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Prof Phil Vercoe with Pingelly farmer Garry Page discuss the benefits of including native based pastures on farms

UWA Farm valued in local community

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Regular field days where the local community is welcomed to UWA Farm Ridgefield to observe and participate in our research and development is one of many ways the Future Farm 2050 Project strives to contribute to the local community in Pingelly.

This year's field day was held in September and attracted a record 200 attendees from the surrounding region, local community, agriculture industry, and UWA staff and students.

Future Farm 2050 Project leader Professor Graeme Martin said being valued as a good neighbour by the residents and local Pingelly community is a key outcome for the Future Farm 2050 Project on UWA Farm Ridgefield.

"The theme for this year's event was managing risk as it is a pertinent issue for the rural community," Prof Martin said.

"The rural community is a key

player in the success of sustainable farming for the future"

The day was opened with an engaging 'Welcome to Country' by Gary Bennell and his sister Nora Dann. Gary and Nora's family grew up in the Pingelly region and they captivated field day attendees when they reminisced what life was like for Aboriginal communities in Pingelly when they were growing up.

Assoc/Prof Ross Kingwell from IOA, School of Agricultural and Resource Economics and DAFWA spoke about crop yield risk and said broadacre farming in WA is currently in a healthy state.

Prof Geoff Riley from the UWA Rural Clinical School of WA discussed how farming challenges and isolation can affect mental health of farmers. He advised the audience to talk directly about mental health with someone they suspect may be depressed.

Greening Australia then launched the 20 Million Trees Project, a Federal

program, in which Ridgefield Farm is a site where they will plant trees and associated understory.

The formal presentations were followed by field demonstrations, where participants got the chance to interact with the researchers and see some of the research being done on the farm. Dr Matthias Leopold explained the Critical Zone Observatory, an environmental observatory located on the farm and used to study the "Earth's outer skin" where water, atmosphere, ecosystems, soil and rock interact.

Attendees also visited a multi-species native based pasture paddock with E/Prof Lynette Abbott, Prof Phil Vercoe, Greening Australia and neighbouring farmer Garry Page, to consider the benefits of including native based pastures on farms.

One participant said what they liked most about the event that it dealt with the social side of sustainable farming, with some of the science behind it thrown in.

"It was great to see participation by the local community and to see the mutual benefit the farm and community have. I was impressed by the work being done there."



DIRECTOR'S COLUMN

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I am pleased to report that UWA's reputation as a global leader in agricultural research has been further reinforced by internationally acclaimed rankings in 2015.

In Shanghai Jiao Tong University's highly esteemed Academic Ranking of World Universities (shanghairanking.com), UWA maintained its position of 1st in Australia for life and agricultural sciences, and 25th in the world. Overall, UWA was ranked 87th in the world.

In the National Taiwan University Ranking (<http://nturanking.lis.ntu.edu.tw>), which is based on performance ranking of scientific papers for world universities, UWA climbed four places to 30th worldwide for agriculture, and climbed six places to 18th worldwide for plant and animal science.

UWA researchers have been granted a three year project through the International Wheat Yield Partnership (IWYP). Prof Harvey Millar and Dr Nicolas Taylor from IOA, ARC Centre of Excellence in Plant Energy Biology will form part of a team of Australian scientists selected to investigate energy efficiency of wheat. Set to commence in 2016, the project will see wheat improvement through energy use efficiency tackled at the cell, tissue and whole plant level. It is primarily funded by Australian partner GRDC.

In September, we opened up UWA Farm Ridgefield to the community and hosted our largest Field Day on record. Participants heard presentations about managing risk in a rural setting, and were treated to field demonstrations

of some of the current research being conducted on the farm. Thank you to all involved with making the day a success.

Last month was a busy month of travel to Kansas and California in the US, and Beijing and Zhejiang in China. In the US, I visited the University of California, Davis and Kansas State University with colleagues Professors Tim Colmer and Wallace Cowling. UWA has common strengths in agricultural research with the two universities and we discussed further research and teaching collaboration opportunities.

I also attended the International Workshop on Climate Change and Integrated Dryland Agricultural Ecosystems held in November in Beijing by Chinese Academy of Agricultural Sciences (CAAS), where I delivered a key note address on innovations in dryland agriculture and chaired a session at the workshop. The key outcome from the workshop is to develop technical integration and pilot demonstration on climate smart dryland agriculture.

The visit to Zhejiang was for the Worldwide Universities Network (WUN) Workshop on Legumes 2020, organised by UWA's Dr Mick Considine and his peers from Leeds University and Zhejiang University. UWA was well represented at the workshop and our researchers gave several oral presentations.

Helping make 2015 such an effective year were IOA's Industry Advisory Board, the Institute Management Board, Theme Leaders, UWA Farm Ridgefield Committees, IOA members and staff. They have worked tirelessly to conduct cutting edge research and research training, translate the research outcomes to the agriculture industry and help streamline business processes. Your efforts are much appreciated.

Finally, I would like to sincerely thank Ms Cora Castens for her excellent work and dedication to IOA over the past four and a half years. Replacing Cora as Personal Assistant to the Director is Ms Rachel Benton. Please make her feel welcome.

Season's greetings and best wishes for a happy new year to you and your family.

