The UWA Institute of Agriculture

Number 32, August 2017

L-R: PROF KADAMBOT SIDDIQUE, DR LARISSA TAYLOR, MR TIM HUNT, MR GREG KIRK, DR TERRY ENRIGHT, MS TRESSLYN WALMSLEY, MR MICK KEOGH, DR JOHN MANNERS AND DR GRAEME ROBERTSON

Consolidation: what does it mean for the agriculture sector?

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More than 200 people from across the agriculture industry, academia and students came together in July for the 11th UWA Institute of Agriculture Industry Forum, to deliberate the worldwide trend of consolidation.

Specifically on the agenda was how consolidation in the agriculture sector impacts the farm, research and agribusiness.

UWA's Vice-Chancellor Professor Dawn Freshwater made the introductory remarks and welcomed Regional Development and Agriculture and Food Minister Alannah MacTiernan to officially open the forum. Minister MacTiernan congratulated UWA on being ranked first in Australia for agriculture science and 14 in the world.

In his keynote address, ACCC Commissioner Mr Mick Keogh said there was an understandable impetus for firms to consolidate.

"Liberalised markets and Australian agriculture's high exposure to export markets means firms are driven to find scale efficiencies that allow them to compete globally," Mr Keogh said. "However, continuous vigilance is needed to prevent industries from becoming uncompetitive."

Mr Keogh also said the digital revolution, in particular the rights over access to data and the purposes it can be used for can limit the potential anti-competitive effects of market consolidation.

Planfarm's managing director Mr Greg Kirk said farming in WA was following the global trend of consolidation and that the demographics of WA's family dominated sector suggest consolidation is here to stay.

Comparing case studies from 1995 and 2015, Mr Kirk showed that in 20 years, farms have become bigger, cropping

area has increased, and a greater operating surplus per farm is being achieved with only a small increase in labour.

Focusing on the research sector, Dr John Manners, CSIRO director of Agriculture and food said the efficiency and scale generated from consolidation will allow new efficiency and productivity technologies to thrive, but that this encourages uniformity not diversity. "It does not promote new higher value consumer food product technologies, particularly if they are disruptive," Dr Manners said.

He said a new way of getting smart R&D ideas into farming is to start small and grow big. "What I mean by that is using the new start-up company mechanism or methodology to test the commercial viability before getting the attention of the larger Ag-Tech companies."

Rabobank's head of Raboresearch food and agriculture Mr Tim Hunt agreed, saying big corporations had a tendency to concentrate on big markets, which creates opportunities for niche markets and start-ups.

The forum closed with a panel discussion, where Grain Industry of WA (GIWA) CEO Larissa Taylor, and InterGrain CEO Tress Walmsley joined the speakers on the panel, facilitated by Dr Graeme Robertson.

The Industry Forum was supported by CSBP Fertilisers through the CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship.

Director's Column

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The below average rainfall has made the 2017 season extremely challenging for the agriculture sector. The recent rains have no doubt been welcomed, but it has been patchy and the final grain production for this year in the State will largely depend upon the spring rainfall. The drought and heat resistance research being conducted at UWA is increasingly important to contribute towards the development of climate resilient crop varieties for the future (see page 4).

In the Shanghai Jiao Tong Academic Ranking of World Universities (ARWU), Agricultural Sciences at UWA jumped ten places to 14th in the world, and 1st in Australia. In previous years, agricultural sciences has been grouped with Biological Science, Human Biological Sciences, and Veterinary Sciences under the Life and Agricultural Sciences Field. This is the first year ARWU has separated the four disciplines, and we are very pleased to be recognised for our strength in agricultural science at UWA.

Eight PhD students from three faculties presented their research at the annual Postgraduate Showcase: Frontiers in Agriculture in June (see page 13). The students did an excellent job at engaging with the industry and I am sure will benefit from the challenge questions they fielded from the audience.

In July we hosted the biggest yet industry forum on Consolidation in Agriculture: impacts to farm, research and agribusiness (see cover story). Minister for Regional Development; Agriculture and Food, Alannah MacTiernan opened the forum and said she was pleased to note members of the three universities, Department of Primary Industries and Regional Development (DPIRD) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in the audience, and emphasised the need for continued collaboration in agriculture between the research organisations. We thank CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship for supporting the event.

Minister MacTiernan is committed to driving development of existing infrastructure in the Ord to maximise its agricultural and horticultural potential. IOA's research theme leaders have been in discussions with leading Ord River Region farmer Christian Bloecker to identify researchable issues affecting the North. IOA can therefore tailor its research activities to meet their needs, across the five research themes; Crops, Roots and Rhizosphere, Sustainable grazing systems, Water for food production, Food quality and human health and Agribusiness ecosystems.

After five years of hard yakka and dedicated service, we bid farewell to UWA Farm Ridgefield farm manager Steven Wainewright. Steven has worked incredibly hard balancing the research component and commercial operations of the farm, and went above and beyond to make sure visitors and short-term residents on the farm were well looked after. On behalf of IOA, I thank Steven for his service and wish him all the best in his future endeavours.

ANIMAL REPRODUCTION STUDENTS LEARN FIRSTHAND ABOUT LAMB SURVIVAL AT UWA FARM RIDGEFIELD.

Animal reproduction students learn firsthand about lamb survival on UWA Farm Ridgefield

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Six animal reproduction students visited UWA Farm Ridgefield in July. For most of them, this was their first visit to rural Australia.

PhD Candidates Umair Hassan and Shamshad-Ul-Hassan from University of Agriculture Faisalabad, Pakistan joined MSc students Amandeep Kaur from India, Nicolas Castro from Argentina, Gereltsetseg Enkhbat from Mongolia and Juan Perez Mato from Venezuela to visit the farm, taking particular note of the water storage project, the new air-seeder that forms the foundation of the ecological cropping project, and the various ecosystem management projects.

Most relevant was the native shrubs been grazed by sheep¬ as well as being a restoration of local native vegetation. These plants help reduce methane emissions, reduce worm burdens, and provide shelter to newborn lambs, thus reducing neonatal mortality.

While the students were watching, Merino ewes carrying multiple lambs were in the process of giving birth, providing an ideal opportunity for the students to learn firsthand about the process of mother-young recognition in sheep, and its importance for lamb survival.

In addition, the students witnessed the effects of the very poor rainfall during the 2017 season, with sheep being fed pellets because of the complete absence of pasture.

"I have learned more in one day than in the past year of my theoretical studies," MSc student, Amandeep Kaur, from Punjab, India said. "I need to see and feel things to gain a real understanding."

UWA Ag Science graduate gains experience at Ridgefield Farm

Mr Cameron Broun
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In January 2017 I began working as the assistant at UWA Farm Ridgefield. Having just graduated from UWA with a degree in Agriculture and Chemistry, I was eager to gain experience in carrying out research.

The first six months in the position have been a rollercoaster learning experience with multiple new projects being launched, continuing work on the pre-existing projects, and day to day management of the farm.

The highlight so far has been the privilege of being the first driver of the farm's new Ausplow DBS D260-36 airseeder (see page 14).

Testing the new tyne components is exciting, not just in its operation but also in the variability observed in the germination from the different tyne setups in one of the worst starts to a growing season on record, and in the wide-ranging landscapes at UWA Farm Ridgefield

Along with the farm's cropping program there has been a substantially larger sheep work component with three major projects (Date Pregnant Ewes; Lambing Density and Lifetime Productivity Project being run alongside the Future Farm 2050 Project goal. As someone with a preference towards cropping this is helping me develop more of a liking for sheep as more of my time is invested in them.

Most importantly I have had the opportunity to meet and work alongside some amazing people. In particular, farm manager Mr Steve Wainewright has been very supportive and at times very tolerant of me. I look forward to continuing in the position and the valuable knowledge I will gain.

FARM ASSISTANT CAMERON BROUN

UWA Law students advise on agricultural IP

Prof Michael Blakeney
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Agriculture has numerous intellectual property (IP) aspects, such as patented seed, protected plant varieties, patented smart faming technologies, and proprietary data bases.

