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The 12th consecutive annual Industry Forum looked at how disruptive technologies are shaping the future of agriculture.

Disruptive technologies shaping the future of agriculture

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The 12th UWA Institute of Agriculture Industry Forum was held in July and saw approximately 200 diverse attendees spanning industry, academia and students, eager to learn more about the role technology will play in the future of agriculture.

This year's topic, Disruptive technologies: a new revolution in agriculture, covered remote sensing, robotics, artificial intelligence and BigData and the impact these technologies will have on the food production value chain.

Chair of IOA's Industry Advisory Board Dr Terry Enright opened the event, welcoming Minister for Water; Fisheries; Forestry; Innovation and ICT; Science, the Hon Dave Kelly.

In his address, Minister Kelly congratulated UWA for again ranking first in Australia for agriculture science and 14th in the world.

The keynote address was delivered by CSIRO's Digiscape Future Science platform leader Dr Andrew Moore, who highlighted the effect new technologies will have on food production.

"Field monitored data is really valuable, but it tells you where you've been. Sensor technologies give you information closer to real time and can tell you where you are going," Dr Moore said. "This information can be used to better inform decisions around crop choices and planting."

Dr Moore also talked about the benefits of combining multiple technologies, making them more powerful when used in collaboration. The addition of machine learning and AI has the potential to bring huge changes to agriculture.

"We expect the fourth industrial revolution technologies will transform not just the terms of production but the social connection," he said.

Director of AgWorld, Mr Matthew Macfarlane, spoke about a number of Perth based AgTech start-ups. AgTech has evolved to include drones, satellites, seed tech, Internet of Things (IoT) devices and BigData. While privacy remains a concern, the outlook is positive. Start-ups are now focusing on finding customers before building new technology as the model shifts away from building without a client in mind.

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Director's column

Hackett Professor Kadambot Siddique AM, CitWA, FTSE, FAIA, FNAAS, FISPP
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It was no surprise that spirits were high at the recent Dowerin Field Days in August. The 2018 growing season looks to be in excellent shape and the current good prices for all grains is positive.

In this issue of IOA News we showcase some of the research activities happening in the Food Quality and Human Health research theme including the cardiovascular benefits of broccoli, cabbage, Brussels sprouts and cauliflower (see page 9), healthy apples (see page 6), improvements in food legumes (see page 9) and the antibacterial properties of honey (see page 12). This research theme focuses on the composition and quality of foods for dietary health, as well as improved strategies for breeding, production and manufacture.

I am pleased to share that Professors Ajmal Mian and Mohammad Bennamoun from the Faculty of Engineering and Mathematical Sciences and IOA are part of a team that was awarded $5.0 million plus and additional $3.82 million in industry partner funding for an ARC Industrial Transformation Research Hub. The hub will contribute to improved farming efficiency, lower production costs and fewer disease risks, giving the Australian industry new business opportunities and an international competitive advantage (see page 7).

In the Shanghai Jiao Tong Academic Ranking of World Universities (ARWU), UWA maintained its position at 14th in the world, and 1st in Australia for Agricultural Sciences, and 93rd overall (shanghairainking.com). These results reinforce UWA's strategy of steady improvement through academic strength, and world class research outcomes.

Eight of our top postgraduate students studying agriculture and related areas presented their research at the annual Postgraduate Showcase: Frontiers in Agriculture in June (see page 4). More than 130 members of the agriculture industry, scientific community and students attended the event, and the students did an excellent job at engaging with them.

In July, we hosted the 12th annual industry forum which discussed Disruptive technologies: a new revolution in agriculture. The industry forum continues to be the highlight in our calendar bringing together the who's who in agriculture. CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship supported the event.

The next event on the horizon is the Pingelly Astrofest, at UWA Farm Ridgefield in Pingelly, on Saturday, 20 October. Astrofest is an astronomy event for the young and old to learn more about the Universe and night sky. If you have yet to visit UWA Farm Ridgefield, I encourage you to attend the Pingelly Astrofest and interact with our friends in the Pingelly community.

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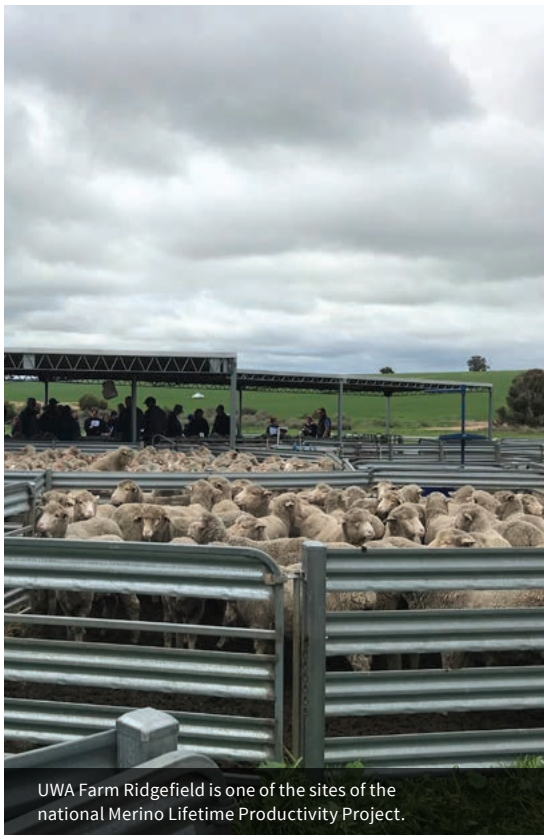
Presenting on global views of automation in farm technology, were Mr Ben White and Mr Josh Giumelli from the Kondinin Group. They discussed where the technology is headed as improvements in GPS can bring pinpointing a location accurately to within 10cm.

Tammin farmer Mr Brad Jones presented as a case study of his grain farm with DPIRD economist Dr Brad Plunkett. Mr Jones is using continuous improvement to disrupt down the cost curve on his farm. Through better crop and soil data collection he can run his farm more efficiently.

Final presenter Dr Andrew Guzzomi from UWA's Faculty of Engineering and Mathematical Sciences discussed engineering innovations for food production at UWA. He gave an overview of agricultural engineering research activities at UWA including how infrared technology can be applied to soil crops to kill weeds when still small.

The forum closed with a panel discussion, led by Dr Manjusha Thorpe from GRDC during which the speakers fielded questions from the audience. The Industry Forum was supported by CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship.



UWA Farm Ridgefield is one of the sites of the national Merino Lifetime Productivity Project.

Worldwide Universities Network deliberates on the future of food

Professor Graeme Martin
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The Worldwide Universities Network (WUN) held its 2018 Annual General Meeting at UWA over 20-22 May, 2018. The AGM is accompanied by several workshops that review previous partnerships among WUN partners and the plan for the next generation of partnerships.

For the 2018 meeting, the Global Challenge Steering Group of the WUN focussed on its program on Responding to Climate Change.

During the meeting, the extensive successes achieved by the Global Farm Platform Group (globalfarmplatform.org) in sustainable animal and plant food production, within which the Future Farm 2050 Project is a foundation partner, was reviewed. In addition, the WUN ran a workshop on Water for sustainable food, renewable energy and biodiverse ecosystems under a changing climate. Together, these activities explored initiatives that link to sustainable agriculture, such as the water-energy-food nexus and implications for the environmental livelihood security of smallholder farmers.

The meeting included a trip to UWA Farm Ridgefield where Future Farm 2050 Project Leader Professor Graeme Martin led a party of approximately 60 international visitors from countries as diverse as the United Kingdom, France, Canada and Ghana. Also in attendance were members of IOA's Industry Advisory Board Dr Dawson Bradford, Mr Neil Young and Mr Philip Gardner who provided the visitors with insights into local farming systems.

The group heard an overview of Future Farm 2050 Project, then visited two sites: the development of native shrubs as forage for sheep led by Professor Philip Vercoe and the Greening Australia ecosystem restoration site led by CEO Greening Australia Dr Blair Parsons. The visitors were also given an overview of WA soils of by Dr Matthias Leopold from UWA's School of Agriculture and Environment and IOA.

Prof Phil Vercoe discussed the development of native shrubs as forage

Back on campus, a series of keynote speakers provided stimulating presentations on sustainable food production, renewable energy and biodiverse ecosystems under a changing climate. In addition to the Global Farm Platform, the themes included the Blue Economy, clean energy production, plastic and waste, policy impact, and water-energy-food security and livelihoods.

UWA welcomes Lambex participants to Ridgefield

LambEx, the national conference for the sheep and lamb industry has been running since 2010 and this year returned to Western Australia, attracting more than 900 delegates.

Over two days in early August, international and Australian speakers discussed issues facing the sheep and lamb industry and presented exciting possibilities for technological innovations that will help producers in the years ahead. Among the speakers was the leader of the Future Farm 2050 Project, Professor Graeme Martin, who outlined the possibilities for 'gene editing' to improve the muscling of Merino sheep.

