



The BeefLinks partnership will coordinate an integrated research and practice change program for the West Australian Beef Industry

BeefLinks Partnership To Boost Red Meat Industry

Professor Philip Vercoe philip.vercoe@uwa.edu.au

A four-year partnership between The University of Western Australia, Meat & Livestock Australia (MLA) through the MLA Donor Company (MDC) has been launched to coordinate and drive an integrated research and practice change program for the West Australian Beef Industry.

The partnership, BeefLinks, aims to enhance the red meat value chain through a greater understanding of efficient use of farm resources, better use of grazing mosaics, and the production of cattle that reach and exceed domestic and export ready standards. BeefLinks will provide better knowledge and a range of technologies to support the sustainability credentials of products and interconnectivity between producers, processors and consumers.

UWA Program Lead, Professor Philip Vercoe from the UWA's Institute of Agriculture and School of Agriculture and Environment said

the program aims to foster the prosperity of the red meat industry and achieve profitable, consistent and sustainable beef yields matched to consumer expectations.

"The partnership is exciting because it is based around a model of collaboration, engagement, discussion and genuine sharing of information amongst producers, the wider industry, State Government and researchers to make faster progress towards improving both productivity and the environmental footprint of the northern beef industry," Professor Vercoe said.

"A number of research projects are now underway that have been designed to help develop a higher valued supply chain that is more productive and sustainable for northern WA.

"There is a key focus on understanding more about the nutritional characteristics of the northern mosaic feedbase and how to transition animals more efficiently across different parts of the mosaic. Of particular interest is using the information to strengthen the existing north-south alliance and establish practices that increase productivity and improve the consistency of growth paths in cattle that transition from north to south."

MLA Group Manager – Productivity & Animal Wellbeing, David Beatty said the new knowledge developed by the BeefLinks projects will be shared with producers and other supply chain operatives.

"The goal is to make sure producers and industry are an integral part of the BeefLinks partnership and to use the strategy to engage other collaborative partners," Dr Beatty said.



Director's Column

Hackett Professor Kadambot Siddique,
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Last month, UWA welcomed its 19th Vice-Chancellor Professor Amit Chakma. Vice-Chancellor Chakma is a Professor of Chemical Engineering, and joins UWA from The University of Western Ontario, Canada where he served as President and Vice-Chancellor for ten years. He brings with him demonstrated success in building research capability and important partnerships across academic, government and industry sectors.

The Annual Research Report 2019 has been published and highlights the depth and breadth of agriculture and related research conducted at through The UWA Institute of Agriculture (IOA) and the six research

themes. A full version can be downloaded at ioa.uwa.edu.au/annualreport.

UWA has improved its world ranking in agriculture research and is now 17th in the world in the recently released Academic Ranking of World Universities 2020 (www.shanghairanking.com/Shanghairanking-Subject-Rankings/agricultural-sciences.html). We continued our number one position in Australia. The above achievement is due the outstanding contribution IOA members, staff, national and international collaborators.

The Federal Government announced in June that students would pay 62 per cent less to obtain a degree in agriculture science. The recognition of the important role agriculture plays and will continue to play in the future in Australia is well received, and we look forward to welcoming more of the brightest students to UWA to study agriculture and related areas.

Two of our key events were postponed this year and I'm pleased to say that with the easing of government restrictions we should be able to hold these events in person over the next few months. The Postgraduate Showcase: Frontiers in Agriculture is scheduled for Wednesday, 30 September. This year we have eight students who will present their research in agriculture and related areas.

The annual Industry Forum will go ahead on Wednesday, 28 October 2020 at the University Club of Western Australia. This year's topic is *Climate change and agriculture: challenges and solutions for Australian Farmers*. In line with social distancing requirements both these events will have reduced capacity so please register early.

There have been a few changes to the team in recent months. We bid farewell to Ms Sam Carlson who joined the team as Business Support Manager in 2019. Her calm temperament and can do attitude have been invaluable. Mrs Diana Boykett has returned from parental leave and has accepted the Business Support Manager position. Diana has been a valued member of IOA since 2014 and her thorough knowledge of the Farm, Institute and wider University will ensure a smooth transition into this role.

I'd like to thank Ms Laura Skates for her work as Communications Officer for the past 18 months. Laura fit seamlessly into the team and has been a pleasure to work with. We wish her all the best in her new endeavours in Kings Park and Botanic Gardens. Ms Rosanna Candler will take the reigns as Communications Officer, so you will hear more from her in the future.

We welcome Amanda Zanatta to the team as Farm Assistant at UWA Farm Ridgefield. With experience from various veterinary clinics and animal care centres as well as CBH and AFGRI Equipment Australia, Amanda brings a broad range of knowledge to this newly established role.

Finally, I'd like to thank Mrs Sandra Mata for her contribution as Project Officer to the activities on UWA Farm Ridgefield. Sandra's background in education has added a lot of value to the teaching and outreach activities in the Future Farm 2050 Project.

The first half of the year has no doubt been very challenging for many but I am encouraged by the exciting research that is happening on campus every day and look forward to an even more productive end to 2020.

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"Building participant engagement and coordination within the program and with each other ensures informed and empowered participants who can confidently communicate and adopt the program messages.

"In addition to this specific partnership, MLA is further supporting the program through in depth consumer and market

insights analysis, linked to MSA insights and analysis, to identify possible new opportunities for higher value supply chain growth and investment."

Producers within the rangeland region of WA, producers who have the capacity to facilitate the backgrounding of cattle, and feedlots who are looking for new opportunities are invited to participate in the program.

BeefLinks is a collaborative research and development (R&D) partnership involving Meat & Livestock Australia (MLA), MLA Donor Company (MDC) and The University of Western Australia (UWA). MLA and UWA acknowledge the matching funds provided by the Australian Government, through the MLA Donor Company, to support the research and development of the BeefLinks Program.

Aerospace team launch high altitude balloon on UWA Farm Ridgefield

Student engineers from UWA's Aerospace team have been attempting to launch a high altitude helium balloon from UWA Farm Ridgefield.

Working with Farm Manager Richard McKenna, the team have ensured all safety precautions have been met, including obtaining approval through the Civil Aviation Safety Authority.

The team hope to test out their custom-built electronics and recovery systems in the relatively low risk environment of a High Altitude Balloon. They will use the equipment and lessons learned from this project in future missions to Earth's upper atmosphere and beyond.

Team captain James Dingley said their first launch day in February coincided with extremely windy conditions as a result of a cyclone making landfall in WA's north.

"We had not fully appreciated how challenging these conditions would make filling the balloon," James said.

"The balloon inflation and final setup of the lines were completed swiftly but establishment of a GPS and communications lock took much longer than anticipated. During this time the strong wind blew the balloon to the ground and it burst."

Having made the necessary changes, the team plan to make their next attempt in early August.

More information about the team and their work can be found at www.uwaaero.space



UWA Aerospace launch high altitude balloon on UWA Farm Ridgefield.

Rural Utopias art project in Pingelly

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Mike Bianco, a lecturer in Fine Arts in UWA's School of Design, has been selected as one of fifteen artists worldwide to participate in the International Art Space's program *Spaced 4: Rural Utopias*, an international program presenting residency-based art projects in 12 rural and remote communities in Western Australia.

