Sydney Institute of Agriculture

Georgika

Image courtesy of Stephen Cattle - Nowley farm, near Spring Ridge NSW

Edition 8, June 2022

Georgika

Georgika - an online newsletter for those interested in academic aspects of the Ag sector

From the Director

Brent Kaiser

Welcome to this issue of Georgika. June is a special time for the Sydney Institute of Agriculture as we host our annual RD Watt Lecture in the Great Hall at the Camperdown campus. RD Watt is a celebration of the first lecture in Agriculture at the University of Sydney, delivered over 100 years ago by Professor and Dean of Agriculture, Sir Robert Dickie Watt. This is a great event that welcomes back alumni and guests alongside current members of the University community to hear talks and discourse from a distinguished group of USYD graduates on their significant achievements since graduating from the University. Next Thursday's event is themed 'Food Safety and Security: Australia and Beyond.' This is a critical area of research and training that is necessary to secure both Australia's domestic food supplies and the country's opportunities for global food exports. The University has shown leadership in this area and committed significant capacity that is delivering outputs in food-focussed research and development with impact to both industry and the community. I look forward to seeing you next week, hopefully to share some wine and canapes, and celebrate the University's achievements in this important area.

Events

Annual RD Watt Lecture

Topic: Food Safety and Security: Australia and Beyond

Date: 6.00pm to 8.30pm Thursday 16 June, 2022

Venue: The Great Hall, Science Road, University of Sydney

RSVP: By Friday 10 June, 2022. Although there is no charge to attend this event, registration is essential. Click on the link below for speaker information and to register.

REGISTER

Theme Leader Updates

Plant Breeding and Production

Richard Trethowan

Cereal Rust Research Program Update by Robert Park

The cereal rust research program at the Plant Breeding Institute Cobbitty continues a 100-year research effort targeting genetic solutions to controlling these damaging diseases. The research program spans 9 different rust pathogens that attack wheat, barley, oat, triticale and/ or cereal rye.

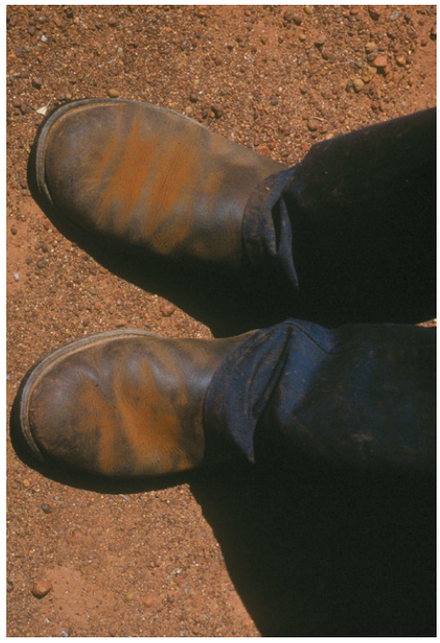
The work was initiated by Professor Walter Waterhouse, who was appointed as a Lecturer in Plant Pathology, Genetics and Plant Breeding by the University in 1921. Waterhouse initiated studies of the actual fungal rust pathogens themselves, identifying what plant pathologists refer to as “pathotypes”. The emergence and spread of these pathogenic variants (syn. strains, races) within the rust pathogens of cereals show very strong parallels with recent experiences with the Covid19 pandemic. As the Covid19 coronavirus has built up in populations, new strains have emerged via the random process of mutation. Rusts do exactly the same thing.

The first rust sample Waterhouse received for pathotype was collected from Hawkesbury Agriculture College in May 1921; it was a sample of stem rust that he identified as race “43”- which we now know would have been virulent on the stem rust resistance genes Sr5 and Sr21. This was one of six pathotypes of the wheat stem rust pathogen that he found. He used these to artificially infect wheat lines to find those that were resistant and could be used in resistance breeding. Interestingly, these original six races were over-ran by a new pathotype of presumed exotic origin that Waterhouse detected in 1925. This new pathotype,”126”, became dominant across Australia from 1929, after which the old pathotypes were no longer detected. Race 126 has not been detected since 1969, but a viable isolate of it is still maintained and used in our rust research at the University of Sydney.

Cereal rust pathogenicity surveys at the University since they began in 1921 have documented a further 14 invasions of exotic wheat rust isolates, two barley rust isolates, and a probable three oat rust isolates. Many of these incursions have resulted in losses and added costs to the grains industry in the order of tens of millions of dollars.

While stem rust and leaf rust of wheat have been present in Australia since at least the earliest attempts to grow wheat here, stripe rust was not detected until 1979 when it is believed it was inadvertently brought here from Europe on contaminated clothing or the like. A second stripe rust incursion was detected in 2002, into WA. In this case, the presumed origin of the new “WA” pathotype group was North America. Significantly, our work has recently confirmed two additional incursions of wheat stripe rust, one first detected in 2017 and the other in 2018, both in eastern Australia. These two pathotypes caused widespread and damaging epidemics of stripe rust in eastern Australia in 2020 and in 2021.