After the conference, a group of 40 delegates visited UWA Farm Ridgefield. The delegates first heard from Professor Martin, who introduced the Future Farm 2050 Project and emphasised the importance of the relationship between UWA and the people of Pingelly.

Dr Bronwyn Clarke, Murdoch University then spoke about the Merino Lifetime Productivity Project. The project will capture lifetime performance data for Merino sires in diverse environments so we can better understand and deliver production outcomes for the Australian Merino Industry. It is being run from 2015 to 2025 on five sites across Australia, with UWA Farm Ridgefield representing WA. Dr Clarke presented an update on the results from the Ridgefield site.

After viewing the MLP sheep, the group proceeded to the native shrub forage site, where Professor Philip Vercoe from the UWA School of Agriculture and IOA, and local Pingelly farmer, Mr Garry Page, described the value of this Eureka Prize-winning concept to the sheep industry.

Australian native shrub systems offer a variety of advantages including reduced production of methane, the major greenhouse gas produced by sheep and cattle; high quality feed in the autumn when most pastures are worthless; control of dryland salinity and erosion because they are deep rooted; reduction in worm burden, helping overcome the problem of drench-resistant worms; shelter for newborn lambs, greatly reducing neonatal mortality in twins; and improved ecosystems and biodiversity.

Postgraduates shine at showcase

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From L to R: Prof Graeme Martin, Assoc/Prof Megan Ryan, Ms Candy Taylor, Dr Nic Taylor, Mr Michael Wallace, Mr Ali Oumer, Mr Yaseen Khalil, Mr David Minemba, Mr Trung Tuan Pham, Ms Jolene Otway and Hackett Prof Kadambot Siddique.

Eight postgraduate students studying agriculture and related areas across two Faculties presented their research at the 12th annual Postgraduate Showcase: Frontiers in Agriculture in June. An audience of more than 130 academics, students and agriculture industry representatives attended the presentations to hear the latest research.

UWA's Senior Deputy Vice Chancellor Professor Simon Biggs gave the opening address after which Dr Nic Taylor, ARC Future Fellow from the Centre of Excellence in Plant Energy Biology introduced Session One's presenters.

Ms Candy Taylor from UWA's School of Agriculture and Environment presented her research on narrow-leafed lupin breeding. Candy is investigating flowering time so that high-yielding varieties better adapted to its climate can be developed. She received the Mike Carroll Travelling Fellowship last year and has also received funding from the GRDC for this research. Candy is supervised by Prof Wallace Cowling, UWA, Dr Matthew Nelson, Kew, Dr Lars Kamphuis, CSIRO and Curtin University, and Dr Jens Berger from CSIRO.

The next speaker was Mr David Minemba who received a prestigious Australia Award Scholarship to undertake his PhD studies on understanding the ability of sweet potato to persist in marginal soils, especially low phosphorous soils. David is supervised by Assoc/Prof Megan Ryan, Prof Erik Veneklaas and Dr Deirdre Gleeson from the UWA School of Agriculture and Environment and School of Biological Science, and Prof Arthur Villordon from Louisiana State University.

Indonesian PhD Candidate Ms Amriana Hifizah spoke next on her research looking into alternative feed sources for ruminants that can increase fermentability, whilst reducing methane emissions. Amriana is in her fourth year and has already published four papers, with one final experiment to go. Her research is supervised by Prof Philip Verco, Prof Graeme Martin, and Dr Zoey Durmic.

Taking us through to afternoon tea was Mr Michael Wallace from the School of Molecular Sciences. Originally from York, Michael is in his second year of postgraduate study where he is investigating potential novel herbicide mode of actions. His research is supervised by was funded by research was funded by Ajunct Prof Keith Stubbs and Assoc/Prof Joshua Mylne and is funded by a Bayer Crop Science Grants4Targets grant.

The second session was chaired by Assoc/Prof Megan Ryan from UWA's School of Agriculture and Environment, who introduced presenters in Session Two. Mr Ali Oumer, the first, presented his research which focuses on the economics of sustainable intensification of maize production systems with a case study of Ethiopia. In particular, he is investigating factors that drive the adoption of sustainable agricultural technologies, the roles of these technologies in improving production efficiency and in offsetting production risk. Ali is supervised by Assoc/Prof Michael Burton, Assoc/Prof Atakelty Hailu, and Dr Amin Mugera from UWA's School of Agriculture and Environment, Prof Salvatore Di Falco from the University of Geneva, and Dr Menale Kassie from the International Centre of Insect Physiology and Ecology, Kenya.

Final year soil science student Ms Jolene Otway discussed her research on soil carbon modelling. According to Jolene, soil carbon sequestration provides an ideal opportunity for Western Australia's large-scale emitters to support local producers in reversing the typically declining carbon trend in agricultural soil by incentivising simultaneous production and sequestering initiatives. Jolene is supervised by E/Prof Lyn Abbott and Dr Louise Barton from UWA's School of Agriculture and Environment, and Professor Jennifer Dungait from Rothamsted Research, UK.

Mr Trung Tuan Pham from the UWA Business School presented his research on factors influencing the member value chain in agricultural co-operatives in Vietnam. He discussed the values that agricultural mutual enterprises offer to their members with the aim to improve Agricultural Co-operative and other Mutual Enterprises in emergent economies.

The final speaker for the afternoon was Mr Yaseen Khalil. Yaseen is a Kurd from the north east of Syria and received an ACIAR John Allwright scholarship to undertake his PhD studies. He gave an excellent presentation on the fate of pre-emergence herbicides intercepted by residues in conservation agriculture systems. Yaseen is supervised by Dr Ken Flower, Prof Kadambot Siddique, Dr Phil Ward and Dr Colin Piggin.

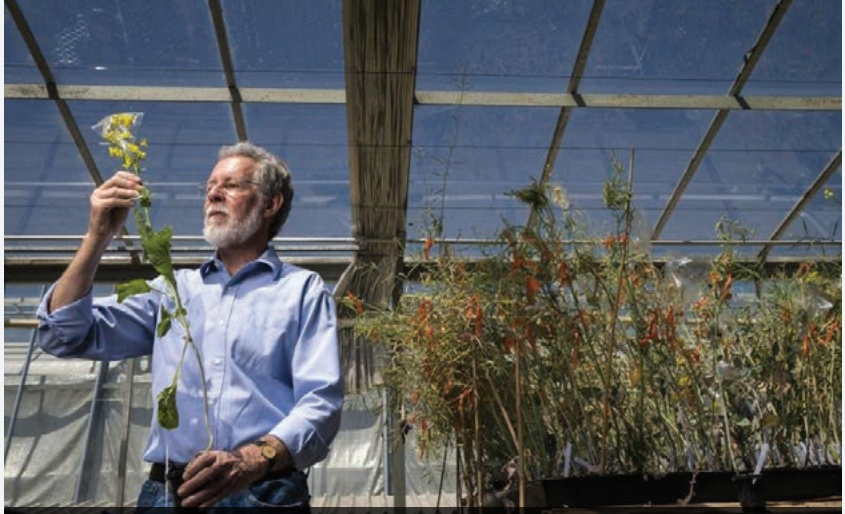
The presentations can be accessed at ioa.uwa.edu.au/publications/showcase.

Powdery Mildew fuelled by global warming

Changing weather patterns in oilseed rape growing areas may be responsible for increasingly severe outbreaks of powdery mildew.

Professor Martin Barbetti, Dr Ming Pei You and PhD Candidate Margaret Uloth from UWA's School of Agriculture and Environment and IOA investigated why largely unaffected areas in the northern agricultural region of WA and NSW are seeing an increase in the parasitic powdery mildew.

The study, which was funded by UWA and the GRDC, showed that powdery mildew infestation on oilseed rape is affected by both ambient temperature and plant age at infestation.



Professor Martin Barbetti inspecting an oilseed rape plant for signs of powdery mildew. Photo: Evan Collis.

Professor Barbetti said powdery mildew has been present in Australian oilseed rape and mustard crops for decades but the reasons for its increasing severity, particularly in recent years, have not been evident until now.

"The current study suggests that increasing incidence, severity and threat from powdery mildew is probably linked to increasing temperatures at the time when plants become more susceptible, especially as they start to flower," Professor Barbetti said.

"Furthermore, it is clear from crop surveys in 2015 and 2016 that most severe powdery mildew epidemics on oilseed rape are largely confined to the northern agricultural regions of WA and NSW, where crops are subject to warmer late winter and early spring temperatures, and to more variable rainfall across the same period."

The research gives further impetus to the need for ongoing identification and development of oilseed rape cultivars that have effective resistance under both current and future climate conditions.