Professor Michael Blakeney, from UWA's Law School and IOA has provided advice on these matters to the Food and Agricultural Organization (FAO), and to the Consultative Group on International Agricultural Research (CGIAR) and a number of its research centres.

In 2016, UWA and the Department of Primary Industries and Regional Development (DPIRD, previously DAFWA) signed a Memorandum of Understanding, in which DPIRD agreed to take ten UWA Law students as interns.

The students are in their third year of study, specialising in IP law. Their role is to advise the DPIRD on the IP aspects of its various agreements.

Prof Blakeney, who is administering the internship program, said the inaugural program which commenced in 2016 was well received by all parties. Ten more students completed more intensive internships at DPIRD in 2017. He expects a number of the interns to pursue local and international careers in agricultural IP.

UWA LAW INTERNS BEING BRIEFED ON DPIRD PROCEDURES.

OLIVE CONDUCTING HER RESEARCH ON DROUGHT RESISTANCE OF WHEAT AT REPRODUCTIVE STAGE.

Drought resistance in wheat

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Water stress is a major factor limiting crop yield in most regions with Mediterranean-type environments, and the growth stage at which plants experience water stress determines the extent of yield limitations.

For the past three years, PhD Candidate Olive Onyemaobi in the School of Agriculture and Environment and IOA, has been working on the genetic analysis of water stress during the reproductive process, the most critical and water sensitive growth phase in wheat.

Her research focuses on studying the effect of water stress during meiosis, which was found to have an irreversible effect on final grain number and thus grain yield at maturity.

In her experiments Olive imposed water stress during meiosis in 46 different wheat cultivars, to examine its effect on the viability of male and female reproductive parts of the plant and grain number at maturity.

It was previously reported that the male part was the most water stress sensitive reproductive structure and a major contributor to low wheat yield while the female parts was regarded as resilient to water stress. However, Olive's experiment identified for the first time that the stressed female reproductive part was also a major contributor to low grain number in wheat varieties.

The result showed that loss of fertility and viability in the female reproductive structures because of water stress during meiosis leading to low grain number and thus lowered grain yield.

Olive's follow up research includes: determining gene actions contributing to the inheritance of seed set under water stress during meiosis; quantitative trait locus (QTL) mapping to identify major QTLs for marker assisted breeding and validation of a major QTL located on wheat chromosome 5AL, contributing to about 50% of the total phenotypic variation.

Olive is currently writing up her research which she plans to submit in September 2017. She is supervised by Prof Guijun Yan, Dr Hui Liu and Prof Kadambot Siddique.

Ag sensing technologies for efficient farm management

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Infrared spectroscopy is finding increasing application in many industries including, pharmaceuticals, defense, and agriculture.

In recent times, multi- and hyper-spectral imaging have arisen as highly potent tools; although the size, weight, and fragile nature of these capabilities, as well as their cost, prevent their practical application on-farm.

With low-cost unmanned aerial vehicle (UAV) platforms increasingly available, there is great potential in implementing multi/hyper-spectral capabilities on a UAV platform on the farm.

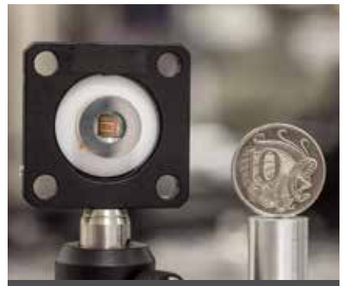
In particular, UAV-based sensing can assist in mapping large areas of farm, and sensing in locations without easy access.

The Advanced Sensing Technologies (AST) group in the Faculty of Engineering and Mathematical Sciences at UWA has strong research activities in micro-electro-mechanical (MEMS) and optical sensing. Of particular significance are the multi and hyper spectral optical sensors being developed for various remote sensing applications.

The focus of this spectral-sensor research is to provide portable multi/hyper-spectral sensing solutions for remote-sensing application, which may be deployed on hand-held, ground-vehicle-based, and UAV platforms. The MEMS spectral sensing technologies developed at the AST group are light-weight, small, robust, and can be built at a fraction of the cost of conventional spectrometers.

The agricultural sensing activities of the AST group are now investigating the use of these MEMS multi/hyper-spectral sensors, as well as other optical sensing modalities, for practical and low-cost sensing solutions on-farm.

In conjunction with IOA, the AST group aims to develop a host of agricultural sensing technologies for efficient farm management. These technologies stand to optimise resource use, minimise environmental impact, and maximise the uniformity, quality, and yield of entire crops.



A PACKAGED MEMS-BASED SPECTROMETER DEVELOPED BY THE AST GROUP

UWA students receive the Agribusiness Connect Honours/ Masters Research Project Scholarship

Two students studying agriculture at UWA have been awarded the Agribusiness Connect Honours/Masters Research Project Scholarship from the WA State Government's Office of Science.

Mr Andrew Henson from the UWA School of Agriculture and Environment and Mr Simon Jankowski from the School of Earth Sciences received the $10,000 scholarship through the Science and Agribusiness Connect (SAC) initiative.

The SAC initiative which has been made possible by the State Government's Royalties for Regions program, aims to build the capability of the agriculture science sector in WA, improve agriculture practices, and develop WA's research excellence in agriculture science. The funds can be used to support living expenses and project operating costs.

Andrew is completing Honours in Agricultural Science and is researching farmer willingness to pay for a range of grower group services. He is supervised by Dr Abbie Rogers, Assoc/Prof Michael Burton and Dr Fiona Gibson in the UWA School of Agriculture and Environment and IOA.

Simon is completing a Master of Hydrogeology and is assessing borefield extraction designs for irrigated agriculture in the La Grange groundwater area. He is supervised by Dr Sarah Bourke, Adjunct Professor Don MacFarlane and Dr Adam Siade (CSIRO) in the School of Earth Sciences and IOA.

Both students are required to present their research at a seminar series to be held both on campus at UWA and in regional WA at the end of the project. The participating industry partners and wider industry groups and stakeholders will be invited to attend.

SCHOLARSHIP RECIPIENTS SIMON (LEFT) AND ANDREW (RIGHT).

INTERNATIONAL AGRICULTURE: RESEARCH & DEVELOPMENT TRAINING AT UWA

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SOME OF THE STUDENTS IN THE UWA MASTER OF AGRICULTURAL SCIENCE, DURING A BREAK IN THE STUDENT PRESENTATION WORKSHOP FOR THE UNIT 'INTERNATIONAL AGRICULTURE: RESEARCH AND DEVELOPMENT'

Interest in UWA's Master of Agricultural Science has been high, both from domestic and international students.

This year, 29 students from 14 countries enrolled in the course in Semester 1. These students have a wide range of valuable experiences, from recent graduates to those having had several years of work in various roles in industry, science or education. A similar number of students are expected to commence in Semester 2, 2017.

Diversity in student interests is met by four specialisations: Agricultural Economics, Crop and Livestock Farming Systems, Genetics and Breeding, Soil Science and Plant Nutrition; with topics as options also within each specialisation. The diversity in student background, experience and interests, provides a rich teaching and learning environment.

In 2017, a new core unit 'International Agriculture: Research and Development' was introduced in the Master of Agricultural Science. It has further enhanced training in the analysis of agricultural systems, the impact of research, research adoption, teamwork, and scientific communication.

As part of the unit, students work in teams of three to examine an agricultural system of their choice from any location in the world. Each team conducts a detailed analysis of issues related to climate, soils, crops, livestock, and economics of an agricultural system, with support from lectures and workshops by four academics each with different areas of expertise (soil science, plant science, animal science, and agricultural economics). The student teams examine a range of agricultural systems, from intensive to extensive, irrigated or rain-fed, and crop- or animal-dominated or mixed-farming enterprises, from all over the world, and findings are communicated in individual reports and a final team presentation.

