers. However, the extensive use of herbicides for weed control has led to the evolution of herbicide resistant weeds.

Herbicide resistant weeds have become such a common problem that growers will often use resistance testing to determine whether they have resistance, before spending time and money applying herbicides that may potentially be ineffective due to resistance. Classical methods of testing for resistance consist of sampling plants or seeds from the field and taking them to the glasshouse or lab for growth, then spraying with different types of herbicides at differing application rates. These tests are very useful in determining resistance to differing herbicides, but a major disadvantage is the time required for the tests to yield results.

This project will investigate the potential of using molecular detection technologies, such as PCR assays, coupled with knowledge of genetic mutations causing herbicide resistance, in herbicide resistance screening. Techniques that will be used in this project will include plant growth, herbicide application, DNA/RNA extraction, primer design and PCR.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further information

Email: jenna.malone@adelaide.edu.au

EMCR led Honours Project Scheme

Project title: Evaluation of soybeans as a crop in South Australia

Although soybean is grown across a wide range of latitudes in Australia, its production within South Australia is limited. In tropical areas of Australia, soybean can be grown after the summer rainfall but given the dry summer conditions normally experienced in South Australia, growing soybean can be more problematic. Soybeans are sensitive to photoperiod (flowering in response to the shortening of day length) and have varied responses to environmental extremes (such as drought stress). Pathogens (such as *Phytophthora sojae* and *Sclerotinia* spp.) may also present a challenge in southern environments. Anh Pham currently leads a program at the University of Adelaide which is evaluating the characteristics of a diverse set of germplasm for their potential to adapt to South Australian conditions. In particular, the program is interested in identifying potential sources of water stress tolerance and disease resistance. The following projects are therefore available:

1. *Identification of soybean maturity best suited to the South Australian environment*. This project would identify lines with suitable maturity and/or competitive yield to be cultivated in South Australia (SA) at a commercial scale from a soybean germplasm panel. Molecular markers linked with known maturity genes will be used to decipher the genetic controls of maturity for lines that appear best suited for cultivation in SA environments.
2. *Improved water stress tolerance.* This project would investigate the impact of different levels of water stress at different times of the lifecycle on various plant growth parameters (such as flowering, yield potential and end quality) for a soybean germplasm panel.
3. *Improved disease resistance.* This project would investigate the response of a soybean germplasm panel to the main pathogens and include a comparison of tolerant and susceptible plant-pathogen interactions.

Students wishing to further their knowledge of agronomy, plant-pathogen interactions, plant physiology, and molecular biology would be ideally suited to this field of research. Dependent upon the project, techniques or skills learnt will include microscopy; aseptic and microbiological techniques; genetics; molecular breeding, data analysis and interpretation.

Supervisors:

Dr Anh Pham – Postdoctoral Research Fellow in the School of Agriculture, Food and Wine. Her expertise lies in genetic diversity and breeding for yield improvement in a wide range of crops. She currently oversees the Soybean Breeding Program at the University of Adelaide. Further information: anh.pham@adelaide.edu.au

Professor Amanda Able – Professor in Plant Science in the School of Agriculture Food and Wine. Her areas of expertise are broad ranging across plant physiology and plant pathology. They include epigenetics of plants faced with stress, understanding plant-pathogen interactions, stress priming and transgenerational inheritance, postharvest physiology and mycology. See https://researchers.adelaide.edu.au/profile/amanda.able

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

EMCR led Honours Project Scheme

Project title: The function of GIPCs in barley root adaptation to salinity

Project supervisors:

Dr Megan Shelden – Senior Lecturer and Mortlock Fellow within the School of Agriculture, Food and Wine. Her research is focussed on improving crop yields in hostile soils (salinity, drought) and enhancing food security.

Associate Professor Jenny Mortimer – Associate Professor with the School of Agriculture Food and Wine.

https://researchers.adelaide.edu.au/profile/megan.shelden

https://researchers.adelaide.edu.au/profile/jenny.mortimer

Project description:

Soil salinity is a major agriculture problem resulting in the decreased growth and yield of crops. In Australia, two thirds of the cereal growing regions are affected by salinity, significantly reducing crop yield and costing the farming industry around $1.5 billion a year. Most research to improve crop performance and yield has focused on shoot traits, mainly due to the inherent difficulties associated with observing and measuring root systems. However, many environmental stresses including drought and salinity directly impact soil properties and the crop root system.

Halotropism (negative) is the adaptive response of primary roots to grow away from soil areas with high salt. Although demonstrated in model systems, such as Arabidopsis, this has not been explored in a cereal crop. Here, the honours student will test the halotropic response in a collection of barley cultivars. They will then explore the role of a recently identified component of Arabidopsis salt sensing, the glycoinositolphosphorylceramides (GIPCs; Jiang et al. 2019), and determine whether it impacts halotropism. GIPCs are a class of glycosylated sphinoglipids that are highly enriched in the outer leaflet of the plasma membrane (Mortimer & Scheller, 2020). The honours student will profile barley GIPCs using sphingolipidomics. They will also use CRIPSR/Cas9 gene editing to develop a barley line with an altered GIPC glycan headgroup, for comparison to the Arabidopsis mutant.

The student will develop skills in molecular biology and gene editing techniques, plant growth, lipidomics, experimental design and data analysis, as well as independent research skills.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further information

Email: megan.shelden@adelaide.edu.au; jenny.mortimer@adelaide.edu.au

EMCR led Honours Project Scheme

Project title: Improving Salt Tolerance in Grapevine

Project supervisors:

Dr Megan Shelden – Senior Lecturer and Mortlock Fellow within the School of Agriculture, Food and Wine. Her research is focussed on improving crop yields in hostile soils (salinity, drought) and enhancing food security.

https://researchers.adelaide.edu.au/profile/megan.shelden

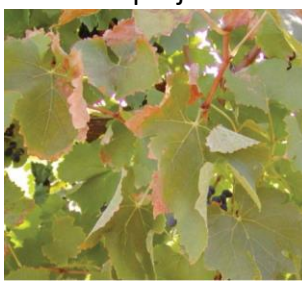
Dr Sam Henderson – postdoctoral fellow with the Shelden lab, School of Agriculture Food and Wine. Sam is a researcher with expertise in plant science, cell membrane biology, and ion channels.

https://researchers.adelaide.edu.au/profile/sam.henderson

Project description:

Salt and drought are the two major abiotic stresses affecting crop plant health, growth and development. Improving productivity of crops is necessary to meet the increasing worldwide demand for cereals, fruits and vegetables. Although, the Australian agricultural industry is dominated by cereal crops, a major economic consideration is the Australian wine industry. Grape growing in Australia accounts for 180,000 ha of which 86% is irrigated. Although the area of irrigated grapevines in Australia affected by salinity is currently relatively small, it is likely to increase due to increasing aridity with consequential inadequate leaching of root zone salts, which is in addition to increasing irrigation water salinity levels in some regions. Salinity seriously affects some iconic grape growing regions such as the Barossa, the Padthaway and the Riverland regions where a large proportion of commercial wines are produced.

