NEWSLETTER 50, SEPTEMBER 2023

The UWA Institute of Agriculture

In her first official visit to The University of Western Australia since embracing the role of WA Agriculture Minister, The Hon Jackie Jarvis opened The UWA Institute of Agriculture's 17th annual Industry Forum at the University Club of WA in July. Continued on page 5

THE UNIVERSITY OF WESTERN AUSTRALIA

IN THIS ISSUE

Whilst navigating the peaks and challenges of another busy year at The UWA Institute of Agriculture, the theme of 'gratitude' has been clear.

From the Director

A significant personal highlight was being named 2023 Scientist of the Year at the WA Premier's Science Awards. This honour represented the culmination of more than four decades living, working, and conducting research in WA. It was also a powerful time of reflection and appreciation for those who I am fortunate to count as colleagues, collaborators, and students. Sadly, we have recently lost two individuals whose scientific and personal impact cannot be overstated: Professor MS Swaminathan (page 4) and Emeritus Professor John Pate (page 6).

It has been very special to welcome new and familiar faces to UWA's Crawley campus over the past few months. We have regularly filled theatres to hear from visiting lecturers including the Institute's Adjunct Professor Madan Pal Singh (page 10), Kyoto University Dr Satoshi Iwakami (page 11), the University of the Sunshine Coast Associate Professor İpek Kurtböke (page 14)and University of Alberta Professor Varghese Manaloor (page 15).

In addition, Dr Kelsey Pool presented the 2023 Lefroy Research Fellow Seminar (page 3), we held our 17th annual Industry Forum on 'Paving the way for the next generation of WA agriculture' (page 5), and seven outstanding PhD candidates presented their achievements at our annual Postgraduate Showcase (page 11).

The Institute contributed to numerous innovative research projects and initiatives last year. These achievements and our events and engagement activities are outlined in the Institute's recently launched 16th Annual Research Report 2022. The digital version is available to download and read online.

Finally, I have some exciting news to share about the location of the Institute. Our team have recently moved downstairs to the ground floor of UWA's Agriculture Central Wing. In addition to being more accessible, we now have more space for academics and students – which I am pleased to report we will put to good use with several international visitors expected in the coming months.

Hackett Professor Kadambot Siddique
AM CitWA FTSE FAIA FNAAS FISPP FAAS FPAS
kadambot.siddique@uwa.edu.au

Hackett Professor Kadambot Siddique cutting his cake, surrounded by colleagues and students.

Home ground celebration the icing on the cake

During an emotional acceptance speech after being named 2023 Scientist of the Year in September, Hackett Professor Kadambot Siddique told the audience that – if he were to get another life – he would choose to do everything the same.

The 22nd annual Premier's Science Awards recognised and celebrated the outstanding scientific research and engagement taking place in WA.

Having been named a finalist for the top award two years in a row, Professor Siddique said the title was a humbling and life-defining honour, which he dedicated to his family in Perth and India.

The UWA Institute of Agriculture fortuitously hosted its monthly morning tea the morning after the award ceremony, which was the ideal opportunity to celebrate and honour its Director.

The informal celebration, complete with a special cake and short speech, was attended by more than 45 university staff and students.

Professor Siddique said he was especially thankful to his expansive network of colleagues, PhD and Master's students, and research collaborators at UWA and universities and research institutions across WA, Australia and the world, especially in China and India.

"Every morning, I jump right out of bed because I love coming to work at UWA so much," he said.

"I am fortunate to work in an environment surrounded by very clever, passionate people at this university.

"I am immensely proud of what we have achieved together."

Lefroy seminar tackles ‘silent pandemic’ of infertility

Dr Kelsey Pool outside the UWA Bayliss Lecture Theatre.

Issues in livestock reproduction parallel and even foreshadow emerging issues in human reproductive health – making livestock systems incredibly valuable populations to study fertility, according to Lefroy Research Fellow Dr Kelsey Pool.

Reproductive biologist Dr Pool explored what she called the “silent pandemic” of mammalian infertility during her Lefroy Fellow 2023 Seminar in May.

“For the past three years, the COVID-19 pandemic has dominated the media,” she said.

“Far less talked about however, is another pandemic spanning decades – an insidious increase, globally, in mammalian infertility.”

> “Endocrine disrupting chemicals, climate change, in-utero stressors … our modern environment challenges our reproductive potential before we are even born.”

Through her work to improve sheep reproduction, Dr Pool has uncovered how dietary endocrine disruptors (very common in the average pantry) contribute to male fertility.

“We found that the diet of your grandparents could be responsible for your reproductive function,” she said.

“Dietary endocrine disruptors target very specific stages of sperm development and function, leading to subtle but deadly defects in a sperm’s ability to fertilise.

“In an agricultural context, this also addresses an 80-year-old myth that oestrogenic pastures, high in ‘plant oestrogens’ or phytoestrogens are safe for working rams. They are not, and in fact contribute to reduced reproductive function in the ram.”

In addition, by treating twin-bearing ewes with a neurohormone called melatonin during late gestation, Dr Pool said it was possible to provide these twin offspring with a physiological advantage before they were born.

“This study offers a commercial solution to improve twin lamb welfare and productivity, whilst also providing insight into strategies to mitigate fetal hypoxia and trauma common in twin pregnancies in several mammalian species,” she said.

Dr Pool’s seminar also included her research into using markers of fertility as a bioassay for biological de-fleecing.

Her team have identified potential alternatives to current methods of biological defleecing, which will allow sheep producers an alternative to manual shearing once refined and tested.

Watch the 2023 Lefroy Research Seminar on The UWA Institute of Agriculture YouTube channel.

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

Rams as part of a 2022 study at UWA Farm Ridgefield.

The UWA SNAGS group visiting the Institute's info stall at Dowerin Machinery Field Days.

Students snag a memorable Dowerin Camp experience

There was great excitement and commotion when the UWA Students of Natural and Agricultural Science (SNAGS) group came to visit The UWA Institute of Agriculture's information stall at the 2023 Dowerin Machinery Field Days.

The Institute sponsored the SNAGS' inaugural three-day Dowerin Camp – which included field trips, farm tours, field day demonstrations and networking.

SNAGS Social Vice President Kaitlin Williams said the "hugely successful" was made affordable for students with financial assistance from the Institute.

"Attendees were given the opportunity to gain valuable knowledge and access to resources and industry connections that will help them during their university career at UWA and as graduates," Ms Williams said.

The Institute's information stall within the Department of Primary Industries & Regional Development (DPIRD) shed was a resounding success.

PhD candidates Ruby Wiese, Agyeya Pratap, Garima and Emanuel Gomez informed visitors about their research projects and encouraged them to participate in related surveys – which was also communicated in a live radio interview with Triple M Rural Focus.

It was valuable to interact with DPIRD Director General Heather Brayford, the neighbouring WA Agricultural Research Collaboration stall, and visit the Australian Herbicide Resistance Initiative at the Grains Research and Development Corporation shed.

Farewell to the Father of India's Green Revolution

Vale Professor MS Swaminathan.

Pioneering plant geneticist and agronomist and the 'Father of India's Green Revolution' Professor MS Swaminathan passed away aged 98 in late September.

Professor Swaminathan was an Indian geneticist and international administrator, world-renowned for his leading role in developing a program under which high-yield varieties of wheat and rice were planted in the fields of poor Indian farmers.

In a career that spanned more than seven decades, he built one of history's most formidable careers in crop science and food production and helped ward off starvation for hundreds of millions of people.

As a young man, the 1943 Bengal Famine motivated Professor Swaminathan to complete multiple degrees and postgraduate studies in his pursuit of a famine-free India.

He spent 18 years at the Indian Agricultural Research Institute, rising from an assistant cytogeneticist to Director of the Institute, where he led the breeding of high-yielding crops for the Green Revolution.

His long and prestigious career included roles of Director General of the Indian Council of Agricultural Research, Principal Secretary of Agriculture to the Government of India, and Director General of the International Rice Research Institute in the Philippines.

The UWA Institute of Agriculture's Director Hackett Professor Kadambot Siddique said Professor Swaminathan was a personal hero and inspiration to scientists and farmers around the world.

"Our Institute was honoured to host Professor Swaminathan when he delivered a public lecture on 'Global Food Security and the role of Science and Technology' at UWA in 2007," Professor Siddique said.

"Over the decades, I was extremely fortunate to be invited to visit the MS Swaminathan Research Foundation on several occasions to present keynote talks and share in his company.

"I will also always cherish his support at the 2015 Silver Jubilee celebrations in New Delhi when I was elected Foreign Fellow of the Indian National Academy of Agricultural Sciences."

IAB member Belinda Eastough facilitating the panel discussion.

Paving the way for the next generation of WA agriculture

After three to six generations of selective breeding (and some interbreeding), Western Australian farmers are like resistant weeds, WAFarmers chief executive Trevor Whittington declared in his keynote speech at The UWA Institute of Agriculture's 2023 Industry Forum.

"They are good at survival, so there'll always be another generation of WA farmers," Mr Whittington said.

"Rather, my focus will be on the question: What do we need to do to put the whole agricultural ecosystem in WA on the global map?

"What's needed to attract the best and brightest to our universities to study agriculture science? How do we secure the research dollars, greater investment in ag innovation, and open up a raft of new opportunities for our graduates to grow the industry?"

These questions and more were explored at the 17th annual Industry Forum, supported by CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship and held at the University Club of WA on 19 July.

More than 230 guests, including agriculture industry leaders and analysts, researchers and working farmers attended the event, which was focused on the next generation of WA agriculture.

