The UWA Institute of Agriculture

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THE UNIVERSITY OF WESTERN AUSTRALIA

Key leaders from UWA and the agriculture industry at a workshop to finalise the Strategic Plan 2021-2025. Photo: Cora Castens

New Strategic Plan drives a future-focused, agile and sustainable vision

The UWA Institute of Agriculture has received an overwhelmingly positive response to its Strategic Plan 2021-2025, which was released in January.

"We will respect and celebrate our heritage while creating future environments and experiences that reflect the innovative nature of our education and research, and the cultural richness of our diverse communities."

The Strategic Plan 2021-2025 was developed and refined over many months, including a full-day workshop in August 2020 attended by Institute partners and collaborators including leaders from The University of Western Australia (UWA) and the agriculture industry.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique said the comprehensive document would guide the Institute to be future-focused, agile and sustainable.

"As we look forward to the next decade, there is wide recognition that, while we have been successful to date, the world as we know it is fundamentally changing at such a rate that the status quo will no longer suffice," Professor Siddique said.

UWA Deputy Vice Chancellor (Research) Professor Tim Colmer said it was a comprehensive, confident, and commendable Strategic Plan.

"I look forward to seeing The UWA Institute of Agriculture implement the Strategic Plan and continue to work with our many collaborators to further the University's achievements in research and translation for impact in agricultural systems and industries, in Australia and internationally," Professor Colmer said.

In the Academic Ranking of World Universities 2020, UWA was ranked 17th in the world and number one in Australia in agriculture.

The UWA Institute of Agriculture has played a significant role in achieving this global reputation.

Download the Strategic Plan 2021-2025

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Director's Column

A most welcome and rewarding part of my role is meeting and working with enthusiastic young people who are passionate about agriculture and food production systems.

UWA held its annual Open Day for prospective students on 28 March. It was a very busy and well-attended event, with many visitors to The UWA Institute of Agriculture information booth at the EZONE and hundreds of students packing out the Q&A sessions held by the science schools. There was also much interest and enthusiasm from students at the Ag Institute Australia WA Division Career's Night (page 6) and GRDC Grain Research Update (page 14).

We have now surpassed 12 months since Australia closed its borders due to the COVID-19 pandemic. Despite this freeze on international travel, The UWA Institute of Agriculture has experienced one of its busiest periods ever – producing a plentiful crop of research publications (pages 18-20), strengthening partnerships with collaborators and industry, and holding well-attended events including the 2021 Pingelly Astrofest (page 16), and our 2021 Alan Sevier Memorial Lecture (page 12).

At the time of writing, The University of Sydney Associate Professor of Animal Reproduction has just landed at Perth Airport to deliver this lecture on 'The future of sheep artificial breeding', marking the first interstate visitor the Institute has hosted since 2019.

I offer my congratulations to Alannah MacTiernan on her second term as WA Agriculture and Food Minister following the recent State election, and also WA Nationals leader Mia Davies for becoming the leader of the Opposition. Strong leadership is important, especially given the difficult start to the year with recent Cyclone Seroja – which left a trail of devastation across our mid-west coast and inland into the grain belt. Although rain is always welcome by our farmers, I was saddened to hear that some families had only recently had power returned to their homes.

On a more positive note, I wish to celebrate achievements within the university with the recent opening of Robson Walk (page 3), two of our Emeritus Professors being honoured with prestigious accolades (pages 9 and 15) and UWA graduates taking out the top three places at the Young Professionals in Agriculture Forum (page 7). The recent completion of our Strategic Plan 2021-2025 (page 1) is also cause for celebration.

At our 2021 Postgraduate Showcase on 2 June, I look forward to hearing seven of our outstanding PhD students in agriculture and related areas present their research. I invite you to register now to attend this wonderful annual event. Please also save-the-date for our 2021 Industry Forum on 21 July, which will explore the important and timely topic 'Future-proofing WA agriculture: Maximising opportunities for a resilient food production system'.

If you have not already done so, subscribe to our mailing list to ensure you receive our regular media releases, event invitations and publications.

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Partnership cemented by extended MOU

The long-standing Memorandum of Understanding (MOU) between UWA and the International Center for Agricultural Research in the Dry Areas (ICARDA) will continue.

A five-year extension to the MOU, which was established in 2007, was signed by the UWA Deputy Vice Chancellor (Global Partnerships) Tayyeb Shah and ICARDA Director General Aly Abousabaa in January 2021.

Since its establishment in 1975, ICARDA has implemented research-for-development programs in 50 countries across the world's dry areas.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique said he was very pleased that the productive and rewarding relationship with ICARDA would continue.

"This collaboration with ICARDA has resulted in numerous joint publications, training PhD students, and commercial release of many grain and pasture legume cultivars," Professor Siddique said.

The Institute has partnered with ICARDA on many projects over the decades, including research into breeding new chickpea varieties, intensification of cropping through short-duration food legumes, and the rehabilitation of agricultural production in Iraq.

Many of these projects were in collaboration with the Grains Research and Development Corporation (GRDC) Council of Grain Grower Organisations (COGGO) and the Australian Centre for International Agricultural Research (ACIAR).

UWA and ICARDA have also worked together on undergraduate and postgraduate training opportunities, global conferences and seminars, and establishing new international partnerships.

Uruguay researcher maximises year-long visit

Almost two decades since completing her PhD on sheep reproduction at UWA, Dr Georgget Banchero Hunzicker returned for a sabbatical year in 2019.

Dr Georgget Banchero (left) and Dr Graciela Quintans (INIA, Uruguay) visiting UWA Farm Ridgefield.

"I was so glad to be back in sunny Perth for the year, along with my family," the senior researcher from the National Institute of Agricultural Research (INIA) in Uruguay said.

Dr Hunzicker worked with The UWA Institute of Agriculture Professor Graeme Martin, Dr Katia Stefanova, Emeritus Professor David Lindsay and Dr John Milton on an analysis of a large dataset from 20 experiments done with sheep in Uruguay.

A total of 3,720 ewes were studied, including Corriedale, Polwarth, or East Friesian x Polwarth genotypes.

The aim of the research was to resolve some of the confusion around the relationship between nutrition and twinning (ovulation rate).

In all experiments, the control groups had grazed native pastures and the treatment groups were given extra nutrition using either improved pastures or supplements.

Published in the journal *Animal* in February 2021, the research showed that, in general, the 'decision to ovulate' was most affected by overall energy intake.

However, for the effect of short-term nutritional supplementation on ovulation rate, a major factor was the intake of protein from, for example, highly digestible supplements or as dietary protein protected by tannins from ruminal degradation.

This research more broadly aimed to combine knowledge on farming practices in both Australia and Uruguay.

Dr Hunzicker said visiting UWA Farm Ridgefield in Pingelly was a particular highlight.

"I spent time at UWA farm Allandale during my PhD, and so I was excited to see the new advancements in place at Ridgefield," she said.

"In Uruguay, I want to help push the development of sustainable farms because the INIA farm, Treinta y Tres, is also part of the international network of Future Farms."

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Robson Walk celebrates former UWA VC

The official opening of Robson Walk, named for former UWA Vice Chancellor Emeritus Professor Alan Robson, was held on 12 April.