Spaced 4: Rural Utopias is a multi-year program of residencies and socially engaged art projects in regional and remote Western Australian communities. The program focuses on the idea of "Rural Utopias" and includes 15 artists from Australia, USA, Italy, UK, Austria and Indonesia.



Mike Bianco conducting a bee-hunting workshop as part of Know Thy Neighbour at Perth City Farm. Image: Mike Bianco.

Mr Bianco will spend six weeks in Pingelly between July to December 2020 during which he will draw on community conversations, workshops and collaborative working methodologies to develop an ecologically-minded folk school.

The partnership is with the Pingelly Community Resource Centre and the UWA Future Farm 2050 Project and contributes to a vision to create socially engaged art through a dialogue with the local Pingelly community.

"This project is entirely contingent on collaborations with the community, and ideally letting the community lead the way," Mr Bianco said.

Mr Bianco added that he was drawn to the UWA Future Farm 2050 Project because it was modelling scientific, economic, and technological solutions for the future of farming.

"I'm interested to look at the future of farming from a cultural perspective," Mr Bianco said. "I want to discuss with the community how they see farm and regional life changing, and what the social and cultural side of farming might look like in 2050."

The project will run over two years, with ongoing consultation with the Pingelly community and art workshops currently scheduled for summer 2020.

Outcomes from the project will be presented and shared in the form of a collaboratively developed exhibition featuring documentation, objects, and ephemera. For more information about the project, visit spaced.org.au

Feed source *Leucaena* to decrease methane emissions in livestock

Master of Agricultural Science Student Daniel Geurts from UWA's School of Agriculture and Environment has been investigating ways to reduce enteric methane emissions from livestock.



Leucaena plants in the glasshouse.

In particular, he has looked at the tropical legume tree *Leucaena* as an alternative feed source which has the potential to decrease methane emissions in cattle.

Leucaena is high in nutritive value and has been shown to have antimethanogenic potential, thought to be caused by the plant secondary compound called tannins.

Daniel received the Agribusiness Connect Scholarship supported by Royalties for Regions to conduct the research and hypothesised that there would be differences in levels of methane production depending on *Leucaena* species.

"Tannins were expected to be the causal factor of the antimethanogenic effect, alongside leaf age and environmental differences," Daniel said.

A total of 48 accessions from 13 species grown in the Department of Primary Industries and Regional Development glasshouse and field sites were screened

using an *in vitro* fermentation system that simulates rumen fermentation in a test tube. Specifically, gas pressure, a measure of fermentability, and methane were measured.

"As expected gas and methane production varied by species, with gas pressures ranging by 40 kPa and some species producing 50% less methane," Daniel said. "Tannins were found to be influential in methane production for some species but not all, indicating that other compounds are causing the antimethanogenic effect in *Leucaena*."

The large variability in fermentation within *Leucaena* species provides an opportunity for developing an improved commercial variety, both in terms of fermentability and methane production.

Daniel was supervised by Professor Phil Vercoe, Dr Zoey Durmic and Dr Clinton Revell from the Department of Primary Industries and Regional Development.

Secret to on-off fertility discovered in pigeonpea

This article was adapted from *ICRISAT Happenings Newsletter*

Adjunct Professor Rajeev Varshney
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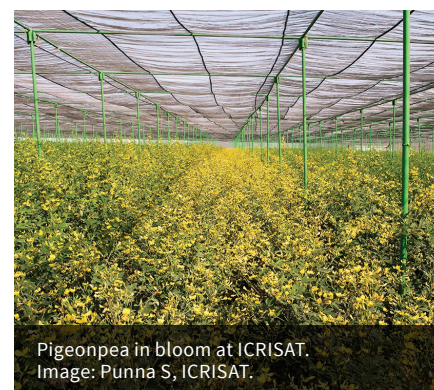
Researchers from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), University of Vienna and UWA have identified how temperature controls male fertility in some lines of pigeonpea, and have unraveled the phenomenon's molecular mechanism in a recently published study in *The Plant Genome*.

They have also shown that sterility can be reversed with auxin treatment. The new findings are expected to pave the way for techniques that can reduce the cost and effort in hybridizing the crop, and lead to increased yields.

Pigeonpea is extensively grown and consumed in South Asia and Eastern Africa, being one of the oldest food crops and a staple source of protein.

Through their research, the authors demonstrated that pigeonpea lines turning fertile in response to the environment, called Environment-sensitive Genic Male Sterility (EGMS) lines, can go from being male sterile to male fertile if the temperature of the growing environment is reduced to 24°C.

Dr Rajeev Varshney, Director for the Genetic Gains Research Program at ICRISAT and UWA Adjunct Professor with IOA, led the study and said that the research is a result of what scientists today call Systems Biology – a combinatorial approach of



Pigeonpea in bloom at ICRISAT.
Image: Punna S, ICRISAT.

transcriptomics, proteomics, metabolomics and computational genomics.

"Together with cytological analysis and multiomics analyses, we have explained the molecular mechanisms underlying fertility transition," Professor Varshney said.

"The findings of this study enable the development of an effective two-line hybrid breeding system for rapid, inexpensive and high-quality hybrid pigeonpea seed production."

Crop diversification and soil health key to agricultural sustainability

Laura Skates
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Researchers from The University of Western Australia's Institute of Agriculture and Swift Current Research and Development Centre, Agriculture and Agri-Food Canada have investigated the impact of conventional cropping systems on soil health and quality.

Soil health is vitally important for sustainable agriculture, and is defined as the capacity of soil to function within ecosystem boundaries to sustain crop and animal productivities, maintain or enhance environmental sustainability, and improve human health worldwide.

Hackett Professor Kadambot Siddique, Director of The UWA Institute of Agriculture, said that it is essential to design and implement actions to protect and restore soil health in agriculture.

“Cropping systems were initially designed to maximize yield, but modern agriculture has become increasingly concerned about the environmental sustainability of the systems,” Professor Siddique said. “The goal of soil health maintenance is to ensure long-term stable high productivity and environmental sustainability of cropping systems.”

Professor Siddique explained that soil degradation is one of the most severe socioeconomic and environmental problems threatening our survival and well-being, particularly when it comes to food security.

“Unfortunately, soil has been and is currently being rapidly degraded at a global scale due to a range of invasive human activities, including intensive mono-cropping agriculture systems,” Professor Siddique said. “Developing sustainable and cost-effective measures for both the prevention of soil degradation and the recovery of degraded soils must be promptly implemented.”