It was opened by the Hon Jackie Jarvis MLC, marking her first official visit to UWA since her appointment as Minister for Agriculture and Food; Forestry; Small Business.

"Today is the perfect collaboration of industry, academia, and government," Ms Jarvis said.

"Research and development will remain critical to maintain and grow production and address challenges from biosecurity threats, to impacts of climate change and of course competition for land and water."

> "This Industry Forum is reflective of the forward-looking nature of the agricultural sector, particularly here in WA."
>
> **The Hon Jackie Jarvis**

The Institute's Industry Advisory Board (IAB) members InterGrain Chief Executive Officer Tresslyn Walmsley and Belinda Eastough served as Master of Ceremonies and panel discussion facilitator, respectively.

For her presentation, farmer and UWA Centre for Agricultural Economics & Development Deputy Director Dr Fiona Dempster said her greatest advice to young researchers was to "Be curious and keep coming back".

Agricultural Education Director Sally Panizza outlined the Department of Education's strategic plan to provide every agricultural college student a pathway to a successful future.

Trevor Whittington presenting the keynote.

Georgia Pugh explored innovative new ag tech from her unique perspective as a neXtgen Agri consultant helping farmers adopt and navigate the sector.

CBH Group chief executive Ben Macnamara reminded the audience that there were "no quick wins in agriculture".

"We don't want any of those sugar hits – we're focused on sustainability to help WA grow currently and into the future," Mr Macnamara said.

Agronomist, project manager and RnD coordinator Nick Eyres concluded the afternoon on a philosophical note.

"The single biggest contribution we can have to our industry is the continual inspiration of passion within the next generation, and making sure the doors of infinite impossibilities remain open at all times," Mr Eyres said.

Watch the 2023 Industry Forum on The UWA Institute of Agriculture YouTube channel.

Emeritus Professor John Stewart Pate AM FRS FAA

A life well lived: Vale Emeritus Professor John Pate

Australian botany and agricultural science is all the poorer for Emeritus Professor John Pate's recent passing at age 91, but will certainly continue to benefit from his legacy for a long time to come.

Professor Pate arrived at UWA as Professor and Head of the Botany Department in 1970, already internationally recognised for his research on the carbon and nitrogen economy of legume plants.

On arrival in WA, he was fascinated by the incredibly diverse botanical flora in the south-west of WA and studied how they adapted to survive the challenging environment.

This led him to chase the roots of the local flora to determine whether they were taking water from their neighbours or transferring water from deep in the profile to near the surface to take up nutrients from otherwise dry soil.

His technicians and academic colleagues would always be reminded that his Northern Irish origins were the source of his ability to dig a hole faster than anyone else.

Several remembered him as a hard-driving, rather intense, and fiercely competitive intellectual.

Others recall a friendly and helpful scientist eager to share his knowledge and experience with colleagues and visitors.

He was an enthusiastic lecturer who inspired many students to pursue higher studies in botany and plant sciences.

UWA Senior Deputy Vice-Chancellor Professor Tim Colmer recalled the various specimens Professor Pate brought to lectures and discussions in laboratory classes.

> "I was fortunate to have experienced John's enthusiasm and great teaching style when I was an undergraduate student."
>
> **Professor Tim Colmer**

During Professor Pate's tenure, Professor Mark Adams said that it was commonplace to find global luminaries in the UWA glasshouses throughout the summer months – perhaps escaping European winters.

Adjunct Professor James Ridsdill-Smith remembered Professor Pate's competitive spirit in sport as well as science.

"At the annual Quaranup Music Camp, it really mattered that he was faster than younger people accompanying him on a morning run," Professor Ridsdill-Smith said.

Professor Pate was also a fine musician, playing the organ or piano in church in Perth and trombone in the local orchestra in Albany.

He published more than 500 peer-reviewed papers and reviews, was elected a Fellow of the Australian Academy of Science in 1980, and a Fellow of the Royal Society in the UK in 1985.

In 2001 he was awarded the Centenary Medal, an Honorary Doctorate of Science from UWA in 2005, and was inducted into the WA Premier's Science Hall of Fame in 2017.

Earlier this year, Professor Pate was appointed a Member of the Order of Australia (AM) for his significant service to botany and tertiary education.

On final retirement from UWA in 2000, Professor Pate moved to his farm and forest in Denmark and continued researching as an Emeritus Professor hosted by the CRC for Legumes in Mediterranean Agriculture.

He studied the local birds and was not above employing visiting colleagues to help him move large rocks blocking the forest paths so they could share the stillness of the mornings with him.

By Adjunct Professor Neil Turner
Contributions from Professor Tim Colmer, Professor Mark Adams, Adjunct Professor James Ridsdill-Smith, and Professor Pauline Grierson.

Dr Bede Mickan, Associate Professor Matthias Leopold, James O'Connor, Zahra Nizbat, Professor Nanthi Bolan and Babul Hossain at the UWA Shenton Park Field Station.

Waste product repurposed as innovative fertiliser

An innovative organic fertiliser product has yielded promising results from a recent field experiment at UWA Shenton Park Field Station.

Led by PhD candidate James O'Connor, the trial investigated the effectiveness of the new fertiliser on wheat plants.

Mr O'Connor said the 'high-value fertiliser product' was derived from a waste product from the anaerobic digestion of food waste.

"This transformation process involves the use of several acids, including sulfuric, nitric, and phosphoric," he explained.

"These acids are utilised to acidify the raw liquid digestate, leading to the formation of different inorganic salts, such as ammonium sulfate, ammonium nitrate, and monoammonium phosphate within the liquid digestate.

"After these changes, the now enhanced and stabilised liquid digestate undergoes dehydration to remove its water content."

Compared to raw liquid digestate, Mr O'Connor said the enhanced product offered increased fertiliser value due to the acid involved in donating its anion to the free ammonium.

"Furthermore, this innovation addresses a key challenge faced by the anaerobic digestion industry," he said.

"The substantial and diluted volumes of raw liquid digestate prove costly to manage and transport to agricultural land.

"Drying of unacidified raw liquid digestate to concentrate causes ammonia volatilisation, thereby leading to the loss of valuable nitrogen nutrient.

"Thus, this new process is a potential solution to enhance handling and reduce the transportation challenges associated with anaerobic digestion."

Supported by a great research team, Mr O'Connor said he aimed to achieve increased sustainability within the food waste and agricultural sectors.

"The most rewarding aspect on my project is the possibility that my research and its associated technology gets developed within industry," he said.

James O'Connor
james.oconnor@research.uwa.edu.au

Flying the flag for UWA study and research

There was strong UWA representation at the Ag Institute Australia WA Division Career's Night at the Royal Agricultural Society of WA earlier this year.

The informal annual event was an ideal opportunity for young people to speak with prospective industry employers and learn more about future study and research opportunities.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique and theme leaders Dr Amin Mugera and Associate Professor Dominique Blache were pleased to meet with dozens of high school, agricultural college, and university students.

Members of UWA Students of Natural and Agricultural Science (SNAGS) also hosted an information stall promoting the UWA student experience.

The Institute's Associate Director Wallace Cowling, UWA Emerita Professor Lyn Abbott and student Lee Hunt are members of the committee that organised the event.

UWA staff and students at the Career's Night.

Kyoto University Assistant Professor Satoshi Iwakami.

Cracking the genetic code of super weeds

Who controls the 'dimmer switch' when it comes to multiple herbicide resistance through enhanced metabolism?

Assistant Professor Satoshi Iwakami tackled this challenging question and more while delivering a seminar for The UWA Institute of Agriculture and the Australian Herbicide Resistance Initiative in September.

Dr Iwakami, who specialises in molecular weed science at Kyoto University's School of Agriculture, completed his post-doc at Bayer Crop Science in Germany.

His seminar, titled 'Cracking the genetic code of super weeds: How a paddy weed defeats selective herbicides in rice' was attended by more than 40 people.

Dr Iwakami's research team studied a rice paddy weed called *Echinochloa phyllopogon* to better understand the mechanism behind this broad-spectrum herbicide resistance.

They found that the resistance was caused by multiple P450s working together to detoxify many different kinds of herbicides.

Dr Iwakami explained the details of this mechanism, how it is consistent across different weed populations, and the development of stable transformation system in this weed for further study.

It was a busy visit to Perth for Dr Iwakami, who also attended the Weeds Genomics Workshop (organised by Colorado State University Dr Todd Gaines, currently on sabbatical at AHRI) following the International Plant and Animal Genome Conference.

Rice paddy weed *Echinochloa phyllopogon*.

Graduates relish return three decades on

A 30-year reunion tour of the UWA Crawley campus was filled with fond memories, meaningful reconnections, and plenty of laughter for a group of 1993 Bachelor of Agricultural Science graduates.

The informal tour was led by UWA Emerita Professor Lyn Abbott and Emeritus Professor Graeme Martin, with Emeritus Professor David Lindsay joining later in the afternoon.

Diana Fisher, now the Manager of Native Forest Transition at South Regional TAFE, said the professors were "living legends" who helped forge their professional pathways.

"With many years between visits, I loved the rich sharing of career and life experiences," Ms Fisher said.

The UWA Bachelor of Agricultural Science graduating class of 1993 outside the former Institute of Agriculture entrance.

Postgraduate journey through plant genetics

Gardening in his backyard and an interest in aquascaping during his adolescence blossomed into pursuing a career in plant genetics and genomics for UWA PhD candidate Sina Nouraei.