Stripe rust of wheat



Stripe rust spores on clothing. Rust spores readily stick to clothing, and will survive for up to 2-3 weeks.

The 2017 incursion, pathotype 239 E237 A- 17+ 33+: We now know that this stripe rust pathotype originated from Europe. It was first detected in samples of stripe rust infected wheat collected from Victoria in November 2017. Although it was not detected in 2018 and only a single isolate was identified in 2019 (from Victoria), 15 isolates were recovered in the 2020 season from widespread locations throughout NSW. Using DNA “fingerprinting”, we were able to determine that this pathotype belonged to a family of stripe rust pathotypes known as the PstS10 group. This is the most common group of wheat stripe rust pathotypes in Europe at present, strongly implicating this region as the origin of this pathotype.

The 2018 incursion, pathotype 198 E16 A+ J+ T+ 17+: This stripe rust pathotype was first detected near Wagga Wagga in late-August 2018 and was subsequently isolated from Victoria and Tasmania that year. In 2019, it was isolated from throughout eastern Australia, where it was the most common pathotype of the wheat stripe rust pathogen. In 2020 it was once again the dominant stripe rust pathotype in eastern Australia (67% of all isolates processed), being isolated from all eastern mainland states. DNA fingerprinting has identified that this pathotype belongs to the PstS13 group. Like the PstS10 group, the PstS13 group is also common in Europe at present where it is principally associated with triticale. It has caused total crop failure in organically grown triticale there, and was responsible for severe stripe rust epidemics on durum and bread wheat in Italy in 2017. Significantly, this pathotype was introduced into South America around 2016, where it caused severe stripe rust epidemics on over 3 million hectares of wheat in Argentina in the 2016/17 and 2017/18 cropping seasons. Many growers there applied fungicides but were unable to control the disease and suffered significant economic losses. Yield losses of between 53 and 70% were recorded in the seven most susceptible varieties being grown.

The confirmation of two further incursions of the wheat stripe rust pathogen brings to four the number documented since this disease was first detected in Australia in 1979. The evidence available implicates Europe as the source of three of these incursions (1979, 2017 and 2018) and North America as the source of the other one (2002). This continues the trend that has emerged from our long-term pathogenicity surveys of cereal rusts of an increasing frequency of exotic incursions with time, presumably associated with increased international movement of people and inadvertent transport of rust spores on contaminated clothing.

Read further about Plant Breeding and Production

Carbon, Water and Soil

Federico Maggi

After decades of overlooking climatic changes that scientists and researchers all over the world were indicating, it appears that we are finally ready to take action. Australia, maybe slightly later than other countries, is now the hotspot of a number of initiatives expected to stimulate reduction in emissions via a number of carbon neutral investments. It is challenging because we globally must drop 7.6% emissions every year from 2020 to 2030 to keep the temperature increase below 1.5oC, and Australia is still not doing that well in Environmental Performance Index, ranking 87th worldwide – and meaning we should drop even more on an annual basis (https://epi.yale.edu/epi-country-report/AUS).

The Australian government and NSW have made commitments to become carbon neutral by 2050 and halve emissions by 2030. Research to achieve these targets is crucial and certainly there is just no one simple solution, but the Australian government targets soil carbon as part of the solution for climate change remediation. Yes, I think we in CWS are fully equipped to drive change and contribute to the government targets. As some may know, SIA's members have recently been successful with three big projects funded through the Soil Science Challenge scheme (https://www.sydney.edu.au/science/news-and-events/unpublished/sydney-soil-scientists-receive-5-million-dollar-federal-grant.html), totaling $5.6M to develop new knowledge in support of productivity, profitability and climate resilience for Australian farmers.

Soil-plant nexus to maximise organic carbon sequestration in the soil (Prof. Balwant Singh, A/Prof. Feike Dijkstra and A/Prof. Charles Warren)

In this project we will investigate plant-soil interactions to maximise soil organic carbon sequestration. Our project focusses on a key knowledge gap that currently limits our understanding of how organic matter (OM) is stabilised. We will use novel experimental methods to directly address for the first time the combined and interactive roles of plants, microbes and mineralogy in OM stabilisation in the soil.