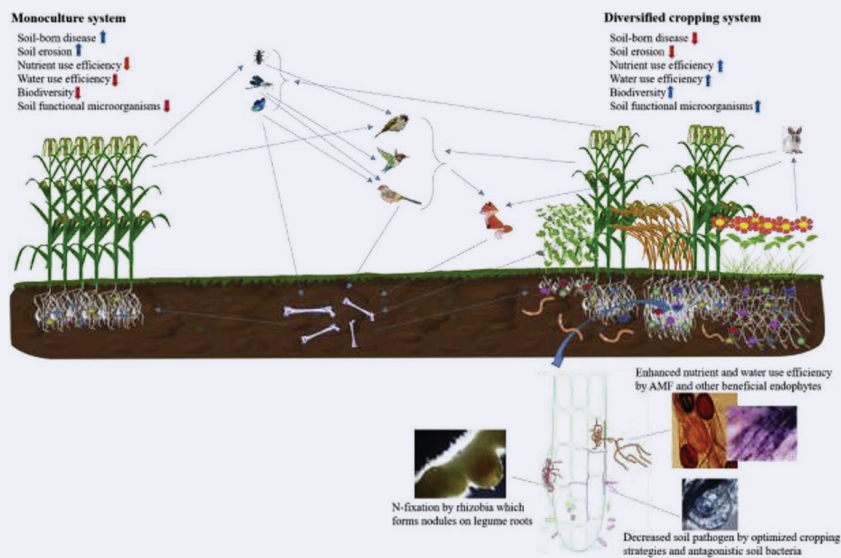
A key step towards ensuring soil health maintenance is to use a range of soil health indicators. Traditionally, physical and chemical properties of soil, such as soil texture and nutrient content, have been used as soil health indicators. However, the importance of soil biological and microbial properties as soil health indicators is becoming increasingly recognised.

"In cropping systems, the symbiosis of diverse soil microorganisms can have multiple benefits for crop plants and soil health," Professor Siddique said. "Determining the taxonomic structure and microbiome functions of these

beneficial soil microorganisms under different cropping systems is critical for understanding and improving soil health.”

Professor Siddique said that this knowledge along with relevant policies will be crucial to ensure soil health is maintained and sustainable ecosystem and agricultural development may be achieved.

The study was published in *Global Ecology and Conservation*, and supported by Agriculture and Agri-Food Canada, Environmental Canada, Saskatchewan Pulse Growers, and Agricultural Development Fund of Government of Saskatchewan.



Soil health comparison in optimized cropping systems and monocultures.

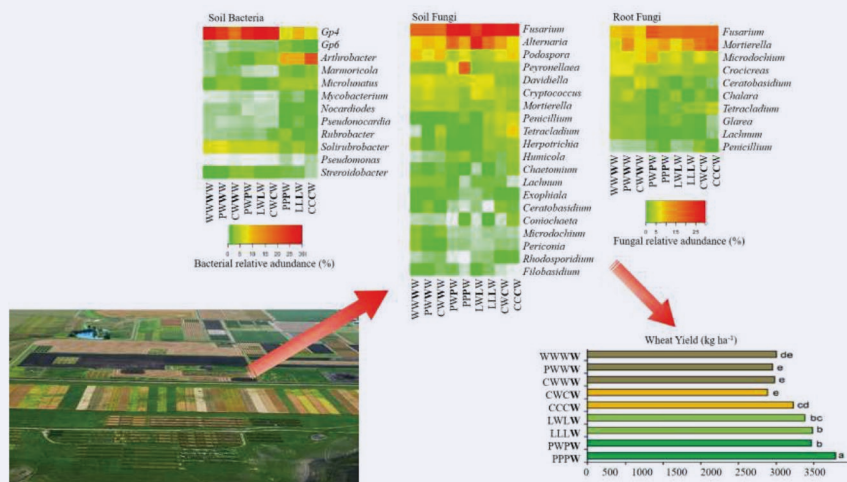


Illustration of how soil microbial profiles are related to crop yield in various crop rotating systems.

Plant Biochemist awarded national Fellowship

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Director of the ARC Centre of Excellence in Plant Energy Biology Professor Harvey Millar from UWA's School of Molecular Sciences and IOA has received a prestigious Australian Research Council (ARC) Laureate Fellowship.

One of 14 Australian Laureate Fellows recognised this year, Professor Millar was granted \$3.3 million to develop new ways to optimise the stability of proteins in crops, in order to increase crop performance and quality.

His project aims to understand the cellular processes and genes that regulate synthesis and degradation of proteins in wheat and barley plants and unveil how to control this for the first time.

Professor Millar said the research had the potential to increase crop quality through the control of protein abundance in wheat and barley, and that this would be harnessed by biotech industries to create future nutritious crops worldwide.

"Mapping out and developing systems to alter the rates of protein production and degradation inside plants will allow us to hone plant protein production in the future, so that we'll gain the nutritional



Prof Harvey Millar was awarded a prestigious Australian Research Council Laureate Fellowship.

benefits of higher-protein, plant-based food products," he said.

UWA Deputy Vice-Chancellor (Research) Professor Tim Colmer said the University's new ARC Laureate Fellow is an outstanding researcher and internationally recognised for discoveries in plant proteomics and energy metabolism, who had continued to innovate in a field that could have an enormous impact on future crops and food for global populations.

"The ARC Laureate scheme recognises cutting-edge research in Australia, by our world-leading researchers, and the University congratulates Professor Millar on receiving this recognition," Professor Colmer said.

"His research will help boost the State's biotechnology capacity, as well as broker new collaborations and provide a high-quality training environment for students and mentoring of early-career researchers."

Tree-ring records to improve drought risk models

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Over the last several years, Dr Alison O'Donnell and Dr Pauline Grierson from UWA's School of Biological Sciences have been developing a "drought atlas" for Western Australia based on multi-centennial tree ring records from across the state.

They are now investigating ways that these tree-ring records of past rainfall variability can be used to better understand decadal-scale drought risk for agriculture in WA's grainbelt region.

Dr O'Donnell said building resilience to drought requires a strong understanding

of the risks to agricultural production, and increased reliability in seasonal as well as longer-term forecasting.

"Current assessments of drought risk are still mostly based solely on approximately 120 years of instrumental data, which is unlikely to capture the full range of potential rainfall variability," Dr O'Donnell said.

Dr O'Donnell and Dr Grierson recently developed an approximately 700 year tree-ring record of annual rainfall from near Bullfinch in WA, which shows that for the eastern grainbelt, several severe and

Virus disease threat to Kimberley cucurbit industry addressed

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For at least 25 years, cucurbit crops in the tropical Ord River Irrigation Area (ORIA) in Western Australia's Kimberley region have suffered from devastating epidemics caused by aphid-borne zucchini yellow mosaic virus (ZYMV). A three-year project led by Adjunct Professor Roger Jones in collaboration with DPIRD, Raitech Ltd and ORIA cucurbit grower representatives has addressed this problem.

Extensive surveys found that the aphid species *Aphis craccivora*, *A. gossypii* and *A. nerii* were responsible for spreading ZYMV to commercial melon and pumpkin crops. These aphids were present all-year-round colonising 38% of leaf samples of introduced weeds, Australian native plants, and volunteer or planted crop plant species collected from diverse ORIA sites. Amongst the 23 plant families sampled, 19 contained aphid-colonised species. Understorey weeds and host trees in sandalwood plantations were found to be important reservoirs for the spread of *A. craccivora* to cucurbit crops.

IOA Adjunct Professor Roger Jones said ZYMV persists in the ORIA's wet season at extremely low incidences in two wild cucurbit species, and volunteer and small-scale garden crop cucurbits.



Adjunct Professor Roger Jones inspects ZYMV infected cucurbit plant.

"These infection reservoirs act as primary infection sources for its spread to irrigated commercial cucurbit crops during the dry season," Professor Jones said. "In all-year-round aphid trapping, winged aphid numbers caught were greatest mid-growing season."

The study revealed the main ZYMV epidemic drivers in the ORIA and a more virulent variant has not been found since ZYMV was first identified there in 1996.