Growing up in Iran, which has an arid and semi-arid climate, Mr Nouraei learned about many environmental challenges that negatively affect agricultural production and threaten food security.

"This further encouraged me to study plant genetics and genomics at university, with the aim of contributing to the development of genetically enhanced, stress-tolerant plant varieties," he shared.

Given that bread wheat is a staple food in diets around the world, Mr Nouraei said he felt compelled to ease global warming's harmful effects on wheat production.

His postgraduate project, supervised by Professor Guijun Yan, Dr Hui Liu, Adjunct Professor Neil Turner and Dr Md Sultan Mia, is focused on the genetic study of drought tolerance in bread wheat.

"Genes play a key role in drought tolerance, as they control the expression of critical proteins and regulatory pathways that enable plants to adapt, conserve water, and withstand the adverse effects of water scarcity," he said.

> "The identification of drought-tolerant genes and pathways can pave the way for integrating these genetic elements into breeding programs, ultimately leading to the development of drought-tolerant wheat varieties with reliable yields in water-scarce regions."

Sina Nouraei in the lab, where he says theories meet experiments, and 'the magic' happens.

As part of his PhD, Mr Nouraei has conducted three experiments that analysed the genetic of drought tolerance in wheat.

Two of the studies integrated RNA (transcriptomics) and protein (proteomics) analyses to gain a deeper understanding of how an important drought tolerance locus (*qDSI.4B.1*) on the short arm of chromosome 4B contributes to drought tolerance.

Another study employed association mapping to identify the genetic elements that control key drought tolerance-related traits at the seedling stage.

As he nears the completion of his PhD, Mr Nouraei said he hoped that his work would contribute, even in a small way, to enhancing sustainability and reducing poverty.

"Breeding is a time-consuming process, and it is important that we prepare ourselves for the future," he said.

"By proactively investing in research and development today, we can contribute to the creation of a more sustainable food system for the future."

Sina Nouraei
sina.nouraei@research.uwa.edu.au

Monitoring wheat's physiological status in the UWA glasshouse facility.

Forum participants from UWA and Chinese universities.

Workshop bridges borders

The UWA Plant Biology Forum enhanced knowledge exchange and fostered further collaborations with esteemed visiting academics from China in May.

Current visiting professors, research fellows and PhD students were hosted by The UWA Institute of Agriculture, the UWA School of Agriculture and Environment, and School of Biological Sciences to share their knowledge and research achievements.

Visiting academics from seven Chinese universities presented talks on a wide range of topics, including land/soil management, crop production, agronomy and physiology, root-soil-microbe interactions, and phenotyping and genotyping.

Professor Min Yu from Foshan University shared her research career pathway, which was inspirational for young researchers, and discussed future research directions.

As Director of the International Research Center for Environmental Membrane Biology, Professor Yu has established strong international collaborations, including with UWA.

Beijing Forestry University Associate Professor Yuehui Chao explored his research in grassland plant genetic resources and molecular improvements adapting to environmental stress.

Having obtained her bachelor, Master and PhD degrees from Northwest Agriculture and Forestry University, Associate Professor Ping Li has become a core member in developing drought-resistant and water-saving cultivation technologies in rice at Huazhong Agricultural University.

Associate Professor Jin He of Guizhou University presented his research on root traits and yield performance in soybean under abiotic stress.

UWA Future Fellow Associate Professor Yinglong Chen said the workshop provided a valuable platform for knowledge exchanges, cooperation, and friendships with visiting academics.

"It was also a good opportunity to showcase UWA research in the area and explore further collaborations," Dr Chen said.

Associate Professor Yinglong Chen
yinglong.chen@uwa.edu.au

New rice cultivars required to combat climate change crop loss

Professor Madan Pal Singh delivering his lecture.

The growth and productivity of agricultural crops are impacted by global climate change mediating rising atmospheric carbon dioxide (CO_2) and air temperature, according to The UWA Institute of Agriculture Adjunct Professor Madan Pal Singh.

Professor Singh, an Emeritus Scientist (Plant Physiology) at the Indian Council of Agricultural Research (ICAR) within Indian Agricultural Research Institute (IARI), explored his research into phenotyping of rice for high temperature and CO_2 environment at UWA lecture in September.

He told the audience that high CO_2 had been expected to increase crop yields through increased photosynthesis, however, a concurrent rise in temperature could mitigate these beneficial effects.

> "To perform better and reduce crop losses during future climate change, rice cultivars with high CO_2 response under high temperature stress should be developed."

To phenotype rice accessions for spikelet fertility, grain yield, membrane stability, and chlorophyll fluorescence, Professor Sigh and his research team exposed a diverse set of rice accessions to high temperature stress (HT) at the flowering stage.

He also outlined the results of a second study, which demonstrated that the effect of eCO_2 on rice crop development and yield may be offset by a concomitant rise in air temperature.

Watch this lecture on The UWA Institute of Agriculture YouTube channel.

Back to beginnings for Biddulph at Postgraduate Showcase

Delivering the opening address at The UWA Institute of Agriculture's 17th annual Postgraduate Showcase was the perfect full-circle moment for Department of Primary Industries and Regional Development (DPIRD) Chief Scientist Dr Ben Biddulph.

Dr Biddulph attended the event 15 years previously – not as an audience member – but as a student presenter himself.

To date, 129 early-career researchers have presented their achievements in agriculture and related areas at the Postgraduate Showcase.

Dr Ben Biddulph presenting the welcome address.

In addition to Dr Biddulph, notable former presenters include the UWA Centre for Agricultural Economics and Development Deputy Director Dr Fiona Dempster, West Midlands Group executive officer Dr Nathan Craig, and InterGrain Business and Research Development Manager Dr Dini Ganesalingam.

In his speech to the 100-strong audience, Dr Biddulph said he was enthusiastic about hearing from the next generation of agricultural researchers.

> "It is critical for our sector to get better engaged with universities and the academic systems to make sure we are working on solving industry problems and challenges going forward."
>
> **Dr Ben Biddulph**

Seven outstanding postgraduate students from across three schools were hand-picked to present their research achievements, and each were coached by Emeritus Professor Graeme Martin.

The two sessions were chaired by the Head of the UWA School of Agriculture and Environment Associate Professor Matthias Leopold and UWA Business School Professor Sharon Purchase.

The topics included Marcela Del Carmen Vieira tracing the economic impact of dung beetles in Australia, Junrey Amas identifying disease resistance in canola, Mukesh Choudhary and Samalka Wijeweera investigating how to enhance heat stress and salt (respectively) tolerance in wheat, and Sylvester Obeng-Darko finding factors that influence dihydroxyacetone in honey.

PhD candidate Bablu Hira Mandal, who explored the role of fulvic acid in alleviating glyphosate damage to crops, said his Postgraduate Showcase experience was both "exciting and inspiring".

"I was thankful to meet new people and discuss current and future research, and possible employment opportunities," Mr Mandal said.

Animal scientist Doraid Alkhishaybi said he was grateful for the opportunity to share his research findings on the effect of heat stress on the sperm quality in Merino rams.

"I really valued the chance to meet other PhD candidates and hear about their multidisciplinary and cutting-edge research," Mr Alkhishaybi said.

"The showcase also allowed me to present my research to a diverse audience, ranging from farmers to scientists, non-profit organisations, and government agencies."

Watch the 2023 Postgraduate Showcase on The UWA Institute of Agriculture YouTube channel.

2023 Postgraduate Showcase student presenters with Hackett Professor Kadambot Siddique, Emeritus Professor Graeme Martin, Dr Ben Biddulph and Professor Sharon Purchase.

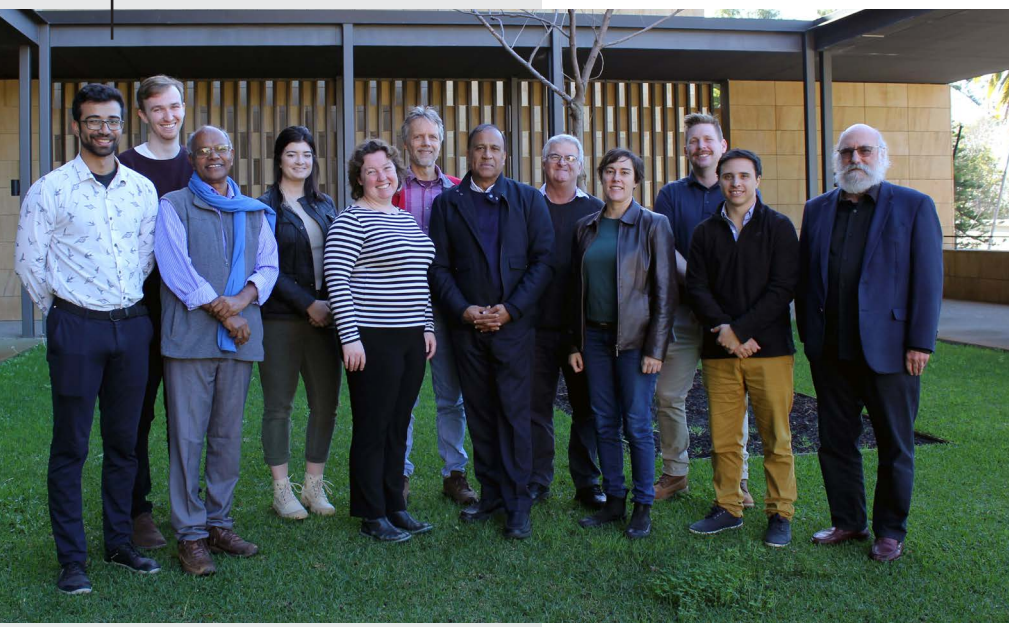
Utilising new sensing and sampling tech at Ridgefield

The exciting capabilities of new infrastructure and technology available at UWA Farm Ridgefield was the focus of a recent workshop led by Associate Professor Sally Thompson.

