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An introductory message from our Head of School:

Welcome to the School of Agriculture, Food and Wine’s. Here you will find all the information you need to choose a project that will interest and challenge you while developing your skills in an unrivalled research environment. The range of opportunities is wide, encompassing all research areas within the School including agronomy, food and nutrition science, oenology, plant biotechnology, plant breeding, plant genetics, plant physiology, plant protection, soil science and viticulture. Equally you can choose to work at levels anywhere from molecules to the field, depending on your interests. I am sure you will find something in this booklet that will excite and challenge you.

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 the South Australian Research & Development Institute (SARDI), the Commonwealth Scientific & Industrial Research Organisation (CSIRO), the Australian Wine Research Institute (AWRI), the South Australian Department of Water, Land & Biodiversity Conservation, and Australia’s largest wheat breeding company, Australian Grain Technologies (AGT).

Undertaking an Honours degree is an exciting phase in your progress to becoming a fully-fledged research scientist. It is our expectation that you will discover the excitement of getting results that will make a real contribution to your field and which merit publication in a journal or presentation at a conference. The School aims to offer a supportive and vibrant research environment which I hope you will enjoy, enhance, and benefit from.

A/Professor Christopher Ford
Acting Dean of Waite
Acting Head, School of Agriculture, Food and Wine
Honours in the School of Agriculture, Food & Wine

What is Honours?
An Honours degree in Agriculture, Food & Wine at the University of Adelaide is the gateway to increased job opportunities and to a great range of rewarding careers in research.

Our teaching and research staff are international leaders in their fields. Join us for your Honours project and you will be a member of a research team working at the leading edge of research. You will use state of the art facilities and train with world class researchers in a contemporary learning environment.

Students who reach a sufficient standard of achievement in their undergraduate courses are eligible to apply for admission to this program. The Honours year consists of a major research project and a series of workshops on various aspects of research throughout the year. The research project is carried out either in a laboratory/field in the School or in a closely affiliated laboratory. A collection of available Honours research projects within the School for 2019 are presented towards the back of this booklet.

Students who are considering Honours are encouraged to discuss any of these potential research projects with the academic(s) listed who will supervise these projects. If none of these projects grab your attention and you have something else in mind, feel free to contact one of the Honours Coordinators (below) who will be able to assist you in identifying a potential supervisor.

What does Honours involve?
As an Honours student you become a member of the School and a valued colleague. You will spend most of your time as part of a research group sharing goals, triumphs, disappointments and all of the other things that are part of the research discovery. For the first time, you become responsible for the outcome of your own work. Honours students also partake in all aspects of the academic and social life of the School. You will form friendships and professional associations that could last a lifetime.

What are the Benefits?
The Honours degree gives students a thorough training in research methodology and a detailed insight into a specific problem in the area of research that they pursue. The approach to problem-solving, maturity and self-discipline gained during the Honours year equips them for a wide variety of careers. Many of our students elect to continue in the research domain by enrolling in the School's PhD programs. Some of the projects also have industry links and scholarships associated with them.

Honours Coordinators

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<thead>
<tr>
<th>Co-ordinator</th>
<th>Phone</th>
<th>Email</th>
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<tbody>
<tr>
<td>Dr Richard Muhlack</td>
<td>08 83136771</td>
<td><a href="mailto:richard.muhlack@adelaide.edu.au">richard.muhlack@adelaide.edu.au</a></td>
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<tr>
<td>Dr Jo Zhou</td>
<td>08 83132065</td>
<td><a href="mailto:jo.zhou@adelaide.edu.au">jo.zhou@adelaide.edu.au</a></td>
</tr>
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<td>Dr Ron Smernik</td>
<td>08 83137436</td>
<td><a href="mailto:ronald.smernik@adelaide.edu.au">ronald.smernik@adelaide.edu.au</a></td>
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Honours Scholarships

A complete list of scholarships can be viewed at:
https://sciences.adelaide.edu.au/study/student-support/scholarships
http://www.agwine.adelaide.edu.au/prizes/

School of Agriculture, Food & Wine Honours Scholarships
The School offers a number of honours scholarships valued at up to $3000 each. All students who enrol to complete Honours within the School are eligible to be considered for a scholarship. As mentioned above in the box there is a complete list of scholarships on the web, so take a look and see what is on offer with our research centres within the School as well as external organisations.

Selection Criteria (this will apply to the majority of scholarships on offer)
Selection will be made on the basis of academic merit and supporting documents. Scholarship winners will have demonstrated high academic achievement in their undergraduate studies and possess a desire to progress within their research career. Holders of Scholarships must be enrolled in a full time program (defined as completed during one academic year).

Application Details
All students who enrol within the School will be automatically considered for the School scholarships. You do not need to apply for it. However, students who hold other scholarships will not be considered for the School scholarships.
Aims and Objectives of the Honours Program

Aims of the Honours course

1. To develop the basic skills required for the practice of independent research

2. To promote an appreciation of the methodology and the application of problem solving strategies in research

3. To enhance the competitiveness of our graduates in obtaining appropriate employment

Objectives for Honours students

➢ to demonstrate an original and critical approach in the assimilation of the current state of knowledge in a particular area of research

➢ to appreciate current gaps in our understanding and the future areas for investigation in a particular area of research

➢ to demonstrate mastery of the basic techniques required for the study of a research question

➢ to develop a rigorous and methodical approach to the maintenance of records and the collection, storage and analysis of data

➢ to develop the capacity to identify and evaluate a problem and define the important elements required for its solution (appreciating the risks and benefits of alternate approaches)

➢ to communicate information clearly and concisely in written and spoken English
How to apply to do Honours in the School of Agriculture, Food & Wine (AFW)

Find a project + supervisor

1. Look at the range of projects / areas of research that are advertised in this booklet
2. Contact the potential supervisor(s) of the project(s) that interest you
3. Arrange a meeting to discuss project(s) with these supervisor(s)
4. Take a copy of your transcript with you to these meeting(s)
5. After the meeting, assuming you want to do that project, fill out the EoI (see below)
6. Undecided about the project? If so, contact an Honours Coordinator (see page 4)
7. Before making a final decision it is useful to talk to previous students/lab members

Once you have found a project + supervisor

Whether you are a domestic student or an international student who has been studying as an undergraduate at the University of Adelaide; go to: [https://sciences.adelaide.edu.au/study/honours](https://sciences.adelaide.edu.au/study/honours) and fill out the online form.

Closing Date: The closing date for your ‘Honours application to be considered for the 1st round of offers is the end of October each year. Students will be notified of the outcome of their application as soon as possible after 3rd year exam results are finalised.

Late Applications: Late applications may be considered, but the range of available projects may become limited.

<table>
<thead>
<tr>
<th>Last Day to Lodge Honours Form: 26th October</th>
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<tr>
<td>Date of Notification of Honours Offers: from 3rd December</td>
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<tr>
<td>Prospective Honours Students to Submit Acceptance: by 8th December</td>
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<tr>
<td>Student to Commence Enrolment: Once formal offer received</td>
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<tr>
<td>Honours Orientation &amp; Start Date: Early February (School of AFW)</td>
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For Mid-Year Entry Dates please visit: [https://sciences.adelaide.edu.au/study/honours#key-dates](https://sciences.adelaide.edu.au/study/honours#key-dates)
Research areas in the School of Agriculture, Food & Wine

The School of Agriculture, Food & Wine provides a world-class concentration of scientific research, education and infrastructure on the Waite Campus within which Honours can be undertaken. In addition to the research strengths listed below, there are a number of co-located research partners on the Waite, at the Roseworthy Campus and at Regency TAFE. Students undertaking Honours with one of these research partners are still required to complete the ‘Expression of Interest’ form that is detailed on the previous page.

Research interests within the School include (but are not limited to): agronomy, food and nutrition science, oenology, plant biotechnology, plant breeding, plant genetics, plant physiology, plant protection, soil science, and viticulture.