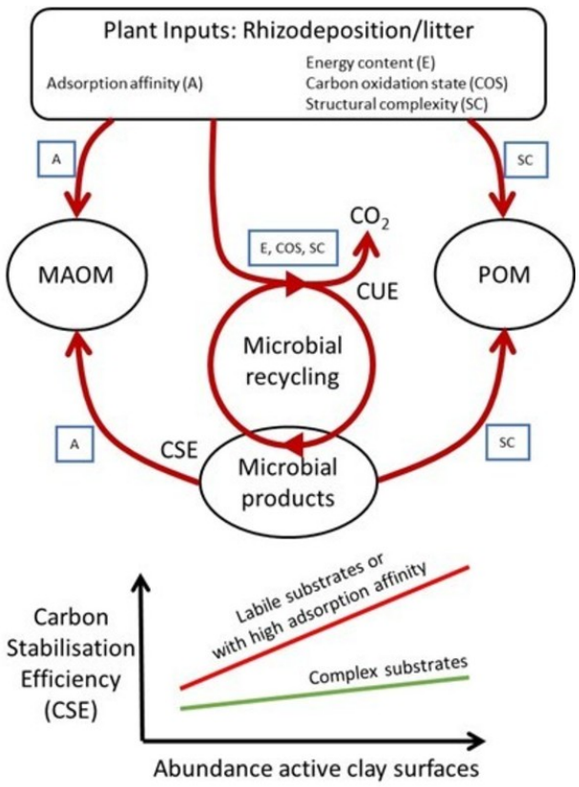


Figure 1. From: Md.Rumainul Islam, BalwantSingh, Feike A. Dijkstra. In revision. Stabilisation ofsoil organic matter:interactions between clay and microbes. Biogeochemistry.

Mounting evidence shows strong plant-soil interactions on the formation of mineral associated organic matter (MAOM) and long-term C stabilisation in the soil. Indeed, MAOM is now considered as the most important mechanism to preserve C in the soil. However, this stabilisation depends on many factors, including the quantity and type of root exudates and litter produced by different plant species, the efficiency by which plant compounds are turned into microbial products, and the strength by which these products are bound to different types of soil minerals (Fig. 1). Our project specifically targets key crop/pastures species and soil types that are unique to Australian conditions in order to maximise long-term C storage and sustainable delivery of soil ecosystem services. We adopt a novel, holistic and multidimensional approach that considers soil-plant nexus to increase OM sequestration in soils.

High-resolution evaluation and monitoring of soil change for the Australian continent (Prof. Budiman Minasny, Prof Alex McBratney, Dr. Mercedes Roman-Dobarco and Dr. Alexandre Wadoux)

This project is a collaborative study between Sydney University with CSIRO (Brendan Malone, Uta Stockmann, Di He and Enli Wang).

In this project, we aim to evaluate how soil has changed in Australia due to human impact, particularly due to intensive agriculture. We know there has been considerable, sometimes catastrophic soil change, but we have not quantified how significant that change has been.

Assessing how much soil has changed is challenging as soil varies according to the factors of soil formation. To address this challenge, we recently have developed a new approach to modelling and mapping soil landscapes by stratifying them into unique soil entities of homogeneous soil-forming factors called pedogenons. Within a pedogenon, we differentiate soils that have been less affected by human activities and soils that have been intensively affected by humans, called pedophenons.

Mercedes Román Dobarco led the development of the approach for identifying pedogenons and assessing changes in soil conditions caused by anthropogenic activities. She has applied the pedogenon mapping in NSW, resulting in pedogenon classes that explain 40% of variation in stable soil properties (e.g. texture). She also derived over 5000 pedophenons units in NSW under grazing and cropping. Comparing these pedophenons under agricultural influences and pedogenons that are still under natural vegetation, we detect trends of soil acidification and organic carbon (OC) losses in topsoils.

At a finer, more regional scale in the Edgeroi area, PhD student Jay Jang demonstrated that the pedogenon classes are unique. His work showed that over a hundred years of intensive agriculture resulted in an average of 50% decrease in topsoil organic carbon.

Based on these research studies, with new ~$2M funding from DAWE National Soil Strategy we will now upscale the approach to the whole Australian continent. First, we will develop pedogenons across Australia using scalable machine-learning techniques (backed by soil science knowledge) based on a set of quantitative state variables representing the soil-forming agents (climate, organisms, relief, parent material, time) for a particular reference time. The underlying assumption is that these classes result from millennial natural soil formation processes and historic anthropedogenesis (i.e., soil formation processes modified by human activities) and hence would have developed similar soil properties. In the next stage, information on human forcings since the time chosen as benchmark (drivers of contemporary soil change) will be incorporated to stratify these soil-landscape classes into subclasses with varying degrees of human pressure. We will validate these maps based on existing soil data from the comprehensive survey studies conducted by Sydney University and CSIRO over the past 20 years. In addition, we will design a new sampling strategy to collect new data where we have knowledge gaps. The team at CSIRO will perform simulations of crop production, resource use efficiency, soil OC dynamics, pH, nutrient balances, GHG emissions etc. in Australian agroecosystems. This will allow the quantification the economic and environmental value of key pedogenons across agro-ecological regions.