Jointly hosted by The UWA Institute of Agriculture and the Centre for Water and Spatial Science, the event explored sensing and sampling capabilities for soil, water and gases at Ridgefield as part of the Critical Zone Observatory (CZO) Network across Australia.

The CZO includes the OzFlux and TERN External link Ecosystem Processes monitoring, recently-installed Sensoil Vadose-zone Monitoring System and more.

The half-day workshop included short presentations from lead researchers, and concluded with small group discussions that explored opportunities for future research, collaborations and ideas.



Associate Professor Sally Thompson and Hackett Professor Kadambot Siddique (front) with UWA staff and students at Forrest Hall.

UWA Emeritus Professor Rana Munns and Professor Harvey Millar in a UWA glasshouse.

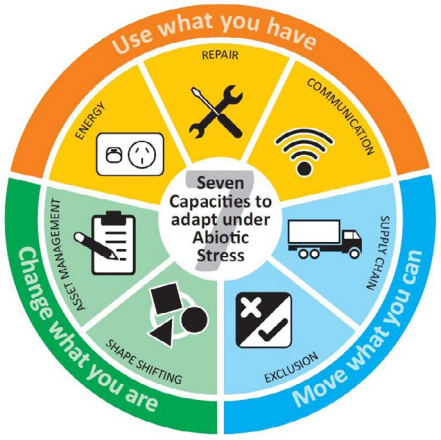
New approach needed in a warming world

The time has come to explore a different way of thinking about the impact of abiotic stress on crops.

UWA Emeritus Professor Rana Munns and Professor Harvey Millar from the School of Molecular Sciences recently teamed up to write a Darwin Review for the *Centenary Issue of Journal of Experimental Botany* outlining seven plant capacities to adapt to abiotic stress.

Professor Millar said their review took a helicopter view of the field of abiotic stress in plants, acknowledging that these would increasingly continue to impact crop production in a warming world.

"Therefore, new concerted efforts to organise plant adaptation research is needed," he said.



A key graphic from the review paper.

The paper distinguishes between stress as an external force and the strain that plants undergo in response.

The authors reduced the success of this strain down to seven inherent capacities that enable plants to respond to abiotic stresses and continue growing, although at a reduced rate, to achieve a productive yield.

Professor Millar said the review used examples to show how all seven plant capacities were important for reproductive success of major crop species during drought, salinity, temperature extremes, flooding, and nutrient stress.

"We hope in the future this approach could focus worldwide strategies that enhance plant adaptation by identifying key responses that can be targets for plant breeding," he said.

Professor Harvey Millar
harvey.millar@uwa.edu.au

Brace for worsening epidemic of wheat streak mosaic disease

Wheat streak mosaic disease (WSMD) outbreaks around the world will increase due to global warming, according to The UWA Institute of Agriculture Adjunct Professor of Plant Virology Roger Jones.

WSMD foliage symptoms are plant dwarfing and yellow leaf streaking, and its seed symptom is small, shriveled grain.

When WSMD infection starts early in a wheat crop's life and then becomes widespread, seed yield losses can exceed 80 per cent – significantly impacting food security.

The disease now occurs in most continents including all major grain growing regions of Australia, with the most damage occurring in NSW and WA.

WSMD has three causal agents; wheat streak mosaic virus (WSMV), High Plains wheat mosaic virus (HPWMoV) and Triticum mosaic virus (TriMV) – all transmitted by the tiny wheat curl mite (WCM).

These viruses often occur together in mixed infection within the same WSMD-affected plant, which enhances the resulting seed yield losses.

"While WSMV and HPWMoV arrived in Australia about 20 years ago, TriMV has yet to be found here, but seems likely to arrive soon," Professor Jones said.

"Because WCM populations increase very rapidly under warm growing conditions, global warming is projected to increase WSMV and HPWMoV spread."

Two recent research publications by Professor Jones and his collaborators at the Australian National University in Canberra and FERA Science Ltd in the UK trace the origins of WSMV and HPWMoV.

The researchers suggest that that they likely both originated in the Middle East, and later were spread inadvertently to other continents via contaminated seed.

Professor Jones said the principal primary source of virus infection for new wheat crops was volunteer wheat plants growing from virus-infected seed.

"WCM then spreads WSMV and HPWMoV from these virus-infected plants to infect other plants within the crop," he said.

"Currently, thorough volunteer wheat control well before sowing wheat seed provides effective control for later sown crops.

"In the future, this control measure will be less effective due to the increasing trend to sow crops early (when the climate is warmer), combined with rapid WCM population growth due to rising temperatures from global warming."

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

Foliage with yellow streaky mosaic in leaves of a wheat plant at Esperance, WA.

UWA Associate Professor Yinglong Chen with Professor Min Yu.

Deciphering plant adaptation to acid soil

The mystery of root growth by fine-tune of plant auxin transport for adaptation to acid soil was solved in findings recently published in *The Plant Journal*.

The study was led by UWA visiting Professor Min Yu and her team at Foshan University, China, in collaboration with UWA professors Yinglong Chen and Sergey Shabala, and researchers from Huazhong Agricultural University, Chinese Academy of Sciences, University of Bonn, and Slovak Academy of Sciences.

The research showed that boron (B) deprivation enhanced auxin biosynthesis in shoots by elevating the expression levels of auxin biosynthesis-related genes.

Nearly half of the global land is acidic, which is the major restriction for plant growth and crop productivity, thus a potentially serious threat to world food security.

"This study advances our understanding of the role of B supply in ameliorating aluminum (Al) toxicity in acid soil," Associate Professor Chen said.

"It provides guidance in agricultural practice for balanced fertilisation in combating with toxic ions (such as Al) in acid soil, and for better crop productivity."

Professor Min Yu
yumin@fosu.edu.cn

Small but significant: The rising importance of microbial resources

Microbiology is one of the most important disciplines feeding into the United Nations' Sustainable Development Goals, according to Associate Professor İpek Kurtböke from the University of the Sunshine Coast.

During her special lecture hosted by The UWA Institute of Agriculture in July, Associate Professor Kurtböke explained that the preservation of microbiological cultures had far-reaching scientific, industrial, agricultural, environmental, and medical purposes.

"There are microbial bioindicators that are telling us, all the time, about the dangers and effects of pollution, climate change and global warming," she said.

"For example, in Chernobyl, there are lichens that have absorbed radioactive cesium tissue and the reindeer feeding on them had to be culled."

Associate Professor Kurtböke emphasised the importance of microbial culture collections and their sustainable use for biotechnology.

"Cultures are commonly collected in a medical, industrial and biotechnological context – such as algae for biofuel production," she said.

"An area that is becoming increasingly important is in a food industry context. Nestlé, for example, has one of the most impressive culture collectors in the world."

More than 3000 food grade strains are integrated into the Nestlé network, which helps them develop and produce a large range of functional foods containing beneficial microbes.

Associate Professor Kurtböke is a graduate of Middle East Technical University in Turkey and has worked in the field of Biodiscovery for more than four decades.

Associate Professor İpek Kurtböke with Professor Cowling outside the UWA Agriculture Lecture Theatre.

Following her post-doctoral research at The University of Western Australia, South Perth Department of Agriculture and Murdoch University, Associate Professor Kurtböke was one of the key scientists who established Australia's largest bioresource library at the former AMRAD Discovery Technologies.

The Africa Forum was attended by delegates from African and Australian member universities.

Director drives collaboration at Africa Forum

The Australia-Africa Universities Network (AAUN) held its Africa Forum at the University of Pretoria's (UP) Future Africa Institute under the theme 'Collaborations and Partnerships for Impact' in June.

Established in 2012, the AAUN is a bilateral network of 13 African universities and 10 Australian universities, including UWA.

It focuses on the engagement of Australian universities in sub-Saharan Africa to enable the provision of specific expertise across areas of priority for Australia and Africa.

During the one-day event, The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique delivered a lead presentation on 'Integrating multidisciplinary research'.

"Collaboration leads to improved science, increased community impact and the identification of research complementarities," Professor Siddique told the audience.

"Partnerships should embrace flexibility by using transparent communication and regular consultation – students must play a central role in all of this."

Forum discussions were held on the critical role of emerging partnership arrangements such as the AAUN in addressing increasingly complex global issues, including climate change, food insecurity, technological changes, and the widening gap between rich and poor.

Professor Batley lands Laureate Fellowship

Professor Jacqueline Batley.

Prominent canola genomics researcher UWA Professor Jacqueline Batley is 'taking a walk on the wild side' as part of her 2023 Australian Laureate Fellowship.

Professor Batley, who heads the School of Biological Sciences' Batley Lab and co-leads The UWA Institute of Agriculture Sustainable Cropping Systems research theme, was recently awarded $3.3 million for her five-year project titled 'A walk on the wild side: understanding disease resistance across plants'.

The study will identify and characterise disease resistance genes across the entire plant kingdom and study their evolution and how they affect disease resistance.

"We will use this information to design and breed disease resistant plants and increase crop yields, with the results translated for industry through the identification of new resistance genes for major Brassica diseases," Professor Batley said.

