

# The UWA Institute of Agriculture

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UWA Vice-Chancellor Prof Paul Johnson (left) with the Hon Ken Baston (centre) and IOA Director and Agriculture Chair, Hackett Prof Kadambot Siddique

## Strategic direction for agriculture at UWA set out

Key leaders at UWA and IOA's Industry Advisory Board have outlined a five-year strategic plan for IOA for 2015-2019.

The Strategic Plan 2015-2019 was released at an event held on 17 March 2016 attended by approximately 80 selected representatives from the agriculture industry and scientific community.

UWA Dean of Faculty of Science Prof Tony O'Donnell and IOA's Industry Advisory Board Chair Dr Terry Enright welcomed the guests before UWA Vice-Chancellor Prof Paul Johnson officially opened the event.

He said the launch of the agricultural strategic plan coincides with the Australian government's emphasis on research innovation and technologies translated into practical outcomes.

"Australia is the driest human inhabited continent in the world and our broadacre agricultural system is largely based on drylands. This presents an

opportunity for Western Australia to lead the way in agriculture."

"The launch of the agricultural strategic plan is timely, and new strategies to tackle the national and international challenges have been identified."

Guest speaker, former Agriculture and Food Minister Ken Baston said agriculture in WA has a lot to offer the global food market and that the scientific community, including IOA play a vital role in advancing agriculture.

"We have set an ambitious goal to double the value of agricultural production in this state between 2013 and 2025," Minister Baston said.

"Your strategic plan provides an important framework and creates the appropriate direction to achieve this goal."

IOA Director Professor Kadambot Siddique gave a 30 minute presentation in which he stressed the increasing

role the university plays in advancing agriculture research, innovation and technology, and importantly in capacity building to help other countries adopt the technologies being developed.

"Our mission is to enhance UWA's contribution to the advancement of agriculture and natural resource management in selected international, national and regional settings."

"For Western Australia, the Institute works with the agriculture industry to create knowledge, and improve workforce skills, to contribute to local and regional prosperity."

A video overview of IOA's new research themes; Crops, Roots and Rhizosphere, Sustainable Grazing Systems, Water for Food Production, Food Quality and Human Health, and Agribusiness ecosystems was played and is available online [ioa.uwa.edu.au/publications/videos](http://ioa.uwa.edu.au/publications/videos).

Prof Robyn Owens, Deputy Vice Chancellor Research summed up the event and reflected on the changes in modern farming and the critical role IOA plays in bridging the gap between the University and industry.



## DIRECTOR'S COLUMN

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**In this issue of the newsletter, I have chosen to highlight some of the achievements our students studying agriculture and related areas have made (see pages 3, 5, 6, 10 and 12). Students make strong contributions to research and are an important part of UWA's research culture.**

Capacity building is an incredibly important for sustainable agriculture and food production. Through capacity building, we can take steps to close the gaps in agricultural development and productivity in developing countries. Offer letters are being sent to fifteen Pakistani students to undertake PhD research training in agriculture at UWA (joint project with University of Agriculture Faisalabad (UAF), Pakistan). Upon completion, these students will return to their home country with a wealth of knowledge, and the tools to improve food production with better management practices. Previously we have trained 12 PhD students from UAF in agriculture at UWA.

Some of our top PhD students will present their research in agriculture and related areas at UWA on Wednesday, 8 June 2016 at the annual Postgraduate

Showcase: Frontiers in Agriculture. All are welcome so please do mark your calendars and register online at [ioa.uwa.edu.au/events/register](http://ioa.uwa.edu.au/events/register).

Recently UWA has had six subjects ranked in the top 50 in the QS World University Rankings by Subject ([www.qs.com](http://www.qs.com)). In particular, Agriculture and Forestry category UWA continued the upward trend and jumped three places to 38 in the world. Congratulations to all involved.

In March, we released IOA's Strategic Plan 2015-2019 at an event attended by approximately 80 members of the agriculture industry and scientific community (see cover story). A video describing IOA's five cross-disciplinary research themes was aired, and it can be viewed on our homepage [ioa.uwa.edu.au](http://ioa.uwa.edu.au).

The annual IOA Industry Forum will be held on Thursday, 7 July 2016 at UWA. The Industry Forum is one of the key events in our calendar, and is driven by our Industry Advisory Board who choose a topic that is pertinent to the agriculture industry in WA and nationally. The topic for this year's event is Australia's Free Trade Agreement with China and its impact on the agriculture industry. All are welcome to participate in the lively discussion on how Australia's agriculture sector can leverage from the agreement to meet China's demand for the high quality, safe foods we produce. Register online at [ioa.uwa.edu.au/events/register-industry-forum](http://ioa.uwa.edu.au/events/register-industry-forum).

Our Industry Advisory Board is a particularly well-functioning group. It comprises of representatives from the agriculture industry, who provide strategic advice to IOA to work towards our common goal of advancing agriculture. We held our first meeting for 2016 in March and welcomed Mr Tym Duncanson from the Department of Water, and Mr Rob Dickie from CBH Group. Tym and Rob have replaced Ms

Verity Klemm and Dr Richard Williams respectively who have completed their terms. They were both excellent contributors and served the board well. Ms Tress Walmsley, CEO, InterGrain has accepted the Vice Chancellor's invitation to join the board, and will attend her first meeting later this year.

The United Nations Food and Agriculture Organisation (UNFAO) has designated 2016 as the International Year of Pulses (the hashtag is #IYP2016 for the social media experts amongst us). Pulses play an important role in farming systems for crop diversification, nitrogen fixation and availability of other nutrients in the system. They also have beneficial effect for human health, including reduction in cardiovascular disease, diabetes, obesity and neuro- degenerative diseases. I am humbled and honoured to have been designated a Special Ambassador for Pulses, to support the UNFAO in raising public awareness on the important contribution of pulses to sustainable cropping system, food and nutritional security especially in developing countries. I will be reporting more about pulses in the August issue.

Finally, I'd like to thank Prof Daniel Murphy for his excellent support as IOA Associate Director throughout 2015. Prof Wallace Cowling has been appointed as the new IOA Associate Director and Prof Phil Vercoe will continue in his current role as IOA Associate Director.



Kelmscott Senior High School students on the school farm  
Photo Credit: Kelmscott Senior High School

## UWA INVOLVED IN SPECIALIST AGRICULTURE PROGRAM AT KELMSCOTT SENIOR HIGH SCHOOL

Debra Mullan, FF2050 Project Officer  
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**Prof Graeme Martin and E/Prof Lyn Abbott have been engaging with students at Kelmscott Senior High School's Specialist Agriculture Program.**

The Specialist Agriculture Program is aimed at academically capable students with a keen interest in agriculture and the biological sciences. Students follow an accelerated agricultural curriculum from Years 7 – 10, and develop practical skills that extend their understanding of food and fibre production in modern Australia.

Prof Martin visited the school in October 2015 and gave Year 7 and 8 students an overview of sustainability, the importance of agriculture, why a 'business as usual' approach is no longer good enough and the different career opportunities within the agricultural sector. He also explained how the Future Farm 2050 Project at UWA Farm Ridgefield addresses the many challenges facing agriculture in the future.

E/Prof Lyn Abbott followed up with a visit to the school in November 2015 and facilitated a 'Living Soils activity'. She introduced students to the importance of soils and undertook an activity to understand the variety of living animals in different soils types.

These students will visit UWA Farm Ridgefield later this year to see first-hand the many exciting projects at the farm.



Ridgefield Farm Manager Steve Wainwright with assistant Harry Williams and the four interns

## FRENCH INTERNS MAKE RIDGEFIELD HOME FOR SIX MONTHS

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**UWA Farm Ridgefield hosted four French interns from September 2015 to March 2016. The interns came from France's top agricultural colleges: Sébastien Abric from AgroParistech, Margaux Weyer from Agrocampus Ouest, Julien Bajard from Montpellier Supagro and Camille Petit from ENSAT Toulouse, and stayed at the Old Farmhouse for the duration of their internship.**

The aim of the internship was to work on a project within the Future Farm 2050 Project and gain experience in Australian broadacre agricultural systems.