An Integrated Disease Management Strategy has been recommended specifically for use against ZYMV epidemics in the ORIA's commercial

cucurbit crops and includes a wide range of phytosanitary, cultural, host resistance and chemical control measures. The strategy is based on earlier research on ZYMV in cucurbits in WA, and new findings on ZYMV control measures and epidemic drivers arising from the project. It uses control measures compatible with the ORIA's crop production system.

Project funding was provided by Royalties for Regions, DPIRD, the Ord River Cooperative, and ORIA cucurbit growers. The research was recently published in two papers in the prestigious scientific journal *Virus Research*.

decade-long droughts – worse than any in the instrumental record – occurred in the 15th, 18th and 19th Centuries.

"Critically, this new long rainfall record reveals that current drought risk models are likely to severely underestimate the actual risk of drought for the grainbelt region," Dr O'Donnell said.

"In this new project, we plan to incorporate information about rainfall variability from tree-ring records into drought risk models to improve their skill."

"In doing so, we aim to provide more realistic estimates of the probability of droughts, which can be tailored to suit the needs of different stakeholders in the agriculture and water resources sectors," Dr O'Donnell said.

The outcomes of the project will inform expectations of future rainfall and thus improve decisions around risk preparedness and management in agriculture.



Dr Alison O'Donnell uses growth rings of the long-lived white cypress pine (*Callitris columellaris*) to understand past rainfall variability. Photo: Hannah Etchells.

National Soils Advocate visits UWA Farm Ridgefield

Senior Policy Adviser to the Office of the National Soils Advocate, Ms Sue Bestow, visited UWA in March. The role of the National Soils Advocate is to protect, restore and maintain the health of agricultural landscapes, and promote the National Soils Strategy across multiple portfolios, including education, training, science, technology, agriculture, water policy and regional development.

Ms Bestow visited the Critical Zone Observatory (CZO) and Flux Tower at UWA Farm Ridgefield, along with Emeritus Professor Graeme Martin, Dr Matthias Leopold, and Associate Professor Fran Hoyle. UWA Farm Ridgefield's CZO contributes to a world-wide network of diverse CZO sites, and the Flux Tower links in with other Flux Towers under the Australian Flux Network (OzFlux) and Australian NCRIS Terrestrial Ecosystem Research Network (TERN).

The Critical Zone encompasses the area of the Earth's surface between the top of the tree canopy to the bottom of the groundwater, where rock, soil, water, air, and living organisms interact. Dr Leopold explained the ongoing paddock-scale monitoring of soil moisture at UWA Farm Ridgefield via 20 subsurface sensors using wireless communication, and how the CZO brings together real time weather data, landscape camera, remote sensing and ecosystem modelling to inform sustainable management of the farm's natural resources.

The Ridgefield OzFlux Tower is a component of the *Land Ecosystem Atmosphere Program (LEAP)* that measures energy and water fluxes, biochemical transformations of elements, and greenhouse gas cycling in the Critical Zone. There is a second *LEAP Flux Tower* in Boyagin Reserve, an area of native woodland close to UWA Farm Ridgefield that allows for comparisons of ecosystem fluxes from the two distinct land uses.

While at the farm, Ms Bestow also visited some of the low-lying saline land regeneration programs, including 10 ha of trees and native shrubs planted into annual pasture in 2016. Emerita Professor Lyn Abbott utilises 7 ha of this site for a 2019 - 2021 Land Care Grant funded project *Farm demonstration to fast-track restoration of soil condition using permeable biomass barriers*.

Ms Bestow presented the goals of the Office of the National Soils Advocate at the 2020 *Talkin' Soil Health: Building Natural Capital* conference in York, which brought together government, researchers, industry



From L to R: Associate Professor Fran Hoyle, Ms Sue Bestow (Senior Policy Adviser to the Office of the National Soils Advocate and UWA Alumna), Dr Matthias Leopold, and Professor Graeme Martin in front of the Ridgefield OzFlux Flux Tower.

professionals and farmers to discuss the importance of soil health for agriculture. UWA was represented at the conference by Emeritus Professor Lyn Abbott, who presented on *Soil biological fertility and climate resilience*, and Associate Professor Fran Hoyle, who presented on *Soil organic carbon: challenges and opportunities*. All presentations from the *Talkin' Soil Health* conference are available at soilhealth.com.au/presentations.

Using thought experiments to strengthen critical thinking at universities

Assoc/Prof Hank Greenway Honorary Research Fellow

Honorary Research Fellow Hank Greenway and colleagues Adjunct Professor David Turner, Dr Jane Gibbs and Dr Brian Atwell have been recognised for their contribution to teaching plant science by the Australian Society of Plant Scientists (ASPS).

The ASPS recognises excellence, innovation and/or contributions of their members to teaching plant science at University level by granting an annual Teaching Award.

Associate Professor Hank Greenway said he began using thought experiments in his courses on environmental plant biology in the 1980s to develop critical thinking in undergraduate students and young researchers.

"These thought experiments proved to be of great help to students and researchers in developing the rigour of their research and their ability to interrogate published information," Assoc/Prof Greenway said.

"They mastered the background material necessary to tackle the thought experiments, and they formulated and solved thought experiments, reinforcing their practice of the scientific method."

Double scholarship for livestock reproduction student



Scholarship recipient Mia Kontoolas is passionate about neonatal lamb survival.

Ms Mia Kontoolas
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PhD candidate Mia Kontoolas from UWA's School of Agriculture and Environment has won two prestigious scholarships to complete her studies in livestock reproduction.

Mia received the Meat and Livestock Australia's Postgraduate Scholarship and the Calenup Postgraduate Research Fund Scholarship to further explore the effects of oestrogenic clovers on ewe reproduction and on early lambs' development.

Oestrogenic sub clover was considered a significant issue in the 1940-70's but had largely fallen off the radar of veterinarians and agronomists in the years since. However, recent research from UWA has shown that some oestrogenic sub clover varieties have persisted on farms throughout southern Australia.

Mia studied the effects of high oestrogenic sub clovers on the fertility of Merino ewes during her Honours research in 2019. She said many of the older cultivars of sub clover growing across southern Australia

contain high levels of compounds known to have oestrogenic effects in ewes.

"Recent feedback indicates a more subtle and less visible form of the disease may be impacting southern Australia's livestock," Mia said.

"This funding will allow me to conduct extensive field trials focusing on the impact of oestrogenic clover ingestion on lamb development and survivability."

During her honours research, Mia had the opportunity to spend time on farms learning about sheep enterprise.

"I developed an appreciation for the challenges and rewards of sheep farming with much guidance and mentorship from local producers," Mia said.

"I am looking forward to the field work, farm research, and translating the laboratory work into real world solutions for sheep production."

Mia is supervised by Associate Professor Dominique Blache, Professor Megan Ryan, and Dr Kevin Foster from UWA's School of Agriculture and Environment and IOA. Dr Caitlin Wyrwoll from the School of Human Sciences will also provide guidance on reproductive biology.

The approach differs from that where the scientific method is described without involving logical reasoning and critical appraisal by students.

Briefly, thought experiments consist of (i) formulating the problem (enigma) and setting a hypothesis, (ii) designing an experiment(s) to solve the enigma, and (iii) considering how far the suggested experiment(s) go towards solving the enigma and what new questions they raise.