Chinese visitor studies a new Brassica species

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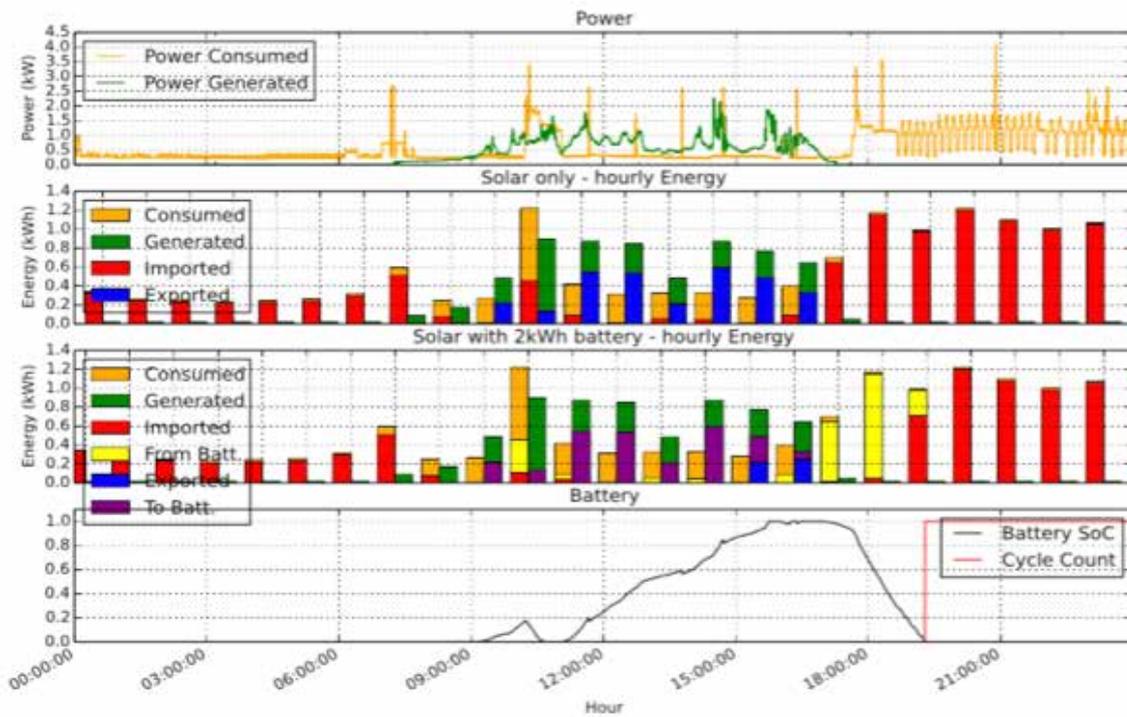
Ms Su Yang, a PhD student from Zhejiang University (ZJU), China, visited UWA's School of Plant Biology and IOA for one year to carry out collaborative research towards her PhD thesis. She received a travel award from the China Scholarship Council (CSC) to visit UWA from October 2014 to November 2015.

Ms Yang worked with Dr Sheng Chen and Prof Wallace Cowling to test the stability of a new population of hexaploid Brassica – based on molecular and agronomic methods. She finalised the first genetic map of hexaploid Brassica, which has genomes from three diploid species Brassica rapa (turnip family), B. oleracea (cabbage family), and B. nigra (black mustard).

Ms Yang's major supervisor at ZJU, Prof Weijun Zhou, helped towards research expenses in Australia and China, including high-density molecular markers for a refined genetic map. Ms Yang returned to China in early November 2015.



PhD student Ms Su Yang from Zhejiang University, China, on a field trip to York, Western Australia.



Comparison of power and energy over a day, with and without battery storage

Monitoring and optimising energy consumption on UWA Farm Ridgefield

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Reducing energy consumption and the use of renewable energy sources have become increasingly important. While the public have been taking steps to reduce energy consumption and switch over to more energy efficient appliances, there is a limit to the possible level of energy reduction using this approach.

Typically occupants are unaware of their energy usage until the end of each billing period. A shift in patterns of consumption to more closely follow energy generation from renewable energy sources would be more effective.

We have developed a system capable of monitoring and processing data for household energy consumption, generation and storage in real-time to provide useful feedback to occupants that is hoped to drive a reduction in

both overall energy consumption and that from the power grid.

The system monitors energy consumption and generation for households with roof-top solar photovoltaic (PV) systems and using that data to drive shifts in energy consumption to better match generation.

The system is able to ingest, process and visualise energy consumption and generation data, which is then used to predict short-term energy generation and consumption. Notifications can then be sent to household occupants to suggest deferring using elastic-load appliances when appropriate.

The UWA Farm Ridgefield has 2 x 5kW ground mounted solar arrays with a 10kWh battery storage to provide up to three days redundancy to the farm house. The initial system was

installed in mid-2012, and a manually switchable grid connection was later added.

We are currently monitoring the energy generated by the solar PV systems, energy consumption in the farm house, and the energy to and from the battery system. Data is collected at approximately 10-minute intervals and shows a strong correlation between energy consumption and time of day, with consumption peaking in the evening and night.

Further development of the system continues with an aim to incorporate further data sources. Improvements to the system to capture feedback from notifications and the creation of additional dashboard visualisations are current areas of work.



Dr Sheng Chen shows UWA Vice-Chancellor Paul Johnson and the senior executive his canola research.

Canola researchers beat the heat

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WA research has shown that canola is most vulnerable to heat damage at flowering and early pod fill stages, and that high temperatures can halve the yield potential of some varieties.

Unseasonably hot weather has reduced the yield potential of many WA canola crops in recent seasons, and some cropping areas this year experienced record temperatures exceeding 34°C in early September.

GRDC is supporting a major canola heat tolerance research project at UWA which aims to identify heat tolerant genes and breeding material for canola breeders. It is also establishing protocols that breeders can use to screen breeding lines.

This research is part of the National Brassica Germplasm Improvement Program which aims to provide canola breeders with advanced genetic lines so Australian growers have access to

cultivars that allow them to compete effectively on world markets.

Researchers led by IOA and School of Plant Biology researcher Sheng Chen have confirmed that the most heat-sensitive stage for canola is seven days before and after the plant produces its first open flower.

According to Dr Chen, a range of canola varieties at this stage of development suffered average yield reductions of 20% when subjected to temperatures of 35°C in a controlled environment.

The most heat susceptible varieties suffered yield losses of up to 50% when exposed to these temperatures in field trials.

Dr Chen says the information could be used by growers to help them adjust sowing times and select varieties to minimise the risk of yield losses.

By checking historic temperature records and variety information, growers can adjust sowing dates so that a canola variety is less likely to start flowering during higher temperatures.

Most canola crops are unlikely to start flowering when temperatures are as high as 35°C. However, late sown crops may be at risk of being exposed to damaging temperatures of above 30°C.

Dr Chen says it is also worth noting that hot weather has occurred earlier in the season in many WA cropping areas in recent years.

The new information will also be useful to canola breeders as they will only need to assess breeding lines for heat tolerance during the two-week period around the onset of flowering.

Another achievement by Dr Chen and his team is the selection of canola lines with potential heat tolerance, following two years of field trials and glasshouse studies.

These lines – sourced from around the world – will undergo further evaluation under controlled conditions at UWA and can be used as parental lines for heat tolerance improvement in Australian canola breeding programs.



Ms Mary-Anne Lowe shows a budding young scientist some rocks found on UWA Farm Ridgefield.

UWA agriculture on show at Dowerin Field Days

Once again, Dowerin and its surrounding towns were packed in the last week of August, welcoming 22,000 exhibitors and attendees who flooded in from around the state to attend the annual Dowerin Field Days 2015.

The two-day event is one of the biggest agricultural events in the country bringing together farmers, industry, city people, students, families and residents of the surrounding communities.

PhD students Ms Mary-Anne Lowe and Mr Abdulkareem Alsih from IOA and the School of Earth and Environment attended the two-day event with IOA Communications Officer Diana Boykett,

Future Farm 2050 Project Officer Debra Mullan and E/Prof Lyn Abbott.