The following pages outline the available projects within the key research areas of the School. Some of these projects are with co-located research partners including CSIRO and SARDI.

We hope that as a potential future research student within the School of Agriculture, Food & Wine, that you can find a project that suits your research interests on the following pages. Should you require any further information about the projects listed, supervisor details have been included at the bottom of each project summary. If you have general queries regarding doing Honours at the School of AFW, please feel free to contact one of the School Honours Coordinators listed on page 4.

Happy hunting for that all important Honours Project!

For more information on the research areas in the School, please visit the website: http://agwine.adelaide.edu.au/research/
Entomology & Plant Pathology

Our research in entomology addresses the biology, behaviour, ecology of insects, with an emphasis on insects of economic importance. We study insects that occur in a wide range of ecosystems, including pasture crops, vegetables, fruits, vineyards, greenhouse crops and natural ecosystems. Key areas of interest are biological control of insects and weeds, integrated pest management, biosecurity, crop pollination and conservation and enhancement of ecosystem services delivered by insects. Our research considers beneficial parasitic wasps, predatory arthropods, crop pollinators and a wide range of pest organisms.

More information and potential supervisors at:
Honours Project Title: Nutrition and collective movement in the Australian plague locust

Supervisor(s): Jerome Buhl and David Vogel


Brief Project Outline:
The overall goal of this research program is to study marching, aggregation and the emergence of activity synchronization in locusts using laboratory and field experiments combined with computer simulations. This project will focus on further refining and exploring computer simulations of locust where groups of up millions of individuals interact locally and result in the emergence of coordinated mass movement. Previous results have shown that patterns commonly observed in different locust species can be reproduced in our simulations using simple rules such as aligning with nearby neighbours. During this project, we will explore how the interplay between nutrition and movement rules affect the emergent collective patterns, with the aim of later comparing these predictions to real locusts surveyed in the field using drones. There might be field trip and lab experiments opportunities.

Students with a strong interest in programming, computational biology and modelling techniques will be best suited for this project given the key role that computer simulations have in this research.

Techniques/Skills Learnt:
- Computer simulations (including coding and managing projects on a super computer)
- Nutritional ecology
- Data and image analysis
- Depending on opportunities: behavioural experiments and drone surveys in the field

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact jerome.buhl@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Brood Guarding in a gregarious parasitoid wasp

Supervisor(s): Maryam Yazdani, Mike Keller


Brief Project Outline:
Some species of parasitoid wasps will guard the clutch of eggs or 'brood' that they lay on the surface of a host until they pupate. The benefit of this tactic is that it allows for the defence of the exposed eggs against competing parasitoids and predators, but the behaviour of guarding should only evolve when the costs of the behaviour (in terms of loss of other reproductive opportunity) is outweighed by the benefits.

The parasitoid wasp species Goniozus jacintae (Farrugia), is a gregarious parasitoid of leaf-rollers such as the light brown apple moth (LBAM) Epiphyas postvittana (Walker) (Lepidoptera: Tortricidae)), and will lay multiple eggs on the surface of the host. Females will typically lay between 1 and 7 eggs, with a sex-ratio of 3 ♀ : 1 ♂. It was found G. jacintae only remain with the brood on LBAM for an average time of 66 minutes (Hopper and Mills, 2015). This is an intriguing observation, as 66 minutes appears to be an arbitrary amount of time. The effectiveness of guarding for only this long is somewhat null, as the eggs will remain vulnerable for a matter of days. Goniozus wasps are typically idiobionts, and will permanently paralyse the host with a sting prior to laying eggs. Hopper and Mills (2015) observed that G. jacintae could only temporarily paralyse the host for a similar length of how long the wasp guarded its brood for. However, the ability of G. jacintae to permanently paralyse LBAM is relatively unknown. It could be that the wasp only remains with the host for as long as the host is paralysed.

The student will be able to manipulate a variety of factors to determine how they influence host guarding time. These factors include, but are not limited to, host paralysation status (permanently or temporarily paralysed), host size (larger hosts are a more valuable resource to guard), and host density (the presence of multiple hosts may influence female laying decisions). In addition, the student can observe the change in fitness of the brood when affected by these factors.

Techniques/Skills Learnt:
- Insect culture rearing (G. jacintae and E. postvittana)
- Experimental design and execution (manipulation + behavioural observations)
- Use of software for behavioural observations (e.g. The Observer)
- Use of wind tunnels for experiments (if applicable)
- Statistical analysis

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact maryam.yazdani@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Genomic analysis of fungal cell wall synthesis

Supervisor(s): Dr Alan Little – Molecular Plant Pathologist
Dr Julian Schwerdt – Computational Biologist
Professor Vincent Bulone – Carbohydrate Biochemist

Supervisor(s) Webpage(s): Adelaide Glycoscience Research Group

Brief Project Outline:
The fungal cell wall is perhaps the most ideal target for the treatment of fungal pathogens. The fungal cell wall represents a considerable metabolic investment as it accounts for 15–30% of the cellular biomass. It plays such a momentous role to survival and maintaining homeostasis that up to 20% of genes in the fungal genome are associated with cell wall biogenesis. The enzymes and signal transduction pathways that govern the synthesis of these cell wall components are prime targets for antifungal drugs. Knowledge of the cell wall composition and its biosynthesis will allow more targeted and tailored approaches towards disease control.
To date, only a small percentage of fungal cell walls have been characterised. The ability of fungi to generate the necessary sugar nucleotide substrates for the synthesis of various cell wall components is determined by the presence of the nucleotide sugar interconverting enzymes. This project aims to characterise the distribution of each nucleotide sugar interconverting enzyme family across the available fungal genomes that have been fully sequenced. In doing so, we will generate a predictive map of what sugars each fungal species is capable of making and potentially incorporating into its cell wall.

Techniques/Skills Learnt:
- Bioinformatics
- Cell wall biochemistry
- Fungal pathology

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact alan.little@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: *Design of biomimetic coatings to understand plant-pathogen relations*

**Supervisor(s):**  
Dr Bryan Coad – Materials Scientist  
Dr Alan Little – Molecular Plant Pathologist  
Professor Vincent Bulone – Carbohydrate Biochemist

**Supervisor(s) Webpage(s):** [Adelaide Glycoscience Research Group](#)

**Brief Project Outline:**  
Plant fungal pathogens have evolved highly sophisticated ways to infect crops and therefore are a threat to global food supply. On surfaces such as leaves, they first adhere to the surface and, interestingly, seem to know how to grow directionally towards ideal locations for infection before beginning surface penetration. If it were possible to better understand how the fungus senses and responds to the physical and chemical cues present on leaf surfaces, then we could develop strategies for interrupting infection, or develop plants which prevent adhesion or conceal inductive cues.

We propose that artificial surfaces can be constructed to model natural leaf surfaces. By designing surfaces with well-defined chemical and physical properties to which the fungus can respond, we will be able to understand the essential triggers for infection. Additionally, studying the adhesion on surfaces will allow us to understand how secreted chemicals prepare the surface before infection. The overall aim is to replicate essential components of the leaf and assemble these into a biomimetic model.

The goal of this research project is to make biomimetic surface coatings and investigate their biological response. This will involve using surface coating methods on materials such as glass slides, and to visualise the fungi using microscopy. This will provide an opportunity to learn about novel polymerisation techniques, characterisation of surfaces using surface analysis, and to visualise their biological effect.