"A statement by Frank Carrigan, Macquarie Law School, that '...university

teaching is there for people to take ownership of their learning' seems so obvious," Assoc/Prof Greenway said.

"Yet it took me years to find a design that motivated students and young researchers to become independent and skilled in critical thinking and debating their views.

"My specific purpose was to foster independence and engender confidence to test new ideas, with an emphasis on skills in practising the scientific method."



Associate Professor Hank Greenway

The human right of water and sanitation

Adjunct Professor Susana Neto susana.neto@netcabo.pt

The human right to water and sanitation and the tariffs that are placed upon them, should be addressed as social and political issues of justice beyond only technical problems, according to a study by UWA researchers.

The analytical report conducted by IOA Adjunct Professors Susana Neto and Jeff Camkin explores the relationship between the human right to water and sanitation. They suggest that the re-politicisation of water, and the setting of affordable water tariffs would help ensure that the responsibilities upon governments for delivering human rights to water and sanitation are clear.

Adjunct Professor Neto said that not only is clean drinking water and adequate sanitation vital to human health and survival but it is also key to social development and economic

prosperity, which can help countries face challenges such as climate change, environmental degradation and natural resource depletion.

“In 2010 the United Nations General Assembly declared that the right to safe and clean drinking water and sanitation as a human right essential for the full enjoyment of life and all human rights,” Prof Neto said.

“We argue that governments should set tariffs in a way that reflects the importance of services in delivering human rights to water, other human rights and other societal values instead of trying to recover costs. This can be done through a series of cross-subsidies or rebates.”

Adjunct Professor Jeff Camkin said although the majority of countries recognise that water resources belong to the public, there are still some issues that

persist, such as extremely high connection costs to the network in Africa, or water prices increasing at a greater rate than inflation in the US.

“Decisions concerning water services have become a political issue and should not be left to water utilities alone, nor government owned/operated or private,” Professor Camkin said.

“This is important because the human right to water is a prerequisite for the realisation of other rights.”

The paper *What rights and whose responsibilities in water? Revisiting the purpose and reassessing the value of water services tariffs* was published in *Utilities Policy*.



The human right to water is a prerequisite for the realisation of other rights.

Runoff and groundwater responses to climate change in South West Australia

Adjunct Professor Don McFarlane don.mcfarlane@outlook.com

The South West of WA has experienced a drying trend since about 1975, something which is becoming increasingly evident in parts of the world with a Mediterranean climate. This drying, along with higher temperatures, has resulted in profound changes in hydrology that were initially hard to detect from year-to-year variability.

Adjunct Professor Don McFarlane from UWA's School of Agriculture and Environment and IOA and colleagues from DPIRD, Murdoch University and CSIRO examined the different impacts of this climate shift on the region's surface water and groundwater hydrology over the past four decades. Their findings were recently published in the *Journal of the Royal Society of WA*.

Adjunct Professor Don McFarlane said while runoff seemed initially to be most affected, it is a reduction in groundwater levels that is often the underlying cause.

"The cumulative effect of dry years is to lower groundwater levels in many grainbelt and Darling Range valleys, which lessens surface water-groundwater interactions," Dr McFarlane said.

"Changes often occur abruptly because processes change as groundwater levels fall below critical levels. This has caused problems for planners who do not anticipate a sudden reduction in water yields."

The researchers examined recorded trends in salinisation, flooding and water resource availability that are likely to intensify in the future. They found that the risk of dryland salinisation has reduced over much of the South West, although there are areas where it continues to seriously impact on agricultural land and native vegetation. Waterlogging and water erosion risks have also decreased. Reduced rainfall amounts and possibly intensities, and

the drying of grainbelt valleys, has resulted in less winter flooding, but there may have been an increase in summer flood risks.

Professor McFarlane said the large reduction of runoff into Darling Range reservoirs, which are important for Perth's water supply, has been well documented.

"Groundwater levels in the Perth Basin are generally falling, especially under perennial vegetation. This affects the availability of groundwater for horticulturalists," Dr McFarlane said.

"Climate change impacts on South West hydrology are still to be fully expressed as future projections are for even higher temperatures and further decreased winter rainfall."



Runoff in a stream in the South West.

What have we learnt from 70 years of reproduction in ewes?

Emeritus Professor Graeme Martin
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Together with colleagues from Spain, Emeritus Professor Graeme Martin has reviewed 70 years of research into managing the oestrous cycle in ewes, and suggested ways to improve animal production protocols so they can meet today's expectations.

The review was published in *Reproduction, Fertility and Development*, and considered how changing technologies and research affected animal welfare, human safety and the environment.

E/Prof Graeme Martin said management of the sheep's oestrous cycle is mainly based on the use of two types of reproductive hormone, progestagen and eCG, and protocols have been applied without major change for decades.

"Improved knowledge on ovarian physiology and follicular dynamics supports the use of shorter-term progestagen protocols from 5-7 days instead of 12-14 days," E/Prof Martin said.

"The short-term protocols also allow re-usable silicone based devices to be used which has both animal health

and welfare benefits, and improved environmental impact."

A major concern related to the use of hormones for breeding is society's perception that it is not safe. E/Prof Martin said such concerns have no scientific support in the case of hormones used to improve reproduction so most of them are still approved by international regulatory systems and are available worldwide.

"The link between food and hormones is stigmatised in public opinion in spite of the fact that most of the hormones used in reproductive technology are naturally produced by both animals and humans and are, often, identical molecules that are essential for functions such as growth, performance and reproduction," E/Prof Martin said.

"However, public opinion is a strong market force so these increasing concerns must be taken seriously, and new protocols and future improvements must be encouraged, to strike a balance between food production and safety of the environment."



Sheep at UWA Farm Ridgefield

How plant viruses differ from animal viruses like SARS-CoV-2

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

Viruses infect animals, plants and bacteria, but strictly speaking are not 'organisms' as they lack organs or organelles. They are small infectious agents that replicate only inside living cells. All consist of a nucleic acid genome made up of RNA or DNA that codes for a small number of genes enclosed in a protective protein coat.

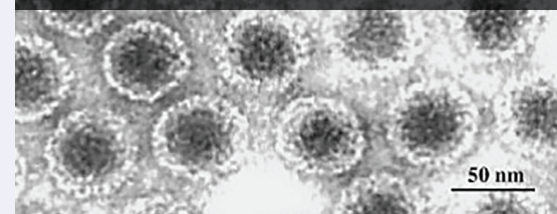
Some viruses, particularly animal viruses, are also enclosed by a protective envelope of lipid and protein molecules. Animal viruses like severe acute respiratory

syndrome coronavirus 2 (SARS-CoV-2), which causes the human disease COVID-19, differ from plant viruses in using 'receptor-mediated endocytosis' to enter cells via their plasma membranes.

As plant cells have a protective cell wall, this cannot occur with them. Instead, they enter plant cells via wounds caused by specific insect, mite, nematode or 'fungal' vectors, or by mechanical damage caused by leaf rubbing, grazing, mowing, spraying and cultivating, or plant handling, transplanting, grafting,

and other similar husbandry procedures. Plant viruses can sometimes multiply in their arthropod vectors but have never been recorded multiplying in humans.

Typical micrograph of a plant virus which always lack the spikes that corona viruses have.