Impacts of historical events on Potato virus evolution

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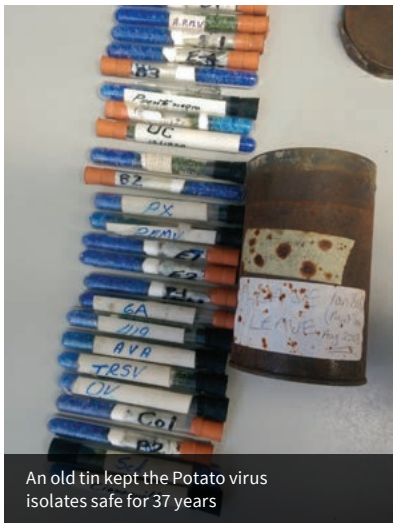
The first detailed analysis of biological and molecular properties of virus isolates from countries spanning the Andes suggests a potato-infecting Potato virus S (PVS) ancestor emerged 5,000-7,000 years ago.



An old tin kept the Potato virus isolates safe for 37 years

The phylogenetic and dating study by Adjunct Professor Roger Jones and a team of international collaborators was conducted using thirty seven year old PVS isolates from South America.

Professor Roger Jones was first involved in PVS research in the mid 70's. These isolates remained untouched until a joint project between UWA, DPIRD, The National Agrarian University and Fera Science in 2015.

The team conducted regression analysis and revealed three major lineages. Two nodes were predominantly South American dating back as early as 1079 and 1055, and one node was non-South American and dated at 1838.

"The earlier dates coincide with the demise of the Tiahuanaco civilization around 1000 CE, when the Inca civilization took over," Professor Jones said.

"The non-South American linage date coincides with introduction of new potato germplasm from the Andes to Europe. This germplasm helped breed disease resistant potato varieties to ease the potato blight famine."

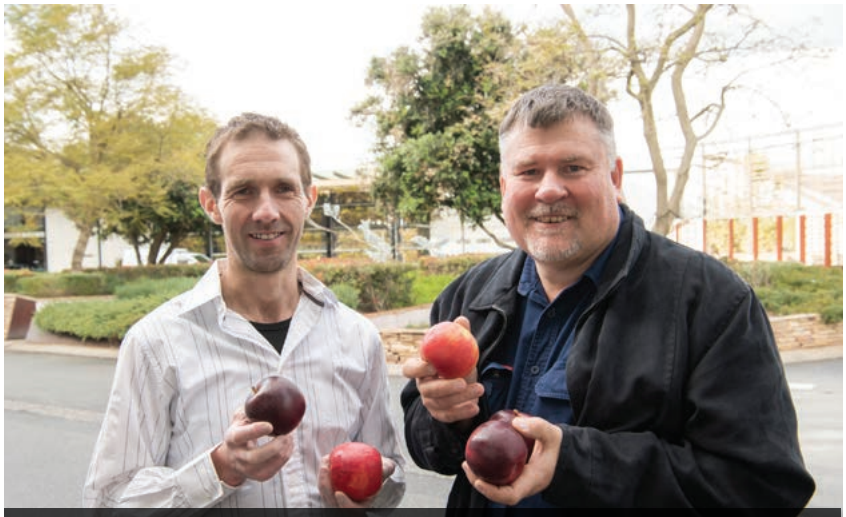
Prof Jones said South American lineage PVS isolates reached higher concentrations in plants and proved more stable, suggesting those isolates are more readily transmitted by contact and aphids.

"PVS causes disease that diminishes potato seed and ware production globally. I urge biosecurity authorities to take precautions to prevent their establishment in other countries."

The collaborative research was undertaken between the International Potato Centre (CIP), the National Agrarian University, University of Cuenca, UWA, DPIRD and Fera Science.

An apple a day keeps the doctor away

Research carried out by UWA, Edith Cowan University (ECU) and DPIRD has shown the consumption of apples has a direct impact on human health by improving cardiovascular health.



UWA's Michael Considine (left) and DPRID technical officer Kevin Lacey with BravoTM-branded apple and Pink LadyTM - clinically proven to improve human health.

The science behind how apples assist human health was presented at the Western Australian Horticulture Update in August, by UWA senior research fellow Michael Considine from IOA and adjunct research fellow Catherine Bondonno, ECU.

Dr Considine said the work began about 10 years ago with the aim of trying to validate the health benefits of apples to add value to varieties developed from the Australian National Apple Breeding Program funded by the Department of Primary Industries and Regional Development.

"The research has three parts: to identify the traits of a healthy apple, develop tools to accelerate the breeding program, and use the outcome as a marketing and promotion tool for WA apples," Dr Considine said.

"This is because we knew early on that we had to take a holistic view and could not ignore market and economic realities.

"Apples are consistently among the top three fruits traded worldwide and are therefore an ideal vehicle to promote nutritional health."

Dr Bondonno said apples were high in flavonoids [widely known as antioxidants], which were concentrated in the skin rather than the flesh of apples.

"Apples are particularly high in the flavonoid quercetin, however consumption of the whole fruit is necessary to obtain the health benefits," she said.

"A large number of studies have shown that dietary flavonoids provide many benefits for cardiovascular health.

"We have screened the flavonoid content of over 100 apples from the national breeding program based in Western Australia, and identified apples that are high in flavonoids, including Pink LadyTM and BravoTM-branded apples.

"Flavonoids work by increasing a molecule that is produced in blood vessels and play a critical role in cardiovascular health by regulating blood pressure and flow.

"Two clinical trials have demonstrated the positive effect of Pink LadyTM apple consumption on cardiovascular health – one study demonstrated improved blood vessel function within hours of eating apple and the second trial showed these effects are sustained following four weeks of daily intake by people at risk of cardiovascular disease.

"A clinical trial is currently being conducted where volunteers eat a BravoTM-branded apple a day for four weeks, and we measure markers of blood vessel health, such as blood pressure and flow."

Dr Considine, who is intimately involved with the national breeding program, said the original motivation was to demonstrate that apples are a natural 'functional food'.

The research has built towards a new international project to deploy genomic breeding techniques and realise a long-held department vision to transform the Australian National Apple Breeding Program strategy.

"Using genomic data will enable us to really sharpen the breeding strategy to accelerate the selection of high value apples," Dr Considine said.

"Initially this will target flavonoid content as a 'pilot' but progressively the strategy is to develop an economic index of valuable traits, such as crispness, colour and shelf life, as well as fibre and pectin content, which have other health benefits.

"This will enable a sustainable pipeline of high-value apple varieties within the medium term."

Research supporting the presentation has been funded by Horticulture Innovation Australia, DPRID, UWA, ECU, Pomewest and Fruit West.

ARC Research Hub Driving Farming Productivity and Disease Prevention

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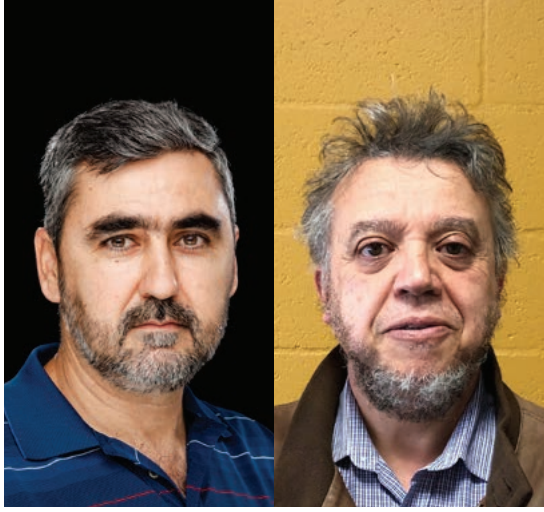

UWA Professors Mohammed Bennamoun and Ajmal Mian are part of a team that has been awarded $5.0 million plus an additional $3.82 million in industry partner funding for an ARC Industrial Transformation Research Hub.

The ARC Research Hub for Driving Farming Productivity and Disease Prevention aims to increase farm production and disease prevention through advancing and transferring new artificial intelligence technologies into industrial deployment.

The Hub will combine machine vision, machine learning, software quality control, engineering, biology, and farming industries to develop technologies to build more intelligent systems. These dynamic systems will help determine what goal to achieve and the most efficient plan to achieve it.

Prof Mian said the Hub is expected to contribute to improved farming efficiency, lower production costs and fewer disease risks, giving the Australian industry new business opportunities and an international competitive advantage.

"In collaboration with other researchers, Prof Bennamoun and I will provide key technological research support in computer vision and machine learning for object detection and recognition in cluttered environments, and machine learning and classification for farming activities," Prof Mian said.

"We will also contribute to the early detection of diseases and pests, as well as automatic product grading and harvesting."

The Hub includes researchers from Griffith University, University of Sydney, University of Adelaide, UWA, Deakin University, CSIRO and five industry partners. Besides researchers from these institutions and field experts from the farming industry, postdoctoral fellows and PhD students will be employed to work closely and build solutions that will enable higher farming efficiency giving the Australian industry a great advantage in the global competition.