IOA's booth formed part of the Department of Agriculture and Food (DAFWA) display, which was themed Careers in Agriculture this year. Amongst the items on display was UWA's Pitch the Course for the Future Campaign, where students submit a two-minute video pitching their idea for a Course of the Future – the prize a \$10,000 travel scholarship to find out more about how to develop the idea.

Groups of high school students from regional agriculture colleges came through and showed lots of interest in studying agriculture at UWA. They liked the idea of UWA Farm Ridgefield being

a commercial farm where large-scale experiments are conducted and research can actually be applied.

IOA's display also showcased Mary-Anne and Abdul's research into non-wetting soils. Farmers were particularly interested in Abdul's study into the use of thermal-imaging to identify the location of non-wetting soils on farms.

Abdul, who comes from Iraq said attending the field days was a great opportunity to share his research with farmers.

"Mapping the precise location of non-wetting soils means farmers can target their soil treatments. It is a common issue for farmers so the response was positive," Abdul said.

Another step forward for the Global Farm Platform

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The Global Farm Platform, funded through the Worldwide Universities Network, had its most recent meeting in Kochi, Kerala, over 17-21 August 2015. The meeting, organised by Kerala Veterinary and Animal Sciences University (KVASU), was attended by UWA Professors Kadambot Siddique and Graeme Martin, along with international participants from Rothamsted Research, University of Bristol, Kansas State University, University of Wisconsin, and Zhejiang University.

Of particular note was Dr Marykutty Thomas who, since the first Kerala workshop in 2013, has taken responsibility for the KVASU farm, 'Thiruvazhamkundu' or 'Silent Valley'.

Following the model of UWA's Future Farm 2050 Project, Thiruvazhamkundu farm has made remarkable progress.

The farm supports a large number of integrated enterprises: pepper, cashew, coconut, dairy production based on cattle, goats, and buffalo, ducks, aquaculture. Importantly, they have set aside a major area of virgin bush to help maintain biodiversity, so several species that are unique to the valley can be conserved.

The workshop on sustainable livestock systems covered optimising resources, carbon credits, greenhouse

gas mitigation, soil fertility, fodder management, precision nutrition, including mineral status, parasite control, animal welfare, the 'one-health' concept, animal adaptation, socio-economic environments, knowledge dissemination systems, and integration of sustainable livestock farming with the commodity value chain.

Of particular interest were the small-holder systems that are typical of Kerala, in which a farmer will manage only a couple of dairy animals, but grazing systems and stall-fed systems were also covered.



Global Farm Platform meeting hosted by KVASU, India

Sustainable livestock systems on the move in Aceh



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Syiah Kuala University, Indonesia, with whom IOA have an MOU through the Faculty of Veterinary Medicine recently celebrated their 55th Anniversary. As part of the celebrations, the Faculty of Veterinary Medicine held an International Veterinary Seminar on 12–13 October 2015 in Banda Aceh on the topics of ‘Food security and food safety: contribution of clean, green and ethical production from healthy animals’.

The aim was to provoke discussion among academics, students, alumni, practitioners and the local community, about the importance of ‘clean, green, and ethical’ livestock management in the drive for secure and safe supplies of livestock-derived food. The meeting was organised by Dr Teuku Reza Ferasyi, the Executive Director of the Centre for Tropical Veterinary Studies (CENTROVETS), and the Dean of Faculty of Veterinary Medicine at Syiah Kuala University, Prof Muhammad Hambal.

Prof Graeme Martin from UWA’s School of Animal Biology and IOA was

invited as a keynote speaker and addressed the question: ‘Clean, Green, Ethical management: What research do we really need?’

Also presenting was Dr TP Sethumadhavan from Kerala Veterinary & Animal Sciences University (KVASU), India, who covered ‘One Health’ and described the work done in India the context of the Global Farm Platform.

Prof Martin was accompanied by Amriana Hifizeh, a PhD student at UWA who is testing local forages in Aceh for their effects on methane production by local goats. She is doing part of her work in Perth, with Prof Philip Vercoe, and part of her work in Syiah Kuala University with Prof Hambal.

Amriana will begin by gathering local information, from animal scientists, farmers, botanists and veterinarians, for a very broad variety of forage plants that are being used currently, or have been used in the past.

She will also look into plants that are normally used, but show theoretical potential in terms of biomass production, and others with a reputation for medicinal value. She will then test them for their methanogenic potential.

Prestigious recognition for UWA researcher

UWA Research Professor Rajeev Varshney has received a Fellowship of the Crops Science Society of America (CSSA) during its annual meeting in Minneapolis, USA last month.

The fellowship is the highest recognition from the CSSA, only awarded to 0.3% of the Society’s active and emeritus members for their professional achievements and meritorious service.

Prof Varshney is the Grain and Legumes Research Program Director, and Director of the Centre of Excellence in Genomics at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

He was conferred the award in recognition of his contribution to developing and deploying genomic resources in breeding legumes such as chickpea, pigeonpea, groundnut, sesame, adzuki bean and mung bean, and cereal such as pearl millet, barley and wheat. These crops are important staple food crops in the developing world.

In addition to the fellowship, Prof Varshney was awarded another three awards in 2015, including the Shanti Swarup Bhatnager Award for Biological Sciences, the Thomson Reuters Research Excellence India Citation awards, and a Fellowship of the National Academy of Sciences, India.

IOA Director Hackett Prof Kadambot Siddique congratulated Prof Varshney for the well-deserved recognition for research that contributes significantly to global food and nutritional security.



UWA students participate in national soil competition

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Four undergraduate students, Tala Al-Obaidi, Charlotte Patrick, Eleanor Liddle and Colin Flower from the School of Earth and Environment represented UWA in the 2015 National Soil Judging Competition, held at Whitby Falls Farm south of Perth on Sunday, 6 September.

The competition to accurately describe and classify an unknown soil profile was fierce, and although the team from La Trobe University, Victoria were the eventual winners, the UWA team performed admirably.

Asst/Prof Matthias Leopold who helped coach the students with Dr Andrew Rate and Dr Louise Barton said the students were totally committed to their task, and more than proved their worth by wading into frigid, muddy water at the bottom of one of the training pits.

“Field soil descriptions are an essential component of many applications in agriculture, mine

site rehabilitation or environmental assessments,” Asst/Prof Leopold said.

“We were glad to see so many 3rd and 4th year students enthusiastically discussing, evaluating and assessing soils during the competition. These skills will be highly relevant for their future careers.”

The Soil Judging Competition was held to coincide with ‘Celebrating Soils 2015’, a conference organised by the WA branch of Soil Science Australia to celebrate the International Year of Soils 2015 from a Western Australia perspective.