The event was attended by current UWA Vice Chancellor Professor Amit Chakma, Deputy Vice Chancellor (Research) Professor Tim Colmer, and Emeritus Professor Robson, his family, friends and special guests.

Prior to his time as Vice Chancellor from 2004 to 2011, Professor Robson was Deputy Vice-Chancellor and Provost of UWA from 1993.

He also held the positions of Foundation Director of the Cooperative Research Centre for Legumes in Mediterranean Agriculture, Dean of the Faculty of Agriculture, Head of the School of Agriculture and Professor of Agriculture (Soil Science) at UWA.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique said Professor Robson was a humble man, outstanding teacher, leader administrator and internationally-recognised agricultural scientist.

"Robson Walk reminds us all of the enormous contribution Professor Robson has made to UWA, Australia and globally," Professor Siddique said.

(l-r) UWA Chancellor The Hon Robert French, Gwen Robson, Emeritus Professor Alan Robson, and UWA Vice Chancellor Professor Amit Chakma.

New common bean varieties to benefit African women and children

Good progress has been made in the first 12 months of an innovative project linking The UWA Institute of Agriculture researchers and east African partners to breed new, fast-cooking common bean (Phaseolus spp) varieties biofortified with iron and zinc.

This Australian Centre for International Agricultural Research (ACIAR)-funded project is a partnership between east African bean breeding programs and supported on the ground by the Alliance of Bioversity International and International Centre for Tropical Agriculture (CIAT) through the Pan Africa Bean Research Alliance (PABRA).

UWA Research Associate Dr Saradadevi said the aim of the study was to shorten the cooking time and increase the iron and zinc content of African beans through breeding.

Successfully breeding and popularising the new varieties through partner countries in east Africa will have significant and long-term benefits for the health and wellbeing of African women and children.

Alliance Bioversity International-CIAT bean breeding programme technician Steven Musoke.

"Dry beans (*Phaseolus vulgaris* L.) are an important staple food in Africa and help to alleviate malnutrition and anaemia due to their protein, iron and zinc content," Dr Saradadevi said.

"However, dietary intake of beans is limited by their typically long cooking time, which demands more fuel and therefore greater expense than cooking less nutritious grains.

African project leader Dr Clare Mukankusi from the Alliance Bioversity International-CIAT and PABRA in Uganda highlighted the importance of rapid cooking and biofortified beans.

"The team has developed a suite of activities for rapid and successful plant breeding, which we call BRÍO, and we are training our African partners in this approach."

"African women and children are exposed to greater health hazards due to smoke inhalation while cooking beans, and higher personal health and safety risks while collecting firewood or charcoal not mentioning the hazards of deforestation to supply wood as the most affordable source of energy," Dr Mukankusi said.

In the first year of the project in 2020, researchers selected parents for cross-breeding based on four years of field and laboratory data for grain yield, cooking time, iron and zinc in 358 varieties of African dry beans.

Each variety was then 'fingerprinted' for thousands of single nucleotide polymorphisms molecular markers.

Australian project leader, UWA Professor Wallace Cowling, is developing new genomic selection and breeding methods for bean breeding based on collaboration with animal genetics and breeding experts at the University of New England, Australia.

"We implemented an optimum mating design for crossing, which predicted that the cross progeny should have eight per cent faster cooking time, eight per cent higher iron and four per cent higher zinc content than the founder parents," Professor Cowling said.

Dr Saradadevi said their African colleagues were now testing the first cycle progeny for cooking time and iron/zinc content in the laboratory, and for agronomic properties in the field in the six partners' research stations.

In lieu of face-to-face meetings due to the pandemic, the project team at UWA introduced online training programs for breeders, and more exchanges were done by video conference.

Jean Claude Rubyogo, Director of PABRA and Bean Programme Leader in Alliance Bioversity International-CIAT, said project partners were very keen to learn the new BRÍO method of breeding and to release rapid-cooking biofortified bean varieties to meet a growing market demand.

Partner institutions in Africa include the National Agricultural Research Organisation (NARO, Uganda), Tanzania Agricultural Research Institute (TARI), Kenya Agricultural and Livestock Research Organisation (KALRO), Institut Des Sciences Agronomiques Du Burundi (ISABU), Ethiopian Institute of Agricultural Research (EIAR) and Rwanda Agriculture and Animal Resources Development Board (RAB).

B	Breeding values accurately predicted from analysis of phenotypic and genomic and/or pedigree relationship data accumulated over cycles
R	Rapid cycles of recurrent selection
Í	Index selection on breeding values for traits, weighted for economic value
O	Optimised mating designs for sustainable and superior genetic gain

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Lefroy Fellowship an opportunity of a lifetime for Dr Kelsey Pool

With a research schedule that frequently takes her from the lab to the field and back again – there is no such thing as a typical day for UWA's Lefroy Fellow Kelsey Pool.

Made possible by a generous bequest from the Lefroy family, Dr Pool was appointed Research Associate under the Lefroy Fellowship in late 2020 to undertake her investigations into the effects of oestrogenic compounds on sheep reproduction.

"This Fellowship is one of the best opportunities I have ever taken," she said.

"It has allowed me to work in a field I am genuinely passionate about with scientists and producers I respect and admire, and has given me the scientific freedom to investigate some fascinating questions around sheep reproduction."

UWA Lefroy Fellow Dr Kelsey Pool. Photo: Rosanna Candler

"I have everything I need at UWA to do good quality research, and this is a constant source of motivation for me. I am so much happier and well-supported than I could have ever imagined."

Dr Kelsey Pool at work on the farm.

On any given day, Dr Pool can be found assessing sperm functionality at the Centre for Microscopy, Characterisation and Analysis after a 6am visit to the rams at Murdoch University, out in the field working with sheep at UWA Farm Ridgefield, or running between her office and the Drosophila lab down the hall to manage fly models.

"At the moment, I'm tackling my research with a multifaceted approach," she said.

"My work ranges from assessing the impacts of phytoestrogens upon ram sperm function, to strategies for early detection of reproductive dysfunction in the ewe, to drosophila (a genus of fly) models to predict the multigenerational and epigenetic effects we may see, across species, following exposure to oestrogenic compounds.

"From here, I've also expanded to look at other environmental factors that could impact upon sheep reproduction such as the effects of climate change, and looking into strategies to improve offspring survival from conception onwards."

Just five months since packing up her life in Sydney and moving to WA, Dr Pool has one study recently accepted for publication, another one just wrapping up and five more in progress.

"In the accepted paper, we found that 'equol' (the oestrogenic metabolite responsible for both permanent and transient infertility in the ewe) also negatively impacts the functionality of ram spermatozoa," she shared.

"This is significant, as it was previously suggested that phytoestrogens only affected ewe reproductive function.

"For the first time in the 70 or so years of research in this area, this work brings into question whether oestrogenic pastures could also influence ram fertility."

Dr Pool said she was excited to see the final results of research that seemed to show that the combination of exposing both parents to phytoestrogens may affect the fertility of the subsequent generation – and this effect differs depending upon the age of the parent at exposure.

Her interest in sheep reproduction was borne through her PhD studies at The University of Sydney, supervised by Associate Professor of Animal Reproduction Simon de Graaf.

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Vale Hank Greenway (1926–2021)

By Professor Tim Colmer
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Hank Greenway when he was a senior research scientist at CSIRO.