"The ultimate goal is to ensure that there is enough food to feed the growing population and that we have an armoury of resistance genes that can be deployed as new diseases emerge."

UWA Deputy Vice-Chancellor (Research) Professor Anna Nowak congratulated UWA's new Australian Research Council Laureate Fellow on the well-deserved recognition.

"We eagerly anticipate the invaluable insights and advancements that will arise from her ground-breaking research endeavour," Professor Nowak said.

Home-cooked meals off the table in post-reform China

With urbanisation and higher disposable income, demand for food-away-from-home in China has greatly increased, according to University of Alberta Professor Varghese Manaloor.

Professor Varghese Manaloor (third from left), Hackett Professor Kadambot Siddique, members of the UWA Global Engagement Office, and Dr Amin Mugera.

Professor Manaloor, who is the John P. Tandberg Chair in Economics, delivered a special lecture for The UWA Institute of Agriculture earlier this year.

His talk referenced yet-to-be-published research he conducted in collaboration with student Ruotong Zhang and research intern Youhan Lu.

Professor Manaloor said China's economy had grown significantly over the past four decades, with per capita booming since liberalisation.

"Liberalisation policies that started in the late 1980s resulted in higher income and improvement in living standards," he said.

The most significant change regarding household consumption patterns in the post-reform period, Professor Manaloor explained, was an increase in the demand of food-away from home in restaurants and eateries.

"The demands on time and work life balance, and migration from rural to urban areas resulted in a change in the consumption basket," he said.

"Notably, these changes occurred among households with higher disposable income."

Awards and industry recognition

Name	Award
H/Prof Kadambot Siddique	2023 Scientist of the Year – WA Premier's Science Awards
Prof David Pannell	2023 Fellow of the Agricultural and Applied Economics Association
Prof Jacqueline Batley	2023 Australian Laureate Fellowship
Dr Kelsey Pool	FameLab Australia 2023 Finalist
Sneha Papula Reddy	Best Poster Award – ICRISAT International Conference on Innovations to Transform Drylands

Visitors to IOA

Name of visitor	Visitor's organisation and country	Host details	Dates of visit
Prof Varghese Manaloor	University of Alberta, Canada	H/Prof Kadambot Siddique	April 2023
A/Prof Yuehui Chao	Beijing Forestry University, China	Associate Professor Yinglong Chen	August 2022 – August 2023
Milad Mousavi	Ferdowsi University of Mashhad, Iran	Associate Professor Yinglong Chen	August 2023 – March 2024
Prof Min Yu	Foshan University, China	Associate Professor Yinglong Chen	Dec 2022 – Dec 2023
A/Prof Ping Li	Huazhong Agricultural University, China	Prof Kadambot Siddique Associate Professor Yinglong Chen	Dec 2022 – Dec 2023
A/Prof İpek Kurtböke	University of the Sunshine Coast, Australia	A/Prof Wallace Cowling	July 2023
Xunzhe Yang	Sichuan Agricultural University, China	Dr Yinglong Chen	July 2023 – July 2024
Prof Feijian Zhong Prof Junqu Yu Prof Xin Chen A/Prof Jianhong Lu Dr Xinmei Yu	Foshan University, China	Dr Yinglong Chen Dr Qin Yu A/Prof Matthias Leopold H/Prof Kadambot Siddique Prof Nanthi Bolan	June 2023
Shuo Liu	Northwest Agriculture and Forestry University, China	Prof Sergey Shabala, Associate Professor Yinglong Chen	May 2023 – October 2024
Chief Scientist Dr Ben Biddulph	DPIRD	H/Prof Kadambot Siddique	June 2023
Agriculture Minister The Hon Jackie Jarvis	WA Government	H/Prof Kadambot Siddique	July 2023
Vice Chancellor Professor Barnabas Nawangwe	Makerere University, Uganda	UWA VC Prof Amit Chakma	September 2023
Prof Madan Pal Singh	Indian Agricultural Research Institute (IARI) Indian Council of Agricultural Research (ICAR)	H/Prof Kadambot Siddique	September 2023
Prof Paul Kenyon	Massey University, New Zealand	H/Prof Kadambot Siddique	September 2023
Tingting An	Northwest Agriculture and Forestry University, China	Dr Bede Mickan Prof Megan Ryan Associate Professor Yinglong Chen	September 2023 – October 2024
Prof Hongju Sun	Inner Mongolia University, China	Prof Sergey Shabala Associate Professor Yinglong Chen	September 2023 – September 2024
Tahira Rasheed	University of Agriculture, Faisalabad	H/Prof Kadambot Siddique	August 2023 – April 2024
Medea Perkons	Hochschule Neubrandenburg University of Applied Science, Germany	E/Prof Lynette Abbott	October 2023 – April 2024
Quentin Huentz	Élève-ingénieur en Agronomie, France	A/Prof Dominique Blache	August - November 2023
Augustin Dusannier	Élève-ingénieur en Agronomie, France	Dr Jiayin Pang	August - November 2023
Gabriel Crepin	Élève-ingénieur en Agronomie, France	Dr Jiayin Pang	August - November 2023
Dr Weina Zhang	Huanghuai University, China	Dr Jiayin Pang E/Prof Hans Lambers	July 2023 – July 2025
Mithraa Thirumalai	Indian Agricultural Research Institute, India	H/Prof Kadambot Siddique	October 2023 – December 2024

New postgraduate research students (PhD)

Student name	Topic	School	Supervisors	Funding body
Md Hosenuzzaman	Alleviating glyphosate damage to crops with fulvic acid and manganese	UWA School of Agriculture and Environment	Dr Sasha Jenkins E/Prof Lynette Abbott	Australian Award Scholarship

Research grants

Title	Funding period	Funding body	Investigators
Between a hot place & hypoxia: Quantifying fish-kill risk in inland rivers	2023-2026	ARC Linkage Project	A/Prof Matthew Hipsey Dr Adrian Gleiss Prof David Hamilton Prof Craig Franklin Dr Jonathan Marshall Andrea Prior
Expanding phenological diversity in narrow-leafed lupin using novel flowering time genes (RFT)	2023 – 2025	GRDC	Prof Wallace Cowling
WAARC Key Personnel Funding	2023 – 2026	DPIRD	H/Prof Kadambot Siddique
Recharge in a changing climate	2023 – 2026	Department of Water and Environmental Regulation (WA)	Dr Sarah Bourke Dr Jim McCallum A/Prof Matthias Leopold A/Prof Sally Thompson
Effective control of Blackleg of Canola	2023 – 2028	GRDC	Prof Jacqueline Batley Prof Dave Edwards Dr Angela van de Wouw A/Prof Alexander Idnurm
Investigate genetic strategies to reduce virus spread through aphid vectors	2023 – 2027	GRDC	Prof Jacqueline Batley Prof Dave Edwards
Increasing intrinsic heat tolerance of wheat through improved genetics	2023 - 2026	GRDC	Dr Nic Taylor Prof Harvey Millar
The potential of biomineral fertilisers to increase soil carbon sequestration	2023 – 2025	Pedaga Investments	Dr Pete Hutton Daniel Hester
Intensification of northern cattle production in WA enabled by feed products from irrigated cropping	2023 – 2026	CRC for Developing Northern Australia	Prof Phil Vercoe A/Prof Dominique Blache Prof Shane Maloney
National Soil Carbon Innovation Challenge – Development and Demonstration round 1	2023 – 2025	Department of Climate Change, Energy, the Environment and Water (Australia)	Dr Joanne Wisdom Prof Megan Ryan
Managing soil carbon to increase soil productivity	2023 – 2026	CRC Soils	Prof Nanthi Bolan
Unlocking new genetic systems for hybrid breeding in wheat	2023	UWA	Dr Joanna Melonek Prof Ian Small
UWA/DPIRD Joint Position in Agriculture	2024 – 2028	DPIRD	Prof Phil Vercoe
MERiL 2: Agolin as AM Additive	2023	Department of Industry, Science and Resources	Dr Zoey Durmic Stephanie Payne
Using genomics to study bacterial pathogen ecology and evolution in animals	2023 – 2026	ARC Discovery Early Career Researcher Award	Dr Daniel Knight
A walk on the wild side: understanding disease resistance across plants	2023 – 2028	Australian Laureate Fellowship	Prof Jacqueline Batley

UWA IOA 2023 Publications

Peer Reviewed Journals

Previously unreported

Baskerville B, Mazzarol T and van Aurich A (2022). Albany Co-operative Society - The Great Cockalorum, CEMI-CERU Case Study Research Report, CSR 2202. Centre for Entrepreneurial Management and Innovation/Co-operative Enterprise Research Unit *www.ceru.com.au*

Neto S and Camkin J (2023). Another big year in the water world. *World Water Policy Journal* **9** doi: 10.1002/wwp2.12095

Zahra N, Hafeez MB, Kausar A, Zeidi MA, Asekova S, Siddique KHM and Farooq M (2023). Plant photosynthetic responses under drought stress: Effects and management. *Journal of Agronomy and Crop Science* **209** doi: 10.1111/jac.12652

May to September 2023

Aggarwal SK, Hooda KS, Kaur H, Gogoi R, Chauhan P, Bagaria PK, Kumar P, Choudhary M, Tiwari RK and Lal MK (2023). Comparative evaluation of management modules against Maydis leaf blight disease in maize *Zea mays*. *European Journal of Plant Pathology* doi: 10.1007/s10658-023-02777

Al-Awad OAS, Prendergast KS, Robson A and Rengel Z (2023). Screening Canola Genotypes for Resistance to Ammonium Toxicity. *Agronomy-Basel* **13**(4) doi: 10.3390/agronomy13041150