To address major economic and environmental concerns, it is necessary to understand, quantify and manage the uptake and transport of sodium and chloride ions and water through a plant. Grapevine is an excellent model plant to study plant water relations and abiotic stress tolerance. This project will aim to investigate how different grapevine varieties take up and move salt and water through the plant, in order to gain a better understanding of salt tolerance.



The student will develop skills in greenhouse and growth chamber experimentation, plant physiology and molecular experiments, experimental design, and data analysis, as well as independent research skills.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further information:

Email: megan.shelden@adelaide.edu.au; sam.henderson@adelaide.edu.au

EMCR led Honours Project Scheme

Project title: Is there a link between embryo size, root architecture and drought stress in barley?

Project supervisors:

Dr. Laura Wilkinson – Plant Breeding Research Fellow in the School of Agriculture, Food and Wine and the Australian Plant Breeding Academy. Her area of expertise is flowering and grain development, and she works on novel crops and new traits of interest to the Australian grains industry.

Paul Telfer – Barley Breeder with Australian Grain Technologies. Paul's knowledge spans grain yield, agronomics, disease performance, malting quality and application of the latest statistical and genomic tools. His farming background drives his passion for agriculture and delivering improved tools to the Australian agricultural sector.

Project Description: Developing crops that can withstand hot and dry climates is becoming increasingly important worldwide. A key component of drought stress tolerance is root architecture, meaning the density, size and overall structure of the plant's root network. Variation in root architecture and the speed of root growth influences how plants access water and nutrients available in the soil, essential for the plant above ground to survive and thrive.

A recent study identified genetic associations between the yield of wheat in drought-stressed fields and the architecture of initial roots developed, as well as embryo size. This research project will explore whether the same associations exist in barley.

This project will develop your ability to design and run controlled experiments, undertake a population screen, perform tissue sampling and dissection, data analysis, RNA extraction and gene expression studies with qPCR, and integrate fundamental laboratory results with real-world agronomic data.

As a researcher on this project you will be part of the Australian Plant Breeding Academy, a new collaboration between the University of Adelaide and Australian Grain Technologies.

Recommended reading:
Rebetzke, G. J., et al. "Genotypic variation and covariation in wheat seedling seminal root architecture and grain yield under field conditions." *Theoretical and Applied Genetics* (2022): 1-18.

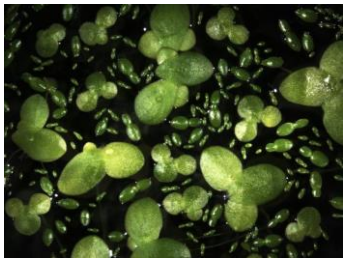
This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest.

Further information

Email: laura.wilkinson@adelaide.edu.au

EMCR led Honours Project Scheme

Project Title: Synthetic biology tools to develop novel Space crops.



Through genetic engineering, duckweed has the potential to nourish astronauts with nutrient dense food and even to produce pharmaceuticals for them on-demand.

Duckweed is a very fast-growing aquatic plant that reproduces via budding every few days and its biology is relatively simple compared to many traditional crop species. These features have caught the attention of plant biotechnologists who can see Duckweed's potential as a platform for production of compounds such as vitamins, pharmaceuticals and bioplastics. It could also be a very useful tool to address countless plant research questions. Furthermore, the whole plant can be eaten and it can be vertically farmed without soil; excellent characteristics for a plant to be grown in Space or on Mars.

The ability to precisely regulate genes to effectively modify plant traits, is essential. In our research group, methods to genetically transform Duckweed have been developed. However, we are currently lacking key molecular tools in our biotechnology kit. In-particular, we require a suite of promoters able to drive expression of desired genes at different strengths, within specific cell types or under certain conditions. To enable future synthetic biology and research work we must identify and test these types of promoters in Duckweed, and this is the focus of this project.

Promising promoters for different expression levels can be identified from other species such as the model plant Arabidopsis and the monocot rice. Using the currently available genome sequences, duckweed homologues of candidate promoters can be cloned, likely from *Wolffia australiana*. Promoter activity in duckweed can then be assessed by driving the expression of a fluorescent protein. Signal intensity can be measured by standardising against a different fluorescent protein driven by a well characterised ubiquitous promoter such as 35S. In addition to identifying native promoters, synthetic promoters previously developed in arabidopsis and tobacco could be assessed for activity in duckweed. This project will contribute to the development of a synthetic biology toolkit to engineer duckweed, which will underpin efforts to generate a novel Space crop.

Key Techniques: This project will be laboratory based and use plant biotechnology techniques such as bioinformatics, genetic cloning and manipulation, plant growth and transformation, as well as light microscopy and analyses.

Project Supervisors: Dr Fleur Dolman is a Senior Research Fellow working in the Plant Synthetic Biology Group, led by Associate Professor Jenny Mortimer at the Waite Campus. https://researchers.adelaide.edu.au/profile/fleur.dolman

Dr Bo (Weasley) Xu is a Senior Research Fellow working in the Plant Transport and Signalling Group, led by Professor Matthew Gilliham at the Waite Campus. https://researchers.adelaide.edu.au/profile/b.xu

This project may be eligible for a $5000 student scholarship.
Please contact the project supervisors for details and to express your interest.

Further Information

Email: fleur.dolman@adelaide.edu.au

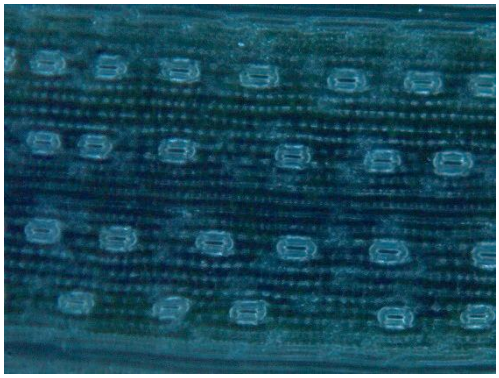
EMCR led Honours Project Scheme

Project title: Stomatal traits for water-use efficient crops

Project supervisor:

Dr Abdeljalil El Habti is a postdoctoral research fellow with the School of Agriculture, Food and Wine at the University of Adelaide. His research focuses on the mechanisms involved in plants' ability to use water and convert it to food in dry environments. In particular, he investigates optimum stomatal traits for plant adaptation to drought. https://researchers.adelaide.edu.au/profile/abdeljalil.elhabti

Project description



Water is the cost of our food. Understanding how plants use available water and convert it to food even in harsh environments is essential to develop resilient crops. Plants regulate water use through tiny pores at the leaf surface named stomata. When water is ample in soil, stomata are open to allow carbon dioxide entry into the leaf and produce carbohydrates via photosynthesis. Simultaneously, water is released to the atmosphere via transpiration. When water supply to the plant is limited, plants close stomata to save available water, which also results in lower carbon fixation and slower growth. The balance between carbon entry and water loss is critical for plant growth and productivity in dry environments.

