

The UWA Institute of Agriculture

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**WESTERN
AUSTRALIA**



Industry Forum presenters Lucy Anderton, Jacinta Foley, Dr Terry Enright, Professor Kadambot Siddique, The Hon Alannah MacTiernan, Paul McKenzie, and Amanda and Bob Nixon. Photo: Rosanna Candler

Maximising opportunities and building resilience at 15th annual forum

How can we future-proof WA agriculture for the next generation and beyond?

This was the burning question on everyone's mind as they took their seats at The University Club of Western Australia Auditorium on 21 July for The UWA Institute of Agriculture's 15th annual Industry Forum.

The UWA Institute of Agriculture Director Professor Kadambot Siddique said the much-anticipated forum attracted a full-house audience of about 250 people.

"It was heartening to see so many members of the WA agriculture industry, research institutions and farming community coming together to share ideas and innovation for the future," Professor Siddique said.

"I was very pleased with the thought-provoking audience questions and passionate discussion that continued into the networking sundowner."

During her opening address, The Honourable Minister for Regional Development, Agriculture and Food and Hydrogen Industry Alannah MacTiernan MLC congratulated UWA on recently ranking number one in Australia and 16th in the world for Agricultural Sciences.

"That achievement is very impressive and very heartening," Ms MacTiernan said.

The Minister also took the opportunity to announce the State Government's new Climate Resilience Fund and Land Restoration Fund.

Keynote speaker Agrarian Management Principal Consultant Paul McKenzie set the tone of the forum with his assessment of how WA can achieve a resilient grain production system.

He outlined six steps to achieve this goal: amend levy and End Point Royalty settings, reinvest in soil health, boost grain production, increase funding for research and development (R&D), encourage farmers to pay current and deferred costs and finally, restore the health balance sheet.

Continued on page 2



Director's Column

We are having a great season in Western Australia so far and it is predicted that we could hit 20 million tons of grain production, which will be the highest record ever achieved.

The UWA Institute of Agriculture has been very productive by hosting a series of well-attended and successful events, including our 15th annual Industry Forum (front page), the always-popular Postgraduate Showcase (page 7) and our 2021 Alan Sevier Memorial Lecture (page 13).

I am very glad to report that the Institute Management Board has been reinstated, with our first meeting held in May. The Board is chaired by UWA Deputy Vice-Chancellor (Research) Professor Tim Colmer and comprises of heads of six UWA schools to provide high-level strategic direction and information exchange across agriculture and related areas at UWA.

Within this newsletter you will find articles on research being conducted by our PhD students, including the black soldier fly project (page 4), using computer modelling to improve farm management (page 5), investigating waterlogging in subclover (page 6) and exploring the on-farm value of serradella (page 15).

UWA is proud to be a partner in two Drought Resilience Adoption and Innovation Hubs – the South West WA Hub and Northern WA/NT Hub. They are part of the Australian Government's \$5 billion Future Drought Fund and will run over the next four years. The hubs will focus on collaboration

between researchers, growers and community groups to make agricultural research useful and accessible, increasing innovation and commercialisation opportunities. We are also part of two bids for Cooperative Research Centres (CRC) – the CRC for Solving Antimicrobial resistance in Agribusiness, Food and Environments (SAAFE), and the CRC for Plant Protein.

I encourage you to read about the return of Professor Nanthi Bolan at UWA (page 6) and then turn to page 11 for his article on enhancing carbon sequestration in WA soils. A very hearty congratulations to Emerita Professor Lynette Abbott for being named the inaugural winner of the General Jeffery Soil Health Award (page 17) and to our two very-deserving Queen's Birthday Honours recipients (page 18).

On a final note, I was extremely pleased to launch our [2020 Annual Research Report](#) last month, which features hundreds of multidisciplinary projects and activities undertaken across our [six research themes](#). Congratulations to all our researchers and collaborators on this fantastic achievement.

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Continued from page 1

In a video recorded from lockdown in NSW, KPMG Australia Food & Agribusiness Sector National Lead Georgie Alely encouraged the WA agriculture sector to "lead the dialogue" about sustainability targets.

Ms Alely said environmental, social and governance regulations were accelerating globally, and that local leaders needed to engage with government and drive constructive outcomes.

While growers have enjoyed an amazing start to the season, LA.One Economics and Consulting Principal Lucy Anderton cautioned against celebrating too soon.

The Albany-based broadacre farmer warned that complacency was "the enemy of resilience" and outlined three "bad habits" that farmers should avoid.

UWA Associate Professor Nik Callow explored the ways new spatial and drone technologies could be applied to WA agriculture in his video presentation.

Associate Professor Callow featured an interview with DPIRD agricultural entomology research scientist Dr Severtson, who described how spatial technology can be used for scouting crop diseases.

Jasper Farms Technical Manager Jacinta Foley then took to the podium to present a case study on the Busselton avocado farm.

Ms Foley expanded on the R&D aspects of the business, including identifying and planning for future needs, conducting in-house trials, keeping up-to-date with the latest research, and adding to their intellectual property with technical manuals.

The final speakers of the day were fourth generation broadacre farming couple Amanda and Bob Nixon from Kalannie.

Nuffield Scholar Mr Nixon outlined some innovative policies and projects on the farm, including their plan to plant 250,000 native trees to generate carbon credits and reverse the effects of salinity.

Mrs Nixon then gave an intimate insight into the family farm history and ways they were planning for the next generation.



Audience members watch the 2021 Industry Forum.



UWA VC Professor Amit Chakma (third from right) and the group on the farm tour.

Ridgefield a hive of activity during VC visit

The UWA Vice Chancellor Amit Chakma recently visited UWA Farm Ridgefield for the first time.

The UWA Institute of Agriculture Director Professor Kadambot Siddique introduced Professor Chakma to Farm Manager Richard McKenna, his wife Cathy, and representatives from the Shire of Pingelly including President William Mulroney.

During the farm tour, the group met with several UWA researchers conducting their research on the farm – including PhD student Mia Kontoolas and co-supervisor

Dr Dominique Blache, who are investigating the effects of oestrogenic clovers on livestock reproduction.

Professor Chakma also met Dr Alison Ritchie with PhD candidates Bianca Berto and Vanessa Brown from the School of Biological Sciences who are developing and implementing innovative seed enhancement technologies for ecological restoration.

The project is in collaboration with the School of Engineering and Kings Park and Botanic Gardens.



Farm Manager Richard McKenna introduces Professor Chakma to the resident sheep.

Farm communications tower a 'game changer'

A significant barrier to the Future Farm 2050 Project's "quest for the future of farming" is overcome now that the Telstra communications tower at UWA Farm Ridgefield has been completed.