Associate Professor Hank Greenway made substantial contributions to research, research training and teaching in plant physiology at UWA.

Hank's expertise in environmental plant physiology benefited many students and colleagues in Agricultural Science; discussions with him frequently stimulated lateral thinking and new ideas.

Born in the Netherlands in 1926, Hank was world-renowned for his research contributions on tolerance of plants to salinity and soil waterlogging.

He and his collaborators published a large volume of primary research papers and several authoritative critical reviews on salinity and anoxia stress physiology of crops and other plants.

Hank's association with UWA spanned more than 50 years; initially as a member of academic staff (1967-1992) and subsequently an honorary research fellow.

His generous and important voluntary contributions were recognised by the award of a Chancellor's Medal in 2004 and he continued to contribute to the University until his advancing years finally slowed him down.

The impact of Hank's journal publications are evident in the various 'research metrics' and his contributions are recognised also by being awarded Life Membership of the Australian Society of Plant Scientists.

He was a great mentor, very generous with his time, and displayed enormous enthusiasm for research students (PhD and MSc supervision) and early-career researchers.

He adopted, and vigorously promoted, the philosophy of his own PhD supervisor Sir Rutherford "Bob" Robertson, that: "You guide a PhD student to Rome and they end up in Stockholm, and isn't Stockholm beautiful".

Hank empowered research students to develop and test their ideas and encouraged, at the appropriate time, rigorous scientific debates to assist researchers to test ideas in a supportive environment and build our confidence and trust amongst peers.

Hank also promoted the importance of multidisciplinary research and he enjoyed many international collaborations.

A feature of his undergraduate coursework teaching was the use of problem-based learning.

Discussions of journal papers and the invigorating experience of developing and testing hypotheses by conducting experiments in small teams, were key elements of Hank's teaching approach.

Hank taught us to think critically, to share and debate ideas, and he showed us the thrill and fun of being a scientist.

I consider myself extremely fortunate to have benefited from having Hank Greenway as a university teacher, honours project supervisor, mentor, colleague and friend.

Several other plant scientists have shared with me their personal stories of joy and appreciation of the positive difference Hank made to their lives.

Opportunities abound at annual Careers Night

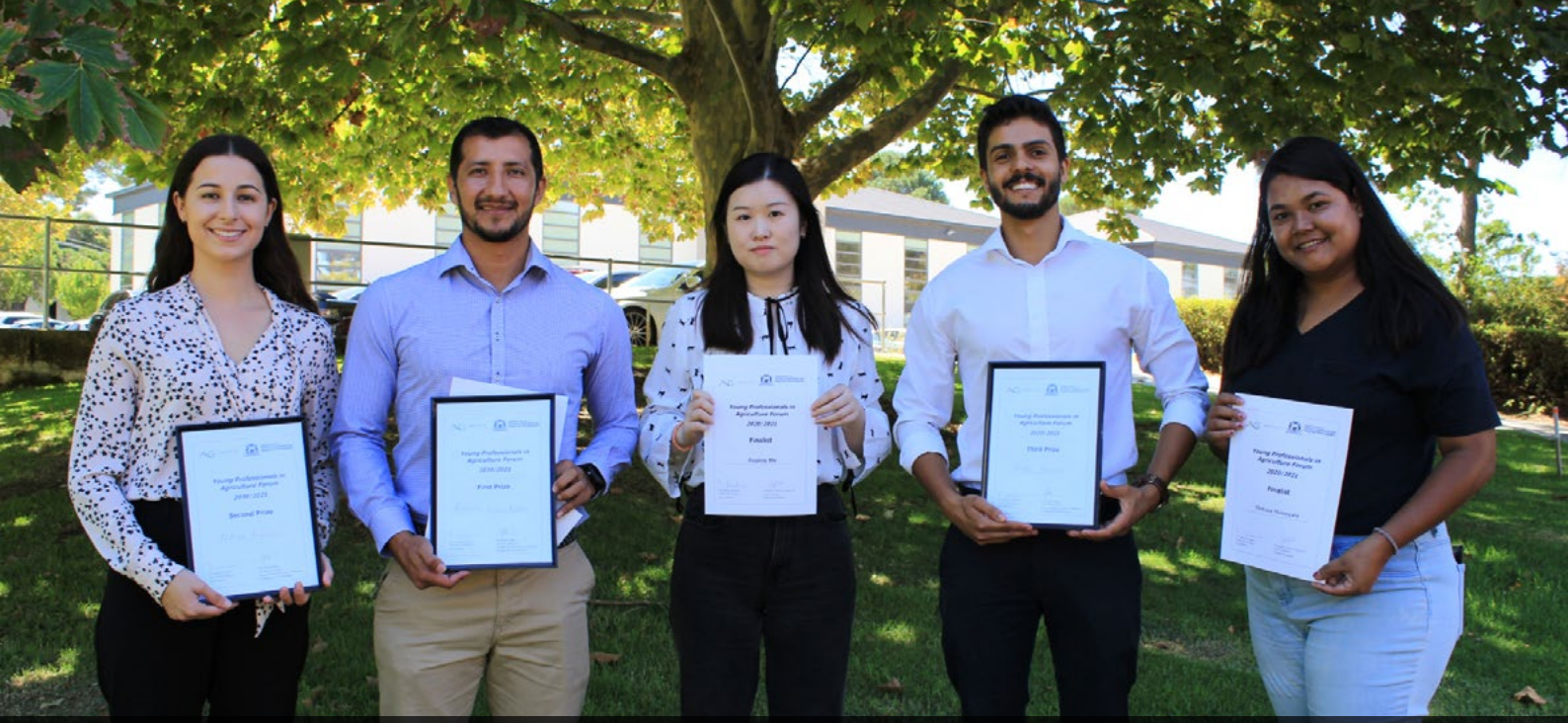
Professor Siddique with students from Kelmscott Senior High School. Photo: Rosanna Candler

Enthusiastic students and recent graduates attended The Ag Institute Australia (WA Division) annual Careers Night on 7 April at The Royal Agricultural Society of WA.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique and Associate Director Wallace Cowling spoke with dozens of attendees about potential study and research opportunities at UWA.

UWA was joined by other WA teaching and research institutions and prospective employers from the agricultural industry at the informal event, which included networking and information exchange followed by pizza and snacks.

"It was heartening to see so many engaged young people exploring new opportunities and discussing the next step in their careers," Professor Siddique said.



(l-r) UWA graduates Nikala Passaris, Roberto Lujan Rocha, Jiaping Du, Álefe Amorim and Curtin University graduate Mohana Matangulu. Photo: Rosanna Candler

UWA presenters impress at annual forum

Graduates from UWA swept the top honours at the Young Professionals in Agriculture Forum on 17 March.

The annual forum, hosted by the Ag Institute Australia (WA Division) and the Department of Primary Industries and Regional Development (DPIRD), showcased the research of agriculture or natural resource management students.

WA Chief Scientist Professor Peter Klinken awarded UWA graduate Roberto Lujan Rocha first place and the Noel Fitzpatrick Medal for his presentation on developing a mechanical scarification technique to quickly break the physical dormancy of wild oat seed.

WA Chief Scientist Peter Klinken with Roberto Lujan Rocha.

Environmental science Honours graduate from UWA Nikala Passaris was awarded second along with the best presentation award for her research on the long-term effect of crop rotation and residue management on soil nutrients in the central Wheatbelt region of WA.