40 years of grain farming

Rod Birch, Catalina Farms, Coorow
rbirch1@bigpond.com

IOA Industry Advisory Board Member Mr Rod Birch has been farming grain at Catalina Farms in Coorow, WA for 40 years.

Catalina Farms is situated 280km northeast of Perth and receives an annual average rainfall of 350 mm, with 250-300 during the crop-growing period (April to October).

The farm is a 100% rotational cropping program with no livestock in the system. The total farming area covers 12,000ha and approximately 10,000ha are cropped annually to wheat, barley, canola and lupins. Typically, the broadleaf crops (lupins and canola) cover 30-38% of the program with cereals filling 60-65%. The soil types are predominately sandy loams and strong sandplains that are highly suited to lupin production, the legume base for the diverse rotational cropping system.

Mr Birch said diversified cropping rotations at Catalina Farms are important for many reasons including rotating the use of

herbicide groups and breaking the disease cycles that build up with mono crop types.

“Legumes are important for fixing organic nitrogen for enhanced crop health and yields in the following crop year. Legumes are also a valuable cash flow contributor in their own right,” Mr Birch said.

“Different crops are often reacting to varying market and pricing signals at any given time. Therefore having multiple grain types to market spreads this marketing opportunity.”

Mr Birch said the Covid-19 pandemic has had a surprisingly low impact on the business, as it is a large broadacre operation with a minimal public interface. The farm operates with three to four full time staff and an additional three casuals at seeding and harvest. Trucking capacity is matched to the seasonal needs.

“Social distancing has been no challenge as most staff individually operate large machines with more than adequate spacing,” Mr Birch said. “Our workforce is mostly long-term and reside locally so this minimised contact threats.”

Both Federal and State governments classified agriculture as an essential service, so the farm received total support in maintaining usual production programs. Their usual support parties such as farm input suppliers, transport suppliers, agricultural contractors, agronomists, machinery dealers and repair support were all able to function and assist the annual cropping program.

“Many of the government business stimulus incentives were of assistance and helped smooth out some of the issues encountered in operating a large business when thrown into turbulent waters,” Mr Birch said. “It was very much appreciated.”

Reflecting on the past 40 years, Mr Birch said relevant and meaningful networks provide invaluable professional and personal development opportunities.

“I believe that in today’s world of agricultural production, communications and connectivity position us globally in real time,” Mr Birch said. “To remain informed in our business, we have to continually engage in extensive and relevant networks.”



Mr Rod Birch has been farming grain at Catalina Farms for 40 years.

ICAR's top honour, Rafi Ahmed Kidwai Award to IOA Adjunct Professor

IOA Adjunct Professor Rajeev Varshney, Director of the Research Program Genetic Gains at ICRISAT has been awarded with the Indian Council of Agricultural Research (ICAR)'s most prestigious Rafi Ahmed Kidwai Award for Outstanding Research in Agricultural Sciences category for 2019.

The award, which was announced through a virtual session in July on ICAR's 92nd Foundation Day recognises Professor Varshney's research contributions to crop sciences. He is internationally renowned for work in the

area of plant genomics and genomics-assisted crop breeding. At ICRISAT, he has led teams that have sequenced some of the most important dryland crops including pigeonpea, chickpea, groundnut and pearl millet.

Expressing his gratitude, Professor Varshney said the award is an acknowledgment of ICRISAT and its partners' contributions to agriculture research. "I thank all my colleagues and collaborators at ICRISAT, ICAR, all collaborating institutes in India, and other parts of the world such as UWA

for their contributions and support," Professor Varshney said.

ICAR is the largest network of agricultural research and education institutes in the world, with unparalleled contributions to the national agricultural research and extension system in ensuring food security in India.

The Rafi Ahmed Kidwai Award is an annual award instituted in 1956 by ICAR to recognize Indian researchers in the agricultural field and carries a ₹ 5 lakh (AU\$9400) prize.



RAID 2020: Leadership, Networking and Fun

Ana Manero, Rodrigo Pires, Alicea Garcia, Daniel Waterhouse - WA RAID Representatives

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The Researchers in Agriculture for International Development (RAID) Network hosted a Capacity Building Workshop for early career researchers (ECRs) in March 2020. The workshop was held at UWA and was sponsored by the Crawford Fund, the Australian Centre for International Agricultural Research (ACIAR), the Ag Institute Australia and IOA.

Over two-and-a-half energising days, the RAID Network Capacity Building Workshop provided 12 participants with the fundamentals of management and leadership in the context of research especially for international agricultural development.

Well-structured theoretical learning was complemented by hands-on exercises in which participants worked in groups to solve challenges derived from real-

life situations. Plenary discussions and role-playing exercises helped build participants' self-awareness of their own professional style, while improving their capacities to give and receive constructive feedback.

ACIAR Country Programs Manager Dr Peter Horne inspired participants with an insightful discussion on what leadership looks like, which behaviours and styles different kinds of leaders demonstrate,

Doctorate awarded to the late Roger Barroga



Dr Roger Barroga awarded PhD from UWA six months after his passing.

The late Roger Barroga has been awarded his Doctor of Philosophy from UWA six months after he passed away.

Dr Barroga submitted his thesis entitled 'The role of information and communications technology in agricultural development in the Philippines' in 2019.

His research explored the role of information and communications technology (ICT) in agricultural development in the Philippines. Specifically, he investigated whether farmers can use ICT to access information

on complex rice production technologies from agricultural knowledge centres.

Analysis of a combination of surveys, case studies and focus groups with farmers in the Philippines showed that conventional barriers to ICT use may be overcome by factors such as relevant content, organisational support and location of the cyber communities.

A strong farmers' organisation (i.e. with ICT champions and resource allocation for system maintenance) determined the sustainability of farmers' e-centres.

These findings are relevant for policy formulation to enhance ICT use for agricultural development in rural areas in the Philippines.

Upon completing his studies in Perth, Dr Barroga returned to the Philippines where he started converting a 5-hectare farm into a model FutureRice farm that combines smart rice farming innovations and farm tourism. The farm showcases the latest inbred and hybrid rice varieties grown with machinery, farming apps, and drones for nutrient and pest management. The FutureRice model was inspired by the Future Farm 2050 Project on UWA Farm Ridgefield.

Dr Barroga's research was supervised by Professor Matthew Tonts and Hackett Professor Kadambot Siddique, and was supported by an Australian Government scholarship under the Australian Leadership Award program of AUSAID from 2008-2012.

UWA Vice Chancellor Professor Amit Chakma has invited Roger's wife, Dr Karen Barroga to attend a graduation ceremony to be presented with Roger's Doctor of Philosophy testamur.

and how to identify and improve our own leadership skills.

Expert in leadership and management, Lynne O'Brien, tackled critical challenges that today's ECRs face, such as communication and conflict resolution in the 'digital era'. Lynne's discussions focused on how to cope with toxic work environments while bringing forward the best version of one's professional self.

To wrap-up the workshop, Professor William Erskine from UWA's School of Agriculture and Environment and IOA shared his experiences and lessons learned through agricultural research in Timor Leste and the Middle East.

During a trivia and networking event, attendees also heard from Emerita Professor Lynette Abbott about the projects, activities, scholarships, and travel opportunities accessible through

the Crawford Fund. RAID's newest WA representative, Daniel Waterhouse, gave an energetic introduction to the group, which is always open to receiving and supporting new members.