It is one of more than 1200 new mobile base stations benefiting from expanded coverage, funded under the Federal Government's Mobile Black Spot Program.

UWA Emeritus Professor Graeme Martin said the communications tower was an important milestone for several reasons.

He said concepts such as combining soil sensors with swarm robots for crop production, or remote animal monitoring for livestock systems all relied on data acquisition.

However, data acquisition requires data communication.

"For this reason, the partnership with Telstra that led to this tower is a game-changing breakthrough," Professor Martin said.



Representatives from UWA, Telstra, DPIRD, DRDC and the Shire of Pingelly at a launch event in August.



UWA Senior Researcher Officer Daniel Kidd being interviewed in front of field trials.



FGS researcher Sofia Katz with a box of flies.

Media buzzing over black soldier fly research

A TV news crew from the Australian Broadcasting Corporation recently visited UWA's Shenton Park Research Facility to film innovative research into black soldier fly technology.

The UWA researchers are part of a consortium that was awarded a \$2.5 million Commonwealth Government grant to develop ways to transform agricultural wastes into valuable commodities.

The project is being led by Australian Pork Limited, with Future Green Solutions (FGS) as the commercial partner.

UWA Senior Researcher Officer Daniel Kidd and FGS researcher Sofia Katzin were interviewed for the story, which is expected to air soon.

Mr Kidd said there was high interest in the life cycle of the larvae, with a number of tubs on display teeming with larvae at various stages of growth consuming organic waste.

"The larvae growth rates were humorously compared to a chicken hatching and being eight tonnes in weight after a week," he said.

"We then took the film crew through a number of experimental plots showing how the frass (larvae excrement) can be used as an organic fertiliser.

"The larvae growth rates were humorously compared to a chicken hatching and being eight tonnes in weight after a week."

"They were amazed at the positive growth responses of wheat, canola, rye grass and clover plots to frass amendments. The frass is looking like a really valuable commodity to feed back into agriculture, horticulture and viticultural systems – and could have particular benefits in WA due to our sandy soils."

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UWA contributes to animal welfare review

The WA Government will modernise its animal welfare laws, following a comprehensive review conducted by a panel of experts including The UWA Institute of Agriculture's Dr Dominique Blache.

Dr Blache, who co-leads the Sustainable Animal Production Systems Research Theme, served on the independent review chaired by barrister and regulatory law specialist Linda Black.

Over 18 months, the panel reviewed the operation and effectiveness of the Animal Welfare Act 2002, concluding that there were five necessary areas of reform to improve the animal welfare regulatory system in WA.

The reform will include clarification on standards of care expected for animals, strengthening compliance, and developing legislation and policies that are science-based and reflect community expectations.

Additional key areas of focus include the training of inspectors and ensuring open and effective administration that clearly outlines the roles and responsibilities of those responsible for animal welfare under the Act.

The next stage will be consultation with key stakeholders as legislation is drafted to implement the recommendations.

A draft Bill will then be opened for comment prior to introduction to Parliament.



UWA PhD candidate Michael Young in the field at Kojonup.

“Research into seasonal management is becoming more and more important to farmers as they are continuing to experience massive variation in climate from one year to the next.”

“It will provide the agricultural industry with access to an improved whole farm optimisation model that can be used to complete detailed economic analysis of many aspect of the farm system. Helping to progress the industry into the future” he said.

“Already, there is a lot of interest from fellow researches to get access to AFO.”

Mr Young is the recipient of the Sheep Industry Business Innovation (SIBI) scholarship from DPIRD, Calenup Research Scholarship established by Dr Irwin Barrett-Lennard, and the 2020 Mike Carroll Travelling Fellowship.



“Without the support of these scholarships, it simply wouldn’t have been possible to commit the required amount of time that the project requires,” he said.

“The SIBI scholarship puts a roof over my head, and the Calenup scholarship provides funds additional research activities, such as paying farmers for their time to participate in focus groups design to determine which aspects of the season have the biggest impact on farm management.”

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‘New and improved’ model will impact future of farming

Growing up on a farm in Kojonup and experiencing the agriculture industry firsthand gave UWA postgraduate student Michael Young a unique insight into rural and farming life.

Understanding the complexities of farming, Mr Young channelled his passion into using computer modelling to help improve farm management.

“Farm modelling is not a new concept,” he said.

“Model of an Integrated Dryland Agricultural System (MIDAS) is a whole farm optimisation model that has been used extensively throughout Australia.

“I used MIDAS in depth throughout my honours research project and experienced both its power and limitations. The main two limitations being that it is an excel based program and that it does not explicitly represent seasonal variation.”

These limitations inspired Mr Young to team up with MIDAS expert John Young for his PhD thesis to build a “new and improved” whole farm optimisation model called Australian Farm Optimisation (AFO).

Now in the second year of his PhD, Mr Young is in the final stage of the model building process.

Once complete, he will use AFO to examine optimal stocking rate.

Mr Young said the analysis would yield important information on sheep management in response to seasonal variation that will be directly applicable to farmers.

“Research into seasonal management is becoming more and more important to farmers as they are continuing to experience massive variation in climate from one year to the next,” he said.

The development of AFO would have a much greater impacts beyond Mr Young’s current project.



Professor Nanthi Bolan with students.

Professor Bolan digs deep in new UWA role

Renowned soil scientist Professor Nanthi Bolan has hit the ground running with a busy teaching and research schedule at the UWA School of Agriculture and Environment and The UWA Institute of Agriculture.

Professor Bolan began his research career at UWA in 1991 when he completed his PhD under the supervision of former UWA Vice-Chancellor Emeritus Professor Alan Robson, Emerita Professor Lynette Abbott and CSIRO Chief Research Scientist Dr Jim Barrow.

As one of the program leaders of Cooperative Research Centre for High Performance Soils (Soil CRC) with an outstanding high-citation index, Professor Bolan has always been passionate about soil.

In addition to his senior roles at Massey University of New Zealand, The University of South Australia and most recently The University of Newcastle, he is a member of the ARC College of Experts and has initiated and fostered collaborations with industry and research institutions both nationally and internationally.

The UWA Institute of Agriculture welcomes Professor Bolan back to UWA.

Breakthrough to breed heat-tolerant livestock

Researchers from UWA have collaborated on a study that found a marker gene to assist in breeding heat-tolerant livestock.

The research, recently published in the journal *Animals*, was led by former UWA Crawford Fellow and current Kerala Veterinary and Animal Sciences (KVASU) University Assistant Professor of Animal Genetics Dr Muhammed Elayadeth-Meethal.

The UWA Institute of Agriculture and KVASU has a current Memorandum of

Understanding for research collaboration and postgraduate training.