This project will ultimately evaluate the best way to manage soils to regenerate them, customized to the soil-climate-landscape setting they are situated.

Revealing the soil viral diversity of the Australian continent (Prof. Budiman Minasny, Prof. Edward Holmes, and Prof Alex McBratney)

Like any great project, it began with an informal chat. Eddie Holmes, world-renown virologist (called the virus hunter) located on the 4th floor of the Biomedical Building at South Eveleigh, mentioned (during an APD interview) that he was working with colleagues in China on viruses in soil. I said that we have been working on soil microbe distribution in NSW, so I suggested that we do something together.

The first opportunity arose last year when SOLES announced its collaborative seed funding, we (Budiman Minasny, Eddie Holmes and Alex McBratney) were funded last December to conduct a preliminary study. And when the Soil Science Challenge was announced In January this year, we were well prepared.

Viruses are the most abundant organisms on earth, ranging from below detection limits in hot deserts to over 10^10 per gram of soil in wetlands. They are responsible for some of the most important diseases of humans, animals and plants. However, viruses play a crucial role in regulating ecosystems by shaping the diversity and abundance of their hosts, including both prokaryotes and eukaryotes. Soil, a complex biomaterial, provides habitat for viruses which in turn serve as a regulator of biogeochemical cycles. Soil viruses infect other microorganisms and, hence, have a huge impact on their hosts' activity and genetic diversity. For example, virus infection could lead to microbial death and release available carbon and nutrients, enhancing biogeochemical cycles.

To date, however, very little information is available on soil viruses, with limited studies of those viruses likely to be associated with bacteria, fungal and protozoal hosts. The few studies have tantalisingly revealed that soil viruses are highly abundant, hugely diverse, derived from multiple sources and may differ in composition according to the local environment (e.g., virus composition will likely differ between woodlands and grasslands). Despite this, we have no clear idea of how viruses might impact the functioning of soil ecosystems crucial to the sustainability of agriculture and the environment. Are they key or not? We don't know.

This is because viruses in soil are difficult to measure. However with the development of virus-separation-from-soil techniques and the metagenomic sequencing of viral genomes, biologists now have the tools to provide detailed studies of viruses in soil. A recent study by Eddie and colleagues in China revealed more than 2,500 novel and diverse RNA viruses from a wide variety of environments, including soil systems. To date, no work has been done on soil viruses in Australia. Our recent work on soil microbiome diversity maps for NSW revealed that soil bacteria and fungi were driven by soil chemistry (pH and CEC) and soil temperature (Pino et al., 2019). Most interestingly, the spatial microbial patterns parallel soil class distributions: for example Vertosols are naturally less microbially diverse. Furthermore, cultivated soils had lower richness due to a decrease in rare microbes, potentially compromising soil functions and ecosystem services over time (Xue et al., 2018). As viruses use bacteria and fungi as hosts, we hypothesise that the soil virome would be controlled by soil types as well.

So in this project, for the first time, we will determine the factors that shape the diversity and abundance of soil viruses in Australia and reveal how these viruses respond to an extensive suite of soil conditions (soil complexity, heterogeneity, diversity). Ultimately, the outcome will provide key data on how we can sustainably manage soil ecosystem functioning. We hope to assess viruses at 500 locations across the continent. So a lot of travelling and sampling to do.

Net Zero Initiative of the University of Sydney

Along with successful research at SIA, meeting the carbon emission reduction is focal to the entire University of Sydney, with the Faculty of Engineering taking a leadership in coordinating and proposing research projects and initiatives toward the Net Zero.

Read further about Carbon, Water and Soil

Digital Agriculture

Tom Bishop

On 7th April the new road map for National Research Infrastructure (NRI) was released.

Current status of national research infrastructure

The national collaborative research infrastructure strategy (NCRIS) currently funds a number of facilities of relevance to digital agriculture:

Terrestrial Ecosystems Research Network (TERN) which as part of its remit facilitates access to and development of continental datasets useful for agriculture such as the Soil Landscape Grid of Australia, fractional cover datasets.

Australian Plant Phenomics Facility (APPF) which as part of its capabilities the field-based sensing of plants with remote and proximal sensing platform.

In addition to these we have domain agnostic facilities:

National Computing Infrastructure (NCI) which facilitates access to high performance computing which is becoming increasingly important for agricultural researchers who generate large amounts of data through sensing and wish to use machine learning to gain insights from such data.

Australia Research Data Commons (ARDC) which focuses on research data infrastructure which includes supporting the development of platforms so researchers have access to domain-specific analysis pipelines. Of relevance is AgReFed (https://www.agrefed.org.au/) which is funded by ARDC to develop the concept of FAIR (findable, accessible, interoperable, reusable) data for agriculture but is now also developing analytical pipelines for agricultural research. We (University of Sydney) are part of this work.