**Techniques/Skills Learnt:**  
- Surface coating and analytical techniques  
- Microscopy  
- Fungal pathology

**Key References:**  

**Scholarship Available:** Yes *

* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact bryan.coad@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: *Characterisation of the fungal extracellular matrix and its role in adhesion*

**Supervisor(s):**
- Dr Alan Little – Molecular Plant Pathologist
- Dr Bryan Coad – Materials Scientist
- Professor Vincent Bulone – Carbohydrate Biochemist

**Supervisor(s) Webpage(s):** [Adelaide Glycoscience Research Group](http://www.adelaide.edu.au/glycoscience/)

**Brief Project Outline:**
Foliar pathogens are commonly dispersed in wind and need to adhere to the plant surface to begin the infection process. Once a fungal conidium lands on a leaf, a thin extracellular matrix is secreted to rapidly establish a strong connection to the plant surface. If adhesion is unsuccessful, the conidia cannot penetrate the plant host and will be removed by wind and rain.

The composition of fungal adhesive matrices has only been partially deduced. Plant/fungal interactions can be disrupted by compounds that block adhesion or by enzymes that degrade the adhesive. Glycoproteins appear to play a key role in the fungal adhesion to the leaf surface. However, their identity and mode of action have not been determined and the glycan structures attached to these proteins have not been characterised. New technologies for genome editing and single molecule imaging will contribute to a better understanding of fungal adhesion, but progress will be limited without a fundamental understanding of the components involved.

**Techniques/Skills Learnt:**
- Cell wall biochemistry
- Fungal pathology

**Key References:**

**Scholarship Available:** Yes *

* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact alan.little@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: *Modulation of the plant defence response by the fungal extracellular matrix*

**Supervisor(s):**  
Dr Alan Little – Molecular Plant Pathologist  
Professor Vincent Bulone – Carbohydrate Biochemist

**Supervisor(s) Webpage(s):** [Adelaide Glycoscience Research Group](#)

**Brief Project Outline:**
Foliar pathogens are commonly dispersed in wind and need to adhere to the plant surface to begin the infection process. Once a fungal conidium lands on a leaf, a thin extracellular matrix is secreted to rapidly establish a strong connection to the plant surface. Whilst fungi have evolved carbohydrate structures to allow quick and reliable adhesion to the plant surface, the plant host has adapted to detect specific carbohydrate epitopes of the extracellular matrix (ECM), leading to activation of its innate immune response.  
Chitin- and glucan-based oligosaccharides common to all fungal cell walls act as key elicitors of the defence response; however, these molecules are located at the innermost layer of the fungal cell wall and cannot be readily detected by the plant unless significant damage has already been made to the pathogen cell wall. In contrast, the carbohydrates of the fungal ECM are secreted by the conidia within minutes of landing on the plant providing the host with a freely available mixture of potential elicitors. Preliminary data from our collaborators show evidence that carbohydrate fractions from our model system are capable of activating the defence response of economically important crops, thereby providing new promising targets for further research. This project will aim to collect and screen fungal ECM fractions for their ability to activate the plant defence response.

**Techniques/Skills Learnt:**
- Cell wall biochemistry
- Fungal pathology

**Key References:**

**Scholarship Available:** Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact alan.little@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: **Structural studies of cell wall proteins involved during pathogenesis**

Supervisor(s):  
Dr Alan Little – Molecular Plant Pathologist  
Dr M Obayed Ullah – Structural Biologist  
Professor Vincent Bulone – Carbohydrate Biochemist

Supervisor(s) Webpage(s): [Adelaide Glycoscience Research Group](#)

Brief Project Outline:  
Fungi and oomycetes are notorious pathogens responsible for infections in plant particularly of agricultural importance. Among different diseases, the late blight disease of potato and downy mildew of grape are examples of infections in plant caused by these pathogens. Chitin is one of the important cell wall components of fungi and oomycetes, which is not common in other plant species. This enables us to target chitin synthesis pathway as an attractive drug target.

Chitin Synthases (CHSs) are transmembrane cell wall proteins which are responsible for the synthesis of chitin, but the molecular mechanism is not clearly understood. The molecular structure of CHSs will significantly contribute in understanding the underlying mechanism of chitin synthesis as well as designing inhibitors for this pathway. In this project, we will study the molecular structure of CHSs using Ion Mobility Mass Spectrometry as well as X-ray Crystallography.

Techniques/Skills Learnt:  
- Protein expression and purification  
- Protein crystallography  
- Ion mobility mass spectroscopy

Key References:  
Kuang, G., Bulone, V. and Tu, Y., 2016. Computational studies of the binding profile of phosphoinositide PtdIns (3, 4, 5) P 3 with the pleckstrin homology domain of an oomycete cellulose synthase. Scientific reports, 6, p.20555.

Scholarship Available: Yes *  
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact alan.little@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: *Improving pathogen resistance in barley plants*

**Supervisor(s):**
- Dr Alan Little – Molecular Plant Pathologist
- Dr Helen Collins – Plant Physiologist
- Dr Natalie Betts – Molecular Biologist
- Professor Vincent Bulone – Carbohydrate Biochemist

**Supervisor(s) Webpage(s):** Adelaide Glycoscience Research Group

**Brief Project Outline:**
Barley is the fifth largest crop in the world. It is used for human food, animal feed and malting and brewing. Numerous genes are involved in plant growth and development, from the initial stages of grain germination through to the senescence of the plant prior to harvest.

This project will focus on grain and leaf resistance to pathogen attacks, specifically investigating:

- The location and amounts of anti-microbial hordatines in grain tissues during germination using a newly developed chromatographic technique
- The timing and roles of jasmonate hormones in directing plant resistance
- Possibly, the effect of foliar application of hordatines on barley leaf resistance to *Blumeria graminis* infection
- Genes that drive barley resistance, with the overall aim to find breeding targets using existing RNAseq datasets developed from barley grain tissues during development and germination.

**Techniques/Skills Learnt:**
- Fungal pathology
- Transcriptome analysis
- High performance liquid chromatography (HPLC)

**Key References:**

**Scholarship Available:** Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact alan.little@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: *Characterising the jasmonate hormones in barley, and how they affect beer*

**Supervisor(s):**  
Dr Helen Collins – Plant Physiologist  
Dr Natalie Betts – Molecular Biologist  
Professor Vincent Bulone – Carbohydrate Biochemist

**Supervisor(s) Webpage(s):** [Adelaide Glycoscience Research Group](https://www.adelaide.edu.au/science/glycoscience/)

**Brief Project Outline:**
Hormones, such as jasmonates, drive many physiological processes during plant development and response to environmental stresses. In barley, jasmonates also regulate the lipoxygenase (lox) pathway, which can affect beer taste and foaming.

This project will:
- Identify genes involved in jasmonate biosynthesis from the recently sequenced barley genome  
- Determine their spatial and temporal patterns of expression from a new barley tissue series using quantitative PCR (qPCR)  
- Examine biochemical profiles (LC/MS) of barley, malt and spent grain samples from a brewery to find jasmonate products  
- Develop a new barley tissue series using lox mutant lines to examine changes in jasmonate biosynthetic gene transcription

**Techniques/Skills Learnt:**
- Plant tissue harvesting and sample preparation  
- Transcriptome analysis  
- LC/MS data analysis

**Key References:**

**Scholarship Available:** Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact [helen.collins@adelaide.edu.au](mailto:helen.collins@adelaide.edu.au) with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Farming Systems

The Farming Systems Research Group at the University of Adelaide is concerned with sustainable agricultural systems with a focus on crop production and agronomy. Research is conducted that addresses Australian dryland agricultural systems as well as agricultural systems overseas.

More information and potential supervisors at:

http://agwine.adelaide.edu.au/research/farming-systems/
Honours Project Title: Use of drones to assess the performance of wheat in sodic soils

Supervisor(s): Rhiannon Schilling, Ramesh Raja Segaran, Glenn Mc'Donald

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/rhiannon.schilling
https://www.adelaide.edu.au/directory/ramesh.rajasegaran
https://researchers.adelaide.edu.au/profile/glenn.mc'donald
https://www.adelaide.edu.au/environment/uraf/

Brief Project Outline:
Subsoil constraints, such as sodicity, prevent current elite wheat varieties from achieving their grain yield potential. The identification of plant traits which enable some wheat varieties to have higher yields than others is needed.