The UWA Institute of Agriculture's Professor Shane Maloney and Emeritus Professor Graeme Martin co-authored the research.

Dr Elayadeth-Meethal said it was important for scientists to find animals that can better tolerate a warming climate.

"Identification of marker genes is an important step in identifying a superior germplasm that can resist increasing heat," he said.

"The rich genetic diversity in cattle provided an opportunity to select varieties that were particularly suitable for hot and humid tropical regions."

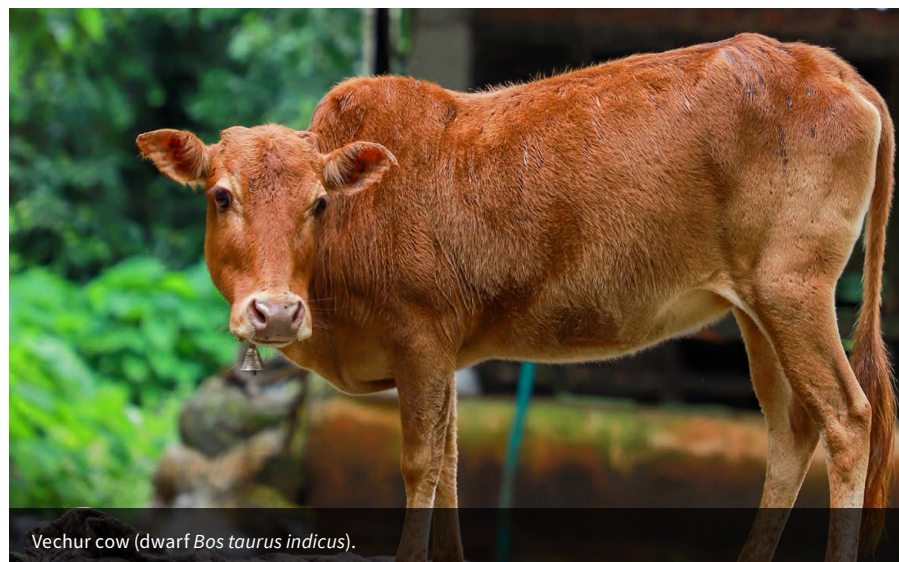
By comparing the heat tolerance of Vechur and crossbred cattle in a field environment, the multidisciplinary team of researchers determined that ATP1A1 expression was significantly associated with heat tolerance in different populations studied.

Dr Elayadeth-Meethal said livestock were both a contributor to and victim of global warming.

"Animal production contributes to global warming as livestock produces major share of methane-one of the prominent greenhouse gases such as carbon dioxide and nitrous oxide," he said.

"The enhanced heat and humidity also cause stress to the animals, called as heat stress that accounts for major loss in growth, production and reproductive efficiency."

The research team is now aiming to utilise the findings for breeding climate-smart animals.



Vechur cow (dwarf *Bos taurus indicus*).

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Postgraduate Showcase presenters pictured with Professor Kadambot Siddique, Professor Shane Maloney, Professor Jacqui Batley, DPIRD Director General Ralph Addis and Emeritus Professor Graeme Martin. Photo: Rosanna Candler

Green shoots for the future at showcase

Seven of UWA's best and brightest postgraduate students in agriculture and related areas presented their research at The UWA Institute of Agriculture's 15th annual Postgraduate Showcase: Frontiers in Agriculture in June.

The UWA Institute of Agriculture Director Professor Kadambot Siddique welcomed the full-house audience, and introduced DPIRD Director General Ralph Addis.

Mr Addis delivered an optimistic opening address that emphasised the “very good environment of opportunity for clear, effective partnerships” between tertiary institutions, government and industry.

“We are starting to see some green shoots for the future.”

“We are starting to see some green shoots for the future,” he said.

“We must work closely with our most-important partners to build our shared interests in a strong and deliberate way.”

First session chair Professor Jacqueline Batley introduced The UWA School of Agriculture and Environment (SAGe) PhD candidate Tamsal Murtza.

Ms Murtza's research was focussed on the geographic and temporal patterns of a rapidly evolving plant pathogen causing white leaf spot disease in canola.

Fellow SAGe student Hira Shaukat then presented her research into using modern technology for quasi-3D field scale soil mapping.

By using “mobile, quick and inexpensive” electrical conductivity sensing, Ms Shaukat's research could help improve farm management decisions.

The School of Engineering student Wesley Moss captured the audience's attention with his presentation title: “The need for seed”.

Mr Moss' research is focused on finding new solutions to increase the efficiency and sustainability of harvesting subterranean clover seed – and is currently investigating whether peanut harvesting machinery may be the answer.

SAGe postgraduate student Shilja Shaji delivered her research into the variability in physiological and production responses of heat stress in dairy cattle.

Following the afternoon tea break, second session chair Professor Shane Maloney introduced PhD student and DPIRD researcher Martin Harries.

Mr Harries explored his research investigation into biophysical constraints as drivers of land use change in the farming systems of South-West WA.

Juwita Dewi from SAGe then introduced the audience to her research into redox regulation of bud dormancy in grapevine.

Ms Dewi said her research would provide a better insight into control of bud burst using non-toxic and environmentally friendly compounds to improve yield.

The final speaker of the day was School of Molecular Sciences PhD candidate Clarisa Castaños, who presented on her research into lipid metabolism in malnourished honey bees.



Audience members during the afternoon tea break.



Changes in biodiversity loss and climate change have profound consequences for human wellbeing.

Dual challenge of biodiversity loss and climate change

Findings from the United Nations' [*Biodiversity and Climate Change Report*](#) have the potential to haste the introduction of biodiversity credits and carbon credits for agriculture in WA.

The UWA Institute of Agriculture Adjunct Associate Professor Judith Fisher was elected to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Multidisciplinary Expert Panel in 2018.

"As a member, I have enjoyed the challenge of bringing my technical and scientific knowledge to advance the innovative work of IPBES to make positive change for the future of the planet," Professor Fisher said.

For the first time, 50 of the world's leading biodiversity and climate experts from the IPBES and Intergovernmental Platform on Climate Change (IPCC) collaborated to produce the peer-reviewed report.

The process included a series of workshops that were attended by the UWA School of Agriculture and Environment's Dr Ram Pandit.

There is clear evidence that healthy ecosystems help support adaptation to and mitigation of climate change including restoration of ecosystems," Professor Fisher said.

"A key outcome from these findings for WA is the need for Ministries of Finance, Agriculture, Environment, Climate and Water to work together to develop policies which address synergies between mitigating biodiversity loss and climate change."