On face value, gaps in NCRIS facilities are that APPF focuses on plants so there is a lack of support for development of capability in field sensing of animals and plants. Furthermore, APPF is dominated by lab and plot-scale research and TERN is more focused on natural landscapes. The clear gap is capability for paddock to farm scale research across soil, plants and animals for improved decision making.

One of the main recommendations from the road map is to focus much of the NRI investment on 8 challenges; one of which is Food and Beverage.

Food and Beverage – Our success is underpinned by our international reputation for premium, safe and high-quality food and beverage products, strong production capabilities, research expertise and market proximity

This is alongside challenges related to Medicine and Defence, so it is pleasing to see Agriculture is up in lights with other heavy hitters in terms of research and general societal interest. It is also pleasing to see the entire supply chain is considered here which is part of the vision for SIA.

Opportunities specific to Digital Agriculture are an interest in developing open source national agriculture data infrastructure which bodes well for AgReFed of which we (University of Sydney) are a member. It is also a possible funding stream for the sensing and analytics infrastructure on our university farms. I can imagine a future where there is as a Digital Agriculture research network of instrumented farms – the ones owned by universities and government agencies - where data is shared. There is also an emphasis on earth observation in terms of developing capability and capacity for researchers.

Beyond the challenges targeting specific domains there are number of areas identified for support that cut across all national research infrastructure. One of relevance is software analysis tools and platforms which is a strength at the University of Sydney especially when applied to soil and cropping. Overall, the Road Map is very promising for an increased support of national research infrastructure of relevance to Agriculture. It is a great time to be an agricultural researcher, the best in my working life.

Read further about Digital Agriculture

Animal Agriculture

Cameron Clark

I have been fortunate enough to be away from my desk and talking with farmers from across the country since my last update. Whilst there remains a focus on recovery for many coastal regions, others are in a peachy spot with words like "... not since the 1950s…" spoken.

Despite this optimism there were significant challenges raised, and associated opportunities, for us in animal agriculture associated with the current conditions. Pink eye and fly strike are prevalent as are issues around drench resistance. But at the top of the list were two words: Labour and goats.

As a university, our engagement with the public and teaching in agriculture are pivotal to such labour pressures and this engagement needs to start earlier. Recently, both Sabrina Lomax and I were invited to speak at Barker College by the head of agriculture, Scott Graham (a USYD ag alumni), to Agriculture HSC students from across the state. As always, engaging with these year 12 students was an excellent opportunity to espouse agriculture and associated career opportunities but from our discussions over lunch, for many, the decision on career had already been made. Changes to the NSW school curriculum requires Agriculture/Food to form 20% of the tech mandatory year 7/8 syllabus for every school student in NSW. It is here that agriculture at the University of Sydney needs to engage in response to our farmers' call, and our farms at the edge of Sydney are a perfect meeting place for such engagement. A partnership between our University and the NSW Government to help our teachers deliver the Ag/Food component of the syllabus appears timely and highly aligned with the broader needs of our producers and food production systems.

Update by Sabrina Lomax

I have recently made the leap to the Northern Farms and am fortunate to have a base out of the IA Watson Grains Research Centre in Narrabri. My current research is focused on sustainable beef production with aims to improve the welfare and productivity of livestock raised in extensive grazing environments. This aligns with industry and community demand for a move toward reducing the environmental impact of our production systems.

The University has over 500 cattle in a commercial beef herd that are located between Spring Ridge's "Nowley" (Breeding) and Narrabri's "Llara" (growing). The 2021 weaner cattle (picture) have recently arrived at Llara to begin their growing journey and will play an important role in grazing management for the Landscape Rehydration and DroughtNet research sites. We are using in-field weigh stations (Optiweigh) to monitor their growth rates across the year which will help us optimise their management.

Our NW farms are multi-functional landscapes that can be used to build collaborative, multi-disciplinary research programs that address the need for an evidence base to develop sustainable agriculture in Australia. We have the opportunity to link our commercial farm practices with our teaching and research programs leveraging our strengths in digital agriculture and the breadth of knowledge across SIA. I am enthusiastic about this developing vision for animal agriculture at The University of Sydney and the role of our Northwest farms.

We recently hosted the NW NSW LLS Prograze soils session at Llara. It was a fantastic opportunity to showcase the diverse landscape of Llara and the importance of soils in a highly productive pasture system.

Nowley 2021 weaners arriving at Llara

Guy Roth shows Prograzeparticipants the production potential of different perennial tropical grasses (in May no less!)