RAID Trivia and networking night at Little Way Restaurant, near UWA.

Special Issues: Call for contributions



Sustainability

Special Issue on Sustainability in Agribusiness Food Chains

For this Special Issue of Sustainability, we welcome original contributions that demonstrate how the various stakeholders in food value chains have collectively addressed any of the following issues:

- Sustainable food marketing
- Adoption of innovative products/ processes to enhance sustainability at any stage of the food chain
- Alternative business models for linking farmers to markets
- Facilitating the adoption of safe, sustainable quality management systems
- Green purchasing
- Minimizing food waste
- Value chain governance, power, and trust
- Minimizing risk and uncertainty
- Promoting local food
- Improving dietary and nutritional outcomes

For more information, visit mdpi.com/journal/sustainability/special_issues/Sustainability_in_Agribusiness_Food_Chains

Deadline for submissions: 28 May 2021



Physiologia Plantarum

Special Issue on Understanding Drought Tolerance in Plants

This special issue aims to bring together high-quality original research, reviews and short communications highlighting the development and adaptation to desiccation, root dynamics, management of turgor and turgor-dependent processes, molecular and genetic responses of plants to drought and seed abortion. The interdisciplinary perspectives towards improved genetic understandings for developing more climate-resilient agriculture shall also be addressed.

- Drought and the regulation of plant development.
- Drought and photosynthetic regulation.
- Root dynamics and drought stress.
- Molecular and physiological regulation of drought tolerance mechanisms.
- Role of secondary metabolites and phytohormones in drought stress tolerance.
- microRNAs and drought stress signaling.
- Role of mineral elements and beneficial microbes in plant drought tolerance.
- Other related aspects.

For more information, visit physiologiaplantarum.org/2020/03/12/call-for-articles-understanding-drought-tolerance-in-plants

Deadline for submissions: August 2020



Plant Physiology Reports

Special issue (October – December 2020) on Heat Stress on Crop Growth and Development

Plant Physiology Reports is pleased to announce a special issue on “HEAT STRESS ON CROP GROWTH AND DEVELOPMENT” that aims to capture a range of original research articles, reviews, opinions, short communications and perspectives on heat stress impacts on crops.

Articles that demonstrate novel methods or new findings that advance our understanding of heat stress response in crops using cutting edge physiological and molecular techniques are particularly encouraged.

Research articles that can demonstrate the applicability of sensors in phenotyping across scales such as growth chambers and field conditions would fit well within the scope of the special issue.

Research articles that have employed a well-known phenotyping approach to capture large genetic diversity for genetic mapping exercises will also be considered provided the study goes beyond just the identification of QTLs or genomic regions.

The special issue will mostly consider articles focusing on field crops.

For more information, visit springer.com/40502/updates/17973628

Deadline for submissions: 31 August 2020

New Appointments



Communications Officer

Ms Rosanna Candler rosanna.candler@uwa.edu.au

Ms Rosanna Candler has been appointed as IOA Communications Officer. She joins the team from the UWA McCusker Centre for Citizenship, where she was the Student Engagement Officer.

Rosanna spent the first five years of her professional life as a journalist for Community News and The West Australian. She holds a Bachelor of Mass Communications (majoring in Journalism and Internet Policy & Culture) and Bachelor of Arts

(Honours) in Journalism from Curtin University, a Graduate Diploma of Education from Edith Cowan University, sits on the Women in Media WA committee and is Secretary of the Raine Study Community Advisory Committee at UWA.



Lefroy Fellow

Dr Kelsey Pool kelsey.pool@uwa.edu.au

Dr Kelsey Pool has recently been appointed as Research Associate under the Lefroy fellowship, a generous bequest by the Lefroy family for post-doctoral candidates to undertake agricultural research at UWA. This project, in collaboration with a number of UWA scientists from diverse research areas, aims to address the mechanistic basis of how oestrogenic pasture species cause infertility in sheep.

Under the Lefroy fellowship, Dr Pool plans to further characterise how pasture-derived isoflavones alter the reproductive function of both the ram and the ewe, an area little explored since the 1970's. The outcomes of this study will contribute to the over-arching goal of finding a solution to mitigate the severe production losses caused by infertile animals.

Prior to her appointment at UWA, Dr Pool completed her PhD as

part of the Animal Reproduction Group at the University of Sydney. Focused primarily on male reproductive physiology and endocrinology, her early research was used to register an Australian product to increase the reproductive efficiency of rams, and has presented the opportunity to analyse the spermatozoa of several species, including rams, bulls, mice and rhinoceroses.



Farm Assistant

Ms Amanda Zanatta amanda.zanatta@uwa.edu.au

Amanda commenced as Farm Assistant at UWA Farm Ridgefield in July 2020. Originally from Perth, Amanda relocated to Pingelly to pursue her passion for agriculture

in 2018. With experience from various veterinary clinics and animal care centres as well as CBH and AFGRI Equipment Australia, Amanda brings a broad

range of knowledge to this newly established role. We welcome her to UWA Farm Ridgefield and look forward to the innovative ideas she will bring.



Business Manager

Ms Diana Boykett diana.boykett@uwa.edu.au

Ms Diana Boykett has returned from parental leave and accepted the Business Manager position at IOA. Diana has been a valued member of the team, serving as Communications Officer since 2014. With her thorough understanding of

the Institute, UWA Farm Ridgefield and wider University's objectives, she is well placed to implement its strategic goals.

Diana's main priority will be to manage the administration and

operations of the Institute. She will also play a key role in promoting the Institute within the agriculture industry, broader university community and key stakeholders to facilitate strategic liaison.

AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Professor Harvey Millar	ARC Laureate Fellowship
Mr Patrick Beale	George Temple Poole Award for the Pingelly Recreation and Cultural Centre
Ms Mia Kontoolas	Calenup Postgraduate Research Fund Scholarship
Mr Michael Young	Mike Carroll Travelling Fellowship 2020
Adjunct Professor Rajeev Varshney	Rafi Ahmed Kidwai Award
Associate Professor Hank Greenway, Dr David Turner, Dr Jane Gibbs and Dr Brian Atwell	Australian Society of Plant Scientists (APSP) Teaching Award 2020

VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
Dr Helen Spafford	Department of Primary Industries and Regional Development, Kununurra	E/Prof Graeme Martin	July 2020

NEW POSTGRADUATE RESEARCH STUDENTS (PhD)

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Mohammad Salim	Drought tolerance, root architecture and Phosphorus levels of Soybean	UWA School of Agriculture and Environment	Dr Zakaria Solaiman, Hackett Prof Kadambot Siddique and Dr Yinglong Chen	Bangabandhu Science and Technology Trust, Bangladesh Government