These agricultural systems were examined:

- Smallholder dairy farming systems in the central highland plateau of Kenya
- Intensive, irrigated rice wheat cropping system in Punjab
- Mixed crop and livestock farming in the great southern region of WA
- Carbon farming in WA's mid-west region
- Animal agroforestry/agrosilvipastoral systems in India
- Broadacre farming in the Saskatchewan region of Canada
- Are there profitable synergies in an avocado-marron-beef farming system?
- Rice-wheat farming in India
- Horticulture of Asian vegetables in WA
- Semi-intensive rice-shrimp farming in Mekong river delta
- Smallholder horticultural system in Venezuela

The students analysed inputs (and costs), products (and expected income), constraints, interactions amongst components of the system, and considered current research and made recommendations on future research priorities.

The teams shared their knowledge with the class, enabling understanding of various interesting systems and the issues faced by farmers. The topics studied highlighted the innovation and adaptability of world agriculture, and the need for well-trained agricultural scientists with multi-disciplinary understanding to contribute to future world food security and the livelihoods of farmers and communities.

UWA introduced its Master of Agricultural Science as part of the course restructuring for 'New Courses 2012'. Students completing the three-year Bachelor of Science majoring in Agricultural Science can add an additional honours year, or progress to Master by coursework (with research project option).

This Master of Agricultural Science is attractive to international students from many countries. Students who have completed other relevant Science or Economics majors and degrees may be eligible for entry

This flexible approach enables students from various backgrounds to undertake advanced-level studies in Agricultural Science. The Master takes 1.5 or two years, depending on the content of the student's undergraduate degree.

PROF WALLACE COWLING WITH PROF JOHN HICKEY AT THE ROSLIN INSTITUTE, UNIVERSITY OF EDINBURGH, ALONGSIDE A POSTER COMMEMORATING THE 20TH ANNIVERSARY OF THE BIRTH OF DOLLY THE SHEEP

Plant breeder collaborates with animal breeders

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IOA Associate Director Professor Wallace Cowling was on sabbatical leave at Roslin Institute, University of Edinburgh, from late June to August 2017.

The Roslin Institute traces its orgins to the establishment in 1919 of the Institute of Animal Genetics, and in 2008 became a part of the Royal (Dick) School of Veterinary Studies at the University of Edinburgh. It is famous for Dolly the Sheep, the first mammal to be cloned from an adult cell, which was bred there 20 years ago.

Prof Cowling's interest in the ground-breaking work of Prof John Hickey at The Roslin Institute in re-designing plant breeding programs, led him to Edinburgh to work with his group.

Prof Hickey's group is modelling genomic selection "in silico" in both animals and plants, and is demonstrating the value of integrating animal and plant breeding methodology to make the most from the latest genomic technology to accelerate plant breeding.

Whilst in Edinburgh, Prof Cowling is modelling crop hybrid breeding with the Hickey group. He is also writing joint grant proposals with Prof Hickey to develop future research collaboration in methods of genomic selection in crop breeding.

In addition, Prof Cowling visited Scotland's Rural College (SRUC) Kirkton and Auchtertyre upland research farms near Crianlarich in the Highlands. He met Prof Davy McCracken, Head of the Hill and Mountain Research Centre, and discussed possibilities for collaboration with the Future Farm 2050 Project on UWA Farm Ridgefield. SRUC and UWA share many similar goals in promoting leading technologies on their Future Farms.

Phenotyping wheat for herbicide resistance

ROOPALI'S DAUGHTER KEEPS A WATCHFUL EYE OVER MUM'S RESEARCH.

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PhD candidate Roopali Bhoite's aims to genetically dissect herbicide tolerance in wheat through large scale phenotyping, quantitative trait locus (QTL) mapping, molecular marker development, mRNA sequencing and proteomic analysis.

Wheat (Triticum spp.) is a major food grain worldwide, supplying more than 35% of human food. Weed infestation by broad-leaf and grassy weeds cause significant yield reduction up to 50% in wheat.

Metribuzin, a photosynthetic-inhibiting herbicide, is versatile and highly effective for weed management, and is widely used in dryland farming systems in Australia and elsewhere. Apart from its weed-control efficacy, tolerance of the wheat crop under the influence of this herbicide is equally important for maximum crop production.

Previous studies have identified some tolerant wheat cultivars such as Eagle Rock, Kite and Blade. However, the narrow safety margin and lack of selectivity in wheat limit the herbicide's wider use.

For the first time, phenotypic screening of 946 wheat diversity panel from six continents identified the most tolerant and susceptible genotypes. The research was published in the paper "Identification of new metribuzin-tolerant wheat (Triticum spp.) genotypes in Crop and Pasture Science" and was Roopali's first paper as part of her PhD candidature.

Roopali is not only undertaking her PhD research but also busy mothering her lovely daughter who was born at the same time her paper was accepted for publication. Rooplai is supervised by Prof Guijun Yan, Dr Ping Si and Prof Kadambot Siddique.

The return of high-oestrogen clovers

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Many forage legumes contain phyto-estrogens, compounds that can cause infertility and other reproductive disorders in grazing animals. Formononetin is the compound in subterranean clovers that can cause infertility in sheep, commonly known as clover disease.

The infertility can be temporary and may resolved after the animal is removed from exposure to Formononetin. The syndrome also includes a range of disorders including difficult births, uterine prolapse, increased death rate of ewes, and post-natal mortality of lambs.

Often there are no visual signs of permanent infertility because the ewes show normal oestrous cycles. As a consequence, the condition often goes unnoticed by producers, especially in Merinos and Merino crossbreds.

The problem was thought to be largely resolved in early 1990s, although one million ewes affected by 'sub-clinical' clover disease that might have caused a 10% increase in non-pregnant ewes.

However, a recent report from a producer of low ewe fertility in Merinos (65% lambing percentage overall; only 35% in maidens identified the cause as clover disease.

Identification of subterranean clover cultivars in the field over the 2015-16 winter seasons by UWA researchers, showed that many pastures across southern Australia contain, or are even dominated by, older high-oestrogen cultivars such as Yarloop, Dwalganup, Geraldton and Dinninup.

At recent field days in South Australia and Victoria, we found all four of the highest oestrogenic cultivars in one paddock, unbeknownst to the producer.

In every subsequent paddock visited, high oestrogen cultivars were present and were often dominant in the sward; in one case, they were the only cultivars present.

Producers were surprised (as were consultants) at the diversity of the cultivars in their pastures and were unaware of how the subterranean clover cultivar and content can impact ewe fertility.

It should also be noted that naturalised variants of subterranean clover have evolved locally (from natural crossing events) and may also occur widely; some of these are also highly oestrogenic (e.g. Eden Valley in SA and Book Book in NSW). The levels of oestrogens in other variants are unknown.

The vast majority of meat producers surveyed had also not resown a paddock to one of the newer varieties in the last 20 years, explaining the strong presence of oestrogenic clovers in the medium to high rainfall zones.

It is clear that many producers unaware of the situation and are not planning to renovate with newer varieties (for low oestrogens, increased yield, or improved disease resistance). The low fertility of sheep is often overlooked, there is a significant economic loss (up to 8% of whole farm profitability) and an animal welfare issue is emerging.

The negative impacts on reproduction and health from high oestrogenic clovers were promoted for decades by State departments and the Universities throughout Australia but, over the last 10-15 years, the once close relationship between these institutions, agronomists and producers has been eroded.

Failure to address the presence of high-oestrogenic cultivars and variants in today's pastures is now causing loss of reproductive potential in the sheep meat industry - with consequences for farm profits and animal welfare.

In discussions with consultants and agronomists, it was clear that none were able to identify subterranean clovers varieties in the field or advise clients with confidence on issues of 'clover disease' in sheep.

There is a need again to provide clear guidance to producers and consultants on the effects of high-oestrogen subterranean clovers on ewe fertility and on measures to control them in pastures.

ANTIMALARIAL DRUGS OFFER A SMORGASBORD OF NEW HERBICIDES

A team of plant biologists and chemists from UWA in collaboration with staff from chemical company BASF have used the surprisingly close relationship between plants and malarial parasites to turn a molecule developed for possible malaria treatment into a new herbicide.