An R, Yu R, Xing Y, Zhang J, Bao X, Lambers H and Li L (2023). Enhanced phosphorus-fertilizer-use efficiency and sustainable phosphorus management with intercropping. *Agronomy for Sustainable Development* **43**(5) doi: 10.1007/s13593-023-00916-6

Ayesha S, Abideen Z, Haider G, Zulfiqar F, EL-Keblawy A, Rasheed A, Siddique KHM, Khan MB and Radicetti E (2023). Enhancing sustainable plant production and food security: Understanding the mechanisms and impacts of electromagnetic fields. *Plant Stress* **9** doi: 10.1016/j.stress.2023100198

Barrow N, Debnath A and Sen A (2023). Investigating the dissolution of soil phosphate. *Plant and Soil* doi: 10.1007/s11104-023-06102-7

Barwal SK, Gautam C, Chauhan C, Vimala Y, Alyemeni MN, Ahamad P and Siddique KHM (2023). Salicylic acid alleviates salt-induced phytotoxicity by modulating physiochemical attributes upregulating the AsA-GSH cycle and glyoxalase system in *Capsicum annum* L. seedlings. *South African Journal of Botany* **161** doi: 10.1016/j.sajb.203.07.061

Berais-Rubio A, Morel Revetria MA, Gimenez M, Signorelli S and Monza J (2023). Competitiveness and symbiotic efficiency in alfalfa of *Rhizobium favelukesii* ORY1 strain in which homologous genes of peptidases HrrP and SapA that negatively affect symbiosis were identified. *Frontiers in Agronomy* **4** doi: 10.3389/fagro.2022.1092169

Bhat JA, Feng X, Mir ZA, Raina A and Siddique KHM (2023). Recent advances in artificial intelligence, mechanistic models, and speed breeding offer exciting opportunities for precise and accelerated genomics-assisted breeding. *Physiologia Plantarum* **175** doi: 10.111/ppl.13969

Bhattarai R, Liu H, Siddique KHM and Yan G (2023). Transcriptomic profiling of near-isogenic lines reveals candidate genes for a significant locus conferring metribuzin resistance in wheat. *BMC Plant Biology* **23** doi: 10.1186/s12870-023-04166-2

Bird T, Nestor BJ, Bayer PE, Wang G, Ilyasova A, Gille CE, Soraru BE, Ranathunge K, Severn-Ellis AA, Jost R, Scheible W, Dassanayake M, Batley J, Edwards D, Lambers H and Finnegan PM (2023). Delayed leaf greening involves a major shift in the expression of cytosolic and mitochondrial ribosomes to plastid ribosomes in the highly phosphorus-use-efficient *Hakea prostrata* (*Proteaceae*). *Plant and Soil* doi: 10.1007/s11104-023-06275-1

Bolan N, Srivastava P, Rao CS, Satyanarya PV, Anderson GC, Bolan S, Nortje GP, Kronemberg R, Bardhan S, Abbott LK, Zaho H, Mehra P, Satyanarayana SV, Khan N, Wang H, Rinklebe J, Siddique KHM and Kirkham MB (2023). Distribution, characteristics and management of calcareous soils. *Advances in Agronomy* **182** doi: 10.1016/bs.sgron.2023.06.002

Bolan S, Hou D, Wang L, Hale L, Egamberdieva D, Tammeorg P, Li R, Wang B, Xu J, Wang T, Sun H, Padhye LP, Wang H, Siddique KHM, Rinklebe J, Kirkham MB and Bolan N (2023). The potential of biochar as a microbial carrier for agricultural and environmental applications. *Science of the Total Environment* **886** doi: 10.1016/j.scitotenv.2023.163968

Bolan S, Wijesekara H, Amarasiri D, Zhang T, Ragályi P, Brdar-Jokanović M, Rékási M, Lin JY, Padhye LP, Zhao H, Wang L, Rinklebe J, Wang H, Siddique KHM, Kirkham MG and Bolan N (2023). Boron contamination and its risk management in terrestrial and aquatic environmental settings. *Science of The Total Environment* **894** doi: 10.1016/j.scitotenv.2023.164744

Camkin J, Ojha H, Bhattarai B and Gurung P (2023). Elevating River Basin Governance and Cooperation in the HKH Region: Yarlung Tsangpo-Siang-Brahmaputra-Jamuna Basin Summary Report. *Australian Water Partnership*

Cao J, Gao X, Hu Q, Li C, Song X, Cai Y, Siddique KHM and Zhao X. (2023). Distribution characteristics and correlation on macro- and microplastics under long-term plastic mulching in northwest China. *Soil and Tillage* **231** doi: 10.1016/j.still.2023.105738

Cao J, Li C, Gao X, Cai Y, Song X, Siddique KHM and Zhao X (2023). Agricultural soil plastic as a hidden carbon source stimulates microbial activity and increases carbon dioxide emissions. *Resources, Conservation & Recycling* **198** doi: 10.1016/j.resconrec.2023.107151

Castro-Urrea FA, Urricariet MP, Stefanova KT, Li L, Moss WM, Guzzomi AL, Sass O, Siddique KHM and Cowling WA (2023). Accuracy of solution in early generation of field pea breeding increased by exploring the information contained in correlated traits. *Plants* **12** doi: 10.3390/plants12051141

Chai Y, Pannell DJ and Pardey PG (2023). Nudging farmers to reduce water pollution from nitrogen fertilizer. *Food Policy* **120** doi: 10.1016/j.foodpol.2023.102525

Chen G, Wu Q, Wang Y, Zhao Y, Yu H, Lu Y, Feng H, Li M and Siddique KHM (2023). Deep soil water use of old-aged vegetation (17- to 36-year stand age) after the formation of dried soil layers based on *in situ* monitoring. *Journal of Hydrology: Regional Studies* **48** doi: 10.1016/j.ejrh.2023.101446

Cheng Y, Zhang T, Hu X, Liu Z, Liang Q, Yan S, Feng H and Siddique KHM (2023). Drip fertigation triggered by soil matric potential reduces residual soil nitrate content and improves maize nitrogen uptake and yield stability in an arid area. *European Journal of Agronomy* **150** doi: 10.1016/j.eja.2023.126932

Chiyaneh SF, Rezaei-Chiyaneh E, Amirnia R, Afshar RK and Siddique KHM (2023). Intercropping medicinal plants is a new idea for forage production: A case study with ajowan and fenugreek. *Food and Energy Security* doi: 10.1002/fes3.501

Ellouzi H, Zorrig W, Amraoui S, Oueslati S, Abdelly C, Rabhi, M, Siddique KHM and Hessini K (2023). Seed Priming with Salicylic Acid Alleviates Salt Stress Toxicity in Barley by Suppressing ROS Accumulation and Improving Antioxidant Defense Systems, Compared to Halo- and Gibberellin Priming. *Antioxidants* **12** 1779 doi: 10.3390/antiox12091779

Feng T, Zhu Y, Chai N, Zhang X, Du, Y, Turner NC, Du P and Li F (2023). Increased grain yield in modern genotypes of spring wheat for dryland cultivation in northwest China is associated with the decreased allocation of carbon to roots. *Field Crops Research* **303** doi: 10.1016/j.fcr.2023.109114

Gebbels JN, Kragt, ME and Vercoe P (2023). Twinning in cattle: a pathway for reducing the methane intensity of beef. *Animal Production Science* doi: 11/05/23

Ghauri S, Mazzarol T and Soutar GN (2023). Networking benefits for SME members of co-operatives. *Journal of Co-operative Organization and Management* **11**(2) doi: 100213

Guo H, Sun L, Yao A, Chen Z, Feng H, Wu S and Siddique KHM (2023). Abandoned terrace recognition based on deep learning and change detection on the Loess Plateau in China. *Land Degradation & Developments* **34**: 2349-2365 doi: 10.1002/ldr.4612

Gupta M, Choudhary M, Singh A, Sheoran S, Singla D and Rakshit S (2023). Meta-QTL analysis for mining of candidate genes and constitutive gene network development for fungal disease resistance in maize (*Zea mays L.*). *Crop Journal* **11**(2) 511–522 doi: 10.1016/j.cj.2022.07.020

Hu Y, Li D, Wu Y, Liu S, Li L, Chen W, Wu S, Meng Q, Feng H and Siddique KHM (2023). Mitigating greenhouse gas emissions by replacing inorganic fertilizer with organic fertilizer in wheat-maize rotation systems in China. *Journal of Environmental Management* **344** doi: 10.1016/j.jemvman.2023.118494

Ijaz M, Khan F, Ahmed T, Noman M, Zulfiqar F, Rizwan M, Chen J, Siddique KHM and Li B (2023). Nanobiotechnology to advance stress reliance in plants: Current opportunities and challenges. *Materials Today Bio* **22** doi: 10.1016/j.mtbio.2023.100759

Islam MM, Rengel Z, Storer P, Siddique KHM and Solaiman Z (2023). Phosphorus fertilization differentially influences growth, morpho-physiological adaptations and nutrient uptake of industrial hemp (*Cannabis sativa* L.). *Plant and Soil* doi: 10.1007/s11104-023-06171-8

Jalil S, Alghamem SMS, Al-Huqail AA, Nazir MM, Zulfiqar F, Ahmed T, Ali S, Abeed AHA, Siddique KHM and Jin X (2023). Zinc oxide nanoparticles mitigated the arsenic induced oxidative stress through modulation of physio-biochemical aspects and nutritional ions homeostasis in rice (*Oryza sativa* L.). *Chemosphere* **338** doi: 10.1016/j.chemosphere.2023.139566