In the context of a changing climate, the dynamic nature of stomatal traits make stomata attractive targets in plant breeding. Until recently, research on stomatal traits was limited by researchers' ability to measure stomata, as current methods used for stomata phenotyping are tedious. We recently developed a rapid non-destructive method[1] that allows high-throughput screening of stomatal traits in large experiment. In this project, the student will learn and apply state-of-the-art tools to investigate the hydraulic and physiological basis of water-use efficiency in plants. Key research questions in this project include:

- What are optimal stomatal patterning for efficient use of water in dry environments?
- Which stomatal traits did breeders select for in recent varieties?
- Which non-stomatal factors influence water-use efficiency?

Knowledge created through this project will guide breeders in targeting specific traits associated with high yielding varieties.

**This project may be eligible for a $5000 student scholarship. Please contact the project supervisor for details and to express your interest.*

Further information

Email: abdeljalil.elhabti@adelaide.edu.au

[1] P. Pathoumthong, Z. Zhang, S. Roy, A. El Habti. "Rapid non-destructive method to phenotype stomata". bioRxiv 2022.06.28.497692; doi.org/10.1101/2022.06.28.497692

EMCR led Honours Project Scheme

Project title: Alternative crops for dryland farming systems

Project supervisor:

Dr Abdeljalil El Habti is a postdoctoral research fellow with the School of Agriculture, Food and Wine at the University of Adelaide. His research focuses on the mechanisms involved in plants' ability to use water and convert it to food in dry environments.

https://researchers.adelaide.edu.au/profile/abdeljalil.elhabti

Project description

Crop-growing regions experience increasingly dryer and warmer climates, and more lands are becoming hostile to any crop currently cultivated. While most cultivated crops, including major crops such as wheat, are not able to physiologically adapt to very harsh environments, other species such as succulent plants are already well adapted to hostile environments with low rainfall and high temperature. Adopting these species as alternative crops in dry areas can help growers maintain stable productivity in a changing climate. In this project, the student will assess the value of Indian fig cactus, a spineless prickly pear, to Australian dryland farming system. This will involve developing methods to propagate plants *in vitro* and conducting phytochemical analyses to evaluate the nutritional value of Indian fig cactus in comparison with other crops.

**This project may be eligible for a $5000 student scholarship. Please contact the project supervisor for details and to express your interest.*

Further information

Email: abdeljalil.elhabti@adelaide.edu.au

EMCR led Honours Project Scheme

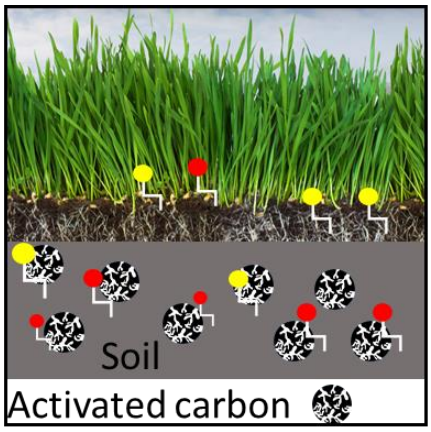
Project Title: Cost-effective remediation strategies to reduce release of PFAS from contaminated soil

Project Supervisors:

Dr. Shervin Kabiri – Postdoctoral Research Fellow with the School of Agriculture, Food, and Wine Fertiliser group. Her research interests are on developing carbon-based materials for soil remediation as well as developing tools for assessing mobility of contaminants in stabilised soils. https://researchers.adelaide.edu.au/profile/shervin.kabiri

Dr. Divina Navarro – Research Scientist at CSIRO Land and Water based at Waite Campus. She is an environmental chemist working on understanding the fate and behaviour of emerging contaminants such as perfluoroalkyl substances and nanomaterials with the view to mitigate their potential risks. https://researchers.adelaide.edu.au/profile/divina.navarro

Project Description: Per and polyfluoroalkyl substances or PFAS are synthetic organofluorine compounds with unique properties and widespread applications in different industries. PFAS are known to be persistent and bioaccumulative. They are detected everywhere in soil, drinking water and air, and have also ended up in our food, bloodstream, and wildlife. However, the presence of PFAS in multiple media is related to the contaminated soil which can serve as a significant pool and long-term source for PFAS locally or globally. Treatment of the source zone contamination can significantly reduce their release and availability in the environment.



This research project will evaluate the combination of two soil remediation strategies - soil stabilisation and phytoremediation – to immobilise and reduce release of PFAS from soil. While activated carbon (AC) will be applied to immobilise PFAS in soil, a non-edible native Australian plant will be also grown in the AC-treated soil. Results from this project can provide insights on the suitability of the combined remediation technology for a variety of PFAS. This project will involve some basic plant growth, soil immobilisation, leaching assessments, and PFAS analysis. This project is an excellent opportunity to gain experience in a field of great environmental significance.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest.

Further information:

Email: shervin.kabiri@adelaide.edu.au Divina.Navarro@csiro.au

EMCR led Honours Project Scheme

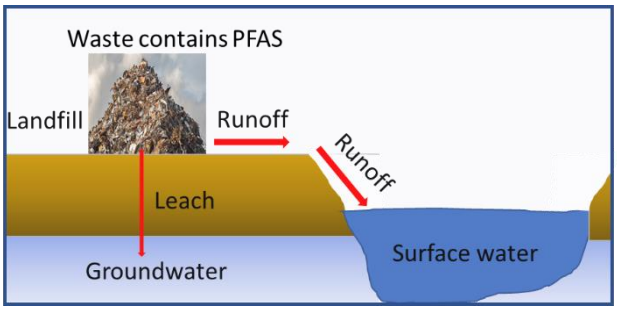
Project Title: Release of PFAS from selected consumer products and building materials waste

Project Supervisors:

Dr. Shervin Kabiri – Postdoctoral Research Fellow with the School of Agriculture, Food, and Wine Fertiliser group. Her research interests are on developing carbon-based materials for soil remediation as well as developing tools for assessing mobility of contaminants in stabilised soils. https://researchers.adelaide.edu.au/profile/shervin.kabiri

Dr. Divina Navarro – Research Scientist at CSIRO Land and Water based at Waite Campus. She is an environmental chemist working on understanding the fate and behaviour of emerging contaminants such as perfluoroalkyl substances and nanomaterials with the view to mitigate their potential risks.

https://researchers.adelaide.edu.au/profile/divina.navarro



Project Description: Per and polyfluoroalkyl substances (PFAS) are manmade chemicals with unique properties. Often called "forever chemicals", PFAS do not break down easily and potentially are toxic to humans and biota. PFAS are widely used in different consumer products (e.g., non-stick cookware, fast-food wrapping, medical equipment, and cosmetics) and in building materials (e.g., for weatherproofing, corrosion prevention, and stain resistance). Indeed, the regular use and disposal of these products in landfills at the end of their life can result in contamination of the surrounding environment with PFAS. Despite these concerns, there is limited information on the extent PFAS is released from some of these materials under relevant conditions.