Published in Angewandte Chemie, the research builds on recent work by the group that found many off the shelf antimalarial drugs are herbicidal; a twist on an evolutionary connection made in the 1990s when herbicides were shown to interfere with processes in the malarial parasite.

Dr Joshua Mylne, a principal investigator with UWA's School of Molecular Sciences and ARC Centre of Excellence in Plant Energy Biology, said there was a desperate need for new herbicides, especially ones that work differently.

"As we ponder herbicidal applications, we expect to be able to repurpose some of the molecules and discover new ways of using them," Dr Mylne said.

"Herbicides are integral for modern day agriculture, but the spiralling costs to develop new herbicides have hindered their progress."

Associate Professor Keith Stubbs, a chemical biologist also from UWA's School of Molecular Sciences said it was exciting to find so many new herbicidal molecules.

"In the past 30 years, no truly new herbicidal molecule has entered the agrochemical market," Associate Professor Stubbs said.

"By using tiny seeds of the model plant Arabidopsis we examined a library of antimalarial compounds and selected the best one - MMV006188. We then examined several variations of it to determine which points were important for its potency."

"This is just the first example we have and a test case of what we can do to develop new herbicides. We may not just find new herbicides, but by working with plants could reveal how some antimalarial molecules work, which could also contribute to drug development in the fight against malaria."


ONE OF THE UWA RESEARCHERS MAXIME CORRAL AT WORK..CREDIT JOSH MYLNE

Novel strategies to improve disease resistance in crops

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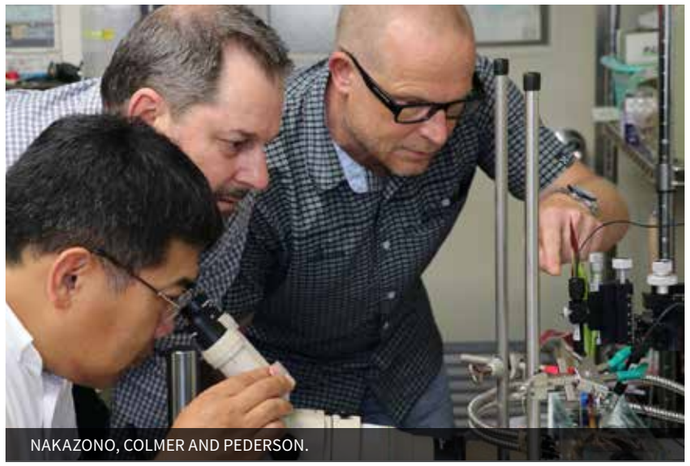
The fungal pathogen Rhizoctonia solani AG8 causes bare-patch and root-rot diseases of wheat, barley and legumes, predominantly in southern Australia.

To understand how crops may better resist the disease, researchers from CSIRO, UWA and Sichuan Agricultural University have studied the differences in gene activity between resistant and susceptible varieties of the pasture legume, Medicago truncatula (barrel medic).

Along with activity of the plant hormone, ethylene, the researchers found a striking accumulation of a class of plant derived chemicals known as iso-flavonoids only in the resistant variety following inoculation with Rhizoctonia.

These findings pave the way for novel strategies to improve the resistance of crop plants to recalcitrant diseases such as those caused by Rhizoctonia.


RESISTANT VARIETY + RHIZOCTONIA (TOP), SUSCEPTIBLE VARIETY + RHIZOCTONIA (BOTTOM).



NAKAZONO, COLMER AND PEDERSON.

UWA and Nagoya University collaborate on crop tolerance to soil flooding

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UWA Adjunct Profs Mikio Nakazono (Nagoya University) and Ole Pedersen (University of Copenhagen), and Prof Tim Colmer collaborating on tolerance of crops to soil flooding.

Prof Nakazono hosted the researchers at Nagoya University for two weeks of intensive experiments using microelectrodes to measure profiles of oxygen across roots. Roots require oxygen to produce energy to grow and to take up nutrients, essential for high-yielding crops.

The measurements have shown that for roots in an oxygen-deficient medium, Zea nicaraguensis, a flooding-tolerant wild relative of corn (maize, Zea mays) has a large internal flux of oxygen from the shoots into and along the roots. This internal movement of oxygen sustains these roots when in flooded soils.

By contrast, the internal movement of oxygen is much less for roots of corn. The higher oxygen supply in the wild relative results from its specialised root anatomy of large gas-filled spaces (aerenchyma) and a barrier to radial oxygen loss (suberin in cell walls near the root exterior) acting synergistically to enhance oxygen diffusion to the root tip.

The findings are significant since the two species have been hybridized to increase the tolerance of corn to soil flooding. These novel corn genotypes were produced by Dr Yoshiro Mano at the Institute of Livestock and Grassland Science, National Agriculture and Food Research Organization, Japan.

The experiments conducted this year add detailed information on the function of the root radial oxygen loss barrier in the wild relative and a chromosome segment introgression line also with the trait, as compared with corn. The research by the Japanese team aims to elucidate the genes regulating root traits for waterlogging tolerance:

UWA's Faculty of Science has been collaborating with the Graduate School of Bioagricultural Sciences at Nagoya University for several years. The initial collaboration was in plant physiology and genetics, and has grown into additional research links, staff visits and student exchanges.

UWA and Nagoya University are working towards establishment of a joint PhD degree in Agriculture, which will further enhance collaborative research and training in Plant Science, Animal Science, Soil Science, Biochemistry and Biotechnology.

HECTOR & ANDREW STEWART MEMORIAL LECTURE TACKLES THE GRAND AGRICULTURAL CHALLENGES

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Snow Barlow, Professor of Viticulture and Horticulture at the University of Melbourne was invited to deliver the 24th Hector and Andrew Stewart Memorial Lecture at UWA in April 2017.

In his talk titled The grand agricultural challenges of climate change, Prof Barlow discussed three challenges: to reduce the impact of increasing carbon dioxide levels on plant nitrogen content, to reduce ruminant methane emissions intensity, and third, to increase nitrogen use efficiency and reduce nitrous oxide emissions.

He said agriculture needs to think deeply about how it could reduce the intensity of its greenhouse gas emissions.

"Most states have targets of doubling agricultural production by 2050, but without improvements in Agricultural Emissions Intensity, the current 14% of national greenhouse gas emissions could become 28%," Prof Barlow said.

"The national emissions intensity target is a 50% reduction by 2050. Agricultural emissions could become more than 50% of national greenhouse gas emissions."

He said these challenges are researchable, but that agricultural researchers have become an increasingly small proportion of university research outputs.

"The metrics of the Excellence in Research for Australia (ERA) favour rapid publication in high impact journals. This is not well suited to applied areas such as field based agricultural systems research."

The grand challenge is for agricultural industries, agribusiness and universities is to find new frameworks, partnerships or arrangements to address these emerging research challenges before it is too late."

The Hector and Andrew Stewart Memorial Lecture is in honour of the late Hon Hector J Stewart, MLC, and his son, the late Mr Andrew M. Stewart, both Wagin wool growers. Mr Stewart Jr was President of UWA's Guild of Undergraduates in 1929 and was invited to join the teaching staff at the University in 1937. He was twice Dean of UWA's Faculty of Agriculture.

The inaugural Hector and Andrew Stewart memorial lecture was 51 years ago in 1966 by Professor TJ Robinson on 'Sheep Fertility Research - Its Potential for WA. The lecture series is held every two years.

PROF KADAMBOT SIDDIQUE AND PROF SNOW BARLOW (BACK ROW, FROM LEFT) WITH THE STEWART FAMILY AFTER THE HECTOR AND ANDREW STEWART MEMORIAL LECTURE.

DR KEVIN FOSTER, DR PARWINDER KAUR AND DEREK WOODFIELD (PGG WRIGHTSONS) INSPECT CLOVER IN THE FIELD.

NEW RESOURCE FOR FORAGE LEGUME BREEDERS

Dr Parwinder Kaur
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Subterranean clover (Trifolium subterraneum L.) is an important annual forage legume, whose diploidy and inbreeding nature made it an ideal model for genomic analysis in Trifolium.