Much of the research conducted through the Future Farm 2050 Project pursues a vision of 'clean green and ethical' systems for livestock management. The students worked with Prof Phil Vercoe on his research which aims to minimise the environmental footprint, especially greenhouse gas emissions.

They also had the opportunity to work on other research farms such as the Department of Agriculture and Food WA's (DAFWA) Mt Barker Research Station and Medina Research Station. This included working with DAFWA researcher on the Merino Lifetime Productivity Project, a joint project led by Prof Graeme Martin with the Australian Wool innovation, Australian Merino Sire Evaluation Association, DAFWA and Murdoch University.

In addition to the project work, the interns provided support in the day-to-day workings of an operational farm and assisted with harvest, farm mechanics, building fences and working with animals including sheep, goats and dogs.

Camille Petit said she especially enjoyed working with animals and learning about sheep and farming in drier climates than what she is used to. In addition to the agricultural experience, she loved improving her English and getting an insight into Australian culture.

## Hackett Professors of Agriculture commemorate founding father



UWA's three Hackett Chairs in agriculture, Kadambot Siddique, Alan Robson and David Lindsay honour Hackett's legacy at St George's Cathedral

**The man who founded UWA, Sir John Winthrop Hackett, was commemorated at a special service held at St George's Cathedral on 21 February 2016.**

Chairman of the Royal Commission on the establishment of the University and its first Chancellor, Hackett (1848-1916) is credited as UWA's founding father.

He was also part-owner and editor of The West Australian newspaper, a member of the Western Australian Legislative Council and Chancellor of the Anglican Diocese of Perth.

Hackett was a passionate advocate of free and accessible education for all and The University of Western Australia had the distinction of being the first

free university in the British Empire, established to 'advance the prosperity and welfare of the people'.

As well as founding UWA and endowing many of its scholarships through his generous gift (equivalent to more than \$52 million today), Hackett insisted that our founding professorial appointment come from agriculture.

In addition to Hackett family members a number of dignitaries including UWA Vice-Chancellor Prof Paul Johnson, attended the commemoration.

UWA's three Hackett Chairs in Agriculture, Prof Kadambot Siddique, E/Prof Alan Robson and E/Prof David Lindsay attended the event to honour Sir Hackett's remarkable, enduring legacy.

## AUSTRALIA AND BRUNEI WORK TOGETHER TO STRENGTHEN AGRIBUSINESS SECTOR

**A delegation of agribusiness experts from IOA led a workshop on Facilitating Agribusiness Development in Brunei Darussalam in April. The event was funded by the Australia-ASEAN Council and supported by the Australian High Commission in Brunei Darussalam. A total of 52 government officials and private sector stakeholders participated in the workshop.**

Adjunct Professor Peter Batt, Dr Nazrul Islam and Agribusiness ecosystems Theme Leader Dr Amin Mugera worked closely with Brunei Darussalam's Department of Agriculture and Agribusiness (DOAA) to develop the workshop, and ensure it was responsive and sensitive to the needs and strengths of Brunei. Topics included improving productivity, adding value by understanding your customers and adoption of agricultural technology.

The Australian High Commissioner His Excellency Todd Mercer who opened

the workshops said Professor Batt, Dr Islam and Dr Mugera had an incredible depth of expertise to share with their Bruneian counterparts, and that he looks forward to seeing the outcomes of their collaboration. The closing ceremony was attended by both the Minister for Primary Resources and Tourism Dato Paduka Awang Haji Ali bin Haji Apong and the Permanent Secretary of Ministry of Primary Resources and Tourism, Dr Haji Abdul Manaf bin Haji Metussin.

The workshop outcomes are expected to contribute to the development of

a holistic, systems-based framework to support agribusiness development in Brunei, directly supporting the Brunei Government's economic diversification agenda.

During the visit, the UWA team visited major agribusinesses and farms to see Bruneian agricultural practices and processes first hand. They also delivered a lecture at Universiti Brunei Darussalam on food security and the challenges faced by governments worldwide in ensuring that there is sufficient food for a growing population in a time of diminishing resources and a variable, changing climate.



Batt, Muger, Islam at the workshop in Brunei Darussalam

## Mike Carroll's fellowship to benefit sheep production

The Mike Carroll Travelling Fellowship is a memorial to the late Dr Mike Carroll, who was associated with the WA Department of Agriculture for over 20 years, serving as Director-General from 1990 to 1994.

Mr Joseph Steer and Ms Anna Aryani Amir, both from UWA's School of Animal Biology and Institute of Agriculture received the 2014 and 2015 fellowship respectively at a ceremony on 25 February 2016. The fellowship gave them the funds to visit and learn new techniques from national and international research centres to advance their studies.

Joseph Steer, whose research is funded by the Australian Wool Innovation and Department of Agriculture and Food WA, spent five weeks at Rothamsted Research in England studying methods to identify which odours attract blowflies to sheep.

"Understanding how these odours influence blowflies provides sheep breeders with an opportunity to selectively breed sheep for resistance to flystrike, a disease that costs the Australian sheep industry around \$280 million dollars a year," Joseph said.

"Such a breeding objective would reduce the need for sheep to be muelsed."

The 2015 fellowship recipient, Anna Aryani Amir used the Mike Carroll Travelling Fellowship to collaborate with the Turretfield Research Centre in South Australia, a world leader in in vitro fertilisation studies in sheep. Anna is researching the effect of plant extracts and plant secondary compounds from grazing new legume pasture *Biserrula pelecinus* on reproduction of sheep.

"We learnt from clover disease outbreak in the 1950s that plant secondary compounds from pastures sheep graze on can affect fertility in sheep," Anna said.

"At the Turretfield Research Centre, I learned how to manage and process eggs sourced from ovaries at random stages in the reproductive cycle to analyse the effect plant extracts have on sheep fertility."

Mrs Helen Carroll, who presented the awards with her son, Mr Andrew Carroll, at a ceremony at UWA's Faculty of Science said the Fellowship honours her deceased husband's devotion to agriculture, and his tireless efforts to give back to the agricultural community.

"Recipients of the fellowship are chosen not just on academic ability, but their potential to benefit from the experience, and their enthusiasm to impart the findings of their travels to the scientific, farming and wider community on their return to WA," Mrs Carroll said.



Ms Cassidy Chambers

## UWA AG SCIENCE STUDENT AWARDED ROB ASHMAN SCHOLARSHIP

Third year undergraduate student, Cassidy Chambers has won the inaugural Rob Ashman Memorial Scholarship.

The scholarship, which was sponsored by Hassad Australia and the South East Premium Wheat Growers' Association (SEPWA), was developed to raise the awareness of depression in rural Australia and support capacity building in agriculture.

It is in honour of Rob Ashman, who sadly took his life in 2015 after suffering from depression for many years. Rob managed properties for Hassad Australia and was an active member of SEPWA.

Cassidy Chambers, who hails from a family farm north of Ravensthorpe is in her third year of study at UWA, majoring in agriculture science and environmental science.

"Growing up on the farm, I have always been interested in all agriculture, the new technology and how much our farming practices have changed even in my lifetime," Cassidy said.

"It's a huge part of our future and I really want to be actively involved in that."

Following the completion of her studies, Cassidy would like to work in the agronomy field with a particular focus on crop nutrition.

The scholarship is available provides a bursary of \$3500 and the opportunity to work with SEPWA for a work experience to an undergraduate student studying agriculture related areas.



Students Joe Steer and Anna Amir with Mrs Helen Carroll and son Mr Andre Carroll

# Tapping the wisdom of French herders

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**Dr Michel Meuret, Director of research at the National Institute for Agricultural Research in France delivered an IOA Public Lecture titled Pastoral livestock systems in France: managing productivity, landscapes and communities during his visit to Australia in March 2016.**

Dr Meuret has been working with French herders for over 25 years, and shared some fascinating insights about the French systems of grazing and herding techniques.

“As we have come to rely on experimental science to understand principles, we place less emphasis on the hands-on experience in understanding and implementing practices,” Dr Meuret said.

“Through experience, herders have learnt a ‘know-how’ of the processes involved in food and habitat selection.”