Hence, this research project will focus on assessing the release of PFAS from selected consumer products and the building industry's wastes. This project will involve the assessment of PFAS release using standard laboratory leaching procedures, and PFAS analysis using liquid chromatography-tandem mass spectroscopy. This project will ideally suit an enthusiastic student who is interested in learning more about soil/environmental chemistry. This project will also provide an excellent opportunity to pursue a research career, or gain experience in a field of great environmental significance.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest.

Further information:

Email: shervin.kabiri@adelaide.edu.au Divina.Navarro@csiro.au

EMCR led Honours Project Scheme

Dr Bryan Coad

Research Interests

My background is in physical chemistry and my research involves developing technologies that can be used to make a difference in agriculture, food and wine research.

One innovative technology is low-temperature plasmas. The use of plasmas for agricultural and plant sciences research is an exciting and emerging area.

Some examples of applied plasma research:

- **Treatments for seeds** (pathogen removal, enhanced germination)
- **Treatments for foods** (for grains & pulses to improve water uptake and softening before cooking)
- **Coatings for fertilisers** (stabilisation and prolonged nutrient release)

Available honours projects

#1. Plasma Food Processing: Treating dry foods (e.g. pulses, grains) with plasma is known to increase the rate and total amount of water that can be taken up. This multidisciplinary project will apply cold plasma treatments to foods to understand changes to their processing properties and their sensory perception. Applications of this technology could be used in the production of "convenience foods" such as ready-to-eat meals.

#2. Improving Germination Success for Australian Native Plant Species: Bushfires, climate change, and land use has resulted in a severe loss to Australian native plant diversity. Restoration of plants to these environments is needed. However, many Australian native plant seeds have low germination success. This project will investigate plasma treatments for native plant seeds and assess their germination.

#3. Assessment of Coatings for Slow Release Fertilisers: To improve fertiliser performance and extend release, coatings will be deposited on fertiliser particles. Coatings will be assessed chemically and leaching assays will be used to assess environmental performance.

For all projects, training will be provided for operating plasma equipment. A basic level of analytical skill and experience with instrumentation is an asset.

Projects may be eligible for a $5000 student scholarship. Please contact the project supervisor for details and to express your interest

Further Information

email: bryan.coad@adelaide.edu.au

Researcher profile: https://researchers.adelaide.edu.au/profile/bryan.coad

EMCR led Honours Project Scheme

Project Title: Seed size variation in chickpea and lentil

Seed size is highly variable in most agricultural crops and affects crop productivity and quality. A large, uniform grain size must be achieved to meet the highest-value market specifications for chickpea, lentil field pea and faba bean. Additionally, seed size is considered to influence several early crop growth traits including seedling emergence, seedling vigour, and inter- and intra-specific competitive ability. We have identified a gene that regulates the size of seeds in chickpeas, and developed pairs of near-isogenic lines (NILs) contrasting for this gene and the seed size trait. NILs are particularly useful research tools, allowing detailed exploration of a phenotype of interest against common genetic backgrounds. In this project, you will use our chickpea NIL material to explore the role of seed size in early seedling emergence and growth. You will also explore the seed size trait in lentil. There will be an opportunity to develop and implement skills in molecular biology (primer design, DNA extractions, PCR, sequence analysis) to search for variation in the lentil orthologue of the chickpea seed size gene, and to determine if this gene contributes to the diversity in seed size found in Australian lentil varieties.

This project would suit a highly motivated student with an interest in the application of molecular genetics to Australian agriculture. A willingness to learn, initiative, engagement and scientific rigour are all essential skills! We are a team comprised of staff from both the University and from SARDI, and you will be exposed to a diverse range of researchers and activities undertaken at Waite.

Project supervisors: Dr Lachlan Lake is a crop eco-physiologist specialising in the adaptation and agronomy of the major Australian pulse crops at the South Australian Research and Development Institute (SARDI). He has previously worked at CSIRO and is an affiliate lecturer at the University of Adelaide. Dr Lake has a network of national and international collaborators, a strong publication record and is currently working on two national GRDC funded projects with the aim of improving our understanding of the genetic basis of pulse phenology and improving local agronomic management practices. Lachlan's other research interests include crop modelling, capture and efficiency in the use of water and nutrients in dryland systems and adaptation of pulses to abiotic stresses.

Dr Mariano Cossani is a Senior Research Agronomist at SARDI and Affiliate Senior Lecturer with the School of Agriculture, Food and Wine. He has interest in crop physiology applied to plant breeding and crop management with focus on adaptation to abiotic stress and in the development of phenotyping methods.

Dr Julie Hayes is a Research Associate with the School of Agriculture, Food and Wine. She has a background in molecular genetics and physiology of crop and pasture plants, particularly relating to plant nutrition and nutritional stress. Dr Julie Hayes | Researcher Profiles (adelaide.edu.au)

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

For further information, please email: Lachlan.Lake@sa.gov.au, Mariano.Cossani@sa.gov.au and/or julie.hayes@adelaide.edu.au

EMCR led Honours Project Scheme

Project Title: High sodium wheat for disease resistance?

Project supervisors

Dr Tara Garrard (@TaraGarrard) is a mycologist by training. She currently leads the Cereal Pathology group at the South Australian Research and Development Institute (SARDI), which is responsible for monitoring disease in South Australian cereal crops and screening for disease resistance for breeders.

Dr Yusuf Genc is a Research Scientist with SARDI and an Affiliate Senior Lecturer with the School of Agriculture, Food and Wine. Yusuf has a long history of salinity tolerance research in cereals and in the development of bread wheat varieties tolerant to salinity.