In collaboration with the Unmanned Research Aircraft Facility (URAF), this project will involve the use of drones fitted with various cameras, such as red-green-blue (RGB) and multispectral cameras, and handheld devices, such as a GreenSeeker, EM38 and ASD FieldSpec, to non-destructively assess the growth and spectral reflectance of wheat in field trials with sodic subsoils. A controlled greenhouse-based experiment would also be conducted to verify results.

A specific project can be tailored to suit your interests with all or some of the following: field phenotyping, drone image analysis, GIS, remote sensing, precision agriculture, plant physiology, plant nutrition and soil science components.

Techniques/Skills Learnt:
- Field trials, greenhouse and growth chamber experimentation
- Gain experience in remote sensing, GIS and drone image analysis
- Independent and collaborative research skills
- Experimental design and data analysis

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact rhiannon.schilling@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Identifying novel tolerance to subsoil constraints in a FIGS wheat set

Supervisor(s): Glenn M’Donald, Rhiannon Schilling

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/glenn.mcdonald
https://researchers.adelaide.edu.au/profile/rhiannon.schilling

Brief Project Outline:
Subsoil constraints prevent current elite bread wheat varieties from achieving their yield potential. Dispersive soils (also referred to as sodic soils) comprise multiple subsoil constraints including high soil pH, salinity, high boron, waterlogging and high aluminium. Novel sources of genetic variation are needed to develop new wheat varieties with enhanced tolerance to one or more subsoil constraints. We have access to a new wheat germplasm collection including 300 lines from a Focused Identification of Germplasm Strategy (FIGS) set. The wheat lines are from various regions around the world and have been selected based on the prevalence of subsoil constraints in their place of origin. This Honours project will involve both greenhouse and growth chamber experiments to screen the FIGS wheat germplasm under one of the following subsoil constraints including high soil pH, salinity, high boron, waterlogging or high aluminium. The overall aim of this project is to identify wheat lines from the FIGS set that contain alternative sources of tolerance to one of these major subsoil constraints.

Techniques/Skills Learnt:
- Plant phenotyping and genotyping
- Soil chemical analysis
- Greenhouse and growth chamber experimentation
- Independent and collaborative research skills
- Experimental design and data analysis

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact glenn.mcdonald@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Improving wheat yields in dispersive soils

Supervisor(s): Glenn M'Donald, Rhiannon Schilling

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/glenn.mcdonald
https://researchers.adelaide.edu.au/profile/rhiannon.schilling

Brief Project Outline:
Dispersive soils reduce wheat yields on 68% of cropping land in Australia. These soils often comprise highly alkaline subsoils (pH > 9) and many other constraints including high salinity, high aluminium, waterlogging and high soil strength. A current GRDC-funded project is aiming to improve the yield of wheat in dispersive soils by pyramiding tolerance to one or more of these soil constraints into elite wheat varieties. We have a range of projects involving the following research areas: plant phenotyping, plant nutrition, plant genetics, soil science and farming systems that can be tailored to your interests.

Techniques/Skills Learnt:
- Plant phenotyping
- Soil chemical analysis
- Greenhouse, growth chamber and/or field trials
- Molecular biology, genotyping and/or gene expression, molecular markers
- Experimental design and data analysis

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact glenn.mcdonald@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Effect of micronutrients on the growth of wheat in sodic soils

Supervisor(s): Rhiannon Schilling, Glenn Mc'Donald

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/rhiannon.schilling
https://researchers.adelaide.edu.au/profile/glenn.mcdonald

Brief Project Outline:
Micronutrients are needed in trace amounts for the optimal growth and development of wheat. The critical concentration range for micronutrients is narrow – too little or too much of a micronutrient can cause deficiency and toxicity to occur respectively.

We recently identified a link between two micronutrients based on the analysis of leaf ion concentrations in wheat growing in sodic soils. This project will investigate the association between the two micronutrients and will involve hydroponics experiments testing several wheat lines in various concentrations and combinations of the two micronutrients in high pH conditions. The aim is to determine if there is any interaction between the two micronutrients and whether they alter the growth and ion concentrations of wheat in sodic soils. This information will assist with the development of wheat lines with improved tolerance to sodicity.

Techniques/Skills Learnt:
- Plant phenotyping – plant growth, leaf and root ion concentration analysis
- Greenhouse and growth chamber experimentation – hydroponics
- Molecular biology, genotyping and/or gene expression, molecular markers (if desired)
- Experimental design and data analysis

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact rhiannon.schilling@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Management practices to enable early wet season forage production in lowland rice production systems of The Lao PDR

Supervisor(s): Dr Joshua Philp; Dr Matthew Denton

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/joshua.philp
https://researchers.adelaide.edu.au/profile/matthew.denton;

Brief Project Outline: The sustainable intensification of crop and livestock production by smallholders has been shown to be an important driver of socio-economic development in Southeast Asia (Young et al. 2014), however productivity in the predominant lowland rice systems is often constrained by variable rainfall and low-fertility, sandy soils. In The Lao PDR, rainfed areas often remain in fallow during April to July in response to the variability in the onset, intensity and reliability of rainfall in the early wet season. This results in lost opportunities to capitalise on early wet season rainfall when it does occur. Management options such as short-duration crops, water-saving technologies and organic soil amendments may minimise the risk associated with crop production in the early wet season. This research will explore the viability of these options in a series of overseas experiments in the Lao PDR. We are seeking a highly motivated student to work on a rewarding, well-defined project which will involve conducting and reporting on a multifactorial field experiment conducted in the early wet season of 2019. The research is aligned with a large project funded through the Australian Centre for International Agricultural Research.

Techniques/Skills Learnt:
- Experimental design
- Crop establishment
- Biophysical and climatic data collection
- Statistical analysis

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact matthew.denton@adelaide.edu.au or joshua.philp@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Food & Nutrition

Improvements in nutritional status of human populations can optimise health outcomes, benefiting quality of life and reducing whole-of-life health care costs. Our research contributes to improving human nutrition through research on agriculture, food and nutrition. Our research activities include clinical intervention trials that provide evidence for public health recommendations.

More information and potential supervisors at:

http://agwine.adelaide.edu.au/research/food-nutrition/
Honours Project Title: Early Origins of Breast and Prostate Cancer

Supervisor(s): Dr Tina Bianco-Miotto and Prof Mary Wlodek (University of Melbourne)

Supervisor(s) Webpage(s): https://researchers.adelaide.edu.au/profile/tina.bianco

Brief Project Outline:
It is well known that maternal complications during pregnancy can impact the short and long-term health of offspring. In particular, uteroplacental insufficiency during pregnancy can predispose offspring who are born small to an increased risk of developing chronic disease later in life such as obesity, diabetes, cardiovascular disease or cancer. In addition, overnutrition of the mother or father prior to and during pregnancy programmes offspring disease risk. Using samples collected from previous animal studies, our research objective is to determine if pregnancy complications alter prostate or mammary gland development in offspring, leading to an increased susceptibility of developing cancer in adult life. Given that obesity is a growing epidemic world-wide, understanding how obesity can influence the development and progression of cancer will help identify targets for intervention and prevention. We are also investigating the molecular mechanisms involved. In summary, this project will ideally suit an enthusiastic student who is interested in learning more about maternal nutrition, developmental origins of disease, cancer and epigenetics.