Dr Meuret and colleagues shadowed herders in south-eastern France on their grazing circuits, took surveys and in situ recordings of the foraging behaviour and conducted semi-structured interviews with the herders.

In the lecture, Dr Meuret described the interrelated relationship between the herder, the herd and the available fodder. He said the herders teach the herd to respect the grazing boundaries and to forage on the full range available in the grazing areas. They use a ‘temporary palatability scoring’ of forages to ensure the herd consume a wide variety, and even establish daily grazing circuits that are designed to stimulate appetite and intake.

He concluded by stressing the importance of more dialogue between scientists and herders so both farmers’ objectives and the environmental objectives are met.



Daily grazing circuits are designed to stimulate appetite

## Iraqi Masters student takes home CSIRO Agriculture Director Award

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**Iraqi Masters student Doraid Amanoel in the School of Animal Biology and CSIRO has been awarded the CSIRO Agriculture Director Award for Outstanding Publication, for his paper on Vitamin E deficiency in sheep.**

He found that Vitamin E deficient sheep are able to detect and consume more of a Vitamin E enriched feed - a discovery that has the potential to provide low-cost management solutions for the livestock industry.

The award, which is typically awarded for outstanding publications from students at the PhD level, was jointly awarded to Doraid and Deakin University PhD student Michael Salini.

Doraid is a Livestock Industry Officer and has been working with the Ministry of Agriculture and Water Resources, General Directorate of Agriculture, in Dohuk, Iraq since 2006. He said his rural background requires high quality knowledge and skills in agriculture to boost the economy.

“My education in Australia is helping me to build an agricultural link between Australia and Iraq based on modern scientific



Doraid Amanoel wins award for his research into Vitamin E deficiency in sheep

innovation which will help me to contribute to a positive change in both countries,” Doraid said.

“The findings of this study have the potential to provide low-cost management opportunities in areas where the incidence of Vitamin E deficiencies and the associated nutritional myopathy are high due to a lack of green pastures during dry seasons.”

UWA supervisor Assoc/Prof Dominique Blache said the achievement of high impact science from a student project was achieved due to a number of factors, the least of which being Doraid’s exceptional talent and hard work.

“Doraid’s Masters project required a wide range of skills in its design and execution. The expertise and advice needed was available to Doraid because of the collaborative partnership between UWA Animal Biology and CSIRO Mixed Livestock Systems groups,” Assoc/Prof Blache said.

“Doraid engaged with CSIRO after introducing himself at the end of lecture at UWA. He has developed an excellent collaborative work ethic, and these interactions are highlighted by the number and diversity of CSIRO and UWA staff involved as co-authors or acknowledged in Doraid’s research paper.”

Doraid’s research was supported with funding from the CSIRO Agriculture Flagship, AusAID Australian awards and the Australia-Iraq Agricultural Scholarship. IOA was responsible bring Doraid and several other Masters students from Iraq to UWA as part of the above scholarship program.



# Industry careers night for ag students

**Approximately 60 students studying agriculture and related disciplines across WA attended the annual Agricultural Careers Night, on 6 April 2016.**

The event, organised by the Agriculture Institute Australia WA Division, was held at the Royal Agriculture Society Showgrounds in Claremont. Groups of students rotated through the 15 industry representatives in ten-minute round-robin intervals.

IOA was once again a major sponsor of the event and was represented by IOA Director, Hackett Professor Kadambot Siddique, Associate Professor Megan Ryan and Communications Officer Diana Boykett.

IOA Director, Prof Kadambot Siddique encouraged undergraduate students to consider pursuing an Honours or Master’s degree in agricultural science.

“The fourth year of study is the icing on the cake. Besides focusing their agricultural knowledge, students learn important skills like science writing, communications and project management, which employers’ value highly,” Prof Siddique said.

“The degree structure at UWA is flexible. Students can complete a three-year Bachelor’s degree, a two-year Master’s degree, a fourth-year Honour’s research project, and if they want to, they can come back to do a final year of coursework to be awarded with an internationally recognised Master’s degree.”



Associate Professor Megan Ryan talks to agriculture students as AIA Careers night

## International Conference on Pulses for Health, Nutrition and Sustainable Agriculture in Drylands

Under the United Nation's 2016 International Year of Pulses (IYP2016), the International Conference on Pulses for Health, Nutrition and Sustainable Agriculture in Drylands was held in Marrakech, Morocco from 18 to 20 April 2016.

The conference was organised by the International Center for Agricultural Research in the Dry Areas (ICARDA), Institut National Recherche Agronomique (INRA)-Morocco, OCP-Foundation, IFAD, UNFAO and CRP-GL and brought together world experts to find a path forward to boost pulse production in developing countries using science, development investments and policy.

In attendance were 250 participants from 32 countries, which notably included 95 students. UWA was well represented through two keynote presentations in sessions on Innovations in Pulse Breeding, by Prof William Erskine, and Innovations in Productivity Management delivered by Prof Kadambot Siddique.

During the meeting the United Nations Food and Agriculture Organization (UNFAO) designated Prof Siddique the Special Ambassador for Pulses 2016.

As Special Ambassador, Professor Siddique will raise awareness on the important contribution of pulses to food security and nutrition, including the positive impact of pulses to climate change, human health and environmental sustainability.

At the close of the conference the participants made a Morocco Pulses Declaration.



### Vale Dr Andrew David Halsted Stewart

*(5 June 1942 – 7 December 2015)*

**Dr Andrew David Stewart passed away peacefully at home on 7 December 2015. He was 73 years old.**

Dr Stewart and family have a long association with The University of Western Australia. He was a medical graduate of UWA, specialising in ophthalmology and was a former President of the Royal Australian and New Zealand College of Ophthalmologists.

The Hector and Andrew Stewart Memorial Lectureship is in memory of Dr Stewart's grandfather, the late Mr Hector J Stewart, MLC, and his father, the late Mr Andrew Malcolm Stewart, who was a member of UWA's teaching staff in agriculture from 1937 to 1959, and Assistant Director of The UWA Institute of Agriculture. His uncle, Sir Hector Stewart was a former Pro-Chancellor of UWA.

Dr Stewart continued his family's devotion to agricultural education through his strong support of the Memorial Lectureship. Dr Stewart was well-known in WA for his hobby, buffalo breeding and was one of the first breeders to import buffalo from the Northern Territory in the 1980s.

Dr Stewart will be sadly missed by members of The UWA Institute of Agriculture.



Diana Boykett and Associate Professor Megan Ryan at the GRDC Grains Research Update, Perth

## Strong UWA presence at GRDC Grains Research Update

**UWA was well represented by staff and students from IOA at the annual Grains Research and Development Council's (GRDC) Grains Research Update in Perth.**

The event, facilitated by Grains Industry Association of WA (GIWA) was held on 29 February and 1 March at the Perth Exhibition and Convention Centre, and attracted approximately 600 grains industry personnel, growers and researchers.

Dr Louise Barton from IOA and the School of Earth and Environment presented findings from a review assessing nitrogen loss and supply from the Western Australian cropping systems done in partnership with the Department of Agriculture and Food WA.

Field-based studies using granular urea, demonstrated loss of nitrogen fertiliser to the atmosphere via ammonia volatilisation can be as high as 29% from WA cropping soils, and that soil a significant source of plant-available nitrogen.

"Further research is needed to quantify soil nitrogen mineralisation and ammonia volatilisation rates under current WA farming practises," Dr Barton said.

"Importantly, the findings need to be incorporated into decision support tools for farmers."

Dr Ken Flower from IOA and the School of Plant Biology updated attendees on the long-term effects of crop rotation and residue retention on wheat crop performance.

"Over the nine years of the trial, continuous cereal had the highest mean gross margin, followed by monoculture wheat," Dr Flower said.

"Heavy canola residues had no effect on wheat yield, whereas heavy cereal residues reduced yields in some years, especially when the harvester did not spread the material uniformly."

UWA's IOA and School of Plant Biology had joint boot at the conference venue.