Approximately 120 national and international delegates attended the event, with a UWA contingent of 16 staff and postgraduate students presenting or co-authoring research presentations.

UWA PhD student Mary-Anne Lowe received the 1st prize in the Student Poster-Presentation Encouragement Awards at the conference for her work



UWA students wade through muddy waters to conduct soils assessments

on the use of electrical resistivity tomography in a small scale physical catchment model to evaluate the effectiveness of surfactant on water repellent agricultural soil.

UWA Researchers take on G20 challenge to make energy efficient wheat

UWA researchers will contribute to a G20 nations plan to strengthen future global food security by breeding more energy efficient wheat, funded through the International Wheat Yield Partnership (IWYP).

Established by the G20 nations, the IWYP is an international funding initiative to co-ordinate worldwide wheat research efforts.

Prof Harvey Millar and Dr Nicholas Taylor from IOA, ARC Centre of Excellence in Plant Energy Biology and the School of Chemistry and Biochemistry will form part of a team of Australian scientists selected to investigate new opportunities for wheat improvement through selective breeding for energy use efficiency.

“Our preliminary data demonstrates that there is untapped genetic variation in the energy use efficiency of wheat,” Prof Millar said.

“This means we can fine-tune and optimise growth, which will have a positive impact on wheat yield.”

The three year project will see wheat improvement through energy use efficiency tackled at the cell, tissue and whole plant level.

More than 85% of the energy captured by plants is used in cell activities, some of which are futile, meaning only a very small amount of plant energy is realised as yield. Improving ways in which energy is used and distributed within wheat plants has the potential to significantly increase their growth and crop yield.

Set to commence in 2016, the project is one of only eight internationally to be selected for funding through IWYP. It is primarily funded by Australian partner the Grains Research and Development Corporation (GRDC).



WA scientists will contribute to research strengthening global food security through energy efficient wheat. Credit ARC Coe in Plant Energy Biology

Changes through time – patterns of microbial succession

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Dr Deirdre Gleeson from IOA and the School of Earth and Environment, and Dr Chris Gazey, DAFWA are collaborating to investigate successional patterns exhibited by microbial communities.

In particular they are interested in how microbial succession is impacted by soil pH – a key driver of microbial structure and function, and what relationship this has with microbial cycling of soil carbon.

Dr Gleeson said ecologists have been documenting the process of plant succession for centuries, yet patterns exhibited by microbial communities have received relatively little attention.

“We know that microorganisms are the primary decomposers of organic

matter and plant residue in soil, yet we do not fully understand how they mediate this process,” Dr Gleeson said.

“In addition, studying microbial succession is difficult because microbial communities are diverse and often their ecological role is not fully understood.”

In this work, which is funded by the Department of Agriculture and Water Resources, the researchers are investigating the impact that pH has on microbial successional patterns where plant residues with different underlying nutritional and chemical characteristics are applied. In an agricultural context they are comparing green and brown manuring and assessing how microbial successional patterns observed influence soil carbon stocks.

State of the art DNA sequencing is being used, combined with an analysis of the microbial functions responsible for soil organic matter decomposition,

specifically key enzymes (e.g. laccase and cellobiohydrolase) associated with this process, to help understand microbial succession during plant residue decomposition.

“There have been promising results obtained to date. Our findings indicate that during decomposition, microbial community composition and function changed predictably over time and differed between residue types applied,” Dr Gleeson said.

This work will aid in the development of more comprehensive ecological models of microbial succession and improve our understanding of the processes that regulate soil carbon cycling.

UWA’s collaboration on animal production with Chinese partner kicks off

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A China-Australia Joint Research Centre for Ruminant Production has been established between UWA and Northwest Agriculture & Forestry University (NWAUFU) in China. The first major event in this interaction was the invitation from NWAUFU to Prof Graeme Martin and Adjunct Prof David Masters to present courses in the Veterinary School.

Prof Martin taught science communication to a class of 28 students, while Prof Masters taught sheep production to undergraduate students in veterinary medicine. Students received credit towards their



Adjunct Prof David Masters and the students he taught about sheep production in a 2-week intensive course at Northwest Agriculture and Forestry University, Shaanxi Province, China

degrees for these intensive courses which ran over ten consecutive days and involved 2-4 hours contact per day, including the full gamut of homework and assessments.

In addition to this rigorous schedule, both Profs Martin and Masters presented science seminars, describing the research they are doing in the UWA-CSIRO Livestock Alliance. The joint centre is focussed on issues in grazing livestock, particularly methane emissions. Considerable discussions about UWA’s Future Farm 2050 project, especially the integration of shrubs into management of ruminant production systems were held.

NWAUFU has a farm which they are considering including in the international network of future farm projects. They have a strong focus on local genotypes, a principle that fits well with those of the Global Farm Platform project funded through the Worldwide Universities Network (WUN).

WA to become Australia's bioinformatics powerhouse

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Researchers from across Perth gathered at the Pawsey Supercomputing Centre in August 2015 to share how they use the supercomputers to advance their understanding of biology through bioinformatics.

Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data. It combines computer science, statistics, mathematics, and engineering to analyse and interpret biological data.

The highly interactive two-day event was co-chaired by Professor David Edwards from IOA and the School of Plant Biology. Presentations were given by 25 speakers from a range of disciplines from pest and disease research through to understanding crops.

Executive director of the Pawsey Supercomputing Centre, Dr Neil Stringfellow said bioinformatics is a



Leading bioinformatics researchers share knowledge at the Pawsey Supercomputing Centre in Perth

rapidly expanding field and one of the areas prioritised for national and state investment.

'By working closely with biologists we can ensure they have the computational systems required for them to continue their world leading research,' Dr Stringfellow said.

The Pawsey Supercomputing Centre is one of the largest computer facilities in Australia and is ranked 58th in the world.

Prof Edwards said having access to powerful computer systems, and the expertise to go with it is essential for world class biological research.

'By bringing together leading bioinformatics researchers from UWA, Curtin University, and CSIRO, we can share our knowledge and capability to make WA a powerhouse for bioinformatics.'

UWA strengthens crop science links with the US Universities



UWA delegation with Prof Vara Prasad at KSU inspecting the new controlled environment facilities.

UWA, Kansas State University (KSU) and University of California, Davis (UCD) have a strong history of agricultural science. In November 2015, Profs Kadambot Siddique, Tim Colmer and Wallace Cowling visited KSU and UCD to identify common strengths in agricultural research and to promote future research collaboration, initially with a focus on crop science.

Prof Siddique said KSU and UWA have a similar agricultural focus on

wheat, forage and rotational crops. The delegation met with Prof Vara Prasad, Director of the new USAid Feed the Future Innovation Laboratory for Collaborative Research in Sustainable Intensification.