Dr Julie Hayes is a Research Associate with the School of Agriculture, Food and Wine. Julie has a background in molecular genetics and physiology of crop and pasture plants, particularly relating to plant nutrition and nutritional stress. See Dr Julie Hayes | Researcher Profiles (adelaide.edu.au)

Project description

In the course of ongoing salinity tolerance research, we observed variation for leaf and stem rust resistance that seemed to be related to a novel trait for sodium accumulation in bread wheat. Normally, levels of sodium in the leaves of bread wheat range between 100-500 ppm, but our novel genotype accumulates up to 100-fold more than this, with no consequences for biomass or grain yield. Could elevated leaf sodium offer resistance to fungal infection? In this project, the student will develop near-isogenic lines for the leaf sodium trait and initiate disease screening with this material to determine if leaf sodium contributes in any way to disease resistance in wheat. Pairs of near-isogenic lines (NILs) are essentially genetically identical to each other, except for a target region controlling a trait of interest. NILs are a very effective tool for investigating the effects of a trait in the absence of confounding background genetic differences.

Our project would suit a student with an interest in the application of molecular genetics to Australian agriculture. We are a team comprised of staff from both the University and from SARDI, enabling the student to be exposed to a diverse range of researchers and activities undertaken at Waite.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

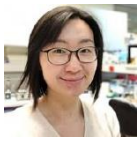
Further information

Please email: Tara.Garrard@sa.gov.au, Yusuf.Genc@sa.gov.au and/or julie.hayes@adelaide.edu.au

EMCR led Honours Project Scheme

Project title: Innovations in producing low alcohol wine: more reasons to say cheers!

Project supervisors:

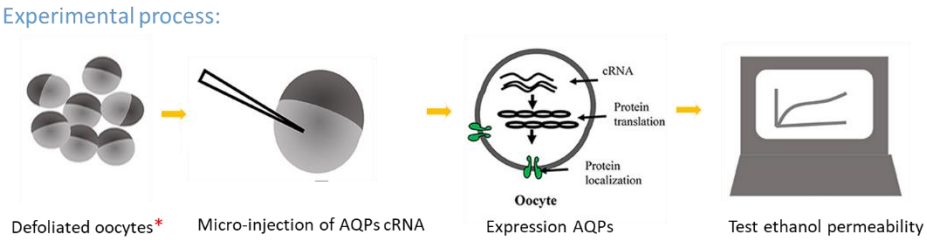


Dr Jiaen Qiu is enthusiastically researching to increase our understanding of how plants regulate water/ion transport. https://researchers.adelaide.edu.au/profile/jiaen.qiu

Prof Steve Tyerman is an Emeritus Professor in plant physiology and viticulture in the Department of Agriculture at the University of Adelaide. Member of Fellow of the Australian Academy of Science. He is a passionate scientist with enormous experience in supervising HDR students.

Project description:

Demand for low alcoholic wine has been experiencing large growth in the past years. Current mainstream ethanol removal methods such vacuum distillation or organic solvents often results in a thin and simple taste. Innovation in ethanol removal techniques is required to reduce alcohol while preserving aromas and flavours of wine. A novel filtering technology has been successfully adopted in the beer industry to concentrate the beer by removing water but preserving nutrients and flavours. The water-only removal process is facilitated by a forward osmotic filtering device that incorporates a large amount of aquaporins (AQPs). The aquaporin protein family is a Noble prize-winning discovery that sets the foundation knowledge of how water is transported by an efficient and regulated manner across all biological membranes. In the past two decades, more substrates other than water have been found to be transported by aquaporins. The selection towards different substrates is largely determined by protein structure, membrane localizations, post-translational regulation and local substrate gradients. Preliminary data has suggested that organic compounds such as ethanol and methanol can also be transported through plant aquaporins. This research project will test the potential of ethanol conductivity in a collection of plant aquaporins using heterologous systems. The outcome of this project will identify ethanol-permeable plant AQPs that can be embedded in industry grade filters to exclusively remove the ethanol in wine without interfering with flavour.



The summary of key experimental processes is described in the image above. This project will also involve basic laboratory molecular work including gene cloning, RNA synthesis and DNA sequencing. Project outcomes may provide a new pathway for the wine industry to make low alcohol wine.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further information

Email: jiaen.qiu@adelaide.edu.au, steve.tyerman@adelaide.edu.au

EMCR led Honours Project Scheme

Project Title: Nonedible to edible

Project supervisors:

Dr Shashi Goonetilleke – Postdoctoral Research Fellow with the Agriculture, Food and Wine Almond Research Group. She works on improving almond productivity through breeding, understanding genetic diversity in almond, understanding the chemical profiles of almonds, and extracting beneficial chemicals from almond by-products.
https://researchers.adelaide.edu.au/profile/shashi.goonetilleke

Dr Michelle Wirthensohn – Team Leader in the Almond Research Group. Her area of expertise is in almond breeding for improving productivity and cultivar development.
https://researchers.adelaide.edu.au/profile/michelle.wirthensohn

Dr Dimitra Capone – ARC Research Associate with the ARC Training Centre for Innovative Wine Production, located in the Department of Wine Science. Dr Capone has extensive experience in the area of aroma and flavour chemistry and has been involved in the identification of compounds that responsible for characteristic wine aroma attributes.
https://researchers.adelaide.edu.au/profile/dimitra.capone

Project description:

Almond hulls are anatomically similar to the fleshy portion of a peach that humans consume, which includes the mesocarp and exocarp, and are a by-product that contain crude fibre, crude proteins, sugars and other beneficial chemical components such as polyphenols and hexane. Based on the available literature, these components can vary significantly between almond cultivars and with growing regions. In Australia, almond hull composition is yet to be investigated. This project aims to characterise the chemical composition of almond hulls from old and new cultivars from parents in our breeding program and to examine the genetic basis for their differences.

This project will involve extraction and quantification of non-volatile and volatile compounds using HPLC and/or GC-MS, DNA extraction, and bioinformatics.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further Information

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EMCR led Honours Project Scheme

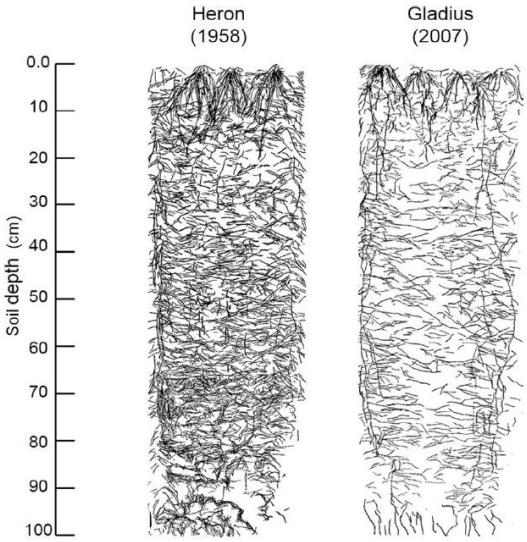
Project: Comparison of root traits in old and new wheat genotypes

Project description

Plant physiologists have studied the single plant, and agronomists have looked at the whole crop, but the plant within the community has scarcely been investigated. Whilst evolution favours competitive phenotypes, agriculture selects for phenotypes with lower competitive ability or a communal behaviour.