Professor Fisher said biodiversity loss and climate change were both driven by human economic activities and mutually reinforced each other. "Neither will be successfully resolved unless both are tackled together," she said.

Adjunct Associate Professor Judith Fisher
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New tool to estimate soil carbon

Farmers, grower group and industry representatives gathered to learn about a new tool to estimate soil carbon at an event hosted by Wheatbelt Natural Resource Management (NRM) at UWA Farm Ridgefield.

Developer Jolene Otway said the South-Western Australian RothC Modelling (SWARM) tool was an excel-based digital tool to estimate soil carbon and help farmers target land restoration efforts

Wheatbelt NRM Project Delivery Officer Bonny Dunlop said the hands-on demonstration of the program was well-received.

"Plans for an instructional video will mean that even more people will be able to access and use the tool," Ms Dunlop said.

During the event, participants also learned about a bio-amendments trial underway at UWA Farm Ridgefield.



SWARM developer Jolene Otway at UWA Farm Ridgefield. Photo: Bonny Dunlop



UWA VC Professor Amit Chakma (third from right) and UWA researchers during their visit to Richgro.

Strong partnership between Richgro and UWA

The UWA Vice Chancellor Professor Amit Chakma recently visited fourth-generation family business Richgro to foster and enhance industry and university collaborations.

The group tour visited WA's largest food waste anaerobic digestion (AD) facility, located in Jandakot.

The food waste AD facility for biogas production can produce up to 2.2MW of electricity by diverting up to 35 thousand tons per annum from landfill.

This is surplus to the on-site electricity requirements, so it also exports electricity to the grid.

Richgro is chaired by Geoff Richards, with his sons Tim and Matt Richards serving as managing directors.

The Richards family visited commercial AD facilities around the world to develop

the state-of-the-art design at Jandakot, which was partly funded by grants from the Australian Renewable Energy Agency (ARENA) and WA Government.

After the facility was built, UWA's Dr Bede Mickan joined Richgro in the role of Research and Development Manager.

Dr Mickan bridges the gap between Richgro and UWA by applying industry-relevant and high-impact outcomes.

Richgro has an exciting bioplastic from food waste project by integrating biopolymer fermentation into AD with PhD candidate Christopher Buhlmann, who is now nearing completion of his studies.

More recently, Richgro joined the UWA node of the Australian Research Council's Training Centre for Transformation of Australia's Biosolids, with Professor Megan Ryan as the UWA node leader alongside Professor Anas Ghadouani.

Dr Mickan is now based at UWA as part of the above project.

Dr Mickan and Dr Liah Coggins will deliver the research objectives relating to soil health and sustainability for the safe reuse of waste-derived fertilisers and soil amendments.

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Research paves way for low temp-tolerant chickpeas

Almost two decades of collaborative research into improving chickpea chilling tolerance has culminated in a new paper for The UWA Institute of Agriculture.

Chickpea is the third most important food legume in the world and is an important source of high-quality protein.

However, its sensitivity to low temperatures often leads to significant crop losses.

For the study, recently published in [Environmental and Experimental Botany](#), The UWA Institute of Agriculture partnered with four Indian universities to investigate the molecular mechanisms governing chickpea's low temperature-induced pollen sterility.

They looked at the impact of low temperatures on carbohydrates, proline and enzymatic antioxidants and expression of genes of these metabolite pathways in anthers at pollen stage.

The study tested on a cold-sensitive and cold-tolerant genotypes.

Metabolite profiling revealed a reduction in starch and proline content in the cold-sensitive genotype.

Meanwhile, when the cold-tolerant genotype was placed under low temperatures, the starch and proline content did not change, but non-reducing sugars increased.

The study found that enzymatic antioxidants were not the major players in cold tolerance or sensitivity as no



Young chickpea pods growing in the field.

correlation existed between pollen fertility and enzymatic antioxidant levels.

The new information will be used to develop improved chickpea varieties with enhanced chilling tolerance at flowering and high yields in Australia and India.

Professor Kadambot Siddique
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East African smallholder maize crop devastated by maize lethal necrosis disease (all maize plants killed), while understory potato crop remained healthy.

Charting virus pandemics that devastate plants

While the COVID-19 pandemic makes global headlines, some may be surprised to learn that viruses cause similar crop devastation.

Plant viruses cause diseases that spread across continents causing pandemics or major epidemics devastating staple crops important for food security and human nutrition.

They reduce yields and disfigure produce making it unsaleable or inedible.

The UWA Institute of Agriculture Adjunct Professor Roger Jones recently authored reviews in the journals *Plants* and *Viruses* describing plant virus disease pandemics and major epidemics.

One focussed on viruses that spread from infected wild plants to crops where they are being domesticated.

These viruses were subsequently transported elsewhere in infected planting material.

“Maize is one of the important staple crops globally,” Professor Jones said.

“The maize lethal necrosis disease pandemic is currently devastating maize in sub-Saharan Africa.”

Its most important causal virus – maize chlorotic mottle virus – is seed-borne in maize.

Trade in infected maize seed spread it from Central America throughout the Americas in the pre-Colombian era,

and more recently to Africa, East and Southeast Asia and Europe, resulting in the current pandemic.

It has not yet reached Australia.

The other focussed on viruses that spread to crops after their introduction to new continents.

“These viruses emerged from indigenous vegetation to infect introduced crops causing damaging crop diseases that became widespread,” Professor Jones said.

Cassava is the third most-important staple crop in developing countries.

After the 1947 Portuguese invasion, cassava’s tuberous roots were distributed from its Amazon rainforest domestication centre to other world regions.

The cassava mosaic disease pandemic is now threatening cassava in sub-Saharan Africa, the Indian sub-continent and Southeast Asia.

“This cassava disease causes severe leaf deformation, stunting and plant death, and greatly reduces tuberous root production,” Professor Jones said.

“In each region, it is caused by distinct cassava mosaic viruses that emerged from local indigenous vegetation to invade the introduced crop.”

Adjunct Professor Roger Jones
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Board welcomes new members

The UWA Institute of Agriculture will welcome two new members to its Industry Advisory Board next month.

New board member CSIRO Senior Principal Research Scientist Dr Hayley Norman is passionate about helping industry achieve profitable and environmentally sustainable farming systems.

Elders senior agronomist Belinda Eastough, who runs a livestock and crop farm at Yuna in WA’s midwest, will also join the board.

The Institute extends its gratitude to outgoing board members CSIRO Agriculture and Food Deputy Director Michael Robertson and Planfarm Consultant Dani Whyte for their dedication and support.



Belinda Eastough



Dr Hayley Norman



Students Brian Unani and Thomas Ferguson extracting soil cores at UWA Farm Ridgefield.