Techniques/Skills Learnt:
- DNA and RNA Extractions
- Quantitative Real Time PCR
- Immunohistochemistry
- DNA Methylation Analyses

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact tina.bianco@adelaide.edu.au with the subject heading 'Honours Project', so that we can have a chat about the project in more detail.
Honours Project Title: The role of micronutrients in pregnancy

Supervisor(s): Dr Tina Bianco-Miotto, Prof Claire Roberts

Supervisor(s) Webpage(s): https://researchers.adelaide.edu.au/profile/tina.bianco
https://researchers.adelaide.edu.au/profile/claire.roberts

Brief Project Outline:
Pregnancy complications such as preeclampsia, intrauterine growth restriction, gestational diabetes and preterm birth affect about 20% of human pregnancies. These pregnancy complications predict lifelong health and sometimes mortality for the baby and/or the mother. Deficiencies in micronutrients in the mother’s diet including folate and vitamin D prior to and during pregnancy have been implicated in these adverse pregnancy outcomes. Exciting research in the Roberts’ laboratory has found clear associations between maternal micronutrient status and pregnancy outcomes and this project investigates the role of the placenta in this association. The placenta has a very important role in providing nutrition for optimal growth and development of the baby.

First trimester and term placental explants will be used in cell culture experiments to determine the effect of folate on changes in placental explant growth, apoptosis, development, gene expression and DNA methylation status. Investigating the effect of micronutrients on placental function is a relatively new area of research with the potential to determine factors that go awry in the placenta during early pregnancy leading to placental insufficiency. Moreover, results of this project may lead to identifying nutritional guidelines and/or therapeutics to address the increasing prevalence of pregnancy complications not only in Australia but worldwide. In summary, this project will ideally suit an enthusiastic student who is interested in learning more about pregnancy, maternal nutrition and placenta.

Techniques/Skills Learnt:
- Placenta explants/cell culture
- Immunohistochemistry
- DNA and RNA extractions
- Quantitative PCR

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact tina.bianco@adelaide.edu.au with the subject heading 'Honours Project', so that we can have a chat about the project in more detail.
Honours Project Title: Epigenetic regulation in placenta development

Supervisor(s): Dr Tina Bianco-Miotto, Prof Claire Roberts

Supervisor(s) Webpage(s): https://researchers.adelaide.edu.au/profile/tina.bianco
https://researchers.adelaide.edu.au/profile/claire.roberts

Brief Project Outline:
The best known function of the placenta is to mediate fetal-maternal exchange throughout pregnancy. It also plays a major role in directing maternal adaptation to pregnancy by secreting a variety of steroid and peptide hormones that modulate maternal physiology without which pregnancy could not be sustained. Although the placenta is a shared organ between mother and fetus, it is an extra-embryonic tissue and is primarily regulated by the fetal genome. The placenta separates from mother and fetus after birth, making it a truly transient organ. For this reason, the epigenetic mechanisms involved in placenta development may not be under the same constraints as other somatic tissues.

Epigenetic mechanisms, like DNA methylation, regulate gene expression without altering the underlying DNA sequence and are critical during development. By determining how epigenetic profiles change in the placenta throughout pregnancy and in response to adverse outcomes we can identify epigenetic biomarkers indicative of future risk of pregnancy complications. In summary, this project will ideally suit an enthusiastic student who is interested in learning more about epigenetics in placenta development and will suit a student interested in learning molecular techniques and working with nucleic acids.

Techniques/Skills Learnt:
- Nucleic acid extraction
- Immunohistochemistry
- Quantitative PCR
- DNA methylation

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact tina.bianco@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Assessing the effects of plant seed extracts on Caco2 and IEC-6 cell cultures

Supervisor(s): Prof Rachel Burton, A/Prof Susan Bastian, Dr Tina Bianco-Miotto

Supervisor(s) Webpage(s): https://researchers.adelaide.edu.au/profile/rachel.burton
https://researchers.adelaide.edu.au/profile/sue.bastian
https://researchers.adelaide.edu.au/profile/tina.bianco

Brief Project Outline:
Interest in highly nutritious plant seeds is increasing as we are becoming more aware of the need to eat a balanced and varied diet. We already consume a wide variety of seeds in our food but some of these have been called “superfoods”, including flax, quinoa, hemp and chia. This is based on their desirable lipid contents (omega 3 vs omega 6 amounts and ratios), and protein profiles because they contain all the essential amino acids or superior dietary fibre content. But how many of these properties have been thoroughly tested and verified, for example using bioavailability assays, and what effects do the seeds have on cells that are exposed to them? Does this vary according to whether the seeds are whole or ground (as we would eat them)?

We would like to use a cell culture model to test the bioavailability of compounds from a range of seeds, including those which have “ideal” omega fatty acid profiles. We would also like to initiate an analysis of the changes occurring in cells which have been exposed to these seed extracts; we can measure cell proliferation and apoptosis using the xcelligence system and oxidative stress and inflammatory reactions using appropriate biomarkers.

Techniques/Skills Learnt:
- Working with human cell cultures
- Bioavailability assays
- Cell proliferation and apoptosis assays
- Oxidative and inflammatory stress assessment
- RNA extraction and transcriptomic analyses

Key References:


Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact rachel.burton@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Projects:
The areas of honours projects I potentially offer are:

- Iodine nutrition in pregnancy and early childhood on pregnancy outcome, growth and development of children.

- Maternal nutrition literacy and dietary quality of mothers and Children

- Effect of processing and cooking methods on physio-chemical properties of oats and glycaemic response.

Supervisor(s): Dr Jo Zhou
Supervisor(s) Webpage(s): https://researchers.adelaide.edu.au/profile/jo.zhou

Techniques/Skills Learnt:

- Assessment of dietary intake and nutritional status
- Analysis of physical and chemical characteristics of Oats
- Statistical analysis technique
- Scientific writing and critical review of scientific literature

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact jo.zhou@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Plant Genetics, Genomics & Breeding

Analysis of the genetic and epigenetic control of economically important traits (abiotic stress, biotic stress, productivity, end-use quality) leads to understanding of causes of observed variation in plants and to the development of tools and technologies that can be used in crop improvement. We develop improved germplasm, breeding methods and breeding technologies. We develop new varieties of durum wheat, faba bean, almond and ornamental eucalypts

More information and potential supervisors at:

http://agwine.adelaide.edu.au/research/plant-genetics-breeding/
**Honours Project Title:** Exploring the function of MADS-box genes in barley inflorescence development

**Supervisor(s):** Dr. Gang Li and Professor Dabing Zhang

**Supervisor(s) Webpage(s):**
https://agwine.webdev.adelaide.edu.au/research/plant-sciences-breeding/
http://www.adelaide.edu.au/directory/dabing.zhang

**Brief Project Outline:**
The barley inflorescence is a single spike, where spikelets with single florets develop on the main stem. To understand the molecular control of barley spike and spikelet formation, we are conducting research using known genes from model plants such as Arabidopsis and rice as guidance. The *MADS*-box gene family is important in inflorescence development in many plants, most notably in the ABC model of floral organ development in Arabidopsis. In this project we will study the expression and function of these E-class *MADS*-box genes in barley. We start with mutants and overexpression lines, and study the effects on inflorescence development, both in mature plants and the developing inflorescence meristem. To find their function we need an expression profile of each gene and since the function of *MADS*-box proteins is often achieved by forming complexes, we will identify interaction partners of the E-class genes. This honours project will involve in both the *MADS* box genes’ expression and regulatory network in morphogenesis and development of inflorescence and spikelet of barley at SJTU (Shanghai Jiao Tong University) & UoA Joint Laboratory for Plant Sciences and breeding. In summary, this project will ideally suit an enthusiastic student who is interested in learning more about functional gene research combined with molecular biology, biochemistry, cell biology, and developmental biology.