Despite progress in breeding, further gains are expected if breeders are able to exploit new traits. Researchers from UWA have assembled a Genome browser for the Trifolium group of species trifoligate.info

This resource is a user-friendly resource for forage legume breeders to find genes and design markers readily for range of economically important traits with a view to developing future smart cultivars.

Dr Parwinder Kaur from UWA's School of Agriculture and Environment and IOA who led the research said the web resource will facilitate the pre-breeding efforts in the annual legumes, by utilising this integrated genomics and phenomics information for future fast-track breeding of pasture legumes.

"This resource has built upon extensive phenotyping and genotyping of 97 world core collection accessions and 28 elite Australian cultivars towards constructing a haplotype map (HapMap) and PanGenome for the key Australian pasture, subterranean clover," Dr Kaur said.

"We expect it to serve as powerful facilitator tool for identifying genes and genetic variations for important economic and morphological traits."

The web resource is a starting point for the integrated genomic and phenomic resources developed to identify loci governing traits allowing marker-assisted breeding, comparative mapping and identification of tissue-specific gene promoters for biotechnological improvement of forage legumes.

A Multi-Disciplinary Attack on the Worm-Diarrhoea-Flystrike Complex in Merino Sheep

Prof Graeme Martin
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The Australian sheep industry loses $600m pa because gastro-intestinal worms cause diarrhoea and thus faecal contamination that attracts blowflies. Worms are now difficult to control because they have developed resistance to anthelminth drugs, and flystrike prevention by mulesing is clearly no longer acceptable.

Decades of research in the Department of Agriculture and Food Western Australian (DAFWA, now DPIRD), by Adj/Prof Johan Greeff and Dr John Karlsson, have clearly shown that sheep can be bred to be resistant to worms and to flystrike, but many resistant sheep still have diarrhoea because they are hypersensitive to the few worms that they still carry.

With respect to the flystrike-resistant sheep, we don't know how the resistance works but suspect that it something to do with the relationship between odours produced by the sheep and the sense of smell in the flies.

LEFT TO RIGHT: SHIMIN LIU, PINGHUA CAO, NICOLA STANWYCK, LINGXIA JIAO, ERWIN PAZ, PRAPAWAN SAWASDEE, HOU QIRUI, TONY SCHLINK

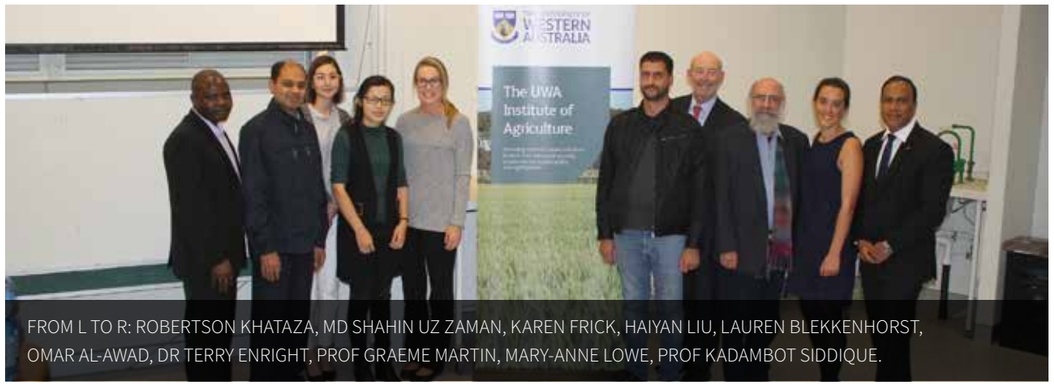
To understand the worm-diarrhoea-flystrike complex, we need a full array of skills and disciplines: genetics, immunology, insect behaviour, gut physiology and health, veterinary medicine, and molecular and cellular biology. We have therefore assembled a team that includes international as well as local expertise. In addition to Adj Prof Greeff, Dr Tony Schlink and Dr Dieter Palmer from DPIRD, other collaborators includes members of IOA (Professors Graeme Martin and Phil Vercoe; Hon Assoc Prof Shimin Liu) and colleagues at Curtin University (Assoc Prof David Groth and Dr Kylie Munyard), and Ondek Pty Ltd (Dr Alma Fulurija).

The international team members are Dr Junhua Liu from Nanjing University (supported by a UWA Research Collaboration Award), Dr Erwin Paz (a post-doctoral fellow supported by INIA, Chile) and PhD students Mr Guanjie Yan (China), Ms Prapawan Sawasdee (Thailand), and Mr Shamshad-Ul-Hussan (Pakistan).

The team will identify the key components of the immune response that causes the hypersensitivity to worms, and identify an easily measured indicator that can be used to develop a selection criterion for low susceptibility to diarrhoea.

The flystrike specialists have developed methods for measuring the activation of the sense of small in blowflies and are now trying to find the odour molecules produced by sheep that attract them to lay their eggs in wool.

The outcome will be genetically robust, easy-care Merino sheep that are more productive, and a wool industry with a strong ethical image.



FROM L TO R: ROBERTSON KHATAZA, MD SHAHIN UZ ZAMAN, KAREN FRICK, HAIYAN LIU, LAUREN BLEKKENHORST, OMAR AL-AWAD, DR TERRY ENRIGHT, PROF GRAEME MARTIN, MARY-ANNE LOWE, PROF KADAMBOT SIDDIQUE.

UWA POSTGRADS SHINE AT SHOWCASE

Mrs Diana Boykett
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Eight PhD students studying agriculture and related areas across three faculties presented their research at the 11th annual Postgraduate Showcase: Frontiers in Agriculture in June. An audience of approximately 130 academics, students and agriculture industry representatives attended the event to hear the latest research.

Two students from the Faculty of Health and Medical Sciences presented their work on the cardiovascular health benefits of eating apples and vegetables. Cardiovascular disease is the leading cause of death in Australia. Ms Nicola Bondonno from the Faculty of Health and Medical Sciences showed that a 50g per day increase in apple intake was associated with 24% lower odds of having severe abdominal aortic calcification in her participant group. Interestingly, this was not seen with pears, oranges or bananas.

Ms Lauren Blekkenhorst, also a PhD candidate from the Faculty of Health and Medical Sciences is a registered nutritionist, whose research focuses on establishing more streamline recommendations around vegetables. She said current recommendations relating to vegetable intake are poorly followed within Australia and over 90% of Australians do not meet the recommended amount.

Iraqi PhD Candidate Mr Omar Al-Awad from the School of Agriculture and Environment in the Faculty of Science presented his research on Ammonium toxicity and resistance in canola genotypes. Urea is one of the most frequently applied ammonium-based fertilisers. Use in Australia has increased over the past 20 years as it is cheap to produce and cheap to transport. However, urea hydrolyses in the soil to release ammonium, causing toxicity in many crops that have poor resistance. Omar's research has found canola genotypes that are resistant to ammonium and ongoing studies will look at the impact of ammonium toxicity on canola yield and oil content.

Physical soil scientist Ms Mary-Anne Lowe, also from the School of Agriculture and Environment presented her research on soil water repellence and its limitations on water infiltration and special distribution attributing to loss of agricultural productivity. Soil erosion costs the WA economy approximately $250 million a year, and Mary-Anne hopes her research will find a way to increase agricultural productivity without increasing environmental degradation.

Ms Haiyan Liu, from the Faculty of Arts, Business, Law and Education is in her final year of PhD studies. She presented her research on cross-country food consumption patterns and the income and price sensitivity of diets globally. Haiyan talked through the three-stage budgeting approach she used to examine the consumption of 25 food items in a large number of countries.

Mr Md Shahin Uz Zahman from Bangladesh is conducting research in field pea, and its waterlogging tolerance at germination. He found genotypic variation to waterlogging tolerance at germination, and transcriptome analysis has revealed a new mechanism for tolerance. Ongoing studies include mapping molecular markers and genomic loci associated with transient waterlogging tolerance.