"Discussions were focussed on common areas of interest, namely drought, heat and salinity stress in crop plants, water-use efficiency, conservation agriculture, climate change adaptation, and linking crop physiology with breeding and genetics," Prof Siddique said.

"We have agreed to sign a MOU in addition to our existing student exchange agreement and Prof Prasad and his team will visit UWA next year to identify joint research projects and PhD students interested in an exchange."

Whilst in Kansas, Prof Siddique also delivered a seminar on 'Innovations in adaptation to climate change in dryland agriculture'.

UCD is ranked first in the world for teaching and research in the area of agriculture and forestry, and ranked number one in the USA for agricultural sciences, agronomy, entomology, environmental ecology, food science and nutrition, plant and animal science, and soil science. Profs Colmer and Cowling both completed their PhD studies at UCD.

The delegation met with Prof Helene Dillard, Dean of the College of Agricultural and Environmental Sciences, a peer of Prof Cowling. She showed keen interest in enhancing collaboration between UCD and UWA in teaching and research.

Amongst two intensive days of meetings, the UWA delegation discussed teaching at an advanced level in plant breeding, co-supervision of PhD students, potential joint publications and collaboration in several research areas.



International Workshop on Climate Change and Integrated Dryland Agricultural Ecosystems, Beijing, November 2015

International collaboration on improving dryland agricultural productivity

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Dryland areas occupy approximately 41% of the earth's land area and are home to 2.5 billion people, or about 30% of the world's population. Most people are rural residents relying on agriculture-based activities as their main source of income.

Dryland agriculture plays an important role in food security, environmental sustainability and poverty elimination and livelihoods improvement. With 34% and 15% of the drylands being located in Asia and Australia respectively, the arid and semiarid areas of China and Australia represent important examples of the challenges and opportunities for agro-ecological sustainability of these regions worldwide.

Decades of research have shown that dryland agricultural ecosystems have a huge potential for improving productivity, which can be achieved by efficient integration of crops, livestock and rangeland production systems and eco-intensification production methods for improving the performance of whole agro-ecosystems. This requires reinventing the dry land agriculture through

systems thinking, an integrated approach to agricultural research for development.

This systems approach includes research on integrated crop-livestock-rangeland systems, more efficient use of soil and water resources, and the introduction of new crops and crop varieties into traditional farming systems to improve yield and yield stability, nutrition, incomes and livelihoods.

The Chinese Academy of Agricultural Science (CAAS) has developed long term cooperation in dryland agriculture with UWA, the University of Sydney, and International Centre for Agricultural Research in the Dry Areas (ICARDA), International Crops Research Institute for the Semi-Arid Tropic (ICRISAT), Lanzhou University and Northwest Agricultural and Forestry University.

In order to promote further cooperation and develop future cooperative projects, an International Workshop on Climate Change and Integrated Dryland Agricultural Ecosystems was held during 20 -22 November in Beijing. The workshop brought about 80 representatives of Chinese national agricultural research systems related to dryland agriculture research and overseas

partner institutes to discuss and exchange the progresses in dryland agricultural research to strengthen the understanding at the international academic frontier of integrated dryland agricultural ecosystems.

Topics discussed at the workshop included the assessment of diversified integrated crop-livestock systems and its effect on the agricultural resources and environment; principles and mechanisms of productivity improvement for integrated crop-livestock systems; soil organic carbon sequestration and enrichment mechanisms in different integrated crop-livestock farming systems; soil fertility evolution, dynamic mechanism and improvement strategy in Dryland Agro-ecosystems; methods and options to support sustainable intensification for boosting productivity; diversification of the farming system with different crop, cereal/legume rotations and multiple cropping and; efficient use of limited water resources.

Hackett Professor Kadambot Siddique represented UWA at the workshop and delivered a key note address on innovations in dryland agriculture. He also chaired a session at the workshop and interacted with CASS Directors, ICARDA, ICRISAT, Lanzhou University and Northwest Agricultural and Forestry University representatives.

The key outcome from the workshop is to develop technical integration and pilot demonstration on climate smart dryland agriculture between the above institutions. A steering committee was formed to oversee the above development.

WA Lupins for Wagyu Cattle in Japan

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Professor Hiroya Kadokawa from the Faculty of Veterinary Science, Yamaguchi University, Japan and Prof Graeme Martin from UWA's School of Animal Biology and IOA have collaborated over about ten years, producing numerous papers on reproductive physiology in ruminants.

Prof Kadokawa recently won a one-year collaborative project, funded by Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF), that will continue the collaboration whilst exploring the possibilities for postgraduate student exchange between UWA and Yamaguchi University.

The team will explore the effect of supplements of Western Australian lupin grain on reproduction in Japanese Black Beef cattle (Wagyu). This raises the possibility of importing lupin grain from WA for the Japanese industry.

The project began with Professor Martin visiting Yamaguchi, with Dr Stacey Rietema, to learn Prof

Kadokawa's techniques with a view to importing them to UWA. The techniques for in vitro culture of cells from the pituitary gland and ovary of cattle and sheep will thus be common to both laboratories.

This will allow rapid progress in testing whether lupin grain contains an oestrogen receptor antagonist that affects the balance of reproductive hormones in cows and ewes. As a follow-up, Dr Kadokawa and his PhD student, Kiran Pandey from Nepal, are spending two weeks in Perth, testing our systems for obtaining tissues from the abattoir, for culture of cells, and for measurement of the cells responses.

IOA Director Prof Kadambot Siddique followed Prof Martin's visit to Japan to sign a memorandum of understanding between Yamaguchi University and UWA. He delivered a lecture on use of legume based pastures in the sustainable grazing in WA

If this exploratory project is successful, it is expected to lead to longer-term, higher-level funding collaborative research, including the integration of postgraduate student exchanges from both countries.



Prof Kadambot Siddique signs MOU with Yamaguchi University.

UWA and ICARDA dissect root trait diversity in chickpea

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Chickpea is the third most important pulse crop worldwide, but its productivity is affected by terminal drought. Development of future chickpea varieties with enhanced drought resistance and increased water-use efficiency is essential for improving yields under dryland environments.

Researchers at IOA and the International Center for Agricultural Research in the Dry Areas (ICARDA) are collaborating to unlock root trait variation in the world chickpea germplasm collection.

Root trait variability in world chickpea reference collection has been characterised using the established high-throughput phenotyping system developed at UWA. The large phenotypic diversity in a range of root traits identified in this study will enhance chickpea breeding efforts for inclusion of root traits leading to improved adaptation to dryland environments.