A copy of all presentations can be downloaded at [www.giwa.org.au/2016researchupdates](http://www.giwa.org.au/2016researchupdates)

## ASIA AUSTRALIA FOOD INNOVATIONS

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**The 2nd Asia Australia Food Innovations Conference (AAFIC) was held on 17-18 March 2016 in Perth and brought together over 200 delegates across both days.**

Res/Prof Jonathan Hodgson from the Faculty of Medicine, Dentistry and Health Sciences and IOA who helped organise the event, said the conference focused on assisting players in the Australian food industry to capitalise on insights and emerging trends in Asia, and boost the information flow through all aspects of the supply chain.

"Technological advances within the food industry, and in the wider scientific community, have redefined the way we produce process value-added foods," Prof Hodgson said.

"While these developments have delivered a more efficient food production system, a greater variety and larger export quotas of processed foods, they have also raised a number of challenges which need to be addressed."

Mr Peter Schutz, Chair of Food Innovation Australia Limited gave the keynote address and discussed strategies to grow Australia's food and agribusiness sector.

A wide range of topics were discussed including agri-food security, functional food and health, value adding for export and grains innovation.

## INTERNATIONAL EXPERIENCE IN AGRICULTURE AND ENVIRONMENTAL SCIENCE FOR UWA STUDENTS

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In December 2015, ten UWA students from UWA's Faculty of Science visited Naresuan University near Phitsanulok in Thailand on a two-week international field course in agriculture and environmental science.

This short-term visit was a collaborative learning program where UWA students were matched with Thai students from the Faculty of Agriculture, Natural Resources and Environment at Naresuan University. Funding was provided through the Study Abroad program.

UWA students visited Nam Nao National Park as well as a rubber plantation where Dr Wanwisa Pansak from the Department of Agricultural Science at Naresuan University is investigating planting of crops under rubber trees to quantify water use efficiency.

The Thai postgraduate students demonstrated the use of field equipment and helped UWA students participate in soil monitoring activities. UWA students prepared literature reviews and research proposals on environmental issues in Thailand with the support of lectures from academic staff at Naresuan University.

Students gained insight into international agricultural and environmental issues and found similarities as well as differences in how these issues are dealt with in Australia and Thailand. Experience of different cultural practices and development of communication skills were important benefits from the visit. Students found the visit to Sukhotai Historical Park was particularly interesting and which gave them insight into a very significant 700 year old Province in Thailand.

UWA's collaboration with Naresuan University has been developed over several years and it strengthens cultural understanding and broadens knowledge of agriculture in an environment. UWA students maintain contact with Thai students through social media, and this prolongs the benefit of the international field course.



Thai postgraduate students demonstrate soil monitoring techniques in the field

## Joint UWA-Tottori University Symposium on Dryland Research

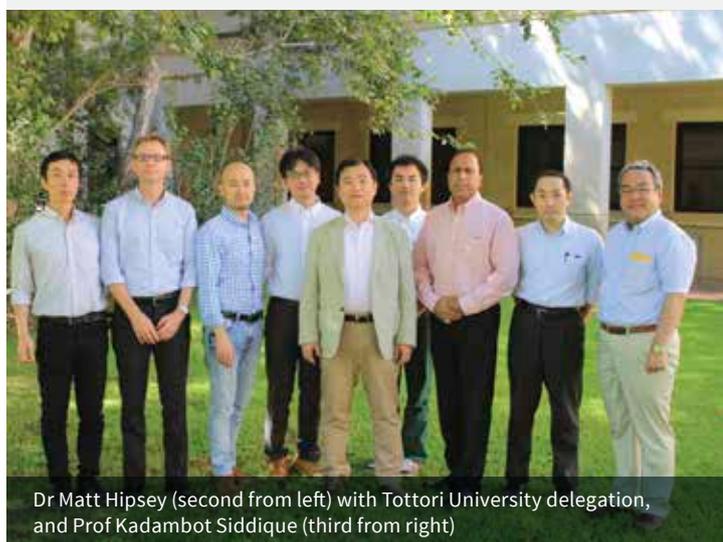
A delegation from Tottori University, Japan visited UWA in March to discuss the challenges in understanding and managing drylands.

Dryland systems are sensitive to changes in water use and extraction yet at the same time provide options for food production and other economic activity. They are also some of the areas expected to be most severely impacted under projected climate change scenarios.

Dr Matt Hipsey from the School of Earth and Environment and IOA Research Theme Leader organised a half day symposium to share knowledge between colleagues from UWA and Tottori University. Recent advances across a broad spectrum of research areas were highlighted including catchment systems and dryland ecohydrology, dryland agriculture, conservation and viable living in a dry land.

Professor Dai Nagamatsu delivered a keynote address on the International Platform for Dryland Research and Education at Tottori University.

The participants agreed to collaborate on dryland research and capacity building between the two universities.



Dr Matt Hipsey (second from left) with Tottori University delegation, and Prof Kadambot Siddique (third from right)

# Unlocking miRNA-mediated regulatory mechanisms underlying plant response to chromium stress

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**Chromium (Cr) is one of the most widely distributed environmental contaminants, with its hexavalent form (Cr<sup>6+</sup>) being an extremely toxic carcinogen.**

Phytotoxicity caused by chromium contamination can result in inhibition of seed germination, nutrient balance and enzymatic activities, reduction of root growth and crop yield. Hexavalent Cr contaminated food poses potential health hazards to humans and animals.

Dr Yinglong Chen from UWA's Institute of Agriculture and School of Earth and Environment in collaboration with Nanjing Agricultural University, China and North Dakota State University, USA used advanced next-generation sequencing (NGS) technology, to understand the regulatory roles of miRNAs in response to Cr stress in radish, a root vegetable crop with economic and dietary importance to China.

The study found that several target genes for Cr-responsive miRNAs encoding different transcription factor

families might regulate corresponding HM-related transcriptional processes in plants.

The researchers also found that a few key responsive enzymes or proteins (HMA, YSL1 and ABC transporter protein) were involved in Cr uptake and homeostasis process.

A schematic model of tolerance mechanism and regulatory networks in response to Cr stress was proposed based on the identification of Cr-responsive miRNAs and analysis of their corresponding target genes.

The findings of this study were published in Nature's prestigious journal *Scientific Reports* and could provide novel insights into miRNA-mediated regulatory mechanisms underlying plant response to Cr stress in root vegetable crops.



Harvest of edible radish crops in an experimental trial in China

## BIOTECHNOLOGIES VINE PERSPECTIVE

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The 'biotechnologies vine perspective' workshop held in January 2016 in Margaret River was a great opportunity to communicate progress on two ARC research grants in wine grapes.

Teams from UWA, DAFWA, Yalumba, the Australian Wine Research Institute (AWRI) and overseas had the opportunity to conceptualise the underlying genetic distinctions between clones of Cabernet Sauvignon, as the stage was set to taste several experimental wines from the DAFWA and Yalumba trials of Cabernet Sauvignon clones.

The clonal wines have certainly captured increasing attention as a means to accentuate regional identity, particularly of 'regional heroes', as Cabernet is for both Margaret River and Coonawarra.

DAFWA winemaker Richard Fennessey led a tasting panel by introducing his base wine. It invited differing opinions of what terms such as 'spice' and 'vegetal' mean in the context of Cabernet. Richard instructed the panel on the framework of the tasting, and scoring protocol, before introducing the experimental wines he'd made from both the 2014 and 2015 vintages.

The wines were assessed 'blind' and the 21 tasters (made up of professional viticulturists and winemakers) were asked to rank the intensity of 20 predetermined aroma and flavour attributes. The data from this sensory exercise is currently being statistically analysed in the aim to determine wine characteristics unique to each of the clones. This information will be used



21 professional viticulturists and winemakers rank the intensity of 20 predetermined aroma and flavour attributes in a blind tasting

to compliment the genomic work on these clones and potentially link genomic and sensory differences between the clones.

Senior red winemaker at Yalumba, Peter Gambetta then presented six clones of Cabernet Sauvignon produced from the Coonawarra wine region in South Australia, which are less readily available in WA, to compare the performance between the six clones. Most commented on how vastly different the styles of these wines differed from the Margaret River clones from the first session.