The negative correlation between yield and competitive ability has been demonstrated experimentally in species of contrasting physiology and morphology, including cereals, pulses and oilseed crops. However, these studies have only analysed aboveground traits. In this Honours, the student will characterise root systems of old and new wheat genotypes in response to stand density to see how they are affected by the competition.

You will learn and use state-of-the-art phenotyping and software tools, as illustrated in the figure comparing root distribution patterns of Heron (released in 1958) and Gladius (released in 2007).



Supervisors: Mariano Cossani, Victor Sadras and Stuart Roy



Mariano Cossani and Victor Sadras work at SARDI and are affiliated to the the School of Agriculture, Food and Wine on crop physiology with focus on plant adaptation to abiotic stress. Their research interests include theoretical model of crop yield in annual species, capture and efficiency in the use of resources for cereals and pulses, yield gap analysis, developing of phenotyping methods and evolutionary aspects of the crop species. Stuart Roy is Associate Professor at the School of Agriculture, Food and Wine and Interim Head of Department & Deputy Director (Industry) for the ARC ITTC for Accelerated Future Crop Development. He has interest in development of quantitative trait locus (QTL) mapping for novel genes involved in salinity and other abiotic stress tolerance and in understanding the physiological mechanisms controlling the plant's reponse to salinity stress

This project may be eligible for a student scholarship. Please contact the project supervisors for details and to express your interest.

Further information

Contacts: Mariano Cossani: Mariano.Cossani@sa.gov.au Ph:0437828185
https://orcid.org/0000-0001-6807-8777
Stuart Roy: stuart.roy@adelaide.edu.au; https://researchers.adelaide.edu.au/profile/stuart.roy

EMCR led Honours Project Scheme

Matthew Knowling

Research Interests

My research sits at the intersection of agricultural systems and data analytics. I use innovative data analytics to help farmers, businesses and policy makers to better manage their resources in the face of uncertainty.

Featured Honours Projects

Climate stress-testing agricultural systems

Understanding how agricultural systems will perform subject to a changing climate is required to achieve sustainability. Scenario-neutral climate stress-testing approaches provide a means to enhance understanding of the complex mechanisms by which a particular system might respond to climatic changes, compared to traditional scenario-driven approaches. This project will employ scenario-neutral climate stress-testing to better understand the sensitivity of performance metrics for a range of agricultural systems such as crop and livestock enterprises across Australia.

Bridging the gap between on-farm data and decisions

While farmers have more and more data at their disposal, how exactly do these emerging data streams help inform on-farm decisions (e.g. timing of fertiliser)? Data alone are often insufficient in complex settings involving uncertain factors. Process-based models enable evaluation of farm outcomes (e.g. crop yield) in response to management decisions and with respect to exogenous factors (e.g. weather). This project will investigate the suitability of available process-based models to support tactical- and strategic-timescale decisions in dryland cropping, horticulture and livestock farming contexts.

Enhancing winegrape harvest logistics

Effective planning and scheduling of winegrape harvest operations is complex, and requires evaluation of both on- and off-farm factors as well as their interactions. However, previous works designed to support decision-making surrounding harvest operations are limited in their consideration of either on- (farm-centric) or off-farm (production-centric) factors, neglecting interactions such as the influence of late-season irrigation on storage and truck scheduling. This project will assess the applicability of recently developed numerical techniques to better support harvest planning and scheduling decisions. The project will employ a case study and there is the potential to work with an industry partner.

This project may be eligible for a $5000 student scholarship. Please contact the project supervisors for details and to express your interest

Further Information

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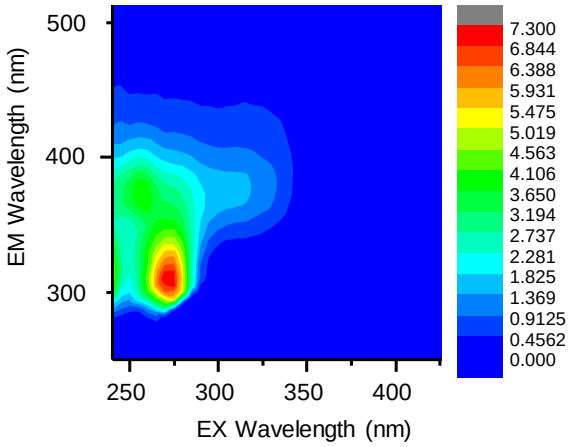
Researcher profile: https://researchers.adelaide.edu.au/profile/matthew.knowling

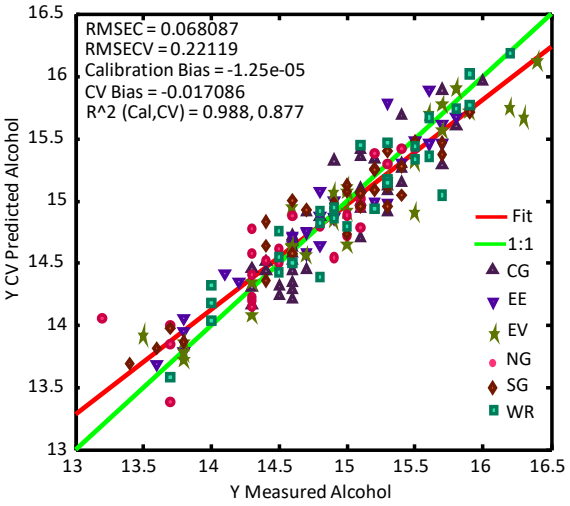
David Jeffery

Honours project in wine chemistry

David Jeffery is seeking students who are interested in chemistry, whether from the perspective of wine or food science, or pure chemistry. His research broadly relates to isolation, identification, synthesis and analysis of natural compounds. The application of organic chemistry, compound isolation, structure elucidation, and analytical techniques such as GC-MS, HPLC-MS, and spectrofluorometry are key features of his research. This relates particularly to grape and wine components and development of methods for the analysis of aroma, flavour, and phenolic compounds that are important to grape and wine quality and sensory appeal.

Projects can be developed to suit a student's interests and may range from sulfur compound synthesis to polyphenol analysis, and many things in between, including spirit production. Among other research priorities such as investigating polyfunctional thiol biogenesis and linking wine composition to sensory properties, David's current emphasis is on using absorbance-transmission and fluorescence excitation-emission matrix (A-TEEM) data with machine learning algorithms for classification and regression. Recent examples include authentication of red wine by variety and region, rapidly determining compositional traits of grape and wine, and predicting wine sensory attributes. There is still much more that can be investigated with this technique.