UWA Master of Biotechnology graduate Álefe Amorim's presentation 'Pathway towards genome editing transformation: A case study for elite Australian wheat varieties' claimed third place.

New method for breaking seed dormancy

Bolivian-born Mr Lujan Rocha will represent WA at the national Young Professionals in Agriculture Forum later this year.

"I am privileged and very happy to have won the prize," he said.

"I honestly was not expecting to win after seeing the quality and complexity of research by the other participants."

Working as a research officer at the UWA-based Australian Herbicide Resistance Initiative gave Mr Lujan Rocha the inspiration for his honours project into one of Australia's most costly weeds in terms of profit loss: wild oat.

For a different project, he was given the daunting task of preparing thousands of wild oat seeds for germination.

To do this, he had to break the physical dormancy of the seed by manually puncturing each individual seed.

"You can imagine how extremely time consuming this is," he said.

"So, the aim of my honours project was to develop a method to make this job more efficient."

Recalling his previous experience with native seeds, Mr Lujan Rocha decided to use a seed thresher machine in the lab to cause injury to the outer coat of the seed and trigger germination.

"Not only was the mechanical scarification technique equivalent to the manual puncturing technique, it actually provided significantly greater germination than the chemical and non-chemical methods," he said.

"Most importantly, it took five seconds to process 50 seeds compared to at least six minutes to manually puncture those same 50 seeds.

Mr Lujan Rocha said this new method significantly increased the efficacy of work and allowed a researcher to test many more samples in a shorter period of time.

Satellite imagery of flowering tree canopies in southwest Australia.

Eye in the sky to chart flowering tree canopies

State-of-the-art satellite imagery gave UWA postgraduate student Daniel Dixon the ultimate birds' eye view for his latest research with the CRC for Honeybee Products.

Mr Dixon is passionate about using remote sensing (such as drone technology and satellites) and geospatial tools to answer questions about environmental health and food security.

For his recent paper, Mr Dixon and fellow researchers Nik Callow and John Duncan, Samantha Setterfield, and Natasha Pauli from the UWA School of Agriculture and Environment and UWA School of Biological Sciences developed a model for detecting flowering eucalypt canopies over large areas with satellite imagery.

The research was done in 2019 and 2020 at field sites in the Northern Jarrah Forest including Mundaring State Forest and John Forest National Park.

"This research greatly relied on both drone and CubeSat imagery," Mr Dixon said.

"Drones allowed us to quantify flowering events on specific dates and locations with high resolution RGB imagery."

UWA postgraduate student Daniel Dixon.

"This data then informed the CubeSat daily image time series to make maps of flowering over the course of the summer. Additionally, because the model works at the satellite level, we could monitor flowering across large areas and into the past with the satellite archive."

Mr Dixon said the larger objective was to understand the drivers behind flowering, which includes forest responses to climate change and other activities such as fire.

"Wildfire and prescribed burning, for example, are common events in WA forests, but it's mostly unknown how fire impacts flowering of various species," he said.

"By studying the drivers of flowering, we aim to also improve our understanding of forest management, biodiversity and beekeeping in southwestern Australia."

Mr Dixon first got involved with honey bees and quantifying bee flora while studying for his Master degree at the University of North Dakota in the USA, where he studied grasslands, land use change and impacts on pollinators.

His PhD thesis 'Understanding environmental drivers of flowering events with remote sensing' is expected to be submitted in early 2022.

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Emeritus Professor Graeme Martin recognised

With a career spanning more than five decades, UWA Emeritus Professor Graeme Martin knows the unpredictable and unforgiving landscape of scientific research better than most.

Although he officially retired last June, the renowned animal scientist has been busier than ever, and was recently named a Fellow of the Australian Association of Animal Sciences.

"As scientists, we rise and fall on the basis of peer review of our research," Professor Martin said.

"It's a fraught and often frustrating process, but we understand its value in validating our contributions to discovery and understanding.

"Thus, after decades of fighting this battle, it is a real honour to be recognised by your peers for a career-long contribution."

For more than 30 years and across many continents, Professor Martin questioned how the sheep brain assessed its environment and then used that information to decide on a reproductive strategy.

"Most of my colleagues focussed on one of three factors: photoperiod, nutrition, or socio-sexual signals," he said.

"I feel that my contribution was to realise, at the beginning of my career, that the sheep does not follow those signals one at a time, but instead responds to them all simultaneously."

"I therefore looked at how the sheep brain assessed the interactions among the three factors."

About 15 years ago, he decided to "apply everything he had learned" to the future of farming and the problem of worldwide food security.

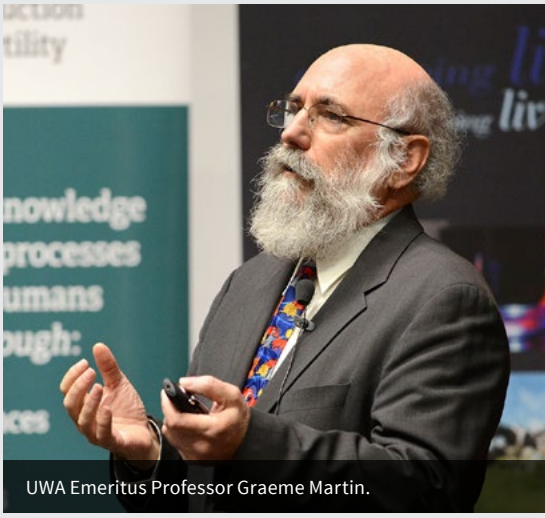
To add to his growing list of accolades, Professor Graeme was presented the 2021 Marshall Medal by the President of the UK-based Society for Reproduction and Fertility during an online ceremony in January.

The Marshall Medal was established in 1963 as the highest honour that the Society awards in the field of reproduction and fertility.

During his acceptance speech, he used a science lineage to show how he was connected to the award eponym, Professor Francis HA Marshall FRS, with only four degrees of separation.

However, the links between himself and Professor Marshall are even deeper than the lineage flow chart suggested.

In his PhD thesis, Professor Martin cited papers that Marshall had published in 1903 and 1937, and also cited UWA Professor Eric Underwood FRS (whose supervisor Sir John Hammond FRS had in turn been supervised by Professor Marshall) and his descriptions of the 'ram effect' (1944), clover disease (1946), and the importance of zinc for testis function (1969).



UWA Emeritus Professor Graeme Martin.

These discoveries in reproductive biology and more underpinned his research career – and therefore led to being awarded the 2021 Marshall Medal.

Professor Martin said his advice for the next generation was inspired by Edward O Wilson, who told us to 'Be a synthesizer' and Tim Minchin's belief that 'Everyone should be a teacher'.

"Don't be afraid to wonder," he said.

"Travel, work outside Australia, then come home."

Centre for Water and Spatial Sciences to make a splash

The UWA School of Agriculture and Environment (SAgE) recently approved the establishment of a Centre for Water and Spatial Sciences (CWSS) at UWA.

CWSS will be led by a membership of experts from across Geographic Information Science and hydrology (SAgE), hydrogeology (UWA School of Earth Sciences) and aquatic ecology (UWA School of Biological Sciences) and environmental engineering (UWA School of Engineering).