Jha UC, Nayyar H, Chattopadhyay A, Beena R, Lone AA, Naik YD, Thudi M, Prasad PVV, Gupta S, Dixit GP and Siddique KHM (2023). Major viral diseases in grain legumes: designating disease resistant legumes from plant breeding and OMICS integration. *Frontiers in Plant Science* **14** doi: 10.3389/fpls.2023.1183505

Jimenez JC and Pedersen O (2023). Mitigation of Greenhouse Gas Emissions from Rice via Manipulation of Key Root Traits. *Rice* **16**(1) doi: 10.1186/s12284-023-00638-z

Katche EI, Schierholt A, Becker HC, Batley J and Mason AS (2023). Fertility, genome stability, and homozygosity in a diverse set of resynthesized rapeseed lines. *Crop Journal* **11**(2) 468–477 doi: 10.1016/j.cj.2022.07.022

Keesstra SD, Veraart J, Verhagen J, Visser SM, Kragt ME, Linderhof V, Appelman WAJ, van den Bert J, Deolu-ajayi A and Groot A. (2023) Nature-based solutions as building blocks for the transition towards sustainable climate-resilient food systems. *Sustainability* **15**(5): 4475 doi: 10.3390/su15054475

Khan HA, Sharma N, Siddique KHM, Colmer TD, Sutton T and Baumann U (2023). Comparative transcriptome analysis reveals molecular regulation of slat tolerance in two contrasting chickpea genotypes. *Frontiers in Plant Science* **30** doi: 10.3389/fpls.2023.1191457

Khan MA, Cowling WA, Banga SS, Barbetti MJ, Cantila AY, Amas JC, Thomas WJW, You MP, Tyagi V, Bharti B, Edwards D, Batley J (2023). Genetic and molecular analysis of stem rot (*Sclerotinia sclerotiorum*) resistance in Brassica napus (canola type). *Heliyon* **9** doi: 10.1016/j.heliyon.2023.e19237

Khan MIR, Khan NA, Sofo A and Siddique KHM (2023). Beneficial elements in plants: Developing resilience under stressful environments. *Plant and Soil* **486** doi: 10.1007/s11104-023-06056-w

Kragt ME, Subroy V and Dempster F (2023) Black soldier fly fertilisers by bioconversion of livestock waste: Farmers' perceptions and willingness-to-pay. *Journal of Cleaner Production* **411**:137271 doi: 10.1016/j.jclepro.2023.137271

Kumar M, Bolan S, Padhye LP, Konarova M, Foong SY, Lam SS, Wagland S, Cao R, Li Y, Batalha N, Ahmed M, Pandey A, Siddique KHM, Wang H, Rinklebe J and Bolan N (2023). Retrieving back plastic wastes for conversion to value added petrochemicals: Opportunities, challenges and outlooks. *Applied Energy* **345** doi: 10.1016/j.apenergy.2023.121307.

Li L, Zhang Y, Wang B, Feng P, He Q, Shi Y, Liu K, Harrison MT, Liu DL, Yao N, He J, Feng H, Siddique KHM and Yu Q (2023). Integrating machine learning and environmental variables to constrain uncertainty in crop yield change projections under climate change. *European Journal of Agronomy* **149** doi: 10.1016/j.eja.2023.126917

Liu B, Zhang B, Feng H, Wu S, Yang J, Zou Y and Siddique KHM (2023). Ephemeral gully recognition and accuracy evaluation using deep learning in the hilly and gully region of the Loess Plateau in China. *International Soil and Water Conservation Research* **10** 371-381 doi: 10.1016/j.iswcr.2021.10.004

Liu G, Mullan D, Zhang A, Liu H, Liu D and Yan G (2023). Identification of KASP markers and putative genes for pre-harvest sprouting resistance in common wheat (*Triticum aestivum L.*). *Crop Journal* **11**(2) 549–557 doi: 10.1016/j.cj.2022.09.002

Luo X, Dong R, Siddique KHM, He J and Jin Y (2023). Soybean breeding on southwestern China improved P and N utilization efficiencies by increasing phosphorus and nitrogen partitioning to pods. *Frontiers in Sustainable Food Systems* **7** doi: 10.3389/fufs.2023.1204293.

Ma L, Niu W, Li G, Du Y, Sun J and Siddique KHM (2023). Linking microbial carbon-degrading potential to organic carbon sequestration in fertilized soils: Insights from metagenomics. *Land Degradation Development* doi: 10.1002/ldr.4894

Maalik S, Moosa A, Zulfiqar F, Aslam MN, Mahmood T and Siddique KHM (2023). Endophytic *Bacillus atrophaeus* CHGP13 and salicylic acid inhibit blue mold of lemon by regulating defense enzymes. *Frontiers in Microbiology* **14** doi: 10.3389/fmicb.2023.1184297

Mahtab Omidvari M, Flematti GR, You MP, Abbaszadeh-Dahaji P and Barbetti MJ (2023). Plant growth stage and *Phoma medicaginis* inoculum concentration together determine severity of Phoma black stem and leaf spot and consequent phytoestrogen production in annual *Medicago* spp. *Plant Pathology* doi: 10.1111/ppa.13770

Mazzarol T (2023). HunterNet Co-operative Ltd. – The Power of Many, CEMI-CERU Case Study Research Report, CSR 2301. Centre for Entrepreneurial Management and Innovation/Co-operative Enterprise Research Unit *www.ceru.com.au*

Mazzarol T. (2023). Australia's Leading Co-operative and Mutual Enterprises in 2023: CEMI Discussion Paper Series, DP 230. Centre for Entrepreneurial Management and Innovation *www.cemi.com.au*

Meier E, Thorburn P, Biggs J, Palmer J, Dumbrell N and Kragt M (2023) Using machine learning with case studies to identify practices that reduce greenhouse gas emissions across Australian grain production regions. *Agronomy for Sustainable Development* **43**: 29 doi: 10.1007/s13593-023-00880-1

Padhye LP, Srivastava P, Jasemizad T, Bolan S, Hou D, Shaheen SM, Rinklebe J, O'Connor D, Lamb D, Wang H, Siddique KHM and Bolan N. (2023). Contaminant containment for sustainable remediation of persistent contaminants in soil and groundwater. *Journal of Hazardous Materials* **455** doi: 10.1016/j.jhazmat.2023.131575

Pandita D, Bhat JA, Wani SH, El Sayed AI, Nawaz G, Mukherjee S, Reyres VP, Kumar A, Shen Q, Ganie SA and Siddique KHM (2023). Mobile Signaling Peptides: Secret Molecular Messengers with a Mighty Role in Plant Life. *Journal of Plant Growth Regulation* **42** 6801–6834 doi: 10.1007/s00344-023-11069-x

Pandita D, Bhat JA, Wani SH, EL-Syed AI, Nawaz G, Mukherjee S, Reyes VP, Shen Q, Ganie SA and Siddique KHM (2023). Mobile signalling peptides: Secret molecular messengers with a mighty role in plant life. *Journal of Plant Growth Regulation* **42** doi: 10.1007/s00344-023-11069-x

Pethick DW, Bryden WL, Mann NJ, Masters DG and Lean IJ (2023). The societal role of meat: The Dublin Declaration with an Australian perspective. *Animal Production Science* doi: 10.1071/AN23061

Qi X, Yang G, Li Y, Hou Z, Shi P, Wang S, Wang X, Liang J, Sun B, Siddique KHM, Wu S, Feng H, Tian X, Yu Q and Xie X (2023). Optimizing biochar application rates for improved soil chemical environments in cotton and sugarbeet fields under trickle irrigation with plastic mulch. *Soil and Tillage Research* **235** doi: 10.1016/j.still.2023.105893

Raza A, Charagh S, Najafi-Kakavand S, Abbas S, Shoaib Y, Anwar S, Sharifi S, Lu G and Siddique KHM (2023). Role of phytohormones in regulating in cold stress tolerance: Physiological and molecular approaches for developing cold- smart crop plants. *Plant Stress* 8 doi: 10.1016/j.stress.2023.100152

Raza A, Charagh S, Salehi H, Abbas S, Saeed F, Poinern GEJ, Siddique KHM and Varshney RK (2023). Nano-enabled stress-smart agriculture: Can nanotechnology deliver drought and salinity-smart crops? *Journal of Sustainable Agriculture and Environment* **2** doi: 10.1002/sae2.12061

Razzaq MK, Rani R, Xing G, Xu Y, Raza G, Aleem M, Iqbal S, Arif M, Mukthar Z, Nguyen HT, Varshney RK, Siddique KHM and Gai J (2023). Genome-wide identification and analysis of the Hsp40/J-protein family reveals its role in soybean (*Glycine max*) growth and development. *Genes* **14** doi: 10.3390/genes14061254

Sharma P, Lakra N, Goyal A, Ahlawat YK, Zaid A and Siddique KHM (2023). Drought and heat stress mediated activation of lipid signalling in plants: a critical review. *Frontiers in Plant Science* **14** doi: 10.3389/fpls.20231216835

Siddique KHM, Bolan N, Rehman A and Farooq M (2023). Enhancing crop productivity for recarbonizing soil. *Soil & Tillage Research* **235** doi: 10.1016/j.still.2023.105863