Root research the way forward in acid soils

A lecture outlining the future of crop improvements in acid soils was presented by visiting CSIRO researcher Dr Manny Delhaize on Thursday, 5 July 2018.

The lecture, *From aluminium tolerance to Twisted Sisters* was attended by over 50 people as part of a joint seminar held by IOA and the UWA School of Agriculture and Environment.

Based in CSIRO's Agriculture and Food flagship in Canberra, Dr Delhaize's focuses on research into identifying and cloning aluminium tolerant genes from bread wheat. Aluminium tolerant root hairs can better enable wheat to take up nutrients in acid soils. These genes could be modified into durum wheat to increase tolerance.

During the lecture, Dr Delhaize shared his research investigating the influence of gravity on the shape of a root system. Root shape is a major contributor to a plants' ability to access nutrients and water. Wheat mutants with altered gravity responses often have altered shoot shapes. These mutants may lead to discoveries of more desirable shoot and root shapes for use in crop selection.

Dr Delhaize with Prof Kadambot Siddique, Dr Vijay Pooniya and Adjunct Prof Jairo Palta in the UWA glasshouse.

With soil acidity becoming widespread across WA agricultural areas, Prof Delhaize's research is playing an important part in developing more resistant crops for the future.

While in Perth, Dr Delhaize spent time at the CSIRO laboratories in Floreat and met with UWA students and researchers. Dr Delhaize is collaborating with Professor Kadambot Siddique, Adjunct Professor Jairo Palta, Dr Yinglong Chen and Dr Vijay Pooniya at UWA on aluminium tolerant wheat root growth in acid soils.

Fish farmers inspecting nets in their artisanal ponds.

Empowering women to improve small-scale aquaculture in Africa

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A recently awarded Partnership Research and Development Fund grant from the Australia-Africa Universities Network (AAUN) will help Associate Professor Richard Vokes from the School of Social Sciences and IOA further his research into gender and fish farming in Uganda and Kenya.

Both Uganda and Kenya have seen a vast expansion in small-scale aquaculture production over the past 20 years. They are now among the leading producers in Sub-Saharan Africa and account for almost a quarter of all aquaculture output across the region.

Dr Vokes has been studying the two countries' recent advances in artisanal fish-farming with colleagues from Makerere University, Uganda and the University of Nairobi, Kenya. The team are working towards further extending the research and evaluating how applicable this approach is for other Sub-Saharan countries. He said Uganda and Kenya's remarkable success in this sector has been the result both of technical and socio-political interventions.

"From early on we noticed that the introduction of artisanal fish-farming into rural communities often improves the livelihoods and well-being of women in particular," Dr Vokes said.

"Many women do not own the land they live on but often play a leading role in decision-making around the construction and management of fish-ponds. So too, it is often up to them when the fish should be harvested."

Dr Vokes said typically women receive a greater percentage of money derived from the sale of fish than from the sale of other kinds of livestock or agricultural produce.

"In contexts in which women and their children may be excluded from men's public 'barbecues', harvested fish are also a key source of protein."

"Further research is required to understand how these observed gendered benefits may be consolidated and expanded upon through better policy-design and program implementation."

The AAUN grant will allow the team to conduct a further social survey of gender and fish farming, using methods adapted from Rapid Rural Appraisal (RRA), across six sample districts – three in Uganda and three in Kenya – and to hold a workshop at UWA.

Eating lots of broccoli, cabbage, Brussels sprouts and cauliflower is good for you

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There is a wealth of evidence linking diets high in vegetables with lower risk of heart disease, including heart attack and stroke. However, there is little evidence linking specific types of vegetables with subclinical measures of atherosclerosis, the major underlying cause of most heart attacks and strokes.

PhD Candidate from the Faculty of Health and Medical Sciences and IOA Lauren Blekkenhorst analysed the diets of 954 Perth women aged 70 and older. The women had the thickness of their carotid arteries measured using ultrasound.

The results of the study suggest eating lots of broccoli, cabbage, Brussels sprouts and cauliflower may help elderly women protect their arteries from thickening. Higher intake of vegetables was related to lower measures of carotid artery wall thickness, an indicator of the level of atherosclerosis.

Among the different types of vegetables in the diet, cruciferous vegetables seemed to be the most beneficial.

There is evidence that increasing a variety of vegetables is important to maintain good health.

The research suggests that recommendations to include a serving of cruciferous vegetables amongst the recommended amount of vegetables (5-6 servings) may help to optimise vascular health.

These findings reinforce the importance of adequate vegetable intake to reduce your risk of atherosclerosis, heart attacks and strokes.

Partnerships needed to deliver innovative solutions in food legumes

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The 7th International Food Legumes Research Conference, held in Marrakesh, Morocco in May brought together 320 food legume experts, students and policy makers from more than 42 countries.

The conference, hosted by the International Center for Agricultural Research in the Dry Areas (ICARDA) provided a platform for legume researchers to explore innovative solutions to food legume crops and promote international collaboration on basic, applied and strategic research. This research is vital to meet the current and future challenges associated with these crops.

UWA Professors Kadambot Siddique and Martin Barbetti from IOA and the UWA School of Agriculture and Environment were invited to deliver talks and chair sessions. PhD candidate Mr Md Shahin Uz Zaman also presented his research into waterlogging tolerance in field peas.

The conference demonstrated the huge strides advanced technologies had made in recent years, including developing varieties are high-yielding and disease-resistant while being heat and drought-tolerant. However, these successes can only provide part of the effort to transform global grain legume production.

Summarizing the discussions over the three-day event, Jacques Wery, Deputy Director General for Research at ICARDA called for a more integrated and holistic approach that goes beyond a single focus on yield and performance. Future efforts, he suggested, should take into consideration adoption constraints and many factors that inform farmer decisions. Strengthening seed systems like those pioneered by ICARDA and ICRISAT in Ethiopia offer potentially useful frameworks.

Group photo at the International Food Legumes Research Conference in Morocco.

Additional considerations include the ecosystem services that legumes provide and the role these plants can play in climate change adaptation; breeding resistance to new pests and disease that emerge with shifting weather patterns; and adopting south-south and south-north collaborations that generate new innovations and approaches.

Modern Science shows roman wheat farming advice was accurate

Plant biologists from UWA have made an important discovery about rising temperatures and wheat crops - and subsequently learned that the Romans suspected the effect more than 2000 years ago.

The study, published in *Scientific Reports*, revealed what happens when wheat plants cannot get enough oxygen because of flooding.

The scientists found the wheat was more susceptible to damage from flooding as the temperature got warmer - only to later read a Roman farming handbook that hinted at the same effect.

Modern research can solve a 2000 year old problem.

De Agri Cultura, believed to be written by Cato the Elder in 160 BC, suggests rainfall can be left on wheat fields through the cold part of winter but will damage the crops if not removed by spring.

Lead researcher Dr Shaobai Huang from the UWA ARC Centre of Excellence in Plant Energy Biology said the study looked at what different types of wheat plants make inside their cells to help them cope with a lack of oxygen.

"We tested the plants at 15°C to 28°C, and found a dramatic negative impact on how well wheat plants recovered from a lack of oxygen under the higher temperatures," Dr Huang said.

"Not only is temperature arguably more important than the type of wheat, but small temperature changes can make a huge difference. At 20°C they were fine but at 24°C they suffered really badly."

Centre Director Professor Harvey Millar said climate change was poised to deliver a double blow to wheat plants, with both increasing temperatures and a greater chance of flooding.

"This research shows that we don't need temperatures to rise at the hottest part of the year to have a big impact on our crops," Professor Millar said.

"It might just be the difference between having a cool spring or a warm spring."

But Professor Millar said being able to understand the mechanism inside wheat cells that is behind the 2000-year-old agricultural advice offered new hope.

"The Romans knew the problem but they didn't have any way to try and find a solution, other than to drain the field," he said.

"Today we now know that amino acids play an important role in how plants respond to a lack of oxygen. Based on this new research we may be able to come up with a breeding solution, because after 2000 years we finally understand the mechanism behind the damage to wheat."

Cattle breeding workshop in Shanghai

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Professors Kadambot Siddique and Philip Vercoe attended a workshop on 'cross breeding of cattle in China' organised by the Cattle branch of China Animal Production Association. The workshop was held in Shanghai during 16-17 May 2018 under the leadership of Mr Gui Guojie, President of Shanghai CRED.

The workshop was attended by researchers, producers and traders from key provinces in China. Professor Siddique delivered a talk on 'crop-pasture-livestock integration in Australian agriculture' and Professor Vercoe presented on 'Introducing China's Luxi yellow cattle for crossbreeding program in Australia: Opportunities and issues to consider'. Both the talks were well received. They also discussed potential opportunities for collaboration between UWA and China.