Dr Mick Considine delivered one of four short seminars to conclude the event, continuing the topic of clonal variation with some insights to the progress of the ARC grant 'Genomic basis of clonal variation in Cabernet Sauvignon wine grapes'.

## Honours degree gives ag students a head start

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**Since completing my Honours in Agricultural Science in 2015 at UWA I have started working at Agribusiness Research and Management (ARM) in Busselton as a Horticultural Business Graduate.**

ARM provides project management services for horticultural projects including avocado and vineyard operations. ARM aims to maximise efficiency of operations in terms of improving production whilst remaining cost effective. I am involved in the technical and operational side of the business which includes researching best practice farming, deciding upon its effectiveness and practicality,

implementing and monitoring practices and deciding upon usefulness for future years.

Completing my Honours degree at UWA gave me the skill set and networking opportunities to successfully gain graduate employment. Managing and being responsible for my own research project gave me the opportunity to enhance my problem solving skills, communication skills and independent learning and research skills.

Honours also gave me a more in-depth understanding of farming systems so I now have the ability to make better informed insights and decisions about actual farming operations. The learning experience during Honours made it a very rewarding year as I can now take the skills and discipline I have acquired into the workplace.



Prof Graeme Martin (centre) with some of the participants at the Sex in Three Cities lecture series

## The 3 Ps of Reproduction: Photons, Pheromones and Phood

Prof Graeme Martin  
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**Prof Graeme Martin from UWA's School of Animal Biology and Institute of Agriculture was recently delivered the 2016 'Sex in Three Cities' lectures for The Society of Reproduction and Fertility (SRF), an initiative designed to promote awareness of SRF and of reproductive biology research.**

Each year, the SRF invites a renowned scientist to present lectures to a broad audience including academics, students and the general public, in Edinburgh, Nottingham and London. The lecturer also interacts informally with staff and students at each location. Previous lecturers include Professor Lord Robert Winston in 2013.

For about 40 years, Prof Martin and his colleagues have been trying to understand how environmental factors affect the reproductive system. Most of their basic research has been on animals but is also relevant to human fertility because it is difficult to ask fundamental questions with experiments on people. Prof Martin thus focused his lecture on the humble sheep: its

reproductive physiology is similar to that of humans but is also an important industrial animal.

The sheep brain takes in information about night length (photons), the odours of its flock mates (pheromones), and the availability of food (by measuring the metabolic status of the body), and integrates this information with information about reproductive status (puberty, pregnancy, lactation). It then enacts a strategy that has been fine-tuned over evolutionary timescales to maximise reproductive success.

"As with most scientific journeys", Prof Martin said, "unexpected discoveries about reproduction in sheep have presented us with new perspectives about mammalian biology. For example, we used to think that brain cells could not divide, but now we know that they can do so in response to photons and pheromones from the outside world."

"We also used to view reproduction as a simple process in which the brain produces a hormone that stimulates the ovaries and testes, but now we know that brain-gonad communication is an intricate two-way exchange."

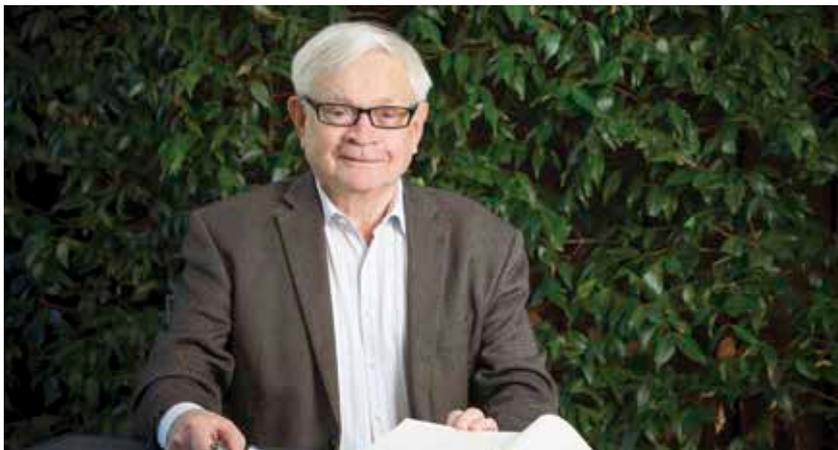
"Even within the gonad there's a whole extra suite of communication channels, perhaps the most astonishing of which involves a massive group of molecules called 'small RNAs' that are produced by DNA and interfere with the control of the cells by the genes," Prof Martin said.

"Gone is the simple traditional view that a gene produces RNA that produces a protein."

According to Prof Martin, these discoveries have three major implications. First, because we now know that brain cells can divide, we are increasingly optimistic about the possibility of regenerating and repairing brain tissue. Second, 'small RNAs' offer a whole new suite of possibilities for dealing with problems in malfunctioning tissues. Third, photons, pheromones and food have led to 'clean, green and ethical' options for managing livestock.

More information about previous lectures can be found at [www.srf-reproduction.org/EducationAndEngagement/Sexin3CitiesLectureSeries.aspx](http://www.srf-reproduction.org/EducationAndEngagement/Sexin3CitiesLectureSeries.aspx)

## PART 1: REFLECTIONS ON BEING TAUGHT RESEARCH AT THE UWA INSTITUTE OF AGRICULTURE, 1957-1965



E/Prof Ivan Kennedy  
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### **IOA Director, Prof Kadambot Siddique, asked me to reflect on my education at UWA half a century ago.**

I graduated in the 5-year degree BSc(Agric)(Hons) in February 1962, then with a 3-year PhD before setting off in June 1965 for the United Kingdom. I boarded the Fairstar from Fremantle, later flying Pan-American to the USA, on CSIRO and Fulbright fellowships. How well did this education fit me for my future intellectual tasks?

Let me take you back to 1957, when Professor Eric Underwood, world renowned for trace element nutrition in humans and animals, was the sole professor and director of Agriculture. He was well supported by young members of staff such as RJ Millington, John Gladstones, Reg Moir, Lex Parker, Don Drover, Max Parker, Henry Schapper, Hadyn Lloyd-Davies (CSIRO), and later Bruce Davidson, public debater of Sir Charles Court. It was also said that Vice-Chancellor Prescott knew by sight almost every student on campus (less than 1500) or sought to do so.

I recall being told by the Registrar in Orientation Week 1957 that only one of either me or my neighbour seated in

Winthrop Hall could expect to survive to second year. This prediction was realised as our first year group of 27 in Agriculture was reduced to 14 in second year (i.e. 13 men and Elizabeth Banks), but all of whom eventually graduated.

First year students were often given lectures by the subject professors. So we benefited from intriguing sessions with Harry Waring (Zoology 1 – anecdotes in reproductive biology sufficiently dramatic to attract engineers to Saturday lectures and a huge subject in which one final rat dissection counted for half the final marks), Don Prider (Geology – innumerable 35 mm slides on geomorphology and a prediction oil would be found under Perth), Andrew Cole (Chemistry in action) and Brian Grieve (Botany and Blackall's keys to wildflower taxonomy) with Charles Gardner lecturing us Botany 2 the very day Mario Lanza died.

A feature of our undergraduate course was flexibility of choice in optional units of study from the basic curriculum, with the Dean's approval. Thus some of our group chose Biochemistry 2 instead of Botany 3 in fourth year, or in my case Chemistry 2, following up with a major in the honours year in Biochemistry 3 or even later in the PhD (Maths 2 and Chemistry 3).

Ivan Oliver, later Professor, gave "no-holds barred" lectures with his focus

on neo-natal rat biochemistry. I recall too the mind-expanding tutorials in thermodynamics run by Noel Bayliss in an upstairs room in the old Chemistry building in 1963. Bayliss had a direct connection with IOA having a research interest in the thermodynamics of nitrogen fixation, publishing with Lex Parker, my eventual choice as PhD supervisor.

With Lex on sabbatical, our microbiology in third year was delivered by Reg Moir, president of the rumen liquor tasters club. I always recall Reg's concluding statement in his lectures in Agricultural Microbiology that "It ain't necessarily so".