Associate Professor Matt Hipsey, who is a joint leader of The UWA Institute of Agriculture's Water for Food Production research theme, said the CWSS would focus on science and management related to water scarcity and associated issues.

"The Centre will seek to partner and collaborate with the Institute through the research theme and leading research on the use of geospatial technologies for food production and farm management," Professor Hipsey said.

UWA inspires Pakistani PhD student to greater heights

Studying at UWA has strengthened PhD student Tamsal Murtza's passion and resolve to make agricultural research her full-time career when she returns home to Pakistan.

Ms Murtza is among 20 outstanding students from The University of Agriculture Faisalabad (UAF) who have received a UWA-UAF joint scholarship to complete their PhD studies at UWA since 2008.

The scholarship program was made possible due to the strong collaboration and Memorandum of Understanding (MOU) between the two universities, signed in 2008.

Under the supervision of the UWA School of Agriculture and Environment Professor Martin Barbetti and Dr Mingpei You, Ms Murtza is researching the geographic and temporal patterns of a rapidly evolving plant pathogen causing white leaf spot disease.

White leaf spot disease is a significant foliar disease that can cause 30 per cent losses in highly susceptible canola varieties in Australia.

"This plant pathogen is challenging the disease management through host resistance by making previously resistant cultivars susceptible," Ms Murtza explained.

UWA PhD student Tamsal Murtza.

"Further, I am exploring some multi-pathogen interactions which are affecting canola and other oilseed crops."

Ms Murtza said growing disease-free canola was challenging, especially in a changing climate.

"My research will help understand the potential link between white leaf spot disease epidemic under different climatic variables and seed yield losses," she said.

Having grown up by the banks of the river Chenab in her home city Muzaffargarh, Ms Murtza said she felt a special connection to the Swan River.

"I like Perth for its cultural diversity, attracting people from all around the world and making them feel at home with its serenity," she said.

Ms Murtza said rigorous research training at UWA had enhanced her understanding of what it took to be a researcher.

"I believe the experience of research skills and scientific communication at UWA will help me to better contribute in science at national and international level," she said.

"The techniques I have learnt will help me to better understand the climatic change mediated pathogen virulence for plant disease modelling.

"This is an important yet overlooked research aspect in Pakistan where climate change is posing a risk to the largest economic sector, agriculture."

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New roles for UWA Adjunct Professor

The UWA Institute of Agriculture Adjunct Professor Ashwani Pareek was made Executive Director of National Agri-Food Biotechnology Institute (NABI) on 1 January.

NABI was established in 2010 by the Department of Biotechnology, Ministry of Science and Technology, Government of India.

The Institute is the first of its kind in India, conducting research in agriculture, food and nutrition biotechnology and aims to catalyse the transformation of agri-food sector in India.

"Our vision is to be a nodal organisation for knowledge generation and translational science leading to value added products based on agri-food biotech innovations," Professor Pareek said.

NABI's main research focus is to harness biotechnological tools in the area of Agriculture Biotechnology, Food Science and Technology and Nutritional Science so as to provide sustainable and novel solutions towards quality food and nutrition.

Professor Pareek was also made chief executive of the Center of Innovative and Applied Bioprocessing (CIAB) in late January.

The UWA Institute of Agriculture Adjunct Professor Ashwani Pareek.

Jasper Farms Technical Manager Jacinta Foley.

UWA agricultural graduate relishes role at top avocado farm

More than half the avocado trees in all of Western Australia were yet to be planted when agronomist Jacinta Foley started her dream job at Jasper Farms five years ago.

The UWA Agricultural Sciences graduate said our burgeoning avocado industry was on the cusp of a significant production boom.

"Most Western Australians probably don't realise that WA, in particular the south west, is a major producing area," Ms Foley said.

"It's such a fast-growing industry with major increases in production forecasted over the next few years as most of the trees in WA are yet to reach full maturity – which happens at around seven-years-old."

In 2019/20, WA contributed 38 per cent of Australia's total avocado production, second only to Queensland at 49 per cent.

Jasper Farms in Busselton – which local brothers Neil and Ian Delroy sold to Ontario Teachers Pension Plan (a Canadian pension fund) in late 2017 – is one of Australia's largest avocado producers.

The business has undergone significant expansion in the last few years with the new orchard developments bringing the total hectares to 600 by late 2021.

In her role as Technical Manager, Ms Foley oversees the agronomy for its three avocado orchards.

"This involves developing agronomic plans, investigating production issues, identifying areas for improvement, and providing technical advice and support to the Farm Managers," she said.

Ms Foley leads the research and development (R&D) aspects of the business, such as identifying and planning for the future R&D needs, conducting in-house trials, keeping up-to-date with the latest avocado R&D and adding to their intellectual property with various technical manuals.

"I am very grateful to have started my career with a very successful agricultural business and great mentors."

"The multifaceted nature of the role can be a challenge, but that is also what keeps it interesting," she said.

"I find it most rewarding to see the incremental improvements in production over the years as we modify and adapt our growing techniques and strategies according to the learnings we've made over time.

"The only way to improve production and efficiencies is to trial new techniques or strategies, which may not always yield successful results, but the process is crucial for continuous improvement."

Ms Foley credits one of her former Honours supervisors, The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique, as paving the way to her "satisfying and challenging" career.

While completing her Honours, Professor Siddique recommended Ms Foley to Neil Delroy, who was the Managing Director and part owner of Jasper Farms at the time.

Ms Foley will present at The UWA Institute of Agriculture's 2021 Industry Forum on 21 July, on the topic 'Future-proofing WA Agriculture: Maximising opportunities for a resilient food production system'.

Hass avocados on the tree.

The Sevier Story: Farmer, inventor and amateur scientist

Alan Richard Sevier was a Western Australian farmer, inventor and amateur scientist who passed away in 2013.

Mr Sevier expressed a wish that his notebooks, journal and writings on cattle reproduction and pheromone experiments be given to UWA.

With the help of the bequeathed materials and speaking with those who knew him, UWA Adjunct Associate Professor Bruce Mackintosh embraced the challenge of writing a short biography of Mr Sevier's life and achievements, which he completed in late 2020.

"Writing this biography has been quite a journey," Professor Mackintosh said.

"I have to say that I have enjoyed every moment of it. He was a remarkable man."

An early model mimic cow.

The Alan Sevier Memorial Lecture

In his will, Mr Sevier bequeathed funds to set up a UWA lecture series in his memory. The 2021 lecture was delivered by University of Sydney Associate Professor Simon de Graaf on the topic 'The future of sheep artificial breeding' on 20 April.

Alan Sevier with one of his Aberdeen Angus bulls.

A series of excerpts from this biography, which can be read in full online, is published below.

Alan came to WA from England in 1928 as an eight-year-old, when his father, a WW1 veteran, came with his family, his mother and an older brother to join three other brothers at Wilgoyne near Mukinbudin.

Life on a barely viable property, with a father suffering from the effects of gassing in France, could not have been easy for Alan. There was a primary school at Wilgoyne from 1924 to 1945, but no high school at Mukinbudin until 1972. So he completed his schooling by correspondence, developing in the process an intense curiosity, an avidity for reading, a methodical nature, and a copperplate writing style to boot. Somehow, he completed a Certificate of diesel mechanics, presumably also by correspondence.