Selected lines for root traits will be further phenotyped under lysimetric facility at ICARDA, Morocco and also in field trials. Analyses of genome-wide association and quantitative trait loci (QTL) will be used to dissect complex quantitative traits to enable identification of specific genes on the genome responsible for variation in root traits.

This research is supported by CRP Grain Legumes under the CGIAR, a Global Agricultural Research Partnership.



Dr Yinglong Chen explains how the phenotypic diversity in chickpea roots are analysed.



Prof Coles discusses issues around changed land-cover-land use and the impact on hydrology and the development of dryland salinity in WA at Dresden Technology University, Germany

World authority on managing critical disease threats to food security visits Australia

Prof Roger Jones
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Dr Lava Kumar from the International Institute of Tropical Agriculture (IITA), Nigeria was a plenary, keynote speaker at the 12th Australasian Plant Virology Workshop held on 16 – 18 September 2015 at the Esplanade Hotel, Fremantle. UWA provided him with distinguished speaker support funding for his visit.

Dr Kumar is the Head of both the Germplasm Health and Virology and Molecular Diagnostics Units at IITA. He is a major recipient of Bill and Melinda Gates Foundation funding for research addressing food insecurity in Africa.

In an inspiring presentation entitled 'New developments in controlling plant virus diseases affecting major tropical food crops in developing countries', Dr Kumar emphasised that the tropical environment offers conducive conditions for survival of virus hosts and insect vectors throughout the year creating high vulnerability of agricultural production systems to viral infections.

This is especially so in tropical parts of the lesser developed countries dominated by fragmented production systems managed by smallholder farmers with limited resources to adopt disease control measures.

More recent efforts on control of plant viral diseases are increasingly based on the knowledge generated from the improved understanding of the virus diversity, virus-vector-host dynamics, disease epidemiology, spatial distribution and ecology, crowd sourcing and use plant health clinics for disease diagnosis, application of next generation sequencing technologies

Continued next page

Endeavour Executive Fellowship

Prof Neil Coles
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Professor Neil Coles from IOA is assessing current research in integrated water resources management and the status of ecoservices valuation and regulatory frameworks in the US and Europe thanks to the Australian Endeavour Executive Awards.

The Fellowship provides an avenue for professional development opportunities of one to four months for high achievers in business, industry, education or government to visit participating countries.

Prof Coles visited seven universities and 12 research centres across Europe and the US where he met with key researchers, academics and students. During these visits Prof Coles delivered 14 Master Classes and lectures, and attended a number of workshops to discuss research and education programs that link water and food security. These interactions gave him the opportunity to assess how these issues are being addressed by some of our major trading partners.

Water is critical to all aspects of

life as we know it on this planet, and while there is an increasing demand for potable water resources for human consumption, industry and agricultural production systems, this water comes at a cost to the environment and sustained ecosystem functionality.

The perception that the environment or ecosystem has no net present value or is considered of lesser value than alternate uses of water reflects the long-term exclusion of ecosystem function from business models.

"The travel was a valuable opportunity for me to promote research IOA's research at UWA and other institutions," Prof Coles said.

"I have been able to consolidate and expand communication and research links between existing professional networks in Australia, and partners in Europe, USA and Asia."

Using these new and existing contacts Prof Coles is now leading a new EU Horizon 2020 proposal through Leeds University where he is a visiting Senior Cheney fellow. The proposed research will develop methods and practices with the agricultural industry, water resource managers and governments to manage non-points pollutant sources, and improve the security of drinking water supplies in the EU.

for diagnosis and also understanding of molecular determinants of pathogenesis and production and distribution of virus-free planting material.

In addition to technical knowledge socio-economic considerations, enabling policies and interest of governments and donors are also critical requirements for successful control of viral diseases.

Dr Kumar finished his presentation by demonstrating how IITA was effectively applying new developments in control measures to overcome several large-scale pandemics currently threatening food security. These included the



devastating disease of banana caused by Banana bunchy top virus in East and Central Africa.

The workshop was co-sponsored by the APPS, GRDC and UWA. It was organized by recently completed UWA

PhD Students Drs Brenda Coutts and Monica Kehoe, DAFWA, and Prof Roger Jones, UWA's School of Plant Biology, IOA and DAFWA.

Mali looks to WA to develop its livestock industry

Mali's livestock is one of the largest in Sub-Saharan Africa, and the second largest in West Africa after Nigeria. Representing 11% of Mali's GDP, livestock production is one of the pillars of the Malian economy.

Estimated in the region of 10 million head of cattle, 13 million head of sheep and 19 million head of goats in 2013, livestock is Mali's largest export earning source behind gold and cotton.

In order to develop its meat industry, Mali needs training in animal production, husbandry and genetics, cattle feed processing factories using corn, soy and cotton seeds, expertise in pasture and forage production, and modern abattoirs complying with international standards for production of meat for domestic and regional markets.

In a visit to Western Australia in October 2015, a delegation from the Republic of Mali met with UWA representatives from IOA, the UWA Business School, UWA Africa Research Cluster, School of Social Sciences, Faculty of Arts and the Centre for Muslim States and Societies. On the agenda was how UWA can train Malian students in



Mali delegation and Prof Paul Johnson sign MOU

animal production through its Masters in Agriculture Science.

IOA Director Hackett Professor Kadambot Siddique said the Mali delegation was impressed with the quality and prestige of UWA, and dedication of the staff they met.

"The delegation clearly indicated the want to develop a long term relationship with UWA in capacity building and research," Prof Siddique said.

"A Memorandum of Understanding between UWA and the relevant universities was signed in December."

Whilst in WA, the delegation also visited a feedlot in Baldvis owned by the Wellard Group, an abattoir in Katanning and TAFE in West Perth. They also met with the WA Department of Education.

Visualisation of phosphorus rhizosphere interactions

Dr Deirdre Gleeson
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IOA researcher Dr Deirdre Gleeson travelled to Armidale, New South Wales to visit collaborators Dr Chris Guppy and Dr Richard Flavel at the University of New England (UNE). They had an ambitious plan to join forces on a GRDC Soil Biology Initiative (II) project to visualise fertiliser phosphorus (P) in soil and to map microorganisms using state-of-the-art 3-D visualisation tools and high-tech DNA sequencing.

The Australian grain industry applies \$1 billion worth of P fertilisers each year with only a small portion taken up by plants. Therefore much of the remaining fertiliser P becomes fixed in soil and this P 'bank' in Australian arable soils is estimated to be worth \$10 billion.

Dr Gleeson said the productivity of the Australian grains industry depends on the small zone of soil surrounding

roots, known as the rhizosphere – the gateway the plant uses to import most of its resources.