Projects are often developed in conjunction with colleagues within the School of Agriculture, Food and Wine or with collaborators at CSIRO and AWRI who specialise in wine chemistry, biochemistry, viticulture, sensory science, or chemical engineering, thereby offering a broader perspective on the research.

Further Information

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Researcher profile:
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Stuart Roy

Research Interests

My main area of research focuses on understanding how abiotic stress affects crop yield and use this knowledge to help develop new cultivars/crops for Australian growers. I have a particular interest in using novel sources of genetic variation, either naturally occurring or created with biotechnology (genome editing and/or genetic engineering), to introduce novel strass tolerance traits.

My research spans from *in silico* analysis using computers, laboratory/greenhouse work, to ultimately evaluating new material and phenotyping tools in the field.

"Featured" Honours project

Loss of crop yield due to high concentrations of Na^+ and Cl^- on agricultural land is a significant problem for Australian farmers. An estimated 4.6 M ha of Australian farmland is affected to some degree by saline soils - currently 1 in 2 Western Australian farms and 1 in 5 South Australian farms are affected by salinity. By 2050 it is expected that around 14 M ha of Australian agricultural land will be affected by dryland salinity, therefore it is imperative that we identify genes and cellular processes which will increase the salinity tolerance of our crop plants.

Wheat and barley are typically thought as being salt sensitive or at best moderately salt tolerant, as they cannot accumulate high concentrations of shoot Na^+ and/or Cl^-. Recently we identified a wheat landrace, which can accumulate 10-fold higher concentrations of shoot Na^+ while still having a good yield. With collaborators from the James Hutton Institute in the UK, we identified a similar phenomenon in barley. If this tolerance mechanism can be introduced into crop plants it would substantially help Australian growers.

We recently identified the gene responsible for the high Na^+ accumulation in the wheat landrace, however, how these plants tolerate the high Na^+ is still unknown. We also found that this gene has been unintentionally selected for by European barley breeders and is now in 35% of European barleys. It is hypothesised this gene has been selected for as it allows the plant to lower its leaf water potential thereby enabling the plant to extract more water from its environment – a desirable trait in the rainfed climate of Australia. Honour(s) projects in this research area will 1) determine the frequency of the high Na^+ accumulating gene in Australian barley and wheat; 2) determine whether this gene confers improvements in yield (greenhouse and field) in the dry Australian climate; 3) Identify the mechanisms by which plants tolerant high shoot Na^+.

Other potential Honours project topics with Stuart Roy

- Use of a novel high throughput microscope and machine learning tool to screen leaf stomata, to identify heat tolerant cultivars of wheat.
- Enhancing wheat yield and drought tolerance by manipulating the expression of genes involved in stomata development

Further Information

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Researcher profile: https://researchers.adelaide.edu.au/profile/stuart.roy

Katja Hogendoorn

Research Interests

My area of expertise is crop pollination, the foraging, nesting and mating behaviour of native bees and introduced honey bees, as well as native bee conservation and taxonomy.

"Featured" Honours project

Worldwide, many bee species specialise on floral resources from local native plant species, and do not incorporate pollen from introduced species, including crops, in their diet. It is hypothesized that local native bees have coevolved with the protections that plants put in against pollen predation. Only a few native bee species have overcome the obstacles imposed by introduced crops and weeds against pollen predation, and have a more cosmopolitan diet.

To facilitate both pollination security and the conservation of native bees it is important to understand both the nature of the impediments against diet diversification as well as the strategies bees have used to overcome them. This research project will explore the latter by investigating the composition of pollen collected by generalist, crop pollinating bees, and explore potential adaptive mechanisms for overcoming pollen toxicity.

This project will involve native bee collection and identification, pollen collection and identification from legs and larval provisions of generalist native bees using metagenomic and microscopic analysis, as well as larval feeding trials.

Other potential Honours project topics with Katja Hogendoorn

- Developing novel methods to localise native bee nests?
- How does netting influence honey bee movement in apple orchards?
- Does pollen specialisation change bee pathogen abundance in the larval food?

Further Information

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Researcher profile: https://researchers.adelaide.edu.au/profile/katja.hogendoorn

Science Education Projects Available for Honours

Historically, Hons projects related to Science Education and Science Communication in the @AbleLab_UA have focused on a wide range of research areas including the perception of the general public to genetically modified crops; why high school students choose particular degrees at University; career pathways in agriculture; curriculum mapping and alignment with assessment; the co-creation of assessment between students and staff; international student perceptions of assessment; and; what employability skills are required by industries in the Sciences. More recently, we have been focused upon metacognition and the art of reflection in relation to the development of career readiness as well as the perceptions of assessment (type and value) across staff and students for various STEM disciplines. Rather than outline a particular project here, we like to tailor Honours projects around a student's interests. We can either provide projects for the traditional disciplinary research pathways or the less research-intensive professional skills pathway. If you like the idea of working on a project from the ground-up, get in contact to have a chat. In summary, these projects will ideally suit students who are interested in science education, science communication and/or gaining some more qualitative research skills.

Supervisor:

Professor Amanda Able – Professor in Plant Science in the School of Agriculture Food and Wine as well as a member of the Adelaide Education Academy. Amanda currently leads projects that explore assessment and how it best demonstrates learning outcomes as well as the development of employability skills in Science graduates. She has previously been involved in the development of Threshold Learning Outcomes in Agriculture for Australia as well as the international project which provided recommendations for the provision of equitable student support in higher education during disruptions such as COVID.

See https://researchers.adelaide.edu.au/profile/amanda.able

Using epigenetics to breed for enhanced reproductive, abiotic and/or biotic traits in cereal crops

Historically, Honours projects in the @AbleLab_UA have focused on a wide range of research areas including understanding particular pathogens and how it is they affect the developing plant; examining grain quality and the diversity within germplasm pools, isolating and deciphering the function of genes that are involved in reproduction and ripening processes, and understanding what molecules regulate and which genes are targets during water-stress (as examples). More recently, we have demonstrated transgenerational inheritance for miRNAs and their target with water-deficit stress. Our recent review (Trends in Plant Science 2022) speculates about the use of priming and epigenetics in breeding for stress tolerance. Outstanding questions focus on the use of epigenetic markers and a reference platform of genes for the development of stress memory by plant breeders. Rather than outline a particular project here, we like to tailor the Honours project around a student's interests. If you like the idea of working on a project from the ground-up, get in contact to have a chat. In summary, these projects will ideally suit enthusiastic students interested in learning more about plant breeding, genetics, molecular biology, abiotic and biotic stress, and/or plant reproduction.