He was also renowned for his wizardry with valve and later transistor radios, an interest which lead to his later attempts to detect oestrus in cattle.

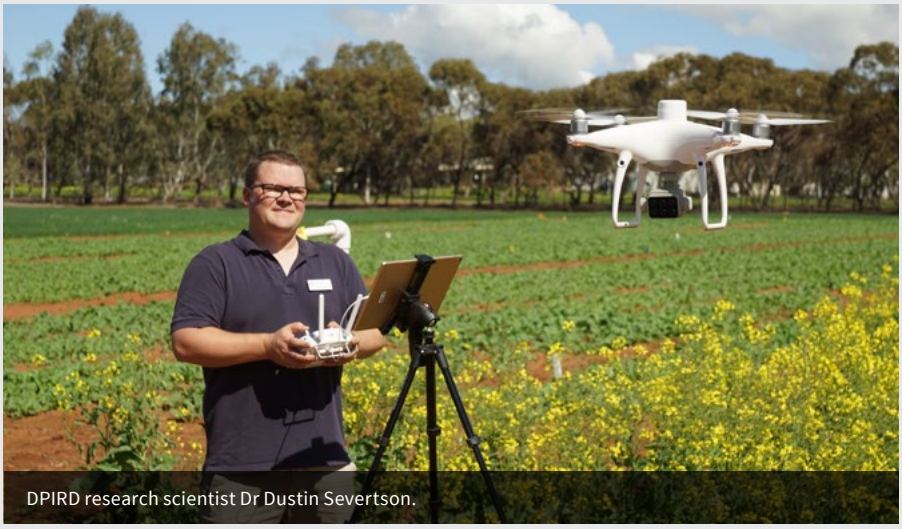
From 1953 to 1963 Alan carried out pot, plot and grazing trials of a wide range of shrubs like saltbush and tree lucerne, vetches, clovers and medics, and grasses like Veldt Grass, Kikuyu, ryegrasses and Phalaris as well as the Swainsona Spp.

Later he owned a bull with a small herd of cows and realised he had the opportunity to carry out his own experiments. He possessed a small but sufficiently powered microscope (200X), had borrowed textbooks from a veterinarian friend who had experimented in AI with the horses, and he had access to "various objects of automotive origin".

Alan constructed and tested his first "teaser dummy" (later termed "mimic cow") in 1959, but a rigid back structure made dismounting difficult. However the tests confirmed his belief that scent was the primary attractant although movement in imitation of the "coquettishness "of an oestrus cow reinforced this, and he manipulated the dummy to achieve it.

Convinced that the key to success of the mimic's use was a good attractant, he continued his search which was given a boost when he discovered that the cow's minor vestibular glands appeared to produce a very potent pheromone "to turn him on". His work now involved visits to dairy farms at milking time, hoping to find animals in oestrus without the presence of a bull which would interfere with sampling.

Drone crop surveillance 'the way of the future'


DPIRD research scientist Dr Dustin Severtson.

Using drone technology for crop surveillance is reaching new heights, thanks to a Grains Science Partnership project partnership between UWA and The Department of Primary Industries and Regional Development (DPIRD).

The UWA School of Agriculture and Environment Associate Professor Nik Callow and Associate Professor Ken Flower are working with project lead, DPIRD entomologist Dr Dustin Severtson, to test the use of high-tech drones with imaging technology to assess crops for damage.

UWA PhD graduate Dr Severtson said the project had acquired two of the latest high-tech cameras from the United States and China that were fitted to drones to live-stream footage of plant health as they flew over the crop.

"The aim is to take drone and mobile device technology and improve current crop monitoring to make pest and disease scouting easier and more accurate, saving on time and costs and creating more sustainable cropping systems," Dr Severtson said.

"These are not technologies that are going to die out, they're the way of the future."

The researchers will fly the drones over cereal and canola crops in the central WA agricultural region in an attempt to pick up hotspots of pest infestation such as aphids.

Associate Professor Nik Callow
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Imaging technology a powerful research tool

Imaging, in particular Magnetic Resonance Imaging (MRI), is a powerful tool for plant and agricultural research at UWA.

The UWA Institute of Agriculture held a special seminar exploring the topic on Friday, 19 February led by National Imaging Facility (NIF) Fellow Dr Tim Rosenow from the Centre for Microscopy, Characterisation and Analysis (CMCA) at UWA.

Several proof-of-concept studies have already been jointly undertaken between WA NIF and the UWA School of Agriculture and Environment.

Dr An Nguyen collaborated with CMCA Research Officer Diana Patalwala to use micro-computed tomography (CT) and fluorescence imaging to demonstrate chimerality in transgenic tobacco x narrow-leafed lupin shoots.

Research Assistant Dr Gustavo Boitt recently begun experiments to measure the effect of micronutrients on root architecture using high-field MRI.

With continual advances in MRI technology, Dr Rosenow said there were great opportunities for WA NIF to further collaborate with UWA agriculture.

"For example, advanced techniques such as diffusion-tensor imaging can be used to view water uptake in potted plants in situ, and magnetic resonance mass spectroscopy can be used to view glucose and other metabolic biomarker distribution in stems, leaves, and fruit," he said.

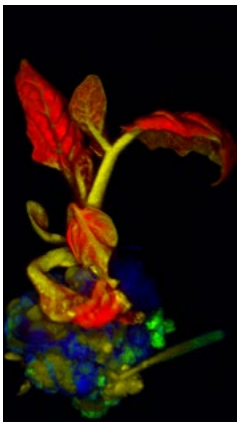
"Live and post-mortem 'ex vivo' small animal imaging is an area in which WA NIF is particularly experienced, which has significant potential in evaluating the condition and properties of animal food products.

"These techniques are readily available at WA NIF. New technologies, such as portable above-ground MRI scanners, are now becoming available across Australia."

To improve their connection and engagement with the agricultural research sector, Dr Rosenow said WA NIF had recently established a community user/reference group.

If you have a research question or potential project, email bioimaging-cmca@uwa.edu.au.

Dr Tim Rosenow
tim.rosenow@uwa.edu.au


Transgenic tobacco x narrow-leafed lupin shoots.

Unearthing human influence on potato virus evolution

A row of potato plants killed by infection with potato virus Y.

A virologist from The UWA Institute of Agriculture has helped unearth critical new information about the evolution of four viruses that endanger potato crops around the world.

An international collective of researchers from Peru, Ecuador, UK, Australia, Japan and the Netherlands contributed to the research, which was recently published in the journals *Phytopathology*, *Viruses*, *Virus Evolution* and *Plant Disease*.

UWA Adjunct Professor Roger Jones said the research was of critical importance to global food security.

"Potato is the fourth most important staple food crop worldwide, and the third most important in developing countries," Professor Jones said.

"The more we know about their biological properties, phylogenetics (evolutionary history), and prehistory, the more likely we will be able to protect potato crops effectively from the severe virus disease and major crop losses they cause, particularly in the developing world."

The studies focused on four main viruses that threaten crops: potato viruses A, S, X and Y.

Each virus reduces tuber (the part of the potato plant that is eaten) yields and disrupts healthy potato stock schemes.

They spread from plant-to-plant by planting tubers from virus-infected plants, and by either aphid vectors or foliage contact.