“In the rhizosphere, plants, microorganisms and the soil interact, using chemistry and physics to compete for the resources they need in a highly complex ecosystem,” Dr Gleeson said.

“Despite the importance of the rhizosphere, we know very little about processes that occur there and in particular how to manage the space to benefit crop productivity.”

In this work, the researchers amended both intact and re-packed soil cores with P fertiliser granules to visualise how pore connectivity in the soil environment and interactions between roots and microbes affects fertiliser P release. They showed that sieving and re-packing soil into cores has a large effect on mobilisation of P.

“By spatially mapping the concentration of P around the granule,



Wheat plants growing in soil cores

they were able to capture how much soil the fertiliser influences, and how root systems respond to that,” Dr Guppy said.

“The combined approach of characterising the soil, plant and microbial systems at the same time helps to elucidate how these systems interact in the field and how we might manage the rhizosphere to improve crop productivity,” Dr Flavel said.

The researchers are currently using next generation sequencing to characterise the microbial communities involved in cycling of this P so that they can link the spatial impact of P on soil microbes.

Going underground to study the barley root system



Dr Yinglong Chen prepares barley root samples for Laser Ablation Tomography imaging and analysing at Pennsylvania State University

Dr Yinglong Chen
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Barley is the second most important cereal crop in Australia. Developing for efficient water- and nutrient-use cultivars for increased adaptation to edaphic stress is an important breeding objective.

Agricultural scientists from UWA, Pennsylvania State University (PSU), USA, and Forschungszentrum Jülich (FZJ), Germany have joined hands to unlock the potential of genetic diversity of root systems thanks to support from the UWA Research Collaboration Award and the Group of Eight Australia – DAAD Germany cooperative projects.

In particular, the team will investigate the root traits in crop germplasm for breeding cultivars adapted to environmental stress.

Using the state-of-the-art phenotyping, imaging and modelling technologies, this study will provide functional and mechanistic explanations for the phenotypic variability in the architectural, anatomic and physiological traits in the root system.

The UWA team, Dr Yinglong Chen, Prof Zed Rengel, and Prof Kadambot Siddique have recently characterised root variability in world core collection of narrow-leafed lupin and chickpea, and barley cultivars from Australia and Germany using a novel phenotyping system, and demonstrated root structural and physiological adaptation to varying soil constraints.

The cooperative projects will make an important contribution towards understanding barley root traits for efficient water and nutrient acquisition in dry and low fertility soils, and will increase UWA's reputation in dryland agriculture through collaboration with the world's leading academic institutions.



Grain Legumes: solutions to human health and agricultural sustainability

Hackett Professor Kadambot Siddique
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As part of the Worldwide Universities Network (WUN) a workshop on Legumes 2020: The hub of diversification and adaptation to climate change in agriculture was held at Zhejiang University on 22 to 25 November 2015.

The workshop was organised by Dr Michael Considine (UWA), Professor Christine Foyer (Leeds University) and Professor Jingquan Yu (Zhejiang University) and was attended by selected participants from Australia, China, UK, USA, Canada and South Africa.

UWA was well represented and oral presentations by Dr Michael Considine, Professors Kadambot Siddique, Wallace Cowling, Tim Colmer, Trevor Mori and Dr Judy Berman were given. Prof Siddique's public lecture entitled Abiotic stress tolerance in cool season grain legumes: genetic and agronomic approaches was the 30th lecture in Zhejiang University's Global Lecture series.

Grain legumes are currently underutilised in comparison to cereals in spite of the known benefits to agricultural productivity, sustainability and human health. Grain legume production is static or declining in developing countries, in the face of an increasing global demand. These crops are grown across a range of farming systems, from subsistence agriculture to sophisticated commercial production systems, so research and development

needs to target particular species to each of these various agro-ecological and cultural systems.

Farming systems need to be profitable and sustainable to meet the growing needs of the world's population and respond to the changing climate. Farmers need to optimise the use of inputs such as water and fertilisers. Legumes have a significant role in cropping systems because of their sustainable and environmental benefits such as reducing the carbon footprint and the need for nitrogen fertilisers. They provide nutritious human food and animal feed in both commercial and low-input subsistence agriculture.

The health advantages of a legume-rich diet are many faceted. Their role in global health including the reduction of non-communicable diseases, such as obesity, diabetes, heart disease and neurodegenerative diseases is underappreciated. A diverse diet including a range of legumes is required for health benefits.

An outcome of the workshop was a policy document targeted at governments, funding agencies, research institutions and the public, with the goal of increasing awareness for grain legumes at the highest level of policy-makers, increasing demand for "healthy grain legumes" from consumers, and improving profitability of grain legume production in farming systems, with the involvement of global

legume researchers at all levels. Papers from the workshop will be published in a special issue of the Journal of Experimental Botany, and the group are preparing a perspectives article for a prestigious journal.

The key recommendations from the workshop include (i) developing a global, publically funded network of shared access to germplasm and data, (ii) developing a better understanding on the health effects with regard to the global obesity epidemic and increased prevalence in diabetes, (iii) undertaking further research to understand cultural attitudes towards the use of legumes, to promote the health benefits and how these can be effectively marketed, (iv) include more participatory approaches to transfer of long established and recently developed technologies related to grain legume production to resource-poor rural communities, (v) developing a comprehensive understanding of the value addition chain for the particular sub-sector, to better understand the bottlenecks, (vi) undertaking fundamental research into biological nitrogen fixation and nitrogen use efficiency, as well as phosphorus in relation to climate change and (vii) developing the underpinnings of transformative technologies necessary for producing new elite varieties.

IOA joins hands with the Chinese to combat salinity



IOA hosted a delegation from The Costal Research Institute of Hebei Academy of Agriculture and Forestry Sciences (HAASS) from 4-6 August 2015. L-R: Yanchao Guo, Zhizhong Xue, Wencheng Wang, Xinhai Wu, Kadambot Siddique (UWA), Guijun Yan (UWA) and Jizhuang Du.

Prof Guijun Yan
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IOA hosted a delegation from The Costal Research Institute of Hebei Academy of Agriculture and Forestry Sciences (HAASS) in August this year.

The delegation of five was headed by Dr Xinhai Wu, Deputy Director of The Costal Research Institute of HAAFS. Their major interests were to develop salinity tolerant plants suitable to grow along the costal lines in north China.

The delegation visited the swan coastal plains surrounding Perth and a coastal rehabilitation project near City Beach. They also visited glasshouse facilities at Crawley and Shenton Park Field Station.