Mr Robertson Khataza from the School of Agriculture and Environment is researching the economics of agricultural sustainability, using his home country Malawi as a case study. In his presentation, he asked why farmers procrastinate adopting new agricultural technologies. He found adoption rates are likely to be higher if better farmer-researcher partnerships are built, and if farmer-oriented technologies are promoted, as farmers want technologies that can help them reach their goals.

The final speaker for the afternoon was Ms Karen Frick, from the School of Agriculture and Environment who is completing her PhD studies in conjunction with CSIRO Agriculture and Food, concerning the improvement of lupin grain quality, a major WA grain legume crop. Alkaloids are secondary metabolites that provide insect resistance but reduce the value of the lupin grain. Karen presented her research using transcriptomic and genomic data to identify candidate genes involved in the biosynthesis of alkaloids. Karen's research is funded by the GRDC.

AUSPLOW WILL TEST VARIOUS CONFIGURATIONS OF THEIR DBS D260-36 MATCHED TO A 6000 LITRE DRAWBAR MOUNTED AIRSEEDER FOR SEEDING

UWA partners Ausplow Farming Systems to optimise seeding performance

IOA has entered a research and development partnership with Ausplow Farming Systems to improve crop yields and machine performance.

Ausplow will test various configurations of their DBS D260-36 matched to a 6000 litre Drawbar mounted Airseeder for seeding in the wide-ranging landscapes at UWA Farm Ridgefield.

Dr Andrew Guzzomi from UWA's School of Mechanical & Chemical Engineering and IOA is leading the partnership with Ausplow Farming System's engineering manager, Mr Carl Vance.

He said the partnership is a major step forward in the transformation of Ridgefield into a farm of the future, the mission of the UWA Future Farm 2050 Project.

"Some of the landscape at UWA Farm Ridgefield is challenging in terms of soil type, obstacles and paddock shape so working in partnership with Ausplow will help optimise seeding practices," Dr Guzzomi said.

"The move toward smaller, more flexible tractor-machine combinations will permit UWA Farm Ridgefield to crop landscapes that at present are inaccessible."

Prof Graeme Martin from UWA's School of Agriculture and Environment and IOA, who leads the Future Farm 2050 Project, said the combination of modern seeding practices and a massive program for bringing weeds under control is critical for our vision for the 'ecological cropping' enterprise of the Future Farm 2050 Project.

Ausplow General Manager Chris Farmer said it was good to know Ausplow's vision of farming into the future is also shared with UWA.

"We believe that the partnership formed this year with the Future Farm 2050 team can be mutually beneficial," Mr Farmer said. "At this early stage from Ausplow's perspective it certainly appears to be heading in the right direction."

UWA Farm Ridgefield will in turn, provide detailed feedback to Ausplow Farming Systems on machine performance and crop yields.

New Appointments

Dr Bruce Mullan

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The Department of Primary Industry and Regional Development's (DPIRD) Dr Bruce Mullan has joined IOA's Industry Advisory Board. Bruce is the Director of Sheep Industry Development, and Project Manager for the Sheep Industry Business Innovation project.

He was raised on the wheat-sheep-pork family farm at Dudinin, east of Narrogin. He graduated with a Bachelor of Science (Agriculture) from UWA in 1978, and later completed a PhD in pig nutrition also at UWA.

Bruce represents DPIRD on a number of state and national research and development bodies, all aimed at increasing the competitiveness of the WA livestock industries and will be a valuable member of IOA's Industry Advisory Board.

Staff Awards and Industry Recognition

AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Mr Brenton Leske	Postgraduate Research Scholarship from Department of Agriculture and Food Western Australia
Dr Marti Kragt	Research Fellowship from the Australian Research Council Centre of Excellence for Environmental Decisions (CEED) under the 2017 Visiting Fellowships program
Mr Simon Jankowski	Agribusiness Connect Masters Research Project Scholarship
Mr Andrew Hansen	Agribusiness Connect Honours Research Project Scholarship
Dr Yinglong Chen	Australian Academy of Science Travel Award to attend Science at the Shine Dome and EMCR Program, Canberra, 23–25 May 2017
Dr Yinglong Chen Dr Jiayin Pang	WUN Symposium cum Research Summit Travel Award to present at WUM Grain Legume Conference, Hong Kong, 6–17 June, 2017
Adjunct Prof Hari D Upadhyaya	Fellow of National Academy of Agricultural Sciences, India (NAAS) 2017
Adjunct Prof Hari D Upadhyaya	Fellow of Uttar Pradesh Academy of Agricultural Sciences (UPAAS) 2016 for his outstanding contribution in the field of Natural Resource Management (Biodiversity)
Professor Rajeev Varshney	Elected Fellow of German Academy of Sciences Leopoldina, Germany
Professor Rajeev Varshney	Elected Fellow of The World Academy of Sciences
Professor Rajeev Varshney	Doreen Margaret Mashler Award (the most prestigious award of ICRISAT) by ICRISAT Governing Board
Professor Rajeev Varshney	IPGI Award-2017 for leadership & contribution to peanut research by the International Peanut Genome Initiative

VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
Prof Yongsheng Xie, Prof Mingde Hao, and Dr Han Luo	The Institute of Soil and Water Conservation, Northwest A&F University, and Chinese Academy of Sciences, China	Dr Yinglong Chen and Prof Kadambot Siddique	June 2017
Dr Hafiz Muhammad Bilal	University of Agriculture Faisalabad	Prof Guijun Yan and Dr Helen Liu	October 2016 – April 2017
Assoc/Prof Weiwei Duan	Hebei Agricultural University	Prof Guijun Yan and Dr Helen Liu	April 2017 – October 2017
Dr Junliang Zhao	Guangdong Academy of Agricultural Sciences (GAAS), China	Prof Dave Edwards	April 2017-April 2018 from
Mr Brent Verpaalen	Bachelor student of Bio-Informatics at HAN University of Applied Sciences Nijmegen	Prof Dave Edwards	February -June 2017
Dr Oliver Schliebs	University Tuebingen	Prof Dave Edwards	Nov2016 – May 2017
Ms Clemence Darley	SupAgro, Montpellier	Prof Graeme Martin, UWA Farm Ridgefield	May – August 2017
Dr Ravi Seewoogoolam	Food and Agricultural Research and Extension Institute, Mauritius	Prof Wallace Cowling	April – October 2017
Dr Junhua Liu	Visiting Research Fellow from Nanjing Agricultural University, China	Prof Graeme Martin	June – September 2017

VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
Prof Weiping Hao and Prof Tinglu Fan	Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, China	Prof Kadambot Siddique	12 – 17 August 2017
Dr Wenqing Zhao	Visiting Research Fellow from Nanjing Agricultural University, China	Prof Kadambot Siddique and Dr Yinglong Chen	February 2017 – February 2018
Ms Chloe Charotte	Lasalle universite, France	Dr Jiayin Pang, Prof Kadambot Siddique and Prof Hans Lambers	June 2017 – September 2017
Mr Junlin Zheng	Visiting PhD student from Shenyang Agricultural University, China	Prof Kadambot Siddique and Dr Yinglong Chen	September 2017 – September 2018
Prof Vara Prasad Vara Prasad	Kansas State University, USA	Prof Kadambot Siddique	24 – 28 November 2017
Dr Elizabeth Ngadze	University of Zimbabwe	Prof Kadambot Siddique	29 July – 30 August 2017
Dr Julian Klaus	Luxembourg Institute of Science and Technology	Prof Keith Smettem, A/Prof Matt Hipsey, A/Prof Nik Callow	February – April 2017
Prof Henry Nguyen	Missouri University, USA.	Prof Kadambot Siddique	12- 19 November 2017
Ms Yuqing Yan	Zhejiang University, China	Prof Kadambot Siddique, Dr Yinglong Chen and Dr Jiayin Pang	6 July - 25 August 2017
Mr Tsubasa Kawai	Nagoya University, Japan	Prof Kadambot Siddique, Dr Yinglong Chen and Dr Jiayin Pang	6 July - 25 August 2017
A/Prof Ole Pedersen	University of Copenhagen	Prof Tim Colmer, Prof Gary Kendrick	21 March – 6 April 2017
Dr Dennis Konnerup	University of Copenhagen	Prof Tim Colmer, Prof Gary Kendrick	21 March – 6 April 2017
Dr Hiro Takahashi	Nagoya University, Japan	Prof Tim Colmer, Prof Gary Kendrick	3 April – 12 April 2017
Dr Gustavo Striker	University of Buenos Aires	Prof Tim Colmer	14 August – 11 September 2017
Muhammad Ishaq Ibrahim	Plant Genetic Resources Institute (PGRI), National Agricultural Research Centre, Pakistan	Prof Jacqui Batley	November 2016 - April 2017
Ziran Zubair	Hazara University Manshera, Pakistan	Prof Jacqui Batley	June 2017 – December 2017
Muhammad Shahid	National Key Laboratory of Crop Genetics Improvement, Huazhong Agricultural University, Wuhan, China.	Prof Jacqui Batley	June 2017 - Feb 2018
Prof Liangzuo Shu	Visiting Research Fellow, from Huaibei Normal University, China	Prof Zed Rengel	June – July 2017
Dr Chunguo Huang and	Visiting Research Fellow from Shanxi Agricultural University, China	Prof Zed Rengel	July –September 2017; December 2017 – June 2018
Dr Xiao-li Han	Visiting Research Fellow from Shanxi Agricultural University, China	Prof Zed Rengel	July 2017 – June 2018