Sun L, Guo H, Wang H, Zhang B, Feng H, Wu S and Siddique KHM (2023). Deep learning for check dam area extraction with optical images and digital elevation model: A case study in the hilly and gully regions of the Loess Plateau, China. *Earth Surface Process and Landforms* doi: 10.1002/esp.5652

Tao Z, Evaristo JE, Wang X, Chen G, Si B and Siddique KHM (2023). Tritium and trees: A bomb peak perspective on soil water dynamics in semi-arid apple orchards. *Catena* **232** doi: 10.106/j.catena.2023.107474

Tao Z, Wang X and Siddique KHM (2023). Evaluating the bias effects of rooting depth and cryogenic vacuum extraction to quantify root water uptake patterns in deep-rooted apple trees. *Agricultural Water Management* **289** doi: 10.1016/j.agwat.2023.108505

Van de Wouw AP, Scanlan JL, Al-Mamun HA, Balesdent M, Bousset L, Burketova L, Mendoza L del R, Fernando WGD, Franke C, Howlett BJ, Huang Y, Jones EE, Koopmann B, Lob S, Mirabadi AZ, Nugent BC, Peng G, Rossi FR, Schreuder H, Tabone AR, Van Coller GJ, Batley J and Idnurm A (2023). A new set of international *Leptosphaeria maculans* isolates as a resource for elucidation of the basis and evolution of blackleg disease on *Brassica napus*. *Plant Pathology* doi: 10.1111/ppa.13801

Waheed R, Deeba F, Zulfiqar F, Moosa A, Nafees M, Altaf MA and Siddique KHM (2023). Physiology and growth of newly bred basmati rice lines in response to vegetative-stage drought stress. *Frontiers in Plant Science* **14** doi: 10.3389/fpls.2023.1172255

Wiche O, Dittrich C, Pourret O, Monei N, Heim J and Lambers H (2023). Relationships between carboxylate-based nutrient-acquisition strategies, phosphorus-nutritional status and rare earth element accumulation in plants. *Plant and Soil* **489**(1–2) 645–666 doi: 10.1007/s11104-023-06049-9

Yan S, Zhang T, Zhang B, Zhang T, Cheng Y, Wang C, Luo M, Feng H and Siddique KHM (2023). The higher relative concentration of K^+ to Na^+ in saline water improves soil hydraulic conductivity, salt-leaching efficiency and structural stability. *Soil EGU* **9** doi: 10.5194/soil-9-339-2023

Yang H, Zhang W, Yu R, Su Y, Surigaoge S, Wang P, Yang X, Lambers H and Li L (2023). Trade-offs and synergies of plant traits co-drive efficient nitrogen use in intercropping systems. *Field Crops Research* **302** doi: 10.1016/j.fcr.2023.109093

Zahra N, Hafeez MB, Kausar A, Al Zeidi M, Asekova S, Siddique KHM and Farooq M (2023). Plant photosynthetic responses under drought stress: Effects and management. *Journal of Agronomy and Crop Science* **209**(5) 651–672 doi: 10.1111/jac.12652

Zahra N, Hafeez MB, Shukaily MA, Al-Sadi AM, Siddique KHM and Farooq M (2023). Influence of abiotic stresses on disease infestation in plants. *Physiological and Molecular Plant Pathology* **127** doi: 10.1016/j.pmpp.2023.10215

Zeleke T, Ali B, Tekalign A, Hailu G, Barbetti MJ, Ayele A, Aliyi T, Ayele A, Kahsay A, Tiruneh B and Tewolde F (2023). Occurrence of faba bean diseases and determinants of faba bean gall (*Physoderma* sp.) epidemics in Ethiopia. *Plant Pathology Journal* **39** 335-350 doi: 10.5423/PPJ.OA.03.2023.0040

Zhang B, Yan S, Li B, Wu S, Feng H, Gao X, Song X and Siddique KHM (2023). Combining organic and chemical fertilizer plus water-saving system reduces environmental impacts and improve apple yield in rainfed apple orchards. *Agricultural and Water Management* **288** doi: 10.1016/j.agwat.2023.108482

Zhang B, Yan S, Wu S, Fang H and Siddique KHM (2023). Organic and inorganic fertilizers combined with a water-saving technique increased soil fertilities and apple production in rainfed hilly orchards. *Journal of Cleaner Production* **414** doi: 10.1016/j.jclepro.2023.137647

Zhang C, Ren Y, Yan M, He Z, Chen Y and Zhang S (2023). Effect of sowing date on water uptake patterns of maize and soybean in intercropping systems using stable isotopes. *Agricultural Water Management* **288** doi: 10.1016/j.agwat.2023.108474

Zhang M, Dang P, Li Y, Qin X and Siddique KHM (2023). Better tillage selection before ridge-furrow film mulch can facilitate root proliferation, and increase nitrogen accumulation, translocation and grain yield of maize in a semiarid area. *Journal of Integrative Agriculture* **22**(6) 1658–1670 doi: 10.1016/j.jia.2022.08.037

Zhang N, Ye X, Gao Y, Liu G, Liu Z, Zhang Q, Liu E, Sun S, Ren X, Jia Z, Siddique KHM and Zhang P (2023). Environment and agricultural practices regulate enhanced biochar-induced soil carbon pools and crop yield: A meta-analysis. *Science of The Total Environment* **905** doi: 10.1016/j.scitotenv.2023.167290

Zhao DY, Zhang XL, Zhao SP, Liu GL, Zhang ZW, Zhao WF, Li XP, Ali Khan S and Siddique KHM (2023). Biomass Allocation and Nutrients Utilization in Wheat as Affected by Phosphorus Placement and Salt Stress. *Agronomy* **13** 1570 doi: 10.3390/agronomy13061570

Zhao DY, Zhang XL, Zhao SP, Liu GL, Zhang ZW, Zhao WF, Li XP, Khan SA and Siddique KHM (2023). Biomass allocation and nutrient utilization in wheat as affected by phosphorus placement and salt stress. *Agronomy* **13** doi: 10.3390/agronomy13061570

Zhao Y, Guo J, Luo S, Shen Y, Siddique KHM and Li Y (2023). Optimizing Lucerne (*Medicago sativa*) termination on the Loess Plateau, China: a comparative analysis of conventional tillage and herbicide. *Frontiers in Sustainable Food Systems* **7** doi: 10.3389/fsufs2023.1194724

Zhong L, Lewis JR, Sim M, Bondonno CP, Wahlqvist ML, Mugera A, Purchase S, Siddique KHM, Considine MJ, Johnson SK, Devine A and Hodgson JM (2023). Three-dimensional food printing: its readiness for a food and nutrition insecure world. *Proceedings of the Nutrition Society* doi: 10.1017/S0029665123003002

Zhu J, Niu W, Du Y, Sun J, Siddique KHM, Yang R and Zhang Z (2023). Non-negligible role of soil archaeal communities in improving microbial stability of tomato fields under aeration drip irrigation. *Scientia Horticulturae* **319** doi: 10.1016/j.scienta.2023.112179

Book

Ojha H, Schofield N and Camkin J (2023). Climate Risks to Water Security: Framing Effective Response in Asia and the Pacific. *Springer Nature*, Switzerland doi: 10.1007/978-3-031-16648-8

Book chapters

Camkin J, Ojha H, Schofield N and Gurung P (2023). Synthesis of Key Messages and Lessons Learnt. In: Ojha H, Schofield N, Camkin J (eds). Climate Risks to Water Security – Palgrave Studies in Climate Resilient Societies. *Palgrave Macmillan*, Cham doi: 10.1007/978-3-031-16648-8_12

Devi P, Chaudhary S, Bhardwaj A, Priya M, Jha U, Pratap A, Kumar S, Bindumadahva H, Singh I, Singh S, Vara Prasad PV, Siddique KHM and Nayyar H (2023). Harnessing genetic variation in physiological and molecular traits to improve heat tolerance in food legumes. In: Samy PMA, Ramasamy, Chinnusamy AV and Kumar BS (eds) 'Legumes: Physiology and Molecular Biology of Abiotic Stress Tolerance'. *Springer Nature*, Singapore Pte Ltd 27-69 doi: 10.1007/978-981-19-5817-5

Ojha H, Schofield N, Camkin J, Gurung P (2023). Introduction. In: Ojha H, Schofield N, Camkin J (eds). Climate Risks to Water Security – Palgrave Studies in Climate Resilient Societies. *Palgrave Macmillan*, Cham doi: 10.1007/978-3-031-16648-8_1

UPCOMING EVENTS

Leveraging smallholder farmers in a changing agricultural scenario: Lecture by Professor Jayasree Krishnankutty

Tuesday 14 November 2023
UWA Agriculture Lecture Theatre

2023 Hector and Andrew Stewart Memorial Lecture by Adjunct Professor John Dixon

Wednesday 22 November 2023
UWA Bayliss Lecture Theatre

Unravelling the evolution of herbicide resistant Alopecurus myosuroides (blackgrass) in the UK: Lecture by Professor Paul Neve

Friday 1 December 2023
UWA Bayliss Lecture Theatre

Register to attend our events on Eventbrite

IOA MISSION

To develop and communicate innovative evidence-based solutions for ethical food production, environmental sustainability and agribusiness advancement.

Editor: Rosanna Candler
rosanna.candler@uwa.edu.au
The UWA Institute of Agriculture
+61 8 6488 4717 | ioa.uwa.edu.au
The University of Western Australia M082
Perth WA 6009 Australia

The UWA Institute of Agriculture acknowledges the contribution of The FA Hadley Bequest and The WE Rischbieth Bequest for support towards communications activities.