What the soil carbon conversation is missing

Researchers at the UWA School of Agriculture and Environment and The UWA Institute of Agriculture are conducting innovative research to enhance carbon sequestration in WA soils.

Renowned UWA soil scientist Professor Nanthi Bolan said the university was helping the farming community to achieve carbon credit and also contribute to emission reduction, farm productivity, profitability and sustainability.

“Soil carbon is in the spotlight in many countries, including Australia,” Professor Bolan said.

“As a key plank in the Commonwealth Government’s technology-led emissions reduction policy, it involves changing farming techniques so soils store more carbon from the atmosphere.

“Farmers can encourage and accelerate this process through methods that increase biomass production – such as improving water and nutrient management, efficient pest control, inclusion of cover crops, addition of lime, manures and composts, sowing permanent pastures and planting trees. For each unit of atmospheric carbon they remove in this way, farmers can earn ‘carbon credits’ to be sold in emissions trading markets.”

Professor Bolan said there was a crucial point missing in the soil carbon conversation.

“There is not enough focus on the value of soil carbon in improving the soil health, crop productivity and farm profitability,” he said.

“Carbon is the major elemental component of soil organic matter.

“Soil organic matter provides the ‘building block’ for binding the primary soil particles such as sand, silt and clay, leading to the formation of micro and macroaggregates, which provide the structural stability to soils.”

Similarly, Professor Bolan said soil organic matter provided the ‘sites’ for the retention of moisture and nutrients, thereby helping soils to overcome drought, reduce nutrient losses and increase nutrient and waste-use efficiencies.

“There is not enough focus on the value of soil carbon in improving the soil health, crop productivity and farm profitability.”

“Organic matter serves as the ‘fuel’ for soil microorganisms, thereby enhancing the functional and genomic biodiversity of soil organisms, which are essential for soil biological health,” he said.

Professor Bolan concluded that carbon was an important component of soil organic matter.

“By improving crop productivity and biomass production, farmers can achieve greater carbon sequestration – what we call positive feedback of soil carbon to overall carbon sequestration,” he said.

Professor Nanthi Bolan
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Soil scientist Dr Matthias Leopold deploying sensors for long term surveys of soil moisture under different management regimes.

Overcoming waterlogging challenges in subclover

UWA postgraduate student Gereltsetseg Enkhbat is working to better understand the traits in subterranean clover ‘subclover’ (*Trifolium subterraneum*) needed to overcome the challenges of waterlogging.

The project is part of an Annual Legume Breeding Australia joint venture between PGG Wrightson Seeds and UWA, made possible through a partnership between Nagoya University and UWA.

In southern Australia, annual plants (such as subclover) grown in Mediterranean

regions have been experiencing transient waterlogging from excessive rainfall during the winter-spring growing season.

Ms Enkhbat said the problem was becoming increasingly worse due to intensive and erratic rainfall as a result of climate change.

Subclover is the most widely sown annual pasture legume in southern Australia and consists of three subspecies, which are each adapted to different soil types.

“Transient waterlogging of subclover can cause extensive biomass reductions,” she said.

Ms Enkhbat said her PhD research was needed because there are conflicting results and insufficient experimental evidence to ascribe differences in tolerance among the subspecies.

A recent paper, co-authored by Ms Enkhbat and published in the journal *Plant and Soil*, determined that the variation of waterlogging tolerance and recovery between the subclover subspecies was related to root and shoot responses.

“In the short term, my research will inform producers on cultivar choice for sowing pastures subject to transient waterlogging,” she said.

“In the longer term, it will inform the traits to be targeted for development of subclover cultivars targeted at environments that regularly experience waterlogging.”

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Gereltsetseg Enkhbat with subclover field trials at the UWA Shenton Park Research Facility.

Bogged-down debacle

Never has the phrase ‘love thy neighbour’ been more pertinent at UWA Farm Ridgefield.

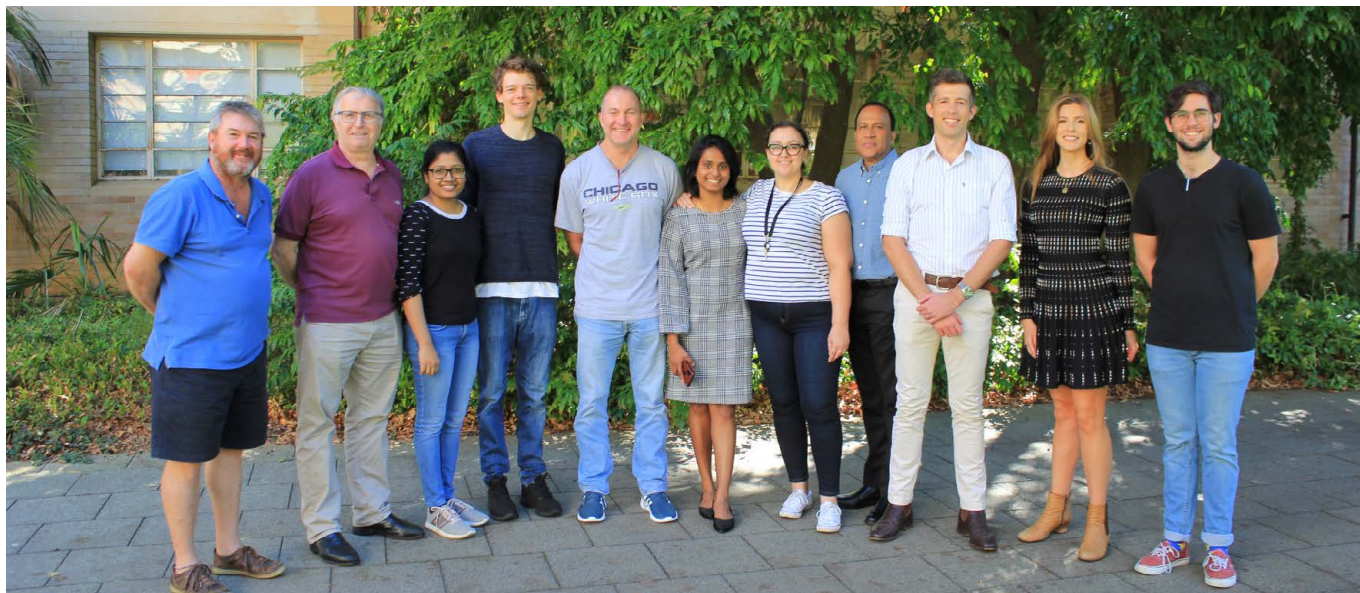
When a vehicle became bogged and the farm’s tractors were not strong enough to tow it out, a kind-hearted neighbour was quick to lend a hand.