Professors Kadambot Siddique and Philip Vercoe attended a workshop on cross breeding of cattle in China.

Following the workshop Professor Siddique had the opportunity to meet with Ms Jan Adams, Australian Ambassador to China and Australian Trade Minister Steve Ciobo and discussed UWA's ongoing collaboration with China in higher education and research.

Scholarship to boost soil research

PhD candidate Mary-Anne Lowe from the UWA School of Agriculture and Environment and IOA has received a GRDC scholarship to support her research into soil water repellence.

Mary-Anne's research aims to improve the understanding of soil water repellence to improve infiltration, enable better water harvesting, and reduce crop yield losses. The grant comes as part of the State Government's bid to boost WA grain quality and production.

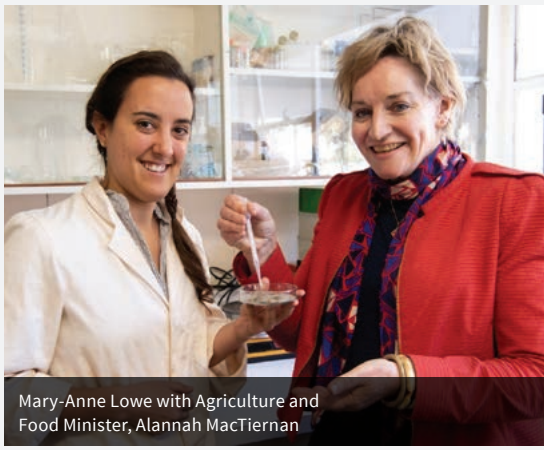
Agriculture and Food Minister Alannah MacTiernan praised the scholarship winners and said the investment supports the next generation of grains scientists to ensure the WA industry is well-equipped to compete in the international marketplace.

"Congratulations to these incredible young scientists, who are dedicated to researching the key issues that will generate real, tangible benefits to the WA grains," Minister MacTiernan said.

"These scholarships continue WA's proud history of producing world-renowned grains scientists, who are passionate about supporting growers and the industry.

In addition, the GRDC scholarship supports Mary-Anne's work by providing greater access to DPIRD field sites and researchers allowing her to include more depth to her research.

"I'm able to monitor infiltration over time at a field site where different treatments are causing different capacities for water movement in water repellent soils,"



Mary-Anne Lowe with Agriculture and Food Minister, Alannah MacTiernan

Mary-Anne said. "The research that I am able to do because of this scholarship is adding that extra step of field work to tie my thesis together."

Mary-Anne is supervised by Dr Matthias Leopold and Dr Gavan McGrath from the UWA School of Agriculture and Environment and IOA. She is also the recipient of the 2017 Mike Carroll Travelling Fellowship.

UWA experts at crop research field day in the Ord River Irrigation Area

Adjunct Professor Roger Jones
roger.jones@uwa.edu.au

A field day was held by the Northern Australian Crop Research Alliance at DPIRD's Kununurra Research Station and Kimberly Agricultural Investment farm in the Ord River Irrigation Area (ORIA) in Western Australia's tropical East Kimberley region in July.

The field day showcased exciting developments in NACRA's research on diverse crops suited to the tropics including new crops, grain legumes, cereals and cotton. It was well attended by a wide range of interested parties from across Australia, including growers, agribusiness, research organisations and universities.

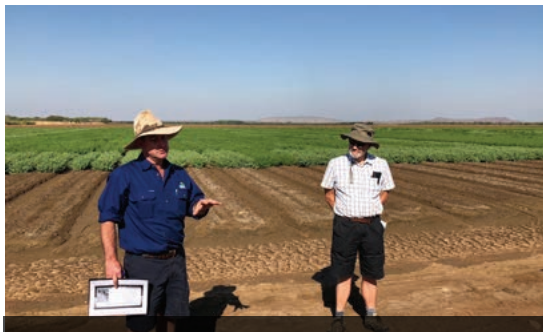
The field trials demonstrated breeding, varietal improvement, and agronomy advances with the new crops chia, quinoa and plantago, and the grain legumes chickpea, mung bean and soybean. Also included were insecticide and herbicide trials with some of these crops, and variety trials with maize.

Dr Janine Croser of UWA's School of Agriculture and Environment and Adjunct Professor Roger Jones from IOA both attended and gave presentations.

Dr Croser outlined the progress at UWA toward developing rapid gene introgression platforms for accelerated improvement of chia and quinoa. This research forms part of the CRC-P suit of projects co-ordinated by NACRA.

Dr Jones described important recent research by UWA's plant pathology group which identified soil-borne pathogens responsible for the decline of chickpea and borlotti bean crops in the ORIA, and emphasised the need for further research on disease management in the ORIA.

The field day ended with a visit to an impressive, large-scale NACRA cotton cropping demonstration at KAI Ltd's property in the new ORD II region of the ORIA, where an extended discussion was held on cotton agronomy and its potential for large-scale production in the ORIA.



Mark McGrath, NACRA - General Manager (left) and Professor Roger Jones, IOA present in front of a chickpea trial

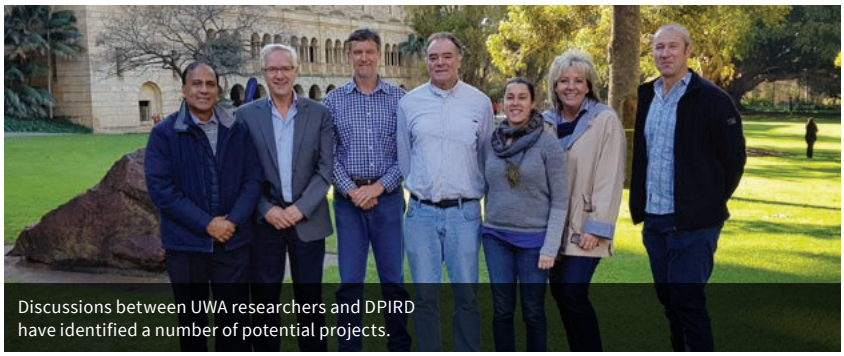
Myalup-Wellington project provides flood of research and development opportunities

The $400m Myalup-Wellington project announced by DPIRD offers a major opportunity to help boost Western Australia's regional economy through irrigated agriculture, linking with the movement of pines from Myalup to Collie and the creation of new irrigation areas.

Current plans propose that saline water flowing into the Wellington Dam be diverted into a mine void, with water being treated in a desalination plant to be built near Collie. Lowering Wellington salinity provides the opportunity to improve crop and pasture yields and recover saline land in the Collie River Irrigation District.

During a joint seminar hosted by UWA's School of Agriculture and Environment and IOA, Adjunct Associate Professor Richard George from DPIRD outlined how this desalination plant could deliver over 10GL per year of fresh water to Great Southern towns.

Leader of IOA's Water for Food Production research theme Dr Matt Hipsey said the project presents a number of opportunities for UWA researchers.



Discussions between UWA researchers and DPIRD have identified a number of potential projects.

"Possible research areas for the future include harvesting surface water from agricultural drains that currently bring problem nutrients into the Harvey Estuary, and optimising the addition of fresher water from the Wellington Reservoir to the Superficial Aquifer to prevent coastal plain wetlands from drying and releasing acidity and nutrients into irrigation waters," Dr Hipsey said.

"Research quantifying the water and salt balances of current and new irrigation areas, as well as the pine plantations, could ensure water is better managed under a drying climate."

Examining alternative crops and rotations for the existing Myalup irrigation area in addition to the area to be released for irrigation after the Myalup pines are harvested were other research interests that were identified.

A spoon full of honey for health

As part of an AgriFutures Australia Honey Bee and Pollination Program supported project, researchers from UWA together with the Cooperative Research Centre for Honey Bee Products are analysing the antibacterial properties of WA honey as part of a three-year study.

Lead researcher Dr Kate Hammer from UWA's Medical School said initial analyses of 50 WA honeys had so far found the highest antibacterial activity was in White gum, Jarrah and Marri honeys.

"These results are expected to an extent, especially with Jarrah, as WA has already gained a lot of experience and knowledge with Jarrah honey as a unique product with antibacterial activity," Dr Hammer said.

"However, what has been incredibly surprising is our investigation of relationships between antibacterial activity and other honey characteristics, such as honey colour or hydrogen peroxide, did not show any significant correlations.

"This means darker honeys are not necessarily more active than lighter coloured honeys."

Dr Hammer said that even though it is already established that hydrogen peroxide contributes to antibacterial activity, the study found it is not the only factor.

WA honey is known for its antibacterial properties.

"In our analyses we found there were some honeys with relatively low hydrogen peroxide levels but reasonably high antibacterial activity, so future chemical analyses of these specific honeys will be further investigated," she said.

This research has implications for honey products in medical uses.