Professor Jones explained that each of the four studies, one with each potato virus, involved newly-obtained complete genomic virus sequences and similar sequences from the global potato virus 'virome' (an assemblage of viruses).

Importantly, each study also included many virus sequences from the Andean region of South America, mostly from Peru, where the crop was domesticated from wild potato species 9000 years ago.

"These Andean sequences were then compared with complete genomic sequences from the rest of the world," Professor Jones said.

"From this comparison, we can first conclude that by far the greatest virus diversity is present amongst virus isolates from the crop's Andean domestication centre.

"Secondly, we found that human activities involving major historical events led to major bursts of diversification and evolution of each virus."

Professor Jones said it was extremely interesting to trace major historical events that led to potato virus diversification, such as the great European potato famine of 1845-1849 AD.

"This famine was caused by arrival from South America of the potato late blight fungal pathogen," he said.

"This resulted in a catastrophic disease epidemic causing the collapse of the European potato crop, especially in Ireland, resulting in starvation, death and major human migration to other continents, especially the Americas."

Contributing research institutions included the Australian National University, The University of Tasmania, Department of Primary Industries and, Regional Development (WA), the International Potato Center and National Agrarian University in Peru, the University of Cuenca in Ecuador, FERA Science Ltd and the University of Newcastle in the UK, the Dutch National Plant Protection Organization Service and Saga University in Japan.

Adjunct Professor Roger Jones
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UWA front and centre at Grains Research Update

UWA was strongly represented at the Grains Research and Development Corporation (GRDC) Grains Research Update on February 22 and 23.

The UWA Institute of Agriculture's exhibition stall acted as a base for dozens of UWA students and researchers who participated in the annual event.

On the first day, UWA School of Agriculture and Environment Professor Ross Kingwell presented a market focus session on 'Wheat 2030 Opportunities', while Associate Professor Ken Flower presented his research on 'Patterns of crop water use in a long term rotation trial'.

Agronomists Dr Mike Ashworth and Dr Roberto Lujan-Rocha from the UWA-based Australian Herbicide Resistance Initiative led a session on crop protection from weeds in the early afternoon.

The Institute Associate Director Professor Wallace Cowling and Dr Sheng Chen then presented their research into 'Pre-breeding canola for heat stress tolerance – a prototype facility for large-scale screening at flowering stage'.

On the second day, UWA Masters student Bowen Zhang presented his Master project 'Cracking the code of group H cross-resistance in wild radish'.

UWA School of Agriculture and Environment Research Fellow Fran Brailsford delivered a research snapshot on 'Unlocking the potential of ironstone gravels', followed by soil microbiologist Khalil Kariman on the 'Effects of a native symbiotic fungus on crop growth and nutrition under controlled environment conditions'.

The right recipe for sustainable sheep worm control

Members of the Sheep Worm Team.

In ruminant livestock, gastro-intestinal worms can reduce productivity and cause diarrhoea that can increase the risk of flystrike in Merino sheep.

Moreover, the worms are becoming increasingly resistant to medication (oral drenches).

The total cost to the Australian sheep industry is in excess of $600 million per annum.

This problem is being tackled by members of the Sheep Worm Team at The UWA Institute of Agriculture.

Led by Adjunct Professor Johan Greeff, the team includes Emeritus Professor Graeme Martin, the Institute Associate Director Professor Phil Vercoe, Associate Professor Shimin Liu, Research Fellow Erwin Paz, and research students Shamshad Ul Hassan and Suyog Subedi.

The team are researching the roles of the various components of the sheep immune responses to worm infection that cause diarrhoea and thus flystrike, with the aim of finding genetic solutions.

They have also been looking into secondary compounds in the sheep diet that can combat worms.

The team began in the 1980s as a partnership between geneticist Professor and veterinarian Dr John Karlsson when they were both working for the Department of Agriculture and Food WA (now the Department of Primary Industries Research and Development).

Dr Karlsson has now retired to his own farm, where he has put many years of research on sustainable sheep worm control into practice.

He came up with a management procedure so effective that he was able to stop mulesing his own flock in 2007.

The keys to the 'Karlsson Recipe' are faecal worm egg counts (FEC), and the measurement of resistance to drenches.

The resistance of the worms to a drench is assessed by measuring the reduction in FEC after drenching. If the egg numbers do not fall by 95 per cent, the worms are resistant.

"Every farm should be making these measurements so they can stop wasting money on drench and, at the same time, stop contributing to the development of resistance," Professor Martin said.

Armed with FEC and resistance data, Dr Karlsson believes that sheep producers can implement sustainable worm control by doing two things.

"One, measure FEC at critical times and, two, use the data to breed sheep that have low FEC because they are naturally resistant to worm infection," he said.

Read the complete recipe online.

Emeritus Professor Graeme Martin
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Pioneer of herbicide resistance research honoured

UWA Emeritus Professor Stephen Powles became the first Western Australian and fourth person ever to receive the prestigious Seed of Gold award at the Grains Research and Development Corporation (GRDC) Grains Research Update in February.

The renowned herbicide resistance expert was presented with the award in recognition of his lifelong service to the grains industry.

For two decades, Professor Powles led the WA Herbicide Resistance Initiative at UWA and continued as Director when it later became the Australian Herbicide Resistance Initiative.

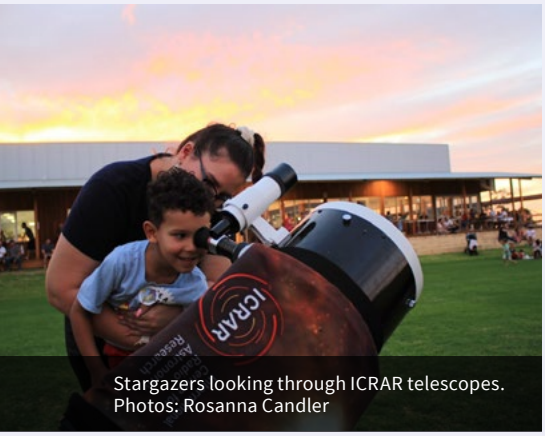
In his acceptance speech, Professor Powles made special mention of the time he had spent teaching and mentoring students at UWA.

"I have had the pleasure of working with so many young, bright, smart undergraduate students, honour students and PhD students," he said.

Emeritus Professor Stephen Powles.

"It's true that I have been the conductor of the orchestra, but a conductor is only as good as the musicians that he has."

Pingelly Astrofest proves astronomically popular



Stargazers looking through ICRAR telescopes. Photos: Rosanna Candler

A crowd of more than 500 astronomy enthusiasts gathered at the Pingelly Recreation and Cultural Centre on 20 March for the 2021 Pingelly Astrofest.

The UWA Institute of Agriculture and the Shire of Pingelly collaborated to deliver the free, family-friendly astronomy festival.

Proudly supported by Lotterywest, the 2021 Pingelly Astrofest attracted a constellation of stargazers both new and experienced – including locals and groups visiting from neighbouring towns and Perth.

The event was previously held at UWA Farm Ridgefield in 2016 and 2018.

Although Pingelly Astrofest quickly outgrew its original location, UWA Farm Ridgefield was still front-and-centre with a popular information stall and craft workshop led by one half of the farm management team Cathy McKenna.

"It was great to share information about the farm with curious visitors and also see lots of our neighbouring farmers and have a chat," Mrs McKenna said.