The local farmer came to the rescue with a very large tractor with tracks (not wheels) and the vehicle was soon back in action.

The debacle was a reminder of the ups and downs of farm life, and the importance of having great relationships with neighbours.



Assessing the stuck situation at UWA Farm Ridgefield. Photo: Michelle Borgsteede



Professor Simon de Graaf met with UWA students for a morning tea Q&A before his lecture.

New technology set to boost sheep breeding

Exciting new technology is on the horizon for Western Australian sheep producers to boost their artificial breeding programs, according to the University of Sydney Associate Professor Simon de Graaf.

Professor de Graaf's bold predictions for the future of sheep artificial breeding captivated the audience at The UWA Institute of Agriculture's 2021 Alan Sevier Memorial Lecture on 20 April.

The lecture was held in honour of [Alan Sevier](#) – a WA farmer, inventor and amateur scientist who bequeathed his research and writings on cattle reproduction and pheromone experiments to UWA before he passed away in 2013.

“We would be able to look at things including the time of the AI, the dose of hormones and analgesia used, what the tone of the uterus looks like, the internal fat score and even the weather.”

The new data capture system, developed by Graham Innovations and trialed by USYD in 2019, has the potential to identify the reasons why artificial insemination (AI) procedures were successful or unsuccessful.

Professor de Graaf said this technology could help breeders eliminate or dramatically reduce unsuccessful AI cases.

“We would be able to look at things including the time of the AI, the dose of hormones and analgesia used, what the tone of the uterus looks like, the internal fat score and even the weather,” he said.

“You combine all of that information... and then by using the same device at pregnancy scanning, that information can be married up with the fertility data we have.”

Professor de Graaf said he hoped the device would even be able to identify if the weather impacted fertility.

“Imagine if you received a warning that said: ‘If you go ahead with your artificial insemination program now, based on the forecast, you will have 20 per cent lower conception rates’,” he said.

“That would be a useful tool for the future.”

Initial trials of the system are expected to be completed by the end of 2021.



UWA Adjunct Professor Bruce Mackintosh, Professor de Graaf and Professor Kadambot Siddique.

USYD is also working on a related project with the Australian Merino Sire Evaluation Association (AMSEA) and NSW Merino Stud Breeders' Association Trust.

All semen used in the AMSEA sire evaluation trials will be tested to link sperm parameters or traits with subsequent fertility.

Professor de Graaf said testing and ranking the semen used in these sire evaluation programs could set new national semen standards and even identify ‘super sires’.

Find out more about the history of the Alan Sevier Memorial Lecture by reading [The Sevier Story: Farmer, inventor and amateur scientist](#).

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Excitement grows over specialised Ag degree return

The specialised Bachelor of Agricultural Science degree will return to UWA in 2022.

Prospective students can apply now to join the university in semester one of next year to study one of the new specialised (named) degrees.

Research and teaching staff have listened to their alumni and industry partners to bring together several degrees that will aid in the successful employability of future graduates.

“We are excited to share this news and provide a closer look at what is on offer,” Head of the UWA School of Agriculture and Environment Associate Professor James Fogarty said.

As of 2022, prospective students can choose one of the following specialised degrees which align closely with future



UWA students in the field at the Shenton Park Research Facility.

agriculture opportunities: Bachelor of Agricultural Science, Bachelor of Agribusiness or Bachelor of Engineering (Honours) – including Bachelor of Science, where there is a choice of up to two Agriculture majors.

In addition, UWA will continue to offer the comprehensive degree of Bachelor of Science where students can choose one or two majors.

The Agriculture-aligned majors include Agricultural Science, Agricultural Technology and Agribusiness.

In this degree, students may choose to complement a single Agriculture major with a different second major from within Science – or even turn to another area such as commerce, geography, law and society or even landscape architecture.

For high-achieving students, UWA has tailored a four-year Combined Bachelor and Masters degree program that will see students graduate with both a Bachelor (undergraduate) and Masters (postgraduate) degree.

Options for this pathway in Agriculture can be [viewed online](#).

“Whether applicants are school leavers, looking to upskill or reskill; choosing a University can be daunting,” Associate Professor Fogarty said.

“At UWA there is a dedicated team available online, on the phone or in-person to help answer specific questions.”

Contact [Future Students](#) or email the UWA School of Agriculture and Environment at admin-sae@uwa.edu.au

Vitamin K the key to reduce disease risk



A variety of foods rich in vitamin K.

Researchers from UWA and Edith Cowan University have found that a diet rich in vitamin K can dramatically reduce the risk of cardiovascular disease related to atherosclerosis (plaque build-up in the arteries).

The research, recently published in the [Journal of the American Heart Association](#), examined data from a Danish health study of 50 thousand people over 23 years.

Vitamin K1 is found in green leafy vegetables and vegetable oils, while vitamin K2 is found in meat, eggs and fermented foods.

The study found that people with the highest intakes of vitamin K1 were 21 per

cent less likely to be hospitalised with the cardiovascular disease related to atherosclerosis.

For vitamin K2, the risk of being hospitalised was 14 per cent lower.

This lower risk was seen for all types of heart disease related to atherosclerosis, particularly for peripheral artery disease at 34 per cent.

“These findings shed light on the potentially important effect that vitamin K has on the killer disease and reinforces the importance of a healthy diet in preventing it,” co-author UWA Dr Jamie Bellinge said.

Dr Jamie Bellinge
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Building farmers' confidence in serradella

The pasture legume serradella (*Ornithopus spp*) should be an “increasingly attractive option” for mixed-use farmers to reduce their fertiliser inputs, according to new UWA research.

UWA School of Agriculture and Environment Senior Research Officer Daniel Kidd is conducting his PhD research on the aluminium (Al) tolerance of new serradella cultivars.

He was inspired to focus on this area after participating in a national project funded by the Rural Research & Development for Profit program with collaborators including CSIRO Canberra and NSW Department of Primary Industries.

This project investigated the phosphorus (P) use efficiency of pasture species commonly used in temperate pasture systems in southern Australia.

“Of the species studied, serradella was identified as one of the most P efficient,” Mr Kidd said.

“This meant that for pastures where it was utilised, they could potentially be managed with less fertiliser inputs, which is a great financial and environmental incentive for growers.”

Despite being broadly adapted to southern Australia, the adoption of

serradella by farmers was not been as great as expected.

“It seemed that there was an opportunity for my PhD thesis to provide more detailed information on the constraints to serradella productivity, which may then give growers greater confidence in its uptake,” Mr Kidd said.

The research results indicated that, while most serradella cultivars could be considered tolerant of Al, there were exceptions.