RAID-Crawford Fund event a success in WA

Alicea Garcia, Ana Manero, Rodrigo Pires - WA RAID Representatives
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rodrigo.pires@research.uwa.edu.au

Researchers in Agriculture for International Development (RAID) and the Crawford Fund hosted an inspirational seminar and networking evening in July in collaboration with UWA.

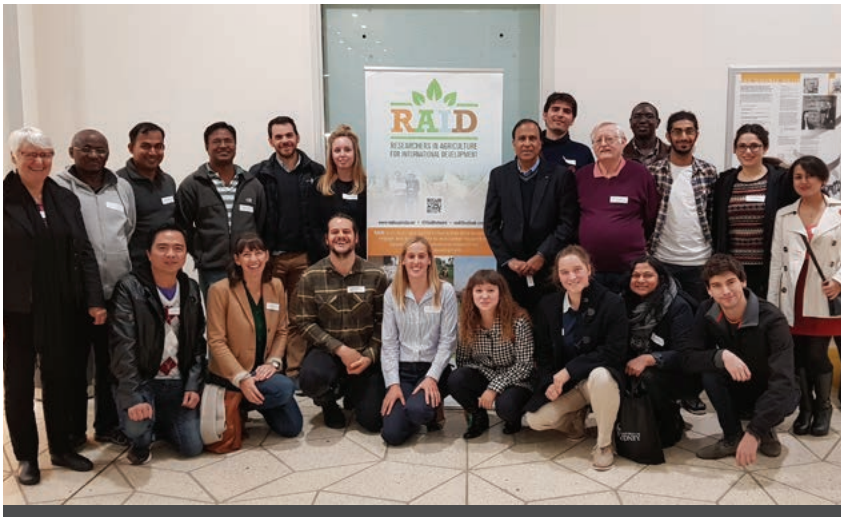
As a program of the Crawford Fund, the RAID event aimed to inspire early-career researchers to further their involvement in international agricultural research, and to showcase some of the vibrant work of WA's researchers in the field.

Emeritus Professor Lyn Abbott gave a thoughtful introduction on support the Crawford Fund provides for students and researchers, and IOA Director Hackett Professor Kadambot Siddique advised the upcoming researchers on how to build and manage international research collaborations. Adjunct Professor Peter Batt captivated the audience sharing recent work experience on food security in urban areas as a consultant for the UN Food and Agricultural Organization.

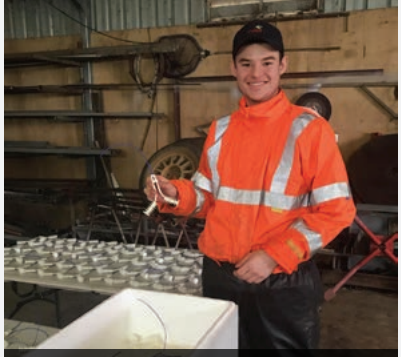
Also speaking was Associate Professor Fay Rola-Rubzen from the UWA School of Agriculture and Environment and IOA who used rural India as a case study to illustrate the opportunities that conservation agriculture provides for poverty alleviation. Finally, PhD candidate Ms Kendra Travaille from the School of Biological Sciences presented her doctoral research in lobster fishery in the Caribbean.

Presentations were followed by a networking session which offered a space for researchers of diverse levels of experience and backgrounds to discuss their common interests and explore avenues for future collaborations.

WA RAID representatives, Ana Manero, Alicea Garcia and Rodrigo Pires, thanked attendees for their enthusiasm in making the event a great success and looked forward to welcoming everyone again at the next event later in the year. For further information please contact the representatives and consider joining RAID Australia.



Organisers, speakers, collaborators and attendees at the RAID event. Photo by Kadambot Siddique.


James Bidstrup completing his practicum at Lawson Angus Stud

Inaugural David Bedbrook bursary to UWA student

Third year Bachelor of Agricultural Science student James Bidstrup was awarded the inaugural David Bedbrook Bursary in May. The bursary, which was presented by Mrs Carol Bedbrook and her son Simon honours the memory of the late David Bedbrook, a UWA graduate who had a long professional career as an Agricultural Consultant.

James plans to use the bursary to fund a one day a week placement at ConsultAg throughout his final semester of studies. His goal for this work experience is to understand the day to day role of an agronomist, and gain solid knowledge of the key principles that help an agronomist provide a quality service to their clients.

James, who is passionate about cattle breeding has already spent a week at Lawson Angus Stud in Youngs Siding to learn more about their artificial insemination schedule.

"The opportunity to visit a highly respected Angus stud during their artificial insemination period has given me a wealth of experience and knowledge," James said.

With James approaching the end of his course, he hopes to secure a full-time agronomy position in WA and said the opportunity provided by the David Bedbrook Bursary will give him a competitive advantage.

Disease resistance genes to halt blackleg in Canola

PhD candidate Soodeh Tirnaz from UWA's School of Biological Sciences and IOA has received a 2018 Grain Research and Development Corporation (GRDC) research scholarship for her PhD studies on devastating blackleg disease in canola.

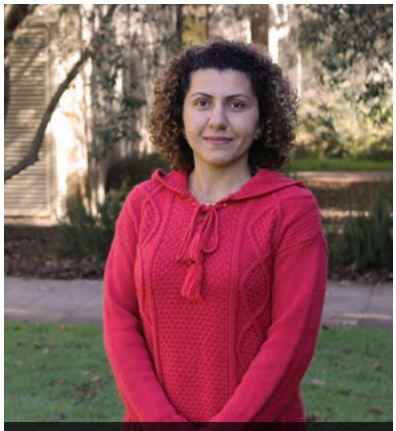
Blackleg disease has a huge economic impact on the canola industry worldwide, with average yield losses of 15% each year. Soodeh is identifying and mapping disease resistance genes in more than twenty species of Brassicaceae.

"Resistance genes have an important role in plants' defense mechanisms, making them a major component of breeding programs towards disease resistance," Soodeh said.

"I am also investigating the association of epigenetic mechanisms that regulate these resistance genes, which will improve our understanding of the plant pathogen interaction."

The scholarship enables Soodeh to attend the Plant Epigenetics Conference in France in October, where she will present a poster. Whilst in Europe, Soodeh will visit collaborators in France and Italy to discuss her research.

Soodeh is supervised by Prof Jacqueline Batley and Prof David Edwards from the School of Biological Sciences and IOA, and Prof Martin Barbetti from the UWA School of Agriculture and Environment and IOA.



GRDC Research Scholarship winner Soodeh Tirnaz

IOA Visitors

IOA hosts numerous international visitors throughout the year. The current group of visitors come from China, India, France and Japan and are visiting UWA from between two months to one year, working with IOA researchers Professor Hans Lambers, Hackett Professor Kadambot Siddique, Associate Professor Megan Ryan, Dr Yinglong Chen and Dr Jiayin Pang.

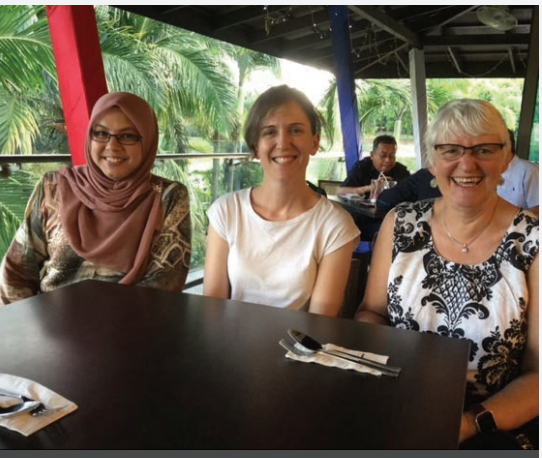
Dr Vijay Pooniya is an Endeavour Research Fellow from the Indian Agricultural Research Institute in New Delhi. He spent four months at UWA from April – August working on durum wheat lines. The major aim of his study is to determine the effect of the TaMATE1B gene on root and shoot traits, as well as yield when grown in acid soils with high aluminium toxicity.

IOA hosts numerous international visitors throughout the year.

Second-year Master's students Ms Yumika Watanabe from Nagoya University, Japan visited UWA for eight weeks as part of UWA's International Research Internship program. During the internship, Yumika participated in three research experiments and gained first-hand experience in examining how wheat and chickpea root systems respond to early drought, aluminium acid and phosphorus deficiency.

French student Mr Guillaume Tueux from Purpan Engineering School in Toulouse, France is completing his three-month internship at UWA from July – September. He is working with Dr Jiayin Pang on a project understanding the role of AMF and carboxylate exudation in phosphorus acquisition in chickpea.

Mr Junlin Zheng from China has been at UWA for the past 12 months on a UWA-China Scholarship. He is working on the effect of genotypes and salinity levels on castor bean plants.



UWA graduates Dr Noraini Jaafarand Dr Jennifer Carson met with their former supervisor E/Prof Lyn Abbott in Malaysia.