Read further about Animal Agriculture

Development Agriculture

Daniel Tan

Mitigating the effects of stripe rust on wheat production in South Asia and eastern Africa

Robert Park, Karanjeet Sandhu, Davinder Singh and Laura Ziems

This four-year ACIAR funded project involves a partnership with Ethiopia, India, Nepal, and Pakistan to combat stripe (yellow) rust of wheat (YR). It will end on 30 June this year. The aim of this project has been to reduce vulnerability to YR of wheat in partner countries, through research undertaken by a group of scientists working within a collaborative network of key cereal improvement centres.

Wheat provides about 20% of world food. It is the most important source of protein and is second only to rice as a source of calories in the developing world. In the countries targeted in this project, wheat provides between 13 and 37% of daily calories in 2011.

While three different rust species infect wheat and impact on wheat production, YR has been the most damaging globally over the past 40 years. A recent study published in Nature Plants (Beddow et al. DOI: 10.1038/NPLANTS.2015.132.) estimated that globally, YR was responsible for annual losses of about 5.47 million tonnes of wheat grain (US$979 million), with a 90% chance of at least 4.70 million tonnes (US$842 million) being lost.

YR has caused devastating epidemics in wheat and barley crops in all project partner countries. It has been especially problematic in Ethiopia; a severe epidemic in 2010 affected over 400,000 hectares across three regions (Oromya, SNNPR, Amhara). Although the Ethiopian Government distributed fungicides worth about 53 million Birr (AUD $2.5 million) on credit to farmers, severe losses followed and about 500,000 households were affected. The disease is also problematic in Australia, where it was first detected in 1979. Up to $90 million has been spent annually on fungicidal control of YR in Australian wheat crops since then.

Breeding for resistance to YR in wheat has increasingly focused on minor (adult plant) resistance genes over the past 20 years. This trend has been apparent in many parts of the world in which YR is problematic and is based on the assumption that minor genes are more durable than the major (seedling) genes that have been used in the past. Studies of stem rust and stripe rust have however clearly established that slow rusting (incomplete/partial) resistance can be race-specific. Similar findings have come from Australian studies, which have shown at least two minor resistance genes being overcome by YR.

A principal underlying research theme of the project has therefore been a critical appraisal of the effectiveness of known and unknown minor gene resistance to YR across different regions. The project objectives were designed to address this theme: characterize resistance to YR in germplasm in partner countries; validate minor resistance gene combinations and refine linked markers; train key personnel from partner countries in rust pathology and genetics.

Assessing the effectiveness of minor gene resistance to YR in different regions

A set of 250 wheat lines (50 from each partner country) carrying minor gene resistance to YR was identified by integrated greenhouse and field testing at the Plant Breeding Institute. This “core” set was comprehensively characterised for major (seedling) resistance to YR in greenhouse tests and genotyped using markers for important minor gene resistances. Over the past 4 years of the project, it has been tested against naturally occurring YR inoculum in all partner countries, providing a rich data set that allowed us to identify 50 lines (Australia (7), Ethiopia (8), India (17), Nepal (10) and Pakistan (8)) that carry uncharacterized (i.e. new) minor gene resistance that was highly effective across all field sites. The core set has been genotyped using the 90Kiselect wheat SNP chip. Combined genome wide association mapping analyses (GWAS) of the extensive data set has so far revealed the presence of genomic regions associated with these resistances on chromosomes 2A, 3A, 5A, 6A, 7A, 1B, 2B, 4B, 5B and 7B.

Nested Association Mapping (NAM) Population

Nested Association Mapping (NAM) allows the dissection of complex traits. We developed a BC1F5 NAM population of 1,466 individuals based on 6 elite minor gene donors and 4 reference cultivars selected to represent each of the partner countries. The population was developed to allow the identification of markers linked to important minor genes conferring resistance to YR to facilitate their use in pre-emptive breeding. It also provided a resource for project partners to select the most promising lines from the NAM population for use in local wheat breeding programs.

The population was intensively phenotyped in the greenhouse and field at PBI and assessed in the field by all project partners who also made selections of the best performing lines for subsequent use in local wheat breeding programs. Final GWAS will be completed in 2022 by incorporating the 2021 field data from Ethiopia and the 2022 data from countries in South Asia. Field rust screening to collect a final data set will be completed in Ethiopia by Dec. 2021 and by May 2022 in SA. This phenotypic data will be used in conjunction with sequencing data to perform GWAS.