RESEARCH GRANTS

TITLE	FUNDING PERIOD	FUNDING BODY	INVESTIGATORS
Queensland Fruit Fly Trapping Grid Optimisation	2020	Agribusiness Yarra Valley	Dr Michael Renton
New opportunities for the production of premium and medicinal honey	2020-2021	AgriFutures Australia	Dr Kevin Foster, Prof Megan Ryan, Mr Daniel Kidd, Dr Joanne Wisdom, Ms Tiffane Bates, Dr Kate Hammer, Assoc/Prof Cornelia Locher
Strengthening the weakest link in peri-urban Medfly suppression	2019-2021	Australian Plant Biosecurity Science Foundation	Assoc/Prof Ben White
Identifying genetic contributors to canola blackleg resistance in the presence of environmental effects using Machine Learning	2020-2022	GRDC	Prof David Edwards, Mr Philipp Bayer, Prof Mohammed Bennamoun, Prof Farid Boussaid, Prof Jacqueline Batley
BeefLinks: Systems of beef production from irrigated fodder production in northern Western Australia	2020-2023	MLA	Prof Phil Vercoe, Dr John Milton, Kevin Bell
BeefLinks: "DietID" Feedbase mapping to raise productivity of cattle	2019-2023	MLA	Prof Phil Vercoe, Dr Zoey Durmic, Dr David Walker
Expanding production of priority fruit tree crops for WA	2019-2023	DPIRD	Dr Michael Considine
Program 1 - Project Number 38 - Ngooka honey – Noongar Land Enterprise Group (NLE)	2020-2021	CRC for Honey Bee Products	Dr Bryan Boruff, Assoc/Prof Cornelia Locher, Dr Kate Hammer, Mr John Duncan
Machine Learning - Project E: Deep Learning for early detection and classification of crop disease and stress	2020-2021	GRDC	Prof Mohammed Bennamoun, Prof Farid Boussaid, Prof David Edwards, Dr Philipp Bayer, Dr Nicolas Taylor

UWA IOA 2020 Publications (March 2020 - July 2020)

Peer Reviewed Journals

- Al-Farsi SM, Nawaz A, Anees-ur-Rehman, Nadaf SK, Al-Sadi AM, Siddique KHM and Farooq M (2020). Effects, tolerance mechanisms and management of salt stress in lucerne (*Medicago sativa*). *Crop & Pasture Science* <https://doi.org/10.1071/CP20033>
- Al-Lami HRD, You MP and Barbetti MJ (2020). Temperature drives contrasting *Alternaria* leaf spot epidemic development in canola and mustard rape from *Alternaria japonica* and *A. Brassicae*. *Plant Disease* **104**: 1668-1674
- Anderson WK, Brennan RF, Jayasena KW, Micic S, Moore JH and Nordblom T (2020). Tactical crop management for improved productivity in winter-dominant rainfall regions: a review. *Crop & Pasture Science* DOI: 10.1071/CP19315
- Bajwa AA, Farooq M, Al-Sadi AM, Nawaz A, Jabran K and Siddique KHM (2020). Impact of climate change on biology and management of wheat pests. *Crop Protection* **137**: 105304
- Bayer PE, Golicz AA, Scheben A, Batley J and Edwards DE (2020). Plant pan-genomes are the new reference. *Nature Plants* <https://doi.org/10.1038/s41477-020-0733-0>
- Chen Y, Palta J, Vara Prasad PV and Siddique KHM (2020). Phenotypic variability in bread wheat root systems at the early vegetative stage. *BMC Plant Biology* **20**: 185 doi: 10.1186/s12870-020-02390-8
- Clarke R, Webster CG, Kehoe MA, Coutts BA, Broughton S, Warmington M and Jones RA (2020). Epidemiology of Zucchini yellow mosaic virus in cucurbit crops in a remote tropical environment. *Virus Research* **281** doi: [10.1016/j.virusres.2020.197934](https://doi.org/10.1016/j.virusres.2020.197934).
- Clarke R, Kehoe MA, Broughton S and Jones RA (2020). Host plant affiliations of aphid vector species found in a remote tropical environment. *Virus Research* doi: [10.1016/j.virusres.2020.197934](https://doi.org/10.1016/j.virusres.2020.197934).
- Cong WF, Suriyagoda LDB and Lambers H (2020). Tightening the Phosphorus Cycle through phosphorus-efficient crop genotypes. *Trends in Plant Science* <https://doi.org/10.1016/j.tplants.2020.04.013>
- Dabina Z, Qian L, Amin M and Liwen L (2020). A Hybrid Model Considering Cointegration for Interval-valued Pork Price Forecasting in China. *Journal of Forecasting* doi: 10.1002/for.2688
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- Farooq M, Khan I, Nawaz A, Cheema MA and Siddique KHM (2020). Using sorghum to suppress weeds in autumn planted maize. *Crop Protection* **133** doi: 10.1016/j.cropro.2020.10516
- Farooq M, Ullah A, Usman M and Siddique KHM (2020). Application of zinc and biochar help to mitigate cadmium stress in bread wheat raised from seeds with high intrinsic zinc. *Chemosphere* **260**: 127652 <https://doi.org/10.1016/j.chemosphere.2020.127652>
- Farooq U, Malecki IA, Mahmood M and Martin GB (2020). Age-related declines in ejaculate quality and sperm kinematics vary among strains of Japanese Quail (*Coturnix japonica*). *Reproduction in Domestic Animals* **55**: 64-73. doi: 10.1111/rda.13585
- Farrukh MU, Bashir MK, Rola-Rubzen MF (2020). Exploring the Sustainable Food Security Approach in Relation to Agricultural and Multi-sectoral Interventions: A Review of Cross-Disciplinary Perspectives. *Geoforum* **108**: 23-27 doi: 10.1016/j.geoforum.2019.11.012
- Gonzalez-Bulnes A, Menchaca A, Martin GB and Martinez-Ros P (2020). Seventy years of progestagen treatments for management of the sheep oestrous cycle: where we are and where we should go. *Reproduction, Fertility & Development* **32**: 441-452. doi: 10.1071/RD18477
- Greeff JC, Liu S, Palmer D and Martin GB (2020). Temporal changes in circulatory blood cell parameters of sheep genetically different for faecal worm egg count and diarrhoea from late summer to spring in a Mediterranean environment. *Animal Production Science* doi: 10.1071/AN19038
- Green K, Quintero-Ferrer A, Chikh-Ali M, Jones RAC and Karasev AV (2020). Genetic diversity of nine non-recombinant potato virus Y isolates from three biological strain groups: historical and geographical insights. *Plant Disease* doi: [10.1094/PDIS-02-20-0294-SC](https://doi.org/10.1094/PDIS-02-20-0294-SC)
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- Kingwell R, Islam N and Xayavong V (2020). Farming systems and their business strategies in south-western Australia: A decadal assessment of their profitability. *Agricultural Systems* **181** doi: 10.1016/j.agry.2020.102827
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- Ling L, Zhang D, Chen S, Muger A (2020). Can online search data improve the forecast accuracy of pork price in China? *Journal of Forecasting* 1-16. doi: 10.1002/for.2649
- Ma H, Lu H, Han H, Yu Q and Powles S (2020). Metribuzin resistance via enhanced metabolism in a multiple herbicide resistant *Lolium rigidum* population. *Pest Management Science* DOI 10.1002/ps.5929
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- Mitrović PM, Stamenković OS, Banković-Ilić I, Djalović IG, Nježić ZB, Farooq M, Siddique KHM and Veljković VB (2020). White Mustard (*Sinapis alba* L.) Oil in Biodiesel Production: A Review. *Frontiers in Plant Science* doi: 10.3389/fpls.2020.00299
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UPCOMING EVENTS

Postgraduate Showcase 2020

30 September 2020
Ross Lecture Theatre, UWA

Industry Forum 2020

Climate Change and agriculture: challenges and solutions for Australian farmers
28 October 2020
University Club of WA

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