Lex Parker was remarkable for his imaginative approach to research, the variety of topics he entertained, always prepared for endless discussion – definitely one of Nature's gentlemen. The Department of Soil Science and Plant Nutrition was established with some friction by Jim Quirk and Alan Posner around 1962, with Jack Loneragan appointed soon after.

Critical attitudes were reinforced at IOA in Biometrics taught by statisticians such as Norm Sternhill (who I recall discussing the statistics of whether lawyers are just procrastinators or liars as well) and Clive Boundy (I recall my brilliant colleague Mike Dilworth was in dispute with), both statisticians from CSIRO at the rear of the IOA building. Of course this approach is all based on Fisher's analyses of population variance and tests for treatment significance he developed for agricultural researchers. There is a second connection with Rothamsted in that two of my books published by Wiley were edited by Phillip Nutman, head of microbiology there in the 1960s.

So we emerged from the IOA nearly all preferentially different. Add to that my post-doc period working with pioneers in molecular biology such as HL Kornberg (later Sir Hans as Professor of Biochemistry at Cambridge University),

anaerobic biochemistry (Gareth Morris later at Aberystwyth) and nitrogenase purification (with Len Mortenson at Purdue).

So when I arrived at the University of Sydney in February 1968 I felt equipped to tackle almost anything. Some of this future license is summarised in the four books below, written as answers to questions posed by students and colleagues. If you don't know something, just write a book on the topic!

My opus magnum is clearly *Action in Ecosystems* (2001) though this conclusion has yet to show in citations. The most frequently cited book is *Acid Soil and Acid Rain* (1992), one that seems to be in every university library in northern America, even with multiple copies in the New York City Library. It simply writes down all the chemical and biochemical reactions for acidifying and alkaline processes in ecosystems and suggests how to manage them. So those long discussions with Lex late in the week have paid as games for formulating null hypotheses and testing to see if they stand or fail.

Even my PhD project with Lex on primary products of symbiotic nitrogen fixation resulted in me rejecting a hypothesis advanced (admittedly on flimsy evidence) that AMP-NH<sub>2</sub> was such a primary product, given the need for ATP. But it concluded that modelling data using from exposures of serradella nodules to heavy nitrogen (15N<sub>2</sub>) ruled this out. Instead, they were consistent with ammonia being the primary product, then forming glutamine and glutamic acid. This is all strictly Karl Popper philosophically and similar falsification of hypotheses has figured strongly in our work ever since. Proving your hypotheses wrong is far more compelling and honest for advancing truth than any amount of data just in confirmation.

*To be continued in the next issue.*



Bean experiment in large pots under field conditions with a rain-out shelter

## Study leave to study beans

Assoc/Prof Erik Veneklaas  
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**Associate Professor Erik Veneklaas from UWA's School of Plant Biology and Institute of Agriculture has spent five months of study leave investigating the physiology of common bean (*Phaseolus vulgaris*) at the International Centre for Tropical Agriculture (CIAT).**

Located in Colombia, CIAT is one of the largest CGIAR centres, and is a former workplace of Assoc/Prof Veneklaas who was employed there from 1996 to 1998 as a Tropical Ecologist. This visit, he was hosted by global leaders in the breeding and physiology of bean, Dr Steve Beebe and Dr Idupulapati Rao, who have decades of experience.

Common beans are the most important grain legume for human consumption at a world scale. They are particularly important in Latin America and East and South Africa. While generally grown on small farms, there is potential for commercial agriculture.

In Western Australia, there may be a niche for common bean in the northern grainbelt. Globally, drought and low soil fertility pose constraints on yield.

The research carried out by Assoc/Prof Veneklaas and collaborators, including researchers from UC Davis and University of Sydney, focussed on the impact of drought as well as low phosphorus availability on yield.

It involved field trials at two locations and a large pot trial under a rain-out shelter. The pot trial included detailed observations of the process of flowering, pod growth and grainfilling. An important aim was to improve understanding of the processes determining harvest index in this crop, particularly under abiotic stress. Research outcomes are likely to include new insights into how seed number, size and seed quality are influenced by when the pods grow and at which position in the plant.

Assoc/Prof Veneklaas also worked with CIAT colleagues in the cassava and tropical forages programs, and is planning to increase collaboration in the future. Collaboration with CIAT offers new opportunities for research funding, especially in East Africa and South East Asia, and also for postgraduate student exchange and recruitment.

# New Appointments

## Professor Wallace Cowling

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Professor Wallace Cowling has been appointed Associate Director of IOA. He will dedicate one day per week with Associate Director Professor Phil Vercoe to provide support to the Director on strategic and operational matters. The Associate Directors share responsibilities for initiatives with state and national funding bodies, international collaboration opportunities, and interaction and communication with relevant farmer groups.

Professor Cowling has been closely associated with IOA since 1999 when he accepted a position in Plant Breeding at UWA. It is an industry-funded position and is 70% involved in canola breeding in the company NPZ Australia Pty Ltd, and 30% involved in teaching and research. His research goal is to apply knowledge of evolutionary genetics, molecular genetics and biotechnology for efficient genetic improvement in plants.

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## Ms Tress Walmsley

Tress Walmsley, CEO, InterGrain has joined IOA's Industry Advisory Board.

Tress has over 15 years of agribusiness experience, along the way gaining a wealth of knowledge in commercial plant breeding operations with a strong understanding of the technical drivers required for success in the grains industry. Tress represents InterGrain on the National End Point Royalty Steering Group and the Grains Industry Association WA wheat committee. She is the 2015 WA Winner of the RIRDC Rural Women's Award.



## Exclusive Alumni Agriculture Tour

UWA's Development and Alumni Relations team invite UWA alumni to attend an exclusive agriculture tour on Wednesday, 8 June.

Take a behind-the-scenes tour of UWA's glasshouses with Hackett Professor Kadambot Siddique, Agriculture Chair and Director of The UWA Institute of Agriculture, and uncover just what UWA's researchers are doing to tackle agricultural challenges like climate variability, soil salinity and acidification, pests, diseases, weeds and more.

Places are limited and registration is essential at [alumni.uwa.edu.au/events](http://alumni.uwa.edu.au/events)



## AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Hackett Professor Kadambot Siddique	Foreign Fellow of the Indian Society for Plant Physiology
Hackett Professor Kadambot Siddique	United Nations Food and Agriculture Organization Special Ambassador for Pulses 2016

## VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
Mr Faisal Younus Khan	Pakistan	Prof Kadambot Siddique, Dr Ying Long Chen, Dr Jairo Palta (CSIRO)	02/03/16 – 10/08/16
Dr Ghulam Abbas	Pakistan	Prof Kadambot Siddique, Dr Ying Long Chen, Dr Jairo Palta (CSIRO)	22/03/16 – 22/08/16
Dr Bekka Brodie	USA	Prof Phil Vercoe	24/04/16 – 13/05/16
Dr Ruchi Bansal	National Bureau of Plant Genetics Resources (NBPGR), India	Prof Kadambot Siddique, Prof Hans Lambers, Dr Jiayin Pang	16/05/16 – 15/11/16

## NEW POSTGRADUATE RESEARCH STUDENTS

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Enoch Wong	Development and regulation of soil water repellence in cropping soils	School of Earth and Environment and IOA	Dr Louise Barton; Dr Matthias Leopold; Dr Phil Ward (CSIRO) and Prof Daniel Murphy	CSIRO (ex GRDC)

## MEMORANDA OF UNDERSTANDING (MoU) WITH EXTERNAL ORGANISATIONS

ORGANISATION	TITLE
Faculty of Veterinary Science, Yamaguchi University, Japan	MOU Signed October 2015
Gansu Academy of Agricultural Sciences, China	Letter of Extension MoU September 2015
Segou University, Mali	MoU Signed December 2015
The Regional Polytechnic Institute, Katibougou, Mali	MoU Signed December 2015
Jawaharlal Nehru University, New Delhi, India	MoU Signed February 2016