Professor Tim Colmer, the Head of School of Plant Biology gave a talk on the salinity research to the delegation, Dr Nicolas Taylor, an ARC Postdoctoral Fellow from the ARC Centre of Excellence in Plant Energy Biology, presented his research on the

molecular mechanism of salt tolerance in wheat, and Professor Kadambot Siddique, IOA Director introduced them to IOA's research and how UWA can collaborate with The Costal Research Institute of HAAFS to undertake research in areas of mutual interest."

Deputy Director Dr Xinhai Wu, on behalf of the delegation and their Institute, expressed their strong gratitude for the UWA's hospitality and invited UWA delegations to visit their Institute.

New Staff



Ms Rachel Benton
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Ms Rachel Benton has joined the IOA team as Personal Assistant to the Director. Rachel previously worked at the University of Leeds in her hometown United Kingdom. She moved to Perth with her husband and two sons in November 2014 and started working at UWA within the Faculty of Law. Rachel is looking forward to meeting new faces around campus so drop and introduce yourself.

Assoc/Prof Theo Evans
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Born and bred in WA, Assoc/Prof Theo Evans completed his BSc in Marine Biology and Zoology at James Cook University in Queensland, honours at UWA, and PhD at the University of Melbourne. He worked at CSIRO in Canberra for over 15 years, and at the National University of Singapore for over four years. Assoc/Prof Evans joined UWA School of Animals Biology and IOA in August 2015 jointly funded by GRDC and UWA. He will work with GRDC and local grow groups in agriculture. He plans to work on integrated pest management in WA, helping to devise when and where to spray insecticides to minimise costs yet maximise control.

Awards and industry recognition

Name	Award
Dr Matt Hipsey	The Vice-Chancellor's Mid-Career Research Award
Dr Olivier van Aken	The Vice-Chancellor's Mid-Career Research Award
Prof David Pannell	The Vice-Chancellor's Award in Research Mentorship
Ms Eviness Nyalugwe	Underwood PhD Scholarship
Prof Stephen Powles	Sectional Committee – Agriculture, Veterinary Science and Applied Biology of the Australian Academy of Science
Prof Wallace Cowling	31st Elmer Heyne Crop Science Lectureship – Kansas State University, Kansas USA
Adjunct Assoc/Prof Muhammad Farooq	COMSTECH Award 2015 for Excellence in Science and Technology – 'Young Scientist Award'
Dr Yichao Rui	Excellent Presentation Award at 3rd International Symposium on Sustainable Agriculture for Subtropical Regions, Changsha, China
Hackett Prof Kadambot Siddique	30th Qi Zhen Global Lecture, Zhejiang, China

Memoranda of understanding (MOU) with external organisations

Institution	Date
Agreement for Academic Cooperation between UWA IOA and The United Graduate School of Veterinary Science, Yamaguchi University, Japan	22 October 2015
Letter of extension between UWA and Gansu Academy of Agricultural Sciences	9 September 2015
MOU between UWA and Segou University, Mali	7 December 2015
MOU between UWA and Rural Polytechnic Institute of Katibougou, Mali	7 December 2015

Visitors to Institute of Agriculture

Name of visitor	Visitor's organisation and country	Host details	Dates of visit
Mashitah Shikh Maidin	Universiti Putra Malaysia	Prof Graeme Martin	September 2015 – December 2015
Sebastien Abric Margot Weyer Julien Bajard Camille Petit	Grand Ecole Nationale, France	Prof Graeme Martin	September 2015 – March 2016
Assoc/Prof Ruihui Wang	Agricultural University of Hebei, Baoding, Hebei Province	Assoc/Prof Guijun Yan, Dr Hui Liu	August 2015 – February 2016
Peng Zhao	Henan Agricultural University, China	Prof Zed Rengel, Dr Yinglong Chen	February 2015 – October 2015
Dr Johannes Postma	Forschungszentrum Juelich, Germany	Dr Yinglong Chen, Prof Zed Rengel	September 2015 – October 2015

New PhD research students

Name of student	Topic	School	Supervisors	Funding body
Xiaodong Mu	Flystrike	Animal Biology and IOA	Prof Graeme Martin, Assoc/Prof Shimin Liu	DAFWA
Candy Taylor	The impact of domestication on genes for key phenological traits in lupin (<i>Lupinus angustifolius</i> L.)	Plant Biology and IOA	Prof Wallace Cowling, Assoc/Prof Matthew Nelson	APA Award and GRDC
Dina Hermawaty	Organelle biogenesis in grapevine bud dormancy	Plant Biology and IOA	Dr Michael Considine, Dr Patricia Agudelo-Romero, Dr Monika Murcha, E/Prof John Considine, Prof Christine Foyer	Self-funded

New research funded projects 2015 (Since July 2015)

Title	Funding Period	Funding body	Researchers
Impact of Compost Carbon on Lettuce Growth and Soil Fertility	2015	C-Wise	Dr Zakaria Solaiman
Reducing stable fly emergence in soils amended with litter	2015–18	Rural Industries Research & Development Corporation RIRDC	Dr Sasha Jenkins, Dr David Cook, Emeritus Professor Lynette Abbott, Mr Ian Waite
Establishing Novel Breeding Methods for Canola Improvement	2015–17	ARC linkage projects	Professor Jacqueline Batley, Professor David Edwards, Mr David Pike, Dr Harsh Raman, Dr Stephen Rae
Towards genome methylation based crop improvement	2015–17	ARC linkage projects	Professor David Edwards, Professor Jacqueline Batley, Mr David Pike, Mr Benjamin Laga
Impact of Weeds on Australian Grain Production & Adoption of No Till Cropping Practices	2015	CSIRO ex GRDC	Dr Michael Renton
New Uses for Existing Chemistry	2015–19	University of Queensland ex Grains Research & Development Corporation GRDC	Dr Michael Walsh
Organic Matter and Nutrient Availability	2015	University of Queensland ex Grains Research & Development Corporation GRDC	Dr Louise Barton, Professor Daniel Murphy, Dr Fran Hoyle, Dr Craig Scanlan
Innovative Approaches to Managing Subsoil Acidity in the Western Region	2015–19	WA Department of Agriculture & Food ex GRDC	Professor Zdenko Rengel, Mr Paul Damon
Spatial Temperature Measurement and Mapping Tools to Assist Growers, Advisors and Extension Specialists Manage Frost Risk at a Farm Scale	2015–17	CSIRO ex Grains Research & Development Corporation GRDC	Dr Kenneth Flower, Mr John Callow, Dr Bryan Boruff
The More the Merrier? Investigating copy number variation in Brassicas	2016–18	ARC Discovery Projects	Professor Jacqueline Batley, Professor David Edwards
The new Soil Quality ebook	2015	WA Department of Agriculture and Food DAFWA	Professor Daniel Murphy

IOA Publications 2015

(August – November)

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