UWA soil scientists reconnect in Malaysia

Emeritus Professor Lyn Abbott
lynette.abbott@uwa.edu.au

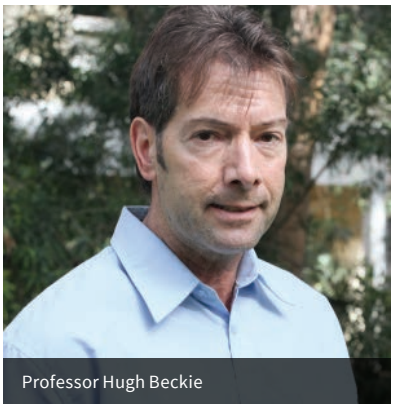
Emeritus Professor Lyn Abbott recently met up with two of her previous PhD students in Kuala Lumpur, Malaysia at the 10th International Symposium on Plant-Soil Interactions at Low pH, where she was a plenary speaker.

Dr Noraini Jaafar is now Senior Lecturer in the Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia. Dr Jennifer Carson moved to Malaysia in 2015. She provides writing and English-language editing to researchers (Ghost Media), and was recently appointed as an Honorary Assistant Professor at the University of Nottingham's campus in Malaysia, where she coordinates an introductory unit in Soil Science.

Both UWA graduates recently co-authored a chapter on Malay soil proverbs for the IUSS book on soil proverbs from around the world.

New Staff

Professor Hugh Beckie | hugh.beckie@uwa.edu.au



Professor Hugh Beckie

Leading international weed scientist Professor Hugh Beckie has joined UWA as Director of the Australian Herbicide Resistance Initiative. Prof Beckie comes to UWA from the Saskatoon Research and Development Centre, Agriculture and Agri-Food Canada, taking on the role from Professor Stephen Powles who has retired after two decades as director.

Prof Beckie is an international expert on herbicide resistance in plants with a focus on strategies, tactics and practises. He is a Fellow of the Weed Science Society of America and Canadian Weed Science Society, and recipient of the QEII Diamond Jubilee Medal.

Associate Professor Fay Rola-Rubzen | fay.rola-rubzen@uwa.edu.au

Associate Professor Fay Rola-Rubzen

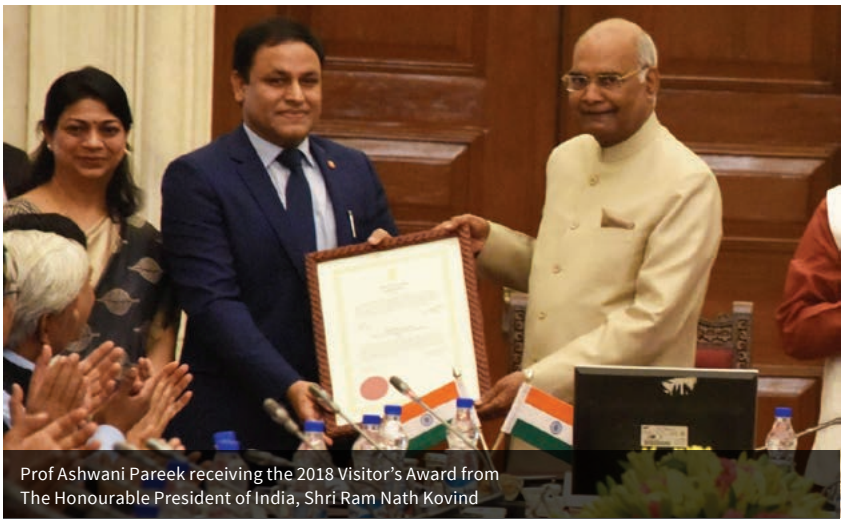
Agricultural economist Associate Professor Fay Rola-Rubzen has joined the UWA School of Agriculture and Environment. She has extensive experience in farming systems research; analysis of farmer behaviour under risk and uncertainty; gender, poverty and food security; agribusiness and supply chain analysis; and poverty and social analysis.

Prior to joining UWA, Assoc/Prof Rola-Rubzen was the Deputy Dean of Research and Development at Curtin Business School, Curtin University. She is currently project leader of a multi-country ACIAR-funded project on *Understanding Farm-Household Management Decision making for Increased Productivity in the Eastern Gangetic Plains*. She is also a co-investigator in the *Sustainable and Resilient Farming Systems Intensification* Project in South Asia, where she leads the gender mainstreaming work and the analysis of farmer behaviour and technology adoption.

Prestigious award for development of stress tolerant rice

The development of a new stress tolerant rice by Professor Ashwani Pareek from Jawaharlal Nehru University (JNU, New Delhi) and Adjunct Professor at UWA has earned the 2018 Visitor's Award for Technology Development.

Prof Pareek's Stress Tolerant Rice of the Next Generation (STRONG) was developed with Jawaharlal Nehru University and has the potential to enhance the income of rice farmers. Prof Pareek was presented the award in May by The Honourable President of India, Shri Ram Nath Kovind.



Prof Ashwani Pareek receiving the 2018 Visitor's Award from The Honourable President of India, Shri Ram Nath Kovind

By manipulating its DNA the new "SMART-sensing" and "HIGH-yielding" rice has been developed especially for farmers with marginal lands. A protein responsible for sensing and responding to changing water status in soil was used.

This new rice type can maintain its yield under stress conditions and when used in conjunction with "SMART-irrigation" this rice would prove highly profitable to the farmers. The technology has been patented and transferred to an agri-industry for further testing and commercialization.

Food security is threatened in India by environmental factors, in particular scarcity and poor quality of irrigation water. It is expected that by 2050 the population of India will reach 1.5 billion. Stress tolerant rice may be the key to feeding future populations.

Lifetime achievement award for UWA Professor

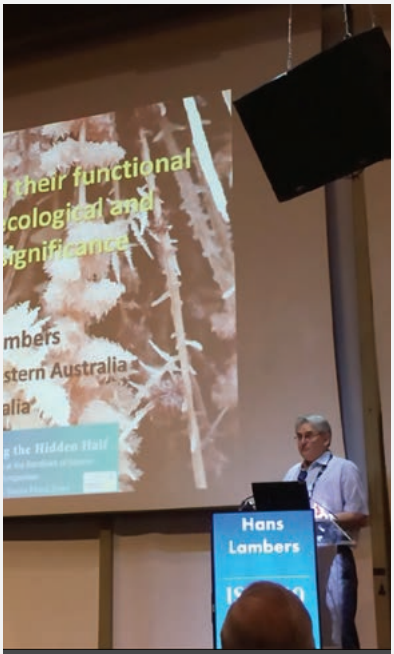
Professor Hans Lambers from the School of Biological Sciences and IOA was awarded the 2018 International Society of Root Research (ISRR) Lifetime Achievement Award in July.

Prof Lambers was presented the award during the Society's 10th Symposium, "Exposing the Hidden Half - Root Research at the Forefront of Science" held in Jerusalem, Israel. The award recognises his outstanding contributions to understanding how roots grow and function. It also recognises his tireless editorship of Plant and Soil journal which has facilitated many root researchers in publishing their research to a wider audience.

During the conference, Prof Lambers delivered the opening lecture titled "Cluster Roots and Their Functional Equivalents: Ecological and Agronomic Significance" detailing similarities between cluster roots and the comparable functional structure of dauciform, capillaroid, vellozoid and sand-binding roots.

The symposium assembled multiple disciplines to expand conversations around the intersections of root physiology, root development, root architecture and root interactions with the environment. Cutting-edge methodologies were highlighted as an important factor of advancing agriculture.

UWA was represented at the conference Dr Yinglong Chen, PhD candidate Wenli Ding, and Dr Daihua Ye who also presented their research at the conference.