POSTGRADUATE RESEARCH STUDENTS

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Mr Daniel Kidd	Environmental factors limiting production and persistence of Ornithopus species	UWA School of Agriculture and Environment and IOA	Assoc/Prof Megan Ryan, Prof Tim Colmer, Dr Richard Simpson (CSIRO)	Rural Research and Development for Profit via Meat and Livestock Australia
Ms Clementine Merce	Pangenome assembly and diversity analysis (TBC)	School of Biological Sciences and IOA	Prof Dave Edwards, Prof Jacqui Bately, Dr Kenneth Chan	ARC
Mr Umair Hassan	Ruminant production	UWA School of Agriculture and Environment and IOA	Prof Phil Vercoe Prof Graeme Martin	UAF-UWA Scholarship
Mr Shamshad-Ul-Hassan	Ruminant production	UWA School of Agriculture and Environment and IOA	Prof Phil Vercoe Prof Graeme Martin	UAF-UWA Scholarship
Mr Brenton Leske	Frost tolerance in wheat: field-based phenotyping tools in pre-breeding	UWA School of Agriculture and Environment and IOA	Prof Tim Colmer Dr Ben Biddulph	GRDC Top-up Scholarship and Postgraduate Research Scholarship from DAFWA

NEW RESEARCH GRANTS MARCH 2017 – JULY 2017

TITLE	FUNDING PERIOD	FUNDING BODY	SUPERVISORS
Increasing wheat yield by genomic sequencing and germplasm exchange	2017-2021	Ministry of Industry, Innovation and Science (Global Innovation Linkages)	Professors Guijun Yan, Jacqueline Batley and Dave Edwards
Integrated economic assessment and business case development for Water Sensitive Cities	2016-19	CRC for Water Sensitive Cities	Mr MD Sayed Iftekhar, Professor David Pannell
Serpentine Managed Aquifer Recharge	2017	Greenacres Turf Group	Miss Sarah Bourke
AW Howard Memorial Trust Research Fellowship: Gustavo Striker visit to UWA for research on submergence tolerance of messina	2017	AW Howard Memorial Trust	Dr Gustavo Striker, Professor Tim Colmer
Frost tolerance in wheat: Grains Research Scholarship for field-based phenotyping tools in pre-breeding	2017-2020	GRDC Grains Industry PhD Research Scholarship	Professor Tim Colmer, Dr Ben Biddulph
Phosphorus-efficient Australian plants: applications for crop improvement	2017-2020	ARC Future Fellowship	Dr Ranathunge Ranathunge
Incorporating salt-tolerant wheat pulses into smallholder farming systems in southern Bangladesh	2016-2016	Australian Centre for International Agricultural Research (ACIAR)	Professor William Erskine, Professor Tim Colmer
Development of novel transcriptional regulators and synthetic logic gates for sophisticated control of plant activity and production	2017-2019	CSIRO Synthetic Biology Future Science Fellowships	Dr Brendan Kidd, Professor Ryan Lister, Professor Karam Singh and Professor Kemal Kazan
Using citizen scientists to test the effectiveness of biofertlizers	2017-2018	Department of Industry Innovation and Science Citizen Science Grants	Dr Barbara Cook

NEW RESEARCH GRANTS MARCH 2017 – JULY 2017

TITLE	FUNDING PERIOD	FUNDING BODY	SUPERVISORS
MicroBlitz: Super-sized citizen science for soil microbiomes	2017-2018	Department of Industry, Innovation and Science Citizen Science Grants	Professor Andrew Whiteley
Infrastructure Grants 2017 – Crop and Weed Agronomy Laboratory	2017	Grains Research and Development Corporation (GRDC)	Professor Stephen Powles, Dr Kenneth Flower, Mr Michael Ashworth
Evaluation and development of castor bean as a commercial crop in Australia	2017-2021	Virtue Australia Foundation	Professor Kadambot Siddique, Dr Yinglong Chen
Markers, markets and validated nutritional qualities of Australian apples	2016-2018	WA Agricultural Produce Commission	Dr Michael Considine

IOA 2017 Publications

(April – July)

Refereed Journals

Adams PI, Boonham N, Jones RAC (20I7). First complete genome sequence of Arracacha virus A from an 38-year-old sample from Peru. *Genome Announc* **5**(18):e00141-17

Bayer PE, Hurgobin B, Golicz A, Chan K, Yuan Y, Lee HT, Renton M, Meng J, Li R, Long Y, Zou J, Bancroft I, Chalhoub B, King G, Batley J, Edwards D (2017). Assembly and comparison of two closely related Brassica napus genomes. *Plant Biotechnology Journa*l.

Bhoite RN, Si P, Stefanova KT, Siddique KHM and Yan G (2017). Identification of new metribuzin-tolerant wheat (Triticum spp.) genotypes. *Crop & Pasture Science* **68**: 401-408

Colmer TD and Barton L (2017). A review of warm-season turfgrass evapotranspiration, responses to deficit irrigation, and drought resistance. *Crop Science* **57**: 1-13

Congdon BS, Coutts BA, Renton M, van Leur JAG and Jones RAC (2017). Seed fractionation as a phytosanitary control measure for Pea seed-borne mosaic virus infection of field pea seed-stocks. *European Journal of Plant Pathology* **148**: 733–737

Congdon BS, Coutts BA, Renton M, Flematti GR, Jones RAC (2017). Establishing alighting preferences and species transmission differences for Pea seed-borne mosaic virus aphid vectors. *Virus Research* doi: 10.1016/j.virusres.2017.04.005

Congdon BS, Coutts BA, Renton M, Flematti GR, Jones RAC (2017). Pea seed-borne mosaic virus pathosystem drivers under Mediterranean-type climatic conditions: deductions from 23 epidemic scenarios. *Plant Disease* **101**: 929-940

Congdon BS, Coutts BA, Jones RAC, Renton M (2017). Forecasting model for Pea seed-borne mosaic virus epidemics in field pea crops in a Mediterranean-type environment. *Virus Research*. doi.org/10.1016/j.virusres.2017.04.005

Considine MJ, Siddique KHM and Foyer CH (2017). Nature's pulse power: legumes, food security and climate change. *Journal of Experimental Botany* **68**(8): 1815-1818

Cowling WA, Li L, Siddique KHM, Henryon M, Berg P, Banks RG and Kinghorn BP (2017). Evolving gene banks: improving diverse populations of crop and exotic germplasm with optimal contribution selection. *Journal of Experimental Botany* **68** (8): 1927-1939