Near isogenic (NIL) stocks to assess the effectiveness of minor gene resistance

Many wheat cultivars carry genes conferring minor gene resistance to YR. While genes Yr18 and Yr29 have been characterised precisely and their occurrence in wheat cultivars is well known, genetic studies at the PBI and elsewhere have shown clearly that other uncharacterised minor genes also occur. This makes it difficult to provide precise information to wheat growers of the resistance carried by wheat cultivars, very difficult to make predictions regarding responses and environmental sensitivity of minor gene resistance in cultivars, and impossible to monitor for the possible development of virulence for these genes. Staff at PBI have produced many genetic stocks near isogenic to the Australian wheat genotype Avocet that carry one or two genes for resistance to stripe rust, only two of which (Avocet +Yr18 and Avocet +Yr29) carry minor genes.

This project has developed 5 additional NIL stocks carrying minor gene resistance to YR that can be used to assess the protective value of these resistances individually and in combination. The NIL stocks will also enable greenhouse and field adult plant tests to assess virulence of local YR isolates on minor resistance genes.

Read further about Development Agriculture

Urban Agriculture

Floris Van Ogtrop

Members from Pocket City Farms came to visit our soil labs to discuss potential areas of collaboration and hatched a few potential honours projects such as removing excess phosphorus in soil, cover crops, and pest pressure. They were really impressed with the facilities which showcase our strength in soil research. There was some interesting discussion around the future of soil based urban agriculture and some of the challenges running a farm on crown land, the importance of local government support to sustain these initiatives, and importantly PCF can help promote our research through their extensive network, board members, and media connections

SIA Director Brent Kaiser, Executive Officer Claire Kennedy and I recently visited Greenspace to look at their farm under Darling Park Tower 3 on Sussex Street in Sydney's CBD. Greenspace, have an interesting hub and spoke model where they have a central farm that supplies surrounding restaurants and smaller micro farms. Ideally the micro farms are within walking distance of the macro farm to reduce reliance on fossil fuels used in transport. The macro farm is located in a 6-star greenstar rated building which sources 100% of its energy from renewable sources. This means that the Greenspace is approaching net zero emissions.

Honour student projects in the urban agriculture space:

Life Cycle Analysis (LCA) to compare different metrics such as CO2 equivalents of lettuce production in different production systems.

Collecting food waste from around the Australian Technology Park to set up a simple fermentation system to process the food waste.

Germinating Warragal Greens *Tetragonia tetragonioides*, looking at optimising transplanting to hydroponics systems and whether Warragals are susceptible to common plant pathogens found in hydroponic systems.

Growing tomatoes on "acid whey", a biproduct of yoghurt production.

Planting hydroponic crops to optimise biofortification of zinc, calcium, and iron in several different species including a local mint variety, Warragals, and purslane varieties.

Quality Food

Tom Roberts

In 2019-20, Australia produced $3 billion worth of barley (Australian Bureau of Statistics). Here I will focus on malting, which is a key value-adding process for the Australian barley industry.

Malt is used mainly in beer brewing but also for whisky and as an ingredient (often as malt extract) in many food products, including Milo, Ovaltine, Weet-Bix, malt vinegar, bagels and other baked products.

Malting is the process of steeping, germinating and kilning (drying) cereal grains – most commonly barley but also wheat, rye and others. The profound modification of the grain to produce malt provides essential substrates (sugars and amino acids) for fermentation by yeast in brewing. Malting for beer production also eliminates raw, grassy flavours, as well as creating a diversity of desirable flavour compounds.

Since every brewery (large or small) has specific and strict requirements for the quality of the malt they purchase, there's a lot of science and engineering in both malt production and the physicochemical tests to put together a certificate of analysis for individual lots of malt.

Certificates of analysis give values for physical parameters for the malt kernel and grist, biochemical properties of the malt, and qualities of the wort from standardised "congress mashes", all essential to most breweries.

Malts for beer brewing are typically classified as base malts or speciality malts. The primary difference between base malts is the degree to which they are kilned: pilsner malt < lager malt < pale malt < ale malt < Vienna malt < Munich malt.

The many types of speciality malts are either kilned for longer than base malts, or roasted (wet or dry), and have a much darker colour and intense flavour. Kilning temperature can be up to about 220 °C.

Malt is a stable product that can be shipped to breweries globally. About three-quarters of the roughly one million tonnes of barley malt that Australia produces annually is exported. According to the brewery database at Brewsnews, there are 45 large breweries, 462 medium/small breweries and 60 brewpubs in Australia.

Large malting companies in Australia include Barrett Burston Malting (owned by the multinational company United Malt), Coopers Maltings and MaltEurop. The Joe White Maltings brand, which like Barrett Burston began in the mid-19th century, is owned by the multinational company Boortmalt.

Small Australian maltsters include Voyager Craft Malt (in the Riverina/Murrumbidgee Irrigation area of NSW), House of Malt (in Ballarat, Victoria), Mortlock Malt (in Perth, WA) and Barossa Valley Malt Company (in South Australia).