Prof Hans Lambers presenting at the ISRR 10th Symposium. Photo Michelle Watt

AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Mr James Bidstrup	AAAC scholarship
Mr Brenton Leske	Calenup Scholarship
Ms Fangning Zhang	Mike Carroll Travelling Fellowship
Ms Yueqi Zhang	Mike Carroll Travelling Fellowship
Ms Mary-Anne Lowe	GRDC Scholarship
Professor Hans Lambers	International Society of Root Research (ISSR) Lifetime Achievement Award
Assoc/Prof Atekelty Hailu	2018 Enduring Quality Award, Canadian Agricultural Economics Society
Adjunct/Prof Ashwani Pareek	2018 Visitor's Award for Technology
Dr Michael Considine	ARC Future Fellowship

VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
Professor Rajeev Varshney	Research Program Director, Genetic Gains Director, Center of Excellence in Genomics & Systems Biology, India	Prof K Siddique	30 Sept – 2 Oct 2018
Professor Rajeev Varshney	Research Program Director, Genetic Gains Director, Center of Excellence in Genomics & Systems Biology, India	Prof K Siddique	30 Sept – 2 Oct 2018
Professor Manny Delhaize	CSIRO Canberra	Prof K Siddique Dr Jairo Palta, CSIRO	5-6 July 2018
Dr RS Paroda	Chairman Trust for Advancement of Agricultural Sciences (TAAS), New Delhi	Prof K Siddique	26-30 Nov 2018
Prof Iain Donnison	Aberystwyth, Wales	Prof Dave Edwards	13-16 May 2018
Ms Yumika Watanabe	Nagoya University, Japan 2018 UWA International Research Internship Program (IRIP)	Dr Yinglong Chen	July – August 2018
NPZ	Germany	Prof Wallace Cowling	November 2018

NEW POSTGRADUATE RESEARCH STUDENTS

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Sajeevee Kadawatha Dina Mithrage	Unravelling the role of contrasting biochars in phytoremediation activity of Industrial hemp and Buffel grass at the heavy metal contaminated soils	UWA School of Agriculture and Environment and IOA	Dr Zakaria Solaiman, Prof Zed Rengel, Prof Andy Whiteley	RTP, UPA and UWA Safety Net Top-Up
Jon Marx Sarmiento	Prospects for Inclusive Modern Agribusiness Value Chains: Improving the Participation of Smallholder Farmers in Mindanao, Philippines	UWA School of Agriculture and Environment and IOA	Dr James Fogarty, Assoc/Prof Fay Rola-Rubzen, Dr L Digal	Australia Award John Alwright Fellowship
Bibek Sapkota	Farmers' perceptions of risk, management strategies and willingness to pay for crop insurance in Nepal.	UWA School of Agriculture and Environment and IOA	Assoc/Prof Fay Rola-Rubzen, Prof Michael Burton, Dr Roy Murray-Prior	Australia Award John Alwright Fellowship
Hira Shaukat	Use of geophysical techniques to assess soil water and soil physical properties	UWA School of Agriculture and Environment and IOA	Dr Ken Flower, Dr Matthias Leopold	RTP, UPA and UWA Safety Net Top-Up
Dinesh Thapa Magar	Adoption, Impacts and Gaps in Agricultural Mechanization in Smallholder Farming Systems in Nepal	UWA School of Agriculture and Environment and IOA	Assoc/Prof Fay Rola-Rubzen, Dr Ram Pandit	SIRF and UPA
Sangay Tshewang	Above- and below ground responses of temperate perennial grass pastures to agricultural management practices	UWA School of Agriculture and Environment and IOA	Dr Zakaria Solaiman, Prof Zed Rengel, Prof Andy Whiteley, Hackett Prof Kadambot Siddique	Sir Eric Smart Scholarship for Agricultural Research

NEW RESEARCH GRANTS MARCH 2018 – JULY 2018

TITLE	FUNDING PERIOD	FUNDING BODY	SUPERVISORS
Elucidating trifluralin resistance in Australian major weed Lolium rigidum	2018-2020	ARC Linkage Projects	Prof Stephen Powles, Dr Qin Yu, Mr Chad Sayer
Understanding farm-household management decision-making for increased productivity in the eastern gangetic plains	2018-2020	ACIAR	Assoc/Prof Fay Rola-Rubzen
Program number 2, sub-program number 2.1 - real-time assessment of Western Australian honeys	2017-2021	CRC for Honey Bee Products	Prof Cornelia Locher, Dr Katherine Hammer
Project 12: development of honey bee products from a biodiversity hotspot	2017-2021	CRC for Honey Bee Products	Dr Katherine Hammer, Prof Cornelia Locher
Project 5: modelling for year round high-value honey production sites	2017-2021	CRC for Honey Bee Products	Dr Michael Renton
Project 25 - pollination harmony	2017-2018	CRC for Honey Bee Products	Dr Bryan Boruff, Mr Edward Hehre
Project 4 (phd4) a "bee credit" to value bee flora in native bush hive sites	2018-2020	CRC for Honey Bee Products	Assoc/Prof Benedict White
A 'focus farms' study to optimize weed resistance management practices in Western Australia	2019-2020	GRDC	Dr Roberto Busi, Prof Stephen Powles, Prof Hugh Beckie, Mrs Lisa Mayer, Ms Mechelle Owen, Mr Peter Newman, Mr Ben Whisson, Mr Garren Knell, Mr Geoff Fosbery
Low weed seed bank persistence under sustained integrated weed management	2017-2018	GRDC	Prof Hugh Beckie, Dr Michael Ashworth
(IAEA) application of stable isotope techniques to close critical knowledge gaps with respect to pollution in agricultural ecosystems	2018-2020	International Atomic Energy Agency	A/Professor Grzegorz Skrzypek
Maximising the reproductive potential of the eat sheep industry by eliminating high oestrogen clovers, more live lambs on the ground	2018-2020	MLA Donor Company	Assoc/Prof Megan Ryan, Prof Philip Vercoe, Dr Dominique Blache, Prof Graeme Martin, Dr Zorica Durmic, Dr Kevin Foster
MDC easy as project	2018	West Midlands Group ex MLA DonorCompany	Prof Philip Vercoe
Managing subterranean clover red leaf syndrome in Western Australia stage 1	2018	Western Australian Agriculture Authority ex Meat & Livestock Australia ex Australian Wool Innovation	Assoc/Prof Megan Ryan, Dr Kevin Foster, Dr Paul Sanford
Oestrogen clovers, more live lambs on the ground	2018		Prof Graeme Martin, Dr Zoey Durmic, Dr Kevin Foster
Transcriptome sequencing to discover herbicide resistance genes in wheat (triticum aestivum l.)	2018	Yitpi Foundation Pty Ltd	Prof Guijun Yan, Mrs Roopali Bhoite, Dr Ping Si, Hackett Prof Kadambot Siddique

UWA IOA 2018 Publications

(April – August)
Refereed Journals

Ahmadi J, Pour-Aboughadareh A, Fabriki-Ourang S, Mehrabi AA and Siddique KHM (2018). Wild relatives of wheat: *Aegilops-Triticum* accessions disclose differential antioxidative and physiological responses to water stress. *Acta Physiologiaw Plantarum* **40:**90-104

Ahmadi J, Pour-Aboughadareh A, Fabriki-Ourang S, Mehrabi AA and Siddique KHM (2018). Screening wild progenitors of wheat for salinity stress at early stages of plant growth: insight into potential sources of variability for salinity adaptation in wheat. *Crop and Pasture Science* **69:** 649-658

Al-Saady NA, Nadaf SK, Al-Lawati AH, Al-Hinai SA, Al-Subhi AS, Al-Farsi SM, Al-Habsi KM and Siddique KHM (2018). Germplasm collection of Alfalfa (*Medicago Sativa L.*) in Oman. *International Journal of Agriculture Innovations and Research* **6** (5): 218-224.

Atique-ur-Rehman, Farooq M, Rashid A, Nadeem F, Stuerz S, Asch F, Bell RW and Siddique KHM (2018). Boron nutrition of rice in difference production systems. A review. *Agronomy for Sustainable Development* **38:** 25-49.

Barua P, You MP, Bayliss KL, Lanoiselet V and Barbetti MJ (2018). Extended survival of *Puccinia graminis* f. sp. *tritici* urediniospores: implications for biosecurity and on-farm management. *Plant Pathology* **67:** 799-809.

Barua P, You MP, Bayliss KL, Lanoiselet V and Barbetti MJ (2018). Inert materials as long-term carriers and disseminators of viable *Leptosphaeria maculans* Ascospores and wider implications for ascomycete pathogens. *Plant Disease* **102:** 720-726

Boruff B, Biggs E, Pauli N, Callow N and Clifton J (2018). Changing water system vulnerability in Western Australia's Wheatbelt region. *Applied Geography* **91**: 131-143.

Busi R, Porri A, Gaines TA and Powles SB (2018). Pyroxasulfone resistance in *Lolium rigidum* is metabolism based. *Pesticide Biochemistry and Physiology* **148:** 74-80.

Chen J, Wang P, Ma Z, Lyu X, Liu T and Siddique KHM (2018). Optimum water and nitrogen supply regulates root distribution and produces high grain yields in spring wheat (*Triticum aestivum* L.) under permanent raised bed tillage in arid northwest China. *Soil & Tillage Research* **181:** 117-126

Chen J, Goggin D, Han H, Busi R, Yu Q, Powles S (2018). Enhanced trifluralin metabolism can confer resistance in *Lolium rigidum Journal of Agricultural & Food Chemistry* http://dx.doi.org/10.1021/acs.jafc.8b02283

Figueroa-Bustos V, Palto JA, Chen YA and Siddique KHM (2018). Characterization of root and shoot traits in wheat cultivars with putative differences in root system size. *Agronomy* **8:**109

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PINGELLY ASTROFEST
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