Dombrovsky A, Tran-Nguyen LTT and Jones RAC (2017). Cucumber green mottle mosaic virus: Rapidly Increasing Global Distribution, Etiology, Epidemiology, and Management. *Annual Review of Phytopathology* Doi:10.1146/annurev-phyto-080516-035349

Dumbrell N P, Kragt ME, Meier EA, Biggs J and Thorburn PJ (2017). Greenhouse gas abatement costs are heterogeneous between Australian grain farms. *Agronomy for Sustainable Development*. doi: https://doi.org/10.1007/s13593-017-0438-6

Fang Y, Du Y, Wang J, Wu A, Qiao S, Xu B, Zhang S, Siddique KHM and Chen Y (2017). Moderate drought stress affected root growth and grain yield in old, modern and newly released cultivars of winter wheat. *Frontiers in Plant Science* **8**: 672

Farooq M, Nadeem F, Gogoi N, Ullah A, Alghamdi SS, Nayyar H and Siddique KHM (2017). Heat stress in grain legumes during reproductive and grain-filling phases. *Crop & Pasture Science*

Flower KC, Ward PR, Cordingley N, Micin SF and Craig N (2017). Rainfall, rotations and residue level affect no-tillage wheat yield and gross margin in a Mediterranean-type environment. *Field Crops Research* **208**: 1-10

Gacek K, Bayer PE, Bartkowiak-Broda I, Szala L, Bocianowski J, Edwards D and Batley J. (2017) Genome-wide association study of genetic control of seed fatty acid biosynthesis in Brassica napus. *Frontiers in Plant Science.* **7:**2062

Guo YM, Samans B, Chen S, Kibret KB, Hatzig S, Turner NC, Nelson MN, Cowling WA and Snowdon RJ (2017). Drought-tolerant Brassica rapa shows rapid expression of gene networks for general stress responses and programmed cell death under simulated drought stress. *Plant Mol Biol Rep* **35:** 416-430

Hane J, Ming Y, Kamphuis L, Nelson M, Garg, G, Atkins C, Bayer P, Bravo A, Bringans S, Cannon S, Edwards D, Foley R, Gao L, Harrison M, Huang W, Hurgobin B, Li S, Liu CW, McGrath A, Morahan G, Murray J, Weller J, Jian J and Singh K (2017). A comprehensive draft genome sequence for lupin (*Lupinus angustifolius*), an emerging health food: Insights into plant-microbe interactions and legume evolution. *Plant Biotechnology Journal*. **15** (3): 318-330

Hanley ME, Gove TL, Cawthray GR, Colmer TD (2017). Differential responses of three coastal grassland species to seawater flooding. *Journal of Plant Ecology* **10**: 322-330.

Heng S, Chen F, Wei C, Hu K, Yang Z, Wen J, Yi B, Ma C, Tu J, Si P, Fu T and Shen J (2017). Identification of different cytoplasms based on newly developed mitotype-specific markers for marker-assisted selection breeding in *Brassica napus* L. *Plant Cell Reports* **36:** 901-909

Hurgobin H and Edwards D (2017). SNP discovery using a pangenome: has the single reference approach become obsolete? *Biology*

Jeffery RP, Simpson RJ, Lambers H, Kidd DR and Ryan MH (2017). Plants in constrained canopy micro-swards compensate for decreased root biomass and soil exploration with increased amounts of rhizosphere carboxylates. *Functional Plant Biology* **44:** 552-562

Jia H, Zhang Y, Tian S, Emon RM, Yang X, Yan H, Wu T, Lu W, Siddique KHM, Han T (2017). Reserving winter snow for the relief of spring drought by film mulching in northeast China. *Field Crops Research* **209**: 58-64

Kaur P, Bayer PE, Milec Z, Vrána J, Yuan Y, Appels R, Edwards D, Batley J, Nichols P, Erskine W, Doležel J (2017). An advanced reference genome of *Trifolium subterraneum* L. reveals genes related to agronomic performance. *Plant Biotechnology Journal.*

Kehoe MA, Jones RAC, Coutts BA (2017). First complete genome sequence of Cucumber green mottle mosaic virus isolated from Australia. *Genome Announc* **5**(12):e00036-17.

Khan HA, Siddique KHM, Colmer TD (2017). Vegetative and reproductive growth of salt-stressed chickpea are carbon-limited: sucrose infusion at the reproductive stage improves salt tolerance. *Journal of Experimental Botany* **68:** 2001-2011.

Khataza RRB, Hailu A, Kragt ME and Doole GJ (2017). Estimating shadow price for symbiotic nitrogen and technical efficiency for legume-based conservation agriculture in Malawi. *Australian Journal of Agricultural and Resource Economics* doi: https://doi.org/10.1111/1467-8489.12212

Kragt ME, Dumbrell NP and Blackmore L (2017). Motivations and barriers for Western Australian broad-acre farmers to adopt carbon farming. *Environmental Science & Policy,* **73**:115-123. doi: https://doi.org/10.1016/j.envsci.2017.04.009

Kurniasih B, Greenway H, Colmer TD (2017). Energetics of acclimation to NaCl by submerged, anoxic rice seedlings. *Annals of Botany* **119**: 129-142.

Li Y, Ruperao P, Batley J, Edwards D, Davidson J, Hobson K, Sutton T (2017). Genome analysis identified novel candidate genes for ascochyta blight resistance in chickpea using whole genome re-sequencing data. *Frontiers in Plant Science*

Lim DKY, Schuhmann H, Thomas-Hall SR, Chan CKK, Wass TJ, Aguilera F, Adarme-Vega TC, Dal'Molin CGO, Thorpe GJ , Batley J, Edwards D, Schenk PM (2017). RNA-Seq and metabolic flux analysis of Tetraselmis sp. M8 during nitrogen starvation reveals a two-stage lipid accumulation mechanism *Bioresource Technology.*

Liu CA, Siddique KHM, Hua S, and Rao X (2017). The trade-off in the establishment of artificial plantations by evaluating soil properties at the margins of oases. *Catena* **157:** 363-371

Maina S, Edwards OR, de Almeida L, Ximenes A, Jones RAC (2017). First complete Squash leaf curl China virus genomic segment DNA-A sequence from East Timor. *Genome Announc* **5**(24):e00483-17

Maina S, Coutts BA, Edwards OR, de Almeida L, Kehoe MA, Ximenes A, Jones RAC (2017). Zucchini yellow mosaic virus populations from East Timorese and northern Australian cucurbit crops: molecular properties, genetic connectivity and biosecurity implications. *Plant Disease* **101**: 1236-1245

Maina S, Edwards OR, de Almeida L, Ximenes A, Jones RAC. 2017. RNA-seq strand-specific library from East Timorese cucumber sample reveals complete Cucurbit aphid-borne yellows virus genome. *Genome Announc* 5(19):e00320-17.

Meier EA, Thorburn PJ, Kragt ME, Dumbrell NP, Biggs JS, Hoyle FC and van Rees H (2017). Greenhouse gas abatement on southern Australian grains farms: Biophysical potential and financial impacts. *Agricultural Systems* **155:**147-157. doi: https://doi.org/10.1016/j.agsy.201

Mirzaei S, Batley J, El-Mellouki T, Liu S, Meksem K, Ferguson B and Gresshoff P (2017). Neodiversification of homeologous CLAVATA1-like receptor kinase genes in soybean leads to disctinct developmental outcomes. *Scientific Reports*

Mohammed AE, You MP and Barbetti MJ (2017). New resistances offer opportunity for effective management of the downy mildew (Hyaloperonospora parasitica) threat to canola. *Crop & Pasture Science* **68:** 234-242

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UPCOMING EVENTS

CHINA IN CONVERSATION LECTURE
Thursday, 10 August 2017
University Club of WA, UWA

UWA OPEN DAY
Sunday, 13 August 2017
Crawley Campus, UWA

BRIAN CARLIN MEMORIAL LECTURE
Wednesday, 16 August 2017
Bayliss Lecture Theatre, UWA

DOWERIN FIELD DAYS
30 -31 August 2017
Dowerin, WA

TECHSPO FIELD DAY
12-14 September 2017
Katanning, WA

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