**Techniques/Skills Learnt:**
- Molecular techniques including genomic DNA and RNA extraction, PCR techniques, qRT-PCR performance and fusion vector construction, CRISPR-Cas9
- Bimolecular fluorescence complementation assay (BiFC), and Yeast-two-hybrid
- Cellular biological skills, such as, confocal laser scanning microscope (CLSM), immunolocalization and *in situ* hybridization
- Competency with ‘*in silico*’ gene and RNA-seq analysis using a variety of bioinformatics tools
- Data analysis, interpretation and reporting, evaluation of the literature and scientific writing

**Key References:**

**Scholarship Available:** Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact dabing.zhang@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Molecular mechanism of male reproduction in cereals

Supervisor(s): Dr. Gang Li and Professor Dabing Zhang

Supervisor(s) Webpage(s):
https://agwine.webdev.adelaide.edu.au/research/plant-sciences-breeding/
http://www.adelaide.edu.au/directory/dabing.zhang

Brief Project Outline:
Male gametophytes develop in the anther compartment of the stamen within the flower and require cooperative functional interactions between gametophytic and sporophytic tissues. During the male reproductive development, there are numerous biological events including cell division, differentiation and degeneration of somatic tissues consisting of four concentric cell layers surrounding and supporting reproductive cells as they form mature pollen grains through meiosis and mitosis. This honours project will take practice of systematic biology (genomics, transcriptomics, proteomics, metabolomics) into our available resources in SJTU (Shanghai Jiao Tong University) & UoA Joint Laboratory for Plant Sciences and breeding, which elucidates the molecular mechanism underlying each biological process of male reproduction in rice and barley. In summary, this project will ideally suit an enthusiastic student who is interested in comprehensive training of functional gene research combined with plant science, cell biology, and developmental biology.

Techniques/Skills Learnt:
- Molecular techniques including genomic DNA extraction, PCR techniques, DNA sequence analysis, RNA extraction and qRT-PCR performance, CRISPR-Cas9
- Protein biochemistry and interaction including protein expression and purification in E. coli, SDS-PAGE, Western-blot, Co-immunoprecipitation, Pull-down, Bimolecular fluorescence complementation assay (BiFC), and Yeast two hybrid
- Cellular biological skills, such as, Confocal laser scanning microscope (CLSM), Immunolocalization and Inverted microscope and scanning electron microscope (SEM)
- Data analysis, interpretation and reporting
- Critical evaluation of the literature and scientific writing

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact dabing.zhang@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Plant nematode-interactions: parasitism and defence

Supervisor: Diane Mather


Brief Project Outline:

Plant parasitic nematodes cause significant yield losses in agriculture.

We have mapped barley and wheat genes for nematode resistance and developed new ways to look inside infected roots (see above). Now we want to discover exactly how the nematodes affect the roots and exactly which genes help the plants fight back. Depending on your interests (e.g., genetics, biotechnology and/or plant pathology) we can work with you to design a project in which you can help solve some of the remaining mysteries about an important host-parasite system.

Techniques/Skills Learnt: You will learn to formulate hypotheses and design experiments to test them and you will gain experience in the research methods used in plant genetics, biotechnology and pathology.

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact diane.mather@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Plant Biology & Biochemistry

*Plant biology and biochemistry are major research strengths in the School of Agriculture, Food and Wine. Research areas include plant and cell physiology, membrane transport, plant energy biology, plant reproductive biology, plant cell wall biology and biochemistry, glycoscience and cereal chemistry.*

*More information and potential supervisors at:*

Honours Project Title: Improving drought tolerance by turgor regulation of guard cells

Supervisor(s): Dr Stefanie Wege and Prof Matthew Gilliham

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/stefanie.wege
https://researchers.adelaide.edu.au/profile/matthew.gilliham

Brief Project Outline:
Many processes in plants depend on regulated gas exchange between leaves and the atmosphere; \( \text{CO}_2 \) uptake and \( \text{O}_2 \) release during the day, transpiration of \( \text{H}_2\text{O} \) to maintain nutrient supply to the shoot. Guard cells are specialised cells in the leaf epidermis; which regulate the size of the stomatal pore.

In this project, we will investigate the importance of the CCC protein in guard cells of the model plant Arabidopsis and the crop plant rice. CCC has been shown to impact osmoregulation, and it might therefore play a vital role in guard cell turgor regulation. The results from this project will contribute in informing breeding strategies for more drought tolerant crops; and enhance our overall knowledge on osmoregulation in cells.

Techniques/Skills Learnt:
- Bright field microscopy - stomata aperture measurements
- Laser scanning confocal microscopy - investigating protein movements and cytoskeleton re-arrangements in guard cells
- Image analysis software – from image to data
- RNA, cDNA preparation, Q-PCR – guard cell specific gene expression

Key References:


Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact stefanie.wege@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: The role of CCC proteins in plant hormone distribution and cell wall composition

Supervisor(s): Dr Stefanie Wege, Dr Yue Qu and Prof Matthew Gilliham

Brief Project Outline:
CCC proteins, or Cation-Chloride-Cotransporters, are large membrane integrated proteins that are localised in the endomembrane system of cells. We recently found that CCCs play an important role in overall levels and gradients of the plant hormone auxin; and that CCC function is required for correct cell wall deposition in seeds and root responses to osmotic stress.

In this project, we will look into more detail of how the function of CCC proteins impacts these aspects, and if they can be separated. In a first step, different versions of CCC proteins of the model plant Arabidopsis and the crop rice will be made, their subcellular localisation identified and their functionality tested. The goal is to identify different protein domains that are responsible for the different functions of the protein; which would then allow to, for example, direct plant cell processes towards higher biomass production or production of more fruit bearing branches/more tillers.

Techniques/Skills Learnt:
- Molecular biology techniques, PCR, cloning of genes, bacterial transformation – construction of different CCC versions
- Laser scanning confocal microscopy – imaging of GFP-tagged CCC versions to confirm expression and localisation in plant cells
- Image analysis software – from image to data
- Heterologous expression in bacterial systems – functionality of CCC proteins

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact stefanie.wege@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: The role of CCC proteins in rice root hairs and pollen development and growth

Supervisor(s): Dr Stefanie Wege

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/stefanie.wege

Brief Project Outline:
CCC proteins, or Cation-Chloride-Cotransporters, are large membrane proteins that are localised in the endomembrane system of cells. It has previously been shown that CCC proteins are important for pollen development and we recently found that CCC are crucial for normal root hair development in the model plant Arabidopsis thaliana and the crop plant rice (Oryza sativa). Root hairs and pollen tubes share common characteristics, cell growth in both is highly dependent on a functional endomembrane system, where CCC is localised. Wildtype rice, Nipponbare cultivar, will be compared to a variety without a functional CCC protein, under different growth conditions and treatments; to characterise the rice root hair and pollen phenotypes and identify the mechanisms in which CCC is involved. Root hairs are important for nutrient and water uptake, while pollen development and growth is crucial for grain development and plant yield. The goal of this project is to increase knowledge in these two fields in rice, providing new information for improving crop plants.

Techniques/Skills Learnt:
- Stereo microscopy – effect of different treatments and growth conditions on root hairs
- Scanning electron microscopy – detailed imaging of root hair morphology
- Differential interference contrast (DIC) microscopy, time-lapse imaging – pollen tube growth
- Image analysis software – from image to data
- Phenotyping stages of pollen development – techniques depend on initial findings

Key References:


Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.
Want to know more? Then contact stefanie.wege@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
**Honours Project Title:** Live cell imaging of γ-aminobutyric acid (GABA) signals in plants  
**Supervisors:** Dr. Bo Xu and Professor Matthew Gilliham  
**Supervisor(s) webpage(s):**  
https://researchers.adelaide.edu.au/profile/matthew.gilliham

**Brief Project Outline:** γ-Aminobutyric acid (GABA) is a stress-inducible metabolite and is believed to act as a recently discovered stress signal in plants that links metabolism to physiological responses. The speed of the GABA response varies from seconds to a few days; however, it is unclear when and where GABA is stimulated by stress in plants. A recent discovery of a synthetic GABA fluorescence sensor allows a real time imaging of GABA metabolism at cellular levels in mammals. Here, we express this sensor in plants for the first time. This project will visualise GABA signals in plants in real time, and is expected to reveal the spatial and temporal regulation of GABA in plants by multiple stresses.