## NEW RESEARCH GRANTS

TITLE	FUNDING PERIOD	FUNDING BODY	SUPERVISORS
Towards genome methylation based crop improvement <sup>1</sup>	2015–2017	ARC Linkage	Prof David Edwards, Prof Jacqueline Batley, Mr David Pike, Mr Benjamin Laga
Establishing Novel Breeding Methods for Canola	2015	ARC Linkage	Prof Jacqueline Batley, Prof David Edwards, Mr David Pike, Dr Harsh Raman, Dr Stephen Rae

Impact of Weeds on Australian Grain Production & Adoption of No Till Cropping Practices'	2015	CSIRO Ex GRDC	Dr Michael Renton
Organic Matter and Nutrient Availability	2015	University Of Queensland Ex GRDC	Dr Louise Barton, Prof Daniel Murphy, Dr Fran Hoyle, Dr Craig Scanlan,
Innovative Approaches to Managing Subsoil Acidity in the Western Region	2015–2019	DAFWA Ex GRDC	Prof Zdenko Rengel, Mr Paul Damon
Novel use of antitranspirants to improve wheat yield in the grainbelt of Western Australia	2016	COGGO	Dr Ken Flower, Prof Kadambot Siddique
Interdisciplinary Wheatbelt Service Learning Unit	2015	Heartlands WA Ex Wheatbelt Development Commission	Prof Fiona Haslam-McKenzie, Prof Matthew Tonts, Prof Carolyn Oldham, Dr Antony Hughe-D'Aeth
Facilitating agribusiness development in Brunei	2016	Australian ASEAN Council, DFAT	Prof Kadambot Siddique, W/Prof Tim Mazzarol, Dr Peter Batt, Dr Amin Mugeru, Dr Nazrul Islam
The More the Merrier? Investigating copy number variation in Brassicas	2016–2018	ARC Discovery Projects	Prof Jacqueline Batley, Prof David Edwards
In touch with the environment: dissecting early tactile responses in plants	2016–2018	ARC Discovery Projects	Dr Olivier Van Aken, Prof Harvey Millar, Prof Karam Singh
RnD4Profit – 14-1-022- Waste to Revenue: Novel Fertilisers and Feeds	2015–2017	Australian Pork Limited	Dr Sasha Jenkins, E/Prof Lynette Abbott, Mr Ian Waite
Spatial Temperature Measurement and Mapping Tool to Assist Growers, Advisors and Extension Specialist Manage Frost Risk at a Farm Scale	2015–207	CSIRO Ex GRDC	Dr Ken Flower, Mr John Callow, Dr Bryan Boruff
Impact of Compost Carbon on Lettuce Growth and Soil Fertility	2015	C-Wise	Dr Zakaria Solaiman
A Long-term Study to increase Water Use Efficiency, Grain Yield and the Profit of Growers in the Western Region in a no-till system	2016–2018	GRDC	Dr Ken Flower
Genetic Analysis of Seed Dormancy for Pre Harvest Sprouting Resistance in Wheat	2015	YITPI Foundation PTY Ltd	Prof Guijun Yan, Dr Hui Liu, Prof Kadambot Siddique

## IOA 2015 Publications

*Not previously reported*

### Refereed journals

Anil B, Tonts M and Siddique KHM (2015) Grower Groups and the Transformation of Agricultural Research and Extension in Australia. *Agroecology and Sustainable Food Systems*, **39**(10): 1104-1123, DOI: 10.1080/21683565.2015.1081857

Chai Q, Gan Y, Zhao c, Xu HL, Waskom RM, Niu Y and Siddique KHM (2015) Regulated deficit irrigation for crop production under drought stress. A review. *Agron Sustain. Dev* DOI: 10.1007/s13593-015-0338-6

Hamouda I, Badri M, Meiri M, Cruz C, Siddique KHM and Hessini K (2015) Salt tolerance of Beta macrocarpa is associated with efficient osmotic adjustment and increased apoplastic water content. *Plant Biology* DOI:10.1111/plb.12419

Rengel Z, Bose J, Chen Q and Tripathi BN (2015) Magnesium alleviates plant toxicity of aluminium and heavy metals. *Crop & Pasture Science* **66**: 1298-1307

### Book Chapters

Kumar A, Salisbury PA, Gurung AM, and Barbetti MJ (2015). Importance and origin. Pp. 1-10, In: *Brassica oilseeds: breeding and management*. Eds. Kumar A., Banga S.S., Meena P.D., Kumar P.R. CABI (UK)

## IOA 2016 Publications

*(January – April)*

### Refereed journals

Ahmad A, Thomas GJ, Barker SJ and MacLeod WJ (2016) Genotype resistance, inoculum source and environment directly influence development of grey leaf spot (caused by *Stemphylium* spp.) and yield loss in narrow-leaved lupin (*Lupinus angustifolius*). *Crop and Pasture Science* **67**: 81-90

Allan CJ, Jones B, Falkiner S, Nicholson C, Hyde S, Mauchline S, Ferrier DA, Ward P, Siddique KHM and Flower KC (2016) Light grazing of crop residues by sheep in a Mediterranean-type environment has little impact on following no-tillage crops. *European Journal of Agronomy* **77**: 70-80

Anderson JP, Hane JK, Stoll T, Pain N, Hastie M, Kaur P, Hoogland C, Gorman J and Singh KB (2016) Proteomic analysis of *Rhizoctonia solani* identifies infection-specific, redox associated proteins and insight into adaptation to different plant hosts. *Molecular and Cell Proteomics*

Anderson W, Johansen C and Siddique KHM (2016) Addressing the yield gap in rainfed crops: a review *Agronomy for Sustainable Development* **36**: 18-30

Ashworth MB, Walsh MJ, Flower KC, Vila-Aiub MM and Powles SB (2016) Directional selection for flowering time leads to adaptive evolution in *Raphanus raphanistrum* (Wild radish). *Evolutionary Applications* **9**: 619-629

Bacon SA, Mau R, Neto FM, Williams RL and Turner NC (2016) Effect of climate warming on maize production in Timor-Leste: interaction with nitrogen supply. *Crop & Pasture Science* **67**:156-166

Bhandari K, Siddique KHM, Turner NC, Kaur J, Singh S, Agrawal SK and Nayyar H (2016) Heat stress at reproductive stage disrupts leave carbohydrate metabolism, impairs reproductive function, and severely reduces yield in lentil. *Journal of Crop Improvement* **30**: 118-151

Busi R and Powles SB (2016) Transgenic glyphosate-resistant canola (*Brassica napus*) can persist outside agricultural fields in Australia. *Agriculture Ecosystems and Environment* **220**: 28-34

Busi R and Powles SB (2016) Cross-resistance to prosulfocarb + S-metolachlor and pyroxasulfone selected by either herbicide in *Lolium rigidum*. *Pest Management Sci*

Chai Q, Gan Y, Zhao C, Xu HL, Waskom RM, Niu Y and Siddique KHM (2016) Regulated deficit under irrigation for crop production under drought stress. A review. *Agronomy for Sustainable Development* **36**: 3

Chen Y, Shan F, Nelson MN, Siddique KHM and Rengel Z (2016) Root trait diversity, molecular marker diversity, and trait-marker associations in a core collection of *Lupinus angustifolius*. *Journal of Experimental Botany*

Congdon BS, Coutts BA Renton M and Jones RAC (2016) Pea seed-borne mosaic virus: Stability and wind-mediated contact transmission in field pea. *Plant Disease* **100**: 953-958

Farooq M, Gogoi N, Barthakur S, Baroowa B, Bharadwaj N, Alghamdi SS and Siddique KHM (2016) Drought stress in grain legumes during reproduction and grain filling. *Journal of Agronomy and Crop Science* doi:10.1111/jac.12169

Goggin DE, Cawthray GR and Powles SB (2016) 2,4-D resistance in wild radish: reduced herbicide translocation via inhibition of cellular transport. *Journal of Experimental Botany* doi:10.1093/jxb/erw120

Guan XK, Turner NC, Song L, Gu YJ, Wang TC and Li FM (2016) Soil carbon sequestration by three perennial legume pastures is greater in deeper soil layers than in the soil surface. *Biogeosciences* **13**: 527-534

Gunasinghe N, You MP and Barbetti MJ (2016) Phenotypic and phylogenetic studies associated with the crucifer white leaf spot pathogen, *Pseudocercospora capsellae*, in Western Australia *Plant Pathology* **65**: 205-217