“French serradella show greater sensitivity than yellow serradella, and two cultivars in particular were highly susceptible to Al. Therefore, care should be taken to select the appropriate species and cultivar for your soil type,” Mr Kidd said.

“While most serradella cultivars have reasonable Al tolerance, their extensive root systems are clearly the biggest advantage in acid soils with high levels of exchangeable Al, where soil nutrition, particularly phosphorus can be limiting.”



Daniel Kidd in a sandy soil type at UWA Shenton Park Research Facility.

“This research provides a higher level of information around current varieties, which should give farmers greater confidence in adopting it in their pastures.”

Given the large proposed adaptive range of serradella and its ability to thrive at lower soil test P concentrations, Mr Kidd assured it was ideal for lowering fertiliser inputs in southern Australian pasture systems.

“Phosphorous is a finite resource and there are environmental implications from its overuse in some regions, therefore serradella should become an increasingly attractive option for future farming systems that include livestock production,” he said.

“This research provides a higher level of information around current varieties, which should give farmers greater confidence in adopting it in their pastures.”

Daniel Kidd
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A solution culture experiment used as a preliminary assessment of the aluminium tolerance of 20 cultivars of French and yellow serradella compared to other commonly grown temperate pasture species.



Researchers from CSIRO and UWA at CSIRO in Floreat.

CSIRO and UWA meet to communicate and collaborate

The successful partnership between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and UWA is stronger than ever.

Agricultural researchers from both institutions have committed to meet on a regular basis to discuss common research interests and promote future research and postgraduate training collaboration.

The first event was held in June and focussed on the topic of crop genetics and pre-breeding.

Dr Hayley Norman from CSIRO, who recently joined The UWA Institute of Agriculture's Industry Advisory Board, welcomed the participants.

During his introduction, Institute Director Professor Kadambot Siddique showed evidence that CSIRO was the university's number one partner in joint publication output with Australian partner institutions – collaborating on more than 1000 joint publications in the past decade.

UWA Professor Wallace Cowling and CSIRO's Dr Matthew Nelson presented their perspectives on canola and lupin pre-breeding research, which has linked CSIRO and UWA over several decades.

Disease resistance was presented by CSIRO Research Scientist Dr Lars Kamphuis and UWA professors Jacqueline Batley and Martin Barbetti.

The final speakers from UWA Professor Guijun Yan and Dr Nicolas Taylor, and CSIRO's wheat agronomist and physiologist Dr Andrew Fletcher, discussed their research into wheat genetics and physiology.

Following the formal presentations, the group discussed potential areas of research collaboration including joint PhD supervision.

The next meeting will be held at UWA Crawley campus in September.

Professor Wallace Cowling
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Grant to unravel secrets of the rhizosphere

Dr Yinglong Chen from The UWA Institute of Agriculture has received an Australian Research Council grant to lead a four-year project aiming to unravel the secrets of the rhizosphere of crops.

The \$786,690 grant, made possible through the Future Fellowship Scheme, will allow Dr Chen and his international collaborators to investigate the way crops use nutrients through the rhizosphere (the zone of soil surrounding a plant root).

Dr Chen said he hoped to establish "breakthrough knowledge" of how root

system architecture, root exudates (secreted substances) and rhizosphere microbiome interact together to facilitate nutrient uptake.

The researchers will develop a systematic research tool in imaging root growth and dynamics of rhizosphere biochemistry.

"The project will also foster collaborative research with international experts in the study of rhizosphere interactions," Dr Chen said.

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Dr Yinglong Chen in a UWA glasshouse.

Passion for soil the ‘root’ to Award

As the inaugural recipient of the prestigious General Jeffery Soil Health Award, Emerita Professor Lynette Abbott has an important message for the next generation of soil scientists.

“Do not avoid investigation of areas that are not mainstream if you are passionate about them,” Professor Abbott said.

“The more challenging the questions, the greater reward in the longer term.”

Professor Abbott is a world-leading academic and science communicator in soil science and soil biology at the UWA School of Agriculture and Environment and The UWA Institute of Agriculture.

During the 2021 National Landcare Awards ceremony held online in August,

Australia’s current National Soils Advocate the Honourable Penny Wensley AC said Professor Abbott was “most deserving” of the new award.

“General Jeffery was a tireless champion of soil health,” Ms Wensley said.

“I am sure all who knew and worked with him will be delighted to see his legacy honoured and maintained in this way.”

During an academic career that has spanned more than five decades, Professor Abbott conducted pioneering research and teaching into symbiotic soil fungi in agriculture and disturbed natural environments.

Her research addresses fungal interactions with plants and implications for fertiliser management and soil amendments.

Professor Abbott established the innovative ‘Know your Soil Biology’ workshops for farmers and provides hands-on activities demonstrating the benefits of soil biota for soil health.



Emerita Professor Lynette Abbott in UWA lab.

She also leads the Land Restoration Demonstration Site research project at UWA Farm Ridgefield, and is currently consolidating soil health knowledge through a project in the Australian Government Smart Farms program.

Emerita Professor Lynette Abbott
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Workshop tackles climate change stress

Climate change is now recognised as a global emergency with serious impacts on millions of people across the world.

While biophysical effects are widely recognised, rapid and slow-onset changes in the climate are also contributing to rising levels of stress and anxiety.

To explore the (often overlooked) impacts of climate change on mental health, the WA branch of Researchers in Agriculture for International Development (RAID) hosted a Mental Health and Climate Change Workshop at UWA in July.

UWA researcher Dr Alicea Garcia guided the audience – which included members of local government and non-for profit organisations, industry and academia – through presentations, discussions and hands-on activities.

Dr Karen Paiva Henrique from the UWA Department of Geography and Planning presented her research on understanding loss from climate change in everyday places.



UWA researcher Elise Haddleton presenting at the workshop.

UWA researcher Elise Haddleton shared learnings from her work on community resourcefulness, followed by Sustainable Simply founder Daisy Goodwin on the importance of reducing waste at home.

“Achieving zero waste can be difficult, but we can all aim for a minimal waste lifestyle,” Ms Goodwin said.

RAID representative Dr Ana Manero said frustration and disappointment, mixed with hope and empowerment, were

common emotions associated with climate change.

“Workshop attendees left with a renewed sense of purpose as a call for action resonated throughout the room to reduce waste, connect with like-minded people and be informed,” attendee Dr Piers said.

Ana Manero
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Masters research could lead to future findings

Exciting results from Yunxiao Zhang's Masters UWA research could spark follow-up studies into the relationship between plant height and production in common wheat.

Under the supervision of Professor Guijun Yan and Dr Hui Liu at the UWA School of Agriculture and Environment and The UWA Institute of Agriculture, Ms Zhang recently completed research into the candidate genes for plant height and grain production in common wheat.