**Techniques /Skills Learnt:**  
- Live cell confocal microscopy imaging  
- Image analysis

**Key References:**  
Ramesh SA, Tyerman SD, Gilliham M, & Xu B (2017) γ-Aminobutyric acid (GABA) signalling in plants. *Cellular and Molecular Life Sciences*, 74(9), 1577-1603.  

**Scholarship Available:** Yes  
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more about this exciting project? Then contact matthew.gilliham@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Exploring the interaction between novel drought signals in plants

Supervisors: Dr. Bo Xu and Professor Matthew Gilliham

Supervisor(s) webpage(s):
https://researchers.adelaide.edu.au/profile/matthew.gilliham

Brief Project Outline: Cytosolic γ-aminobutyric acid (GABA) and chloroplastic 3′-phosphoadenosine 5′-phosphate (PAP) are recently discovered stress-inducible signals in plants. By perturbing the metabolism of either, stomatal signalling responses are disrupted resulting in a reduced ability of plants to survive drought. However, it is unknown if there is a communication between two signals in the regulation of plant gas exchange. This project is to examine the interaction of GABA and SAL1-PAP in stomatal regulation and expected to reveal a new signal network in guard cells.

Techniques /Skills Learnt:
- Molecular biology
- Stomatal aperture assay
- Stomatal conductance measurement

Key References:


Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more about this exciting project? Then contact matthew.gilliham@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Transcriptional control of GABA signalling in plants

Supervisor(s): Professor Matthew Gilliham, Dr Rakesh David


Brief Project Outline:
Being sessile, plants have evolved complex signaling mechanisms to cope with the range of biotic and abiotic stresses to ensure survival. One such mechanism involves the non-protein amino acid Gamma-aminobutyric acid (GABA) that acts as a signal to modulate plant growth and response to stress. GABA is produced from the decarboxylation of glutamate by glutamate decarboxylase (GAD) enzyme and rapidly accumulates in response to environmental stress. While the enzymatic pathway that leads to GABA synthesis in plants is well documented, very little is known about the transcriptional regulation of GAD genes and how GAD expression responds to changing environments.

The proposed Honours project will seek to understand the regulatory mechanism controlling GAD gene transcription. The study will involve computational analysis of GAD promoter sequences and co-expression network analysis to identify candidate transcription factors that enhance or repress GAD transcription. Candidate transcription factors will be tested for GAD activation in plants using a transgenic luciferase reporter system and yeast-one-hybrid analysis. The project will be undertaken in the Centre of Excellence in Plant Energy Biology (CPEB) with an intensive focus on molecular biology techniques to understand GABA regulation in plants.

Techniques/Skills Learnt:
- Molecular techniques including DNA and RNA extraction, gene cloning, PCR, quantitative RT-PCR, yeast one-hybrid assay
- Transient transformation of promoter fusion constructs in Nicotiana benthamiana (tobacco) and stable transformation in Arabidopsis
- Bioinformatics skills including phylogenetic and in silico analysis of promoter sequences for key GABA related genes, co-expression analysis to identify candidate transcription factors
- Fluorescence microscopy to observe luciferase reporter constructs

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact matthew.gilliham@adelaide.edu.au; rakesh.david@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Investigation into chloride exclusion in grapevines

Supervisors: Professor Matthew Gilliham; Dr Yue Qu

Supervisors Webpages:
https://researchers.adelaide.edu.au/profile/matthew.gilliham
http://www.plantransig.com/research/staff/

Contact Details: matthew.gilliham@adelaide.edu.au; yue.qu@adelaide.edu.au

In Australia salinity is dominated by sodium chloride (NaCl). Toxic concentrations of Na\(^+\) and Cl\(^-\) ions affect grapevine metabolism and lead to reduced growth; may also lead to accumulation of sodium and chloride in wine. A backcross population derived from two grapevine species, \(V.\) berlandieri (chloride excluder) and \(V.\) vinifera (chloride accumulator) was previously shown to segregate for chloride exclusion as a Mendelian trait in a 1:1 ratio, suggesting influence of a single dominant gene. Our collaborators in CSIRO Agriculture have performed genetic mapping of the chloride exclusion locus in grapevines, 140 Ruggeri (excluder) and K51-40 (Accumulator). Of the 74 predicted genes in the mapped locus, only three are annotated as putative in transporters. One of the three candidate dominant genes, \(VvCHA20.1\) is only expressed in the stele and higher expressed in 140 Ruggeri compared to K51-40. In further investigation, \(VvCHA20.1\) has high homology with \(GmSALT3/GmCHX1\), which improved soybean salt tolerance by Cl\(^-\) and Na\(^+\) exclusion. Taken together with the recent publications on \(GmSALT3/GmCHX1\), results suggest that \(VvCHA20.1\) is the likely casual gene behind the segregating chloride exclusion trait in 140 Ruggeri and K51-40. However, how \(VvCHA20.1\) conduces to chloride exclusion remains unknown.

This Honours project will involve functional characterisation of \(VvCHA20.1\) in grapevines and heterologous systems, such as \(E.\) coli (\(Escherichia\) coli) and \(Xenopus\) laevis oocytes.

Techniques/Skills Learnt:
- RNA extraction and cDNA synthesis
- PCR and quantitative real-time PCR
- Confocal laser scanning microscope
- Non-invasive microelectrode ion flux estimation technique (MIFE)
- Data analysis, literature review and scientific writing

Key References:


Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact matthew.gilliham@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Honours Project Title: Improving drought and salt tolerance of wheat

Supervisor(s): Dr Allison Pearson, Prof Matthew Gilliham, Assoc. Prof Stuart Roy

Supervisor(s) Webpage(s):
https://researchers.adelaide.edu.au/profile/stuart.roy
https://researchers.adelaide.edu.au/profile/matthew.gilliham
https://researchers.adelaide.edu.au/profile/allison.pearson

Brief Project Outline: Losses in profit due to reductions of yield to salinity is estimated to be $1.3 billion annually, a loss of 18% in potential revenue. By 2050 the area of Australian agricultural land classified as saline is likely to triple and new data suggests that transient salinity may already affect up to 50% of South Australian farms. Bread wheat is moderately salt tolerant, using exclusion of sodium ($\text{Na}^+$) from the shoot as one of its mechanisms of tolerance. However wheat yields are still significantly reduced when grown on saline soils. Barley, is considered the most salt tolerant cereal crop, accumulating up to 10 times more shoot $\text{Na}^+$ than bread wheat. If barley tolerance mechanisms can be introduced into bread wheat it should improve wheat yield in the Australian environment.

Our laboratory has identified a bread wheat accession with barley levels of salt tolerance. This wheat has altered $\text{Na}^+$ transport into and out of the plant and can accumulate larger quantities of $\text{Na}^+$ in its leaves when compared to conventional Australian wheat. Characterisation of the plants water use efficiency under saline and control conditions will enable us to determine which genotypes are best able to maintain water use under this stress. It is envisioned that this project will help to determine what regions of the wheat genome are responsible to the water use efficiency of the plant. This information will be used for future fine mapping and crossing into elite Australian wheat cultivars for growers.

Techniques/Skills Learnt:

• Set up of a large wheat experiment at The Plant Accelerator®
• Performing measurements using specialised equipment
• Data collection and collation
• Bioinformatics analysis to identify candidate genes in wheat
• Genotyping and phenotyping of wheat accessions
• Quantitative trait loci analysis

Key References:
Roy et al. 2014 Current Opinion in Biotechnology 26: 115-124

Want to know more? Then contact allison.pearson@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can have a chat about the project in more detail.
Soil Science

Soils are complex media that support plant growth by supplying nutrients and water. They are critical for sustainability of agricultural and natural ecosystems. By applying expertise in soil chemistry (fertilisers, contaminants, soil carbon), soil physics (soil structure and water availability) and soil biology (nutrient cycling, roots and rhizosphere, mycorrhizae), we conduct research that improves understanding of soil processes and functions, leading to improved methods for soil management.