Supervisors:

Professor Amanda Able – Professor in Plant Science in the School of Agriculture Food and Wine. Her areas of expertise are broad ranging across plant physiology and plant pathology. They include epigenetics of plants faced with stress, understanding plant-pathogen interactions, stress priming and transgenerational inheritance, postharvest physiology and mycology. See https://researchers.adelaide.edu.au/profile/amanda.able

Professor Jason Able – Head of School and Professor in Plant Breeding in the School of Agriculture Food and Wine. Jason has a wide range of research interests, the results of which can be applied to breeding programs. They include fundamental science that centres on microRNAs and their role in enhancing crop productivity, understanding molecular mechanisms that control meiosis in bread and durum wheat, frost tolerance in cereals and barley malt flavour. See https://researchers.adelaide.edu.au/profile/jason.able

What causes Oedema in Brussel Sprouts?


Photo of Oedema supplied by John Cranwell

Recently, there has been a greater occurrence of the physiological condition known as Oedema in Brassica crops grown in the Adelaide Hills. Oedema in brussel sprouts can be particularly damaging to profits for growers as it may not become evident until late in the season or even after harvest. However, little is known about the causes of oedema in brussel sprouts and how it can be managed. Oedema has been associated with increased water absorption when transpiration rates are low, leading to enlarged cells that protrude from the surface and eventually die causing discoloration. In collaboration with AE Cranwell & Sons, we are aiming to:

1. Establish the relationship between weather, irrigation and other management practices in the field with the development of oedema.

2. Identify and characterise environmental conditions that contribute to oedema by using a controlled environment (for example, investigating the impact of different soils, field capacity, water-logging conditions and temperatures on oedema formation).

3. Characterise oedema formation and possible genetic variation in resistance to oedema.

Students wishing to further their knowledge of agronomy, plant physiology, and horticulture would be ideally suited to this field of research. Techniques or skills learnt will include microscopy; basic plant growth, tissue sampling, measuring transpiration and other physiological parameters, data analysis and interpretation.

Supervisor:

Professor Amanda Able – Professor in Plant Science in the School of Agriculture Food and Wine. Her areas of expertise are broad ranging across plant physiology and plant pathology. They include epigenetics of plants faced with stress, understanding plant-pathogen interactions, stress priming and transgenerational inheritance, postharvest physiology and mycology. See https://researchers.adelaide.edu.au/profile/amanda.able

Why does *Pyrenophora teres* cause net blotch disease in some barley plants and not others?

Pyrenophora teres f. *teres* causes net form of net blotch disease in barley. The disease causes net-like necrotic lesions surrounded by chlorosis and can lead to losses in yield for barley growers. *Pyrenophora teres* causes this damage by producing many different toxins. We have identified these toxins in many virulent isolates but have some questions:

1. How do these toxins cause the symptoms they cause (i.e. what are they affecting in a susceptible plant)?
2. Why are resistant plants not affected by the toxin (i.e. how do resistant plants differ or behave when treated with the toxins? What plant genes are responsible for disease resistance?)

Students wishing to further their knowledge of plant-pathogen interactions, plant physiology, and molecular biology would be ideally suited to this field of research. Multiple projects are available to answer these questions by:

a. characterising the production of these toxins and the responsible genes in virulent *Pyrenophora teres* isolates,
b. characterising the expression of plant genes associated with resistance and/or toxin sensitivity during the plant-pathogen interaction
c. identifying genes and Quantitative Trait Loci associated with resistance using Genome Wide Association Mapping.

Dependent upon the project, techniques or skills learnt will include microscopy; aseptic and microbiological techniques; molecular biology (such as RNA, DNA and protein isolation, cloning, heterologous expression); genetics (QTL analysis); data analysis and interpretation. The projects will be based in the Able Lab (@AbleLab_UA) but have the opportunity to work with collaborators with genetics expertise in the School as well as those at the South Australian Research and Development Institute (SARDI) in the field.

Supervisors:

Professor Amanda Able – Professor in Plant Science in the School of Agriculture Food and Wine. Her areas of expertise are broad ranging across plant physiology and plant pathology. They include epigenetics of plants faced with stress, understanding plant-pathogen interactions, stress priming and transgenerational inheritance, postharvest physiology and mycology. See https://researchers.adelaide.edu.au/profile/amanda.able

Dr Anh Pham – Postdoctoral Research Fellow in the School of Agriculture, Food and Wine. Her expertise lies in genetic diversity and breeding for yield improvement in a wide range of crops. She currently oversees the Soybean Breeding Program at the University of Adelaide.

Dr Tara Garrard – Research Scientist, SARDI (@TaraGarrard). Tara is a mycologist by training. She currently oversees the Cereal Pathology group at SARDI which is responsible for monitoring disease in South Australian cereal crops and screening for disease resistance for plant breeders.

Diane Mather

Research Interests

Plant genetics and plant breeding

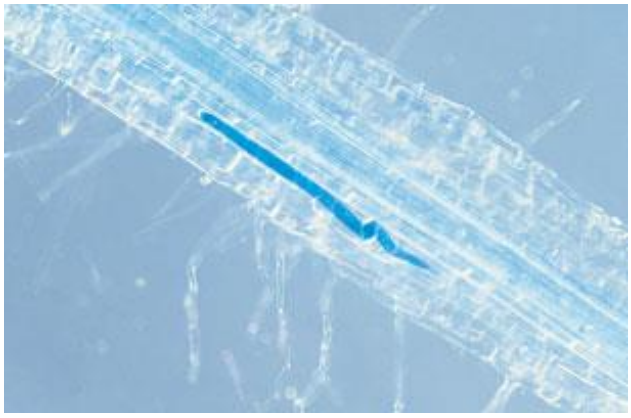
Honours project: CCN resistance in barley

The cereal cyst nematode (CCN) *Heterodera avenae* is a parasitic worm that invades plant roots, robbing water and nutrients from host plants.

CCN was once a devastating parasite of cereal crops in southern Australia. With the development and use of resistant varieties, CCN has largely been overcome in Australia – but it remains very damaging in many other parts of the world.

We want to determine exactly which plant genes underpin CCN resistance in Australian barley, and we want to know how that resistance works.

If you are interested in genetics, plant pathology, or both, we can design an Honours project that suits your interests. The project would be mostly lab-based at the Waite campus.



A juvenile nematode inside a plant root

DNA analysis in our lab

Other potential Honours project topics with Diane Mather

Interested in plant genetics and breeding, but not sure about working with worms? Contact me to discuss other projects related to genetic mapping or plant breeding methods.

Further Information

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