"In this study, we characterised the near-isogenic lines (NILs) targeting the four loci for plant height and yield-related traits," she explained.

"We also identified putative candidate genes controlling the traits through genotype-phenotype association analysis of the contrasting NILs, and tested

whether any candidate genes identified in this study overlap with previously identified QTL and genes."

The genotype-phenotype association analysis of the NILs detected novel 14 candidate genes as having the same functions related to plant hormone, carbohydrate and amino-acid metabolism pathways.

Ms Zhang said the results would also provide a strong impetus to investigate the relationship between plant height and yield related traits.

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Decades of dedication recognised in Queen's Honours

Two prominent contributors to The UWA Institute of Agriculture were recently recognised at the Queen's Birthday 2021 Honours.

Adjunct Professor Neil Turner was awarded a Member of the Order of Australia for his significant service to agricultural and environmental science, and education.

Professor Turner was a research scientist with CSIRO Division of Plant Industry – first in Canberra for 10 years and then in Perth until his retirement in 2005.

He was appointed Research Leader of the Dryland Crops and Soils Research Unit to re-establish CSIRO Plant Industry and Soils in Perth.

For the past 15 years, he has spent one month per year in China as Visiting Professor at Lanzhou University and Gansu Agricultural University.

UWA awarded Professor Turner a Chancellor's Medal in 2012 for his

contributions to research and teaching at the university.

Dr Dawson Bradford, who has served on Institute's Industry Advisory Board since 2015, also earned one of the top accolades in the Queen's Birthday 2021 Honours.

The third-generation Narrogin farmer received a medal in the general division of the Order of Australia for almost five decades' dedication to the livestock industry.

Dr Dawson's many roles include chairman of the Australian Poll Dorset Association, LAMBEX and the WA Meat Market Co-operative and a founding member of Meat Elite Australia.

He received honorary Doctorate of Science from Murdoch University in 2010, and was admitted to the Royal Agricultural Society's Hall of Fame in 2014 to acknowledge his contribution to the Australian prime lamb industry.



Long-time member of the Industry Advisory Board Dr Dawson Bradford.



The UWA Institute of Agriculture Adjunct Professor Neil Turner.

AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Adj/Prof Neil Turner	Medal of the Order of Australia – Queen’s Birthday Honours
Dr Dawson Bradford	Medal in the general division of the Order of Australia – Queen’s Birthday Honours
E/Prof Lynette Abbott	2020 General Jeffery Soil Health Award – Office of the National Soils Advocate
H/Prof Kadambot Siddique	Certificate of Appointment to Seventh Editorial Committee of Bulletin Soil and Water Conservation – Chinese Academy of Science
H/Prof Kadambot Siddique	Certificate of Achievement for contribution to Agriculture Research and Education in India and Australia – Indian Consul General Perth

MEMORANDA OF UNDERSTANDING

NAME	DATE SIGNED
The University of Western Australia and Jawaharlal Nehru University, India	Renewed June 2021

VISITORS TO IOA

NAME OF VISITOR	VISITOR’S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
DPIRD Director General Ralph Addis	Department of Primary Industries and Regional Development, WA	The UWA Institute of Agriculture	2 June
The Hon Minister Alannah MacTiernan MLC	Ministries of Regional Development; Agriculture and Food; Hydrogen Industry, WA	The UWA Institute of Agriculture	21 July

NEW POSTGRADUATE RESEARCH STUDENTS (PhD)

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Hoang Vuong Dang	Integrated phytoplankton modelling for algal bloom risk prediction: linking taxonomic data and hydrodynamic-biogeochemical modelling	UWA School of Agriculture and Environment	A/Prof Matt Hipsey, Dr Stephanie Kermode, Prof Carolyn Oldham	Scholarship For International Research fees, University Postgraduate Award and Ad Hoc Top-Up Scholarship
Yunxiao Zhang	Genetic dissection of a genomic region located on wheat chromosome arm 7AL harboring yield-controlling genes	UWA School of Agriculture and Environment	Dr Hui Liu, Prof Guijun Yan	CSC-UWA Joint Scholarship
George Mercer	Engineering an organic soil amendment to build soil carbon and generate value from urban waste streams.	UWA School of Agriculture and Environment	Dr Bede Mickan, Dr Dierdre Gleeson, Prof Megan Ryan	ARC Training Centre for Transformation of Australia’s Biosolids Resource, University Postgraduate Award, and Australian Government RTP
Sneha Priya Pappula Reddy	The effects of terminal drought in reproductive processes in Chickpea genotypes	UWA School of Agriculture and Environment	H/Prof Kadambot Siddique, Prof Harvey Millar	Scholarship for International Research Fees and University Postgraduate Award
Sarah Babington	Validating novel biomarkers for sheep welfare	UWA School of Agriculture and Environment	Dr Dominique Blache, Prof Shane Maloney, Dr Alan Tilbrook	RTP, University Postgraduate Award, and a Grant from Meat and Livestock in collab with University of Queensland

NEW RESEARCH GRANTS

TITLE	FUNDING PERIOD	FUNDING BODY	INVESTIGATORS
Rethinking and revitalising herbicides to counter resistance	2021-2024	ARC Linkage Project	Prof Joshua Mylne, A/Prof Keith Stubbs, Dr Philippe Herve, Dr Bruce Lee
Unravelling the secrets of the rhizosphere of crops	2021-2025	ARC Future Fellowships	Dr Yinglong Chen

UWA IOA 2021 Publications

(April to August)

Peer Reviewed Journals

Abbaszadeh-Dahaji P, Atajan FA, Omidvari M, Tahan V and Kariman K (2021). Mitigation of Copper Stress in Maize (*Zea mays*) and Sunflower (*Helianthus annuus*) Plants by Copper-resistant *Pseudomonas* Strains. *Current Microbiology* **78**(4): 1335-1343 doi: 10.1007/s00284-021-02408-w

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Amas J, Anderson R, Edwards D, Cowling W and, Batley J (2021). Status and advances in mining for blackleg (*Leptosphaeria maculans*) quantitative resistance (QR) in oilseed rape (*Brassica napus*). *Theoretical and Applied Genetics* doi: 10.1007/s00122-021-03877-0

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Barrett-Lennard EG, Munir R, Mulvany D, Williamson L, Riethmuller G, Wesley C and Hall D (2021). Micro-Water Harvesting and Soil Amendment Increase Grain Yields of Barley on a Heavy-Textured Alkaline Sodic Soil in a Rainfed Mediterranean Environment. *Agronomy* **11**(4): 713 doi: 10.3390/agronomy11040713

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