More information and potential supervisors at:

http://agwine.adelaide.edu.au/research/soil-science/
Honours Projects:
I offer potential projects in the following areas:

- Nutrient cycling and soil respiration as affected by
  - Low soil water content and rewetting of dry soils
  - Amendment with different organic materials alone or in combination with inorganic N and P
  - Elevated soil temperature

Supervisor: Petra Marschner

Supervisor Webpage: https://researchers.adelaide.edu.au/profile/petra.marschner

Brief Project Outline:
Microbial activity and nutrient cycling are known to be influenced by soil temperature and water content as well as organic amendments, but many details are yet to be discovered. In an Honours project you could for example investigate how microbial activity and nutrient availability are influenced by changes in water content or exposure to high temperature as it may occur in fires or on sunny summer days. You could also study how a combination of inorganic fertiliser and organic amendments influences crop growth and nutrient uptake.

Techniques/Skills Learnt:
- Soil respiration with infrared gas analyser
- Extraction and determination of available nutrients and nutrients in the microbial biomass
- Presentation and discussion of data

Key References:

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit.

Want to know more? Then contact petra.marschner@adelaide.edu.au with the subject heading ‘Honours Project’, so that we can discuss a potential project in more detail.
Honours Project Title: Shoots or roots - which controls plant-fungal interactions?

Supervisor(s): Dr Stephanie Watts-Williams

Supervisor(s) Webpage(s): https://mycorrhizalresearch.com/

Brief Project Outline:
Arbuscular mycorrhizal fungi (AMF) colonise the roots of >80% of plants, and proliferate external hyphae into the rhizosphere and beyond, maximising the volume of soil explored by the fungal hyphae for inorganic nutrients. This relationship between plants and fungus can significantly improve the growth and nutrition of the host plant; the benefits to plant nutrition from AMF are highest in soils depleted of these nutrients. We know that plants can selectively control the entry of friendly fungi such as the AMF while excluding other pathogenic fungi. However, the plant tissue responsible for controlling these colonization signals is not known. Here, we will use plant grafting as a technique to test if the control for these colonization signals comes from the roots, or are driven by long-distance signals derived from the shoots. By grafting wild-type and mutant non-mycorrhizal plant genotypes together, we can look at the effects of modified shoot-root signalling on phenotypes such as plant growth and nutrition, expression of genes, and amount of fungus found in the roots. Ultimately, the aim of this project is to dissect the origin of signals that affect AMF colonisation, and be able to answer the question: Is it the shoots? Or the roots?

Techniques/Skills Learnt:
- Propagation of seedlings under aseptic conditions
- Root/shoot grafting of plants
- Preparation of inoculation and soil treatments
- Harvesting of plants
- Growth, nutrition and mycorrhizal colonisation phenotyping
- RNA extraction and DNase treatment
- cDNA synthesis
- PCR and gel electrophoresis
- Primer designing and optimisation
- Data analysis

Scholarship Available: Yes *
* Scholarships are competitive and are awarded principally on academic merit. Want to know more? Then contact stephanie.watts-williams@adelaide.edu.au with the subject heading 'Honours Project', so that we can have a chat about the project in more detail.
Viticulture & Horticulture

*Our research in viticulture addresses:*
- physiology, nutrition, water relations, stress tolerance and management of grapevines
- water relations, nutrition and chemistry of grape berries, and
- vineyard technologies.

*Our horticultural research includes:*
- genetic improvement of almond and ornamental eucalypts, and
- insect pollination of horticultural crops.

*More information and potential supervisors at:*
Currently there are no projects listed. However, if you are interested in this area, please look at the website in the link in the previous page, and contact potential supervisors whose areas of research are of interest to you.
Wine Science

Our wine science research is aimed at understanding the wine-making process and how it can be manipulated to improve the quality of wines. Our research extends over the whole of the grape and wine value chain.

More information and potential supervisors at:

http://agwine.adelaide.edu.au/research/wine-science/
Honours Project Title: Influence of immersive virtual reality on consumers’ perception of wines.
Supervisor(s): Associate Professor Sue Bastian and Dr Lukas Danner

Web pages: https://researchers.adelaide.edu.au/profile/sue.bastian
https://researchers.adelaide.edu.au/profile/lukas.danner

Brief Project Outline: Understanding consumers’ perceptions and liking of wines is of paramount interest to the Australian and global wine industries. Wine consumer liking knowledge alone does not provide the deepest consumer insights and current consumer research also examines the consumer’s emotional response to food and beverages. We already collect data on consumers wine flavour preferences, but the way this is conducted is normally in white, sterile and unengaging sensory labs which do not reflect the real world i.e. the environment in which we would normally consume wine. For collection of consumer data, a number of alternatives to the sensory lab have been proposed to enhance the ecological validity of the data obtained. One of these is with the use of novel digital technologies such as virtual reality (VR). In contrast to a real setting e.g. consuming wine at a restaurant or at a BBQ, VR permits the experimenter to exert some control over the testing conditions while providing a more realistic consumption moment setting experience for the consumer. However, does the use of immersive technology, namely VR, impact the consumer preferences for and emotional responses to wine? Does it also influence their perception of wine aromas, tastes and flavours? This project seeks to examine the impact of immersive VR on consumer perceptions of wine aroma and flavour using a rapid, wine sensory profiling methodology, Rate-All-That-Apply (RATA), in the computerised sensory lab. It also aims to examine the influence of immersive VR on consumers’ preferences for wines using affective tests such as hedonic scaling and emotional responses using the Australian Wine Evoked Emotions Lexicon (AWEEL).

Techniques and skills learnt:

- Experimental design and working with human subjects
- Good sensory science practice
- Conduct of state of the art consumer and sensory test methods
- Analyses of consumer and sensory data
- Use of cutting edge virtual reality equipment and sensory science software
- Basic wine chemistry

Key references:


Honours Project Title: Examining perceived wine complexity and how it impacts consumer preference.

Supervisor(s): Associate Professor Sue Bastian, Dr Lukas Danner, Associate Professor David Jeffery and Dr Trent Johnson

Web pages: https://researchers.adelaide.edu.au/profile/sue.bastian
https://researchers.adelaide.edu.au/profile/lukas.danner
https://researchers.adelaide.edu.au/profile/trent.johnson
https://researchers.adelaide.edu.au/profile/david.jeffery

Brief Project Outline: Deep wine consumer insights are essential to enable the wine industry to produce wines that consumers desire and will purchase. It is generally accepted that wine complexity is a driver of wine quality. Some studies have indicated that wine consumers who display more fine wine behaviour, such as higher wine involvement and knowledge, tend to favour more complex wines. However, our understanding of the drivers of wine complexity is lacking and what the consumer understands about wine complexity is still not known. This project aims to examine methods suitable to assess complexity of wines and collate a range of wines varying in perceived complexity. Wine consumers will be recruited to evaluate the wines and provide hedonic (liking) and emotional responses as well as complete a questionnaire gathering their demographic (gender, age etc.) and psychographic (e.g. opinions, interests) data as well as determine their opinions and understanding specifically about wine complexity. Segmentation of the consumers based on the Fine Wine Instrument (FWI) will examine if fine wine behaviour is linked to consumer response to wine complexity and examine how opinions about wine complexity differ between FWI segments.

Techniques and skills learnt:

- Experimental design and working with human subjects
- Good sensory science practice
- Conduct of state of the art consumer and sensory test methods
- Understanding of market segmentation
- Analyses of consumer and sensory data
- Basic wine chemistry