PhD student, Jake Humphries, is working on a project to brew and compare beers made from triticale (a hybrid of wheat and rye), wheat, rye and barley malts. Jake and I visited the Boortmalt barley malting plant at Minto in south-west Sydney in April. We were given wonderful tours of the factory and labs by staff members. Boortmalt is one of our collaborators for Jake's project, along with University of California, Davis, and the Australian brewer, 4 Pines Brewing Company.

The scale of the highly automated Minto plant is a sight to see. Train loads (80% of the total) and truck loads of barley grain arrive in shipping containers at the site. Sixty tonnes of barley grain are germinated in a four-day process in each of six germination vessels. The kiln to produce the final malt product is enormous, with wind speeds from the giant fans underneath the grain bed so high that you have to hold on to your hard hat when entering the building!

Jake and I came away from our tour with a reinforced view of the enormous potential for increased collaboration between the food and beverage industry and SIA researchers.

Read further about Quality Food

Alumni

Class of 1961 celebrate

Report by Jim Swain

On the 27th April 1961, some 45 graduates received their BSc Agr degree in the Great Hall at the University of Sydney. On the 28th of April 2022, 13 of the Class of 61 graduates accompanied by 4 spouses gathered at the View Hotel in North Sydney to celebrate 61 years since graduating. There should have been 15 but 2 had to withdraw because of illness. One graduate travelled from Darwin to attend the reunion.

The Sydney Institute of Agriculture was represented by Dr Claire Kennedy, Executive Officer, and Jonathan Moore, a PhD student. Claire gave an overview of the activities of the Institute and Jonathan outlined the background to the new degree – BSc – Advanced – (Agriculture).

The Class of 61 thanked Claire and Jonathan for coming to the 61st reunion and for giving us an update on what we knew as the Faculty of Agriculture. We, the Class of 61 graduates believe the reversion to the original degree should be encouraged because of its greater recognition of Agriculture which we feel does not occur with the current degree.

This is the last formal reunion that is planned and follows reunions held after 25 years, 30 years, 40 years, 50 years, 55 years, 58 years and now 61 years. Graduates are encouraged to arrange informal get-togethers wherever possible. All agreed that the course that they undertook had provided them with many opportunities during their working life and would encourage the younger people to undertake such studies.

Class of '61 & Partners Celebrate 61 years Reunion
Faculty of Agriculture University of Sydney
HarbourView Hotel North Sydney 28th April 2022

(L toR) Lawrie Greenup Robin Swain Lawson Lobb John Dillon Joan Dillon (Anderson) Trish Hudson Penny Kirkby (Spencer) Jill Harris Bob Hudson Juliet Clarke (Neild) Dallas Clarke Jim Swain Peter Fogarty Hugh Brownlee Judy Fogarty Kevin Blackburn Nancy Sutherland Image: Graeme Hockey

Lorna Byrne (B.Sc.Agr., 1921) was one of four women who enrolled in the Agricultural degree, and alongside Margaret Brebner was one of the first two women to graduate with an agriculture degree from the University of Sydney. Lorna had an amazing career working as a teacher, an agricultural educator for the NSW government and organiser within the 'women's section' of the NSW agricultural bureau. Lorna was also an extensive public communicator with the ABC where her focus was in supporting rural women in farming communities. This painting of Laura was recently gifted to the Sydney Institute of Agriculture.

News

Alex McBratney was awarded the Ag Institute of Australia Medal of Agriculture, recognising his outstanding contributions to advance agriculture and natural resource management.

Our soil science researchers have received a $5.6 million grant for three projects to improve soil condition and plant productivity as part of the national Soil Science Challenge. The projects will build a new knowldege base to support practices and improve productivity, profitability and climate resilience for Australian farmers. Congratulations to all researchers involved.

PhD candidate Josie Clarke recently won the 2022 Agrifutures Rural Womens Award for NSW/ACT, which supports women's contribution to primary industries and rural communities. Josie founded an online platform, Ability Agriculture, to share stories and create a community for not only rural Australians who have a disability but also carers, family members, health professionals, agribusinesses or anyone with an innovation making agriculture more accessible for those with a disability. The winner of the national award will be announced in September.

Social Media

The Sydney Institute of Agriculture is on Instagram (Sydney_Sia) and we are also on Twitter (Sydney Agriculture). Follow us at the links in the box below.

THE UNIVERSITY OF SYDNEY

Keep in touch

Copyright © The University of Sydney, NSW 2006 Australia
Phone +61 2 4651 9871 ABN 15 211 513 464 CRICOS Number: 00026A

Please add sia.information@sydney.edu.au to your address book or senders safe list to make sure you continue to see our emails in the future.

Manage your preferences | Opt out using TrueRemove®
Got this as a forward? Sign up to receive our future emails.
View this email online.

Disclaimer | Privacy statement | University of Sydney

Subscribe to our email list.