Haling RE, Yang Z, Shadwell N, Culvenor RA, Stefanski A, Ryan MH, Sandral GA, Kidd DR, Lambers H and Simpson RJ (2016) Growth and root dry matter allocation by pasture legumes and a grass with contrasting external critical phosphorus requirements. *Plant Soil* DOI 10.1007/s11104-016-2808-2

Hussain M, Waqas-ul-Haq M, Farooq S, Jabran K and Farooq M (2016) The impact of seed priming and row spacing on the productivity of different cultivars of irrigated wheat under early season drought. *Experimental Agriculture* doi:10.1017/S0014479716000053

Hussain M, Farooq M, Nawaz A, Al-Sadi AM, Solaiman ZM, Alghamdi SS, Ammara U, Ok YS and Siddique KHM (2016) Biochar for crop production: potential benefits and risks. *Journal of Soils and Sediments*

Hussain MI, Lyra DA, Farooq M, Nikoloudakis N and Khalid N (2016) Salt and drought stresses in safflower: a review. *Agronomy for Sustainable Development* doi: 10.1007/s13593-015-0344-8

Jabran K, Hussain M, Fahad S, Farooq M, Bajwa AA, Alharry H and Nasim W (2016) Economic assessment of different mulches in conventional and water-saving rice production systems. *Environmental Sciences and Pollution Research* doi 10.1007/s11356-016-6162-y

Jeffery RP, Simpson RJ, Lambers H, Kidd DR and Ryan MH (2016) Root morphology acclimation to phosphorus supply by six cultivars of *Trifolium subterraneum* L. *Plant Soil* DOI 10.1007/s11104-016-2869-2

Jones RAC (2016) Future scenarios for plant virus pathogens as climate change progresses. *Advances in Virus Research* dx.doi.org/10.1016/bs.avir.2016.02.004

Kashif MS, Farooq M, Cheema ZA and Nawaz A (2016) Allelopathic potential of bread wheat helps in suppressing the littleseed canarygrass (*Phalaris minor* Retz.) at its Varying densities. *Archives of Agronomy and Soil Science* **62**: 580-592

Khan MA, Ammar MH, Migdadi HM, El-Harty EH, Alfaifi SA, Farooq M and Alghamdi SS (2016) Field performance and genetic diversity of chickpea genotypes. *International Journal of Agriculture and Biology* doi: 10.17957/IJAB/15.0151

Khan HA, Siddique KHM and Colmer TD (2016) Vegetative and reproductive growth of salt-stressed chickpea are carbon-limited: sucrose infusion at the reproductive stage improves salt tolerance. *Journal of Experimental Botany* DOI:10.1093/jxb/erw177

Khan HA, Siddique KHM and Colmer TD (2016) Salt sensitivity in chickpea is determined by sodium toxicity *Planta* DOI 10.1007/s00425-016-2533-3

Kehoe MA and Jones RAC (2016) Improving Potato virus Y strain nomenclature: lessons from comparing isolates obtained over a 73-year period. *Plant Pathology* **65**: 322-333

Lacoste M and Powles S (2016) Beyond modelling: considering user-centred and post-development aspects to ensure the success of a decision support system *Computers and Electronics in Agriculture* **121**: 260-268

Macfadyen S, Tylianakis JM, Letourneau DK, Benton TG, Tiltonell P, Perring MP, Gomes-Creutzberg C, Baldi A, Holland JM, Linda Broadhurst L, Okabe K, Renwick AR, Gemmill-Herren, Smith HG (2016) The role of food retailers in global food supply. *Global Food Security*

Mejri M, Siddique KHM, Saif T, Abdelly C and Hessini K (2016) Comparative effect of drought duration on growth, photosynthesis, water relations, and solute accumulation in wild and cultivated barley species. *Journal of Plant Nutrition* DOI:10.1002/jpln.201500547

Mubarak H, Mirza N, Chai LY, Yang ZH, Yong W, Tang CJ, Mahmood Q, Pervez A, Farooq U, Fahad S, Masim W and Siddique KHM (2016) Biochemical and Metabolic changes in arsenic contaminated *Boehmeria nivea* L. *Biomedical Research International* doi: 10.1155/2016/1423828

Mugera A, Burton M and Downsborough E (2016) Consumer preference and willingness to pay for a local label attribute in Western Australian Fresh and Processed Food Products. *Journal of Food Products Marketing*

Mugera AW, Curwen R and White B (2016) Deregulation of the Australian Wheat Export Market: What happened to wheat prices? *Journal of International Food and Agribusiness Marketing* **28**

Nelson MN, Lilley JM, Helliwell C, Taylor CM, Siddique KHM, Chen S, Raman H, Batley J and Cowling WA (2016) Can genomics assist the phenological adaptation of canola to new and changing environments? *Crop and Pasture Science* **67**: <http://dx.doi.org/10.1071/CP15320>

Nyalugwe EP, Barbetti MJ and Jones RAC (2016) Strain specificity of *Turnip mosaic virus* resistance gene TuRBJU 01 in *Brassica juncea*. *European Journal of Plant Pathology* **145**: 209-213

Orchard S, Standish RJ, Nicol D, Dickie IA and Ryan MH (2016) Sample storage conditions alter colonisation structures of arbuscular mycorrhizal fungi and, particularly, fine root endophyte. *Plant Soil* DOI 10.1007/s11104-016-2867-4

Pang J, Turner NC, Khan T, Du YL, Xiong JL, Colmer TD, Devilla R, Stefanova K and Siddique KHM (2016) Response of chickpea (*Cicer arietinum* L.) to terminal drought: leaf stomatal conductance, pod abscisic acid concentration, and seed set. *Journal of Experimental Botany* doi:10.1093/jxb/erw153

Qin X, Feng F, Li Y, Xu S, Siddique KHM and Liao Y (2016) Maize yield improvements in China: past trends and future directions. *Plant Breeding* **135**: 166-176 doi:10.1111/pbr.12347

Rehman A, Farooq M, Nawaz A and Ahmad R (2016) Improving the performance of short duration basmati rice in water saving production systems by boron nutrition. *Annals of Applied Biology* **168**: 19-28

Shah MA, Farooq M and Hussain M (2016) Productivity and profitability of cotton-wheat system as influenced by relay intercropping of insect resistant transgenic cotton in bed planted wheat. *European Journal of Agronomy* **75**: 33-41

Suriyagoda LBD, Tibbett M, Edmonds-Tibbett T, Cawthray GR and Ryan MH (2016) Poor regulation of phosphorus uptake and rhizosphere carboxylates in three phosphorus-hyperaccumulating species of *Ptilotus*. *Plant Soil* **402**: 145-159

Tran HS, You MP, Khan TN and Barbetti MJ (2016) Pea black spot disease complex on field pea: dissecting the roles of the different pathogens in causing epicotyl and root disease. *Eur J Plant Pathol* **144**: 595-605

Uloth MB, Clode PL, You MP and Barbetti MJ (2016) Attack modes and defence reactions in pathosystems involving *Sclerotinia sclerotiorum*, *Brassica carinata*, *B. juncea* and *B. napus*. *Annals of Botany* **117**: 79-95

Wang YP, Li XG, Zhu J, Fan CY, Kong XJ, Turner NC, Siddique KHM and Li FM (2016) Multi-site assessment of the effects of plastic-film mulch on dryland maize productivity in semiarid areas in China. *Agricultural and Forest Meteorology* **220**: 160-169

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## UPCOMING EVENTS

**IOA Postgraduate Showcase 2016**  
Wednesday, 8 June 2016  
Bayliss Building, UWA

**IOA Industry Forum 2016**  
Thursday, 7 July 2016  
UWA University Club, UWA

**Women in Agriculture breakfast**  
Tuesday, 16 August 2016  
UWA University Club, UWA

**Pingelly Astrofest**  
Saturday, 17 September  
UWA Farm Ridgefield, Pingelly

## IOA MISSION

To provide research-based solutions to food and nutritional security, environmental sustainability and agribusiness.

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