The International Centre for Radio Astronomy Research (ICRAR) set up their state-of-the-art telescopes on the oval and generously shared their passion for space with the community throughout the night.

Despite some clouds forming earlier in the evening, ICRAR-UWA Cosmos Consultant Greg Rowbotham said there were many wondrous sights of our night sky seen through the telescopes.

The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique said the event was an outstanding achievement.

"Pingelly Astrofest is a true credit to excellent collaboration and hard work from the Shire, the Institute and ICRAR," Professor Siddique said.

"It was a wonderful opportunity to enthuse youngsters about the role of science and technology."

In addition to workshops from Scitech, the popular UWA School of Agriculture and Environment and UWA Edward de Courcy Clarke Earth Science Museum stall entertained kids with hands-on activities and experiments.

Planning is now underway for the next Pingelly Astrofest in 2023.

High distinction honour a decade in the making


UWA Masters graduate Manish Sharma. Photo: Rosanna Candler

The journey to receiving a coveted high distinction for his Master thesis at UWA may have been longer than most, but that just makes it all the sweeter for Manish Sharma.

After graduating from CCS Haryana Agricultural University in 2006, Mr Sharma moved from India to Melbourne, intending to start his Master studies straight away.

Unfortunately, he was forced to put his dream on hold for more than 10 years.

Two years after becoming an Australian citizen in 2017, Mr Sharma commenced his Masters in Agriculture Science at UWA, supervised by The UWA Institute of Agriculture Director Hackett Professor Kadambot Siddique and Dr Jiayin Pang.

Mr Sharma's research, published in *Plant and Soil*, investigated the effects of water stress under low phosphorus supply on plant phosphorus acquisition and physiological phosphorus use efficiency among four chickpea genotypes.

He then identified a genotype with a faster relative growth rate and relative phosphorus acquisition rate under water stress and low phosphorus supply environment.

"I was inspired to conduct research in this area because drought and plant phosphorus uptake are two major challenges for agricultural production around the world," Mr Sharma said.

Mr Sharma found that water stress imposed at the flowering stage reduced shoot and root growth, root mass ratio, and shoot phosphorus content.

One genotype, named ICC 2884, maintained its stomatal conductance and photosynthesis rate until it reached a lower soil water content.

Mr Sharma commenced his PhD studies at UWA earlier this year.

Mr Manish Sharma
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Professor Jacqueline Batley.

Professor Batley joins Theme Leaders

Professor Jacqueline Batley from the UWA School of Biological Sciences has joined The UWA Institute of Agriculture as a co-leader of the Sustainable Cropping Systems research theme.

Professor Batley leads the Batley Lab at UWA – a group of full-time researchers and postgraduate students in crop genetics and genomics, with a focus on disease resistance in Brassicas.

In 2019, she was awarded the prestigious Nancy Millis Medal from the Australian Academy of Science.

Also led by Professor Megan Ryan and Dr Nicolas Taylor, the Sustainable Cropping Systems theme focuses on genetic and agronomic manipulation of root architecture and function.

The Institute extends its gratitude to outgoing co-leader Dr Janine Croser for her dedication and excellent contribution to the Sustainable Cropping Systems theme.

AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Hackett Prof Kadambot Siddique	Western Australian Indian of the Year 2021
Emeritus Prof Stephen Powles	Seed of Gold Award at the 2021 GRDC Grains Research Update
Emeritus Prof Graeme Martin	Fellow of the Australian Association of Animal Sciences 2021 Marshall Medal from the Society for Reproduction and Fertility UK
Dr Andrew Guzzomi and co-authors	Most Outstanding Paper Award for publications in the Weed Technology journal

MEMORANDA OF UNDERSTANDING

NAME	AWARD
MOU renewal between The University of Western Australia and International Center for Agricultural Research in the Dry Areas	January 2021
MOU between The University of Western Australia and the Institute of Field and Vegetable Crops – National Institute of the Republic of Serbia	April 2021

VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
National Imaging Facility Fellow Dr Tim Rosenow	Centre for Microscopy Characterisation and Analysis, WA	The UWA Institute of Agriculture	19 February 2021
Associate Prof Simon de Graaff	The University of Sydney, NSW	The UWA Institute of Agriculture	19-21 April 2021

NEW POSTGRADUATE RESEARCH STUDENTS

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)
Mr Manish Sharma	Investigating the effectiveness of Struvite (a slow-release phosphorous fertilizer, obtained from dairy wastewater) on phosphorous uptake and drought stress in legume and cereal crops	The UWA School of Agriculture and Environment	Dr Sasha Jenkins, Dr Jiayin Pang, Prof Megan Ryan, Prof Kadambot Siddique
Mr Felipe Castro Urrea	The value of multivariate and genomic analysis to accelerate selection of low-heritability traits in field pea	The UWA School of Agriculture and Environment	Prof Wallace Cowling, Prof Kadambot Siddique, Dr Li Li (UNE)
Ms Hend A Mohamec	The effect of car tyres biochar, chicken manure biochar and the compost amendments on microorganisms and fertility	The UWA School of Agriculture and Environment	Dr Zakaria Solaiman and Prof Zed Rengel

NEW RESEARCH GRANTS

TITLE	FUNDING PERIOD	FUNDING BODY	INVESTIGATORS
Determining the incidence of herbicide resistance in Australian grain cropping	2020-2023	GRDC	Dr Mechelle Owens
BeefLinks: defining the potential and application of (native) Australian plants for a carbon neutral northern beef value chain in Western Australia	2020-2023	MLA	Prof Phil Vercoe
The life and death of plant genes	2021-2023	ARC	Dr Zoey Durmic
Early stress experiences and stress resilience and emotionality in pigs	2020-2022	ARC	Dr Dominique Blache
Developing strategies to mitigate and manage resistance to key herbicides	2020-2025	GRDC	Dr Philipp Bayer

UWA IOA 2020 Publications
(Not yet reported)

Peer Reviewed Journals

Bhaskarla V, Zinta G, Ford R, Jain M, Varshney RK and Mantri N (2020). Comparative Root Transcriptomics Provide Insights into Drought Adaptation Strategies in Chickpea (Cicer arietinum L.) *International Journal of Molecular Science* **21** doi: 10.3390/ijms21051781

Crété R, Pires RN, Barbetti MJ and Renton M (2020). Rotating and stacking genes can improve crop resistance durability while potentially selecting highly virulent pathogen strains. *Scientific Reports* **10** doi: 10.1038/s41598-020-76788-7

Inturrisi FC, Barbetti MJ, Tirnaz S,Patel DA, Edwards D and Batley J (2020). Molecular characterization of disease resistance in Brassica juncea – The current status and the way forward. *Plant Pathology* **70:** 13-34 doi: 10.1111/ppa.13277

Jagadish SVK, Pal M, Sukumaran S, Parani M and Siddique KHM (2020). Heat stress resilient crops for future hotter environments. *Plant Physiology Reports* **25:** 529–532 doi: 10.1007/s40502-020-00559-9

Jaganathan D, Bohra A, Thudi M and Varshney RK (2020). Fine mapping and gene cloning in the post-NGS era: advances and prospects. *Theoretical and Applied Genetics* **133:** 1791–1810 doi: 10.1007/s00122-020-03560-w

Jones RAC (2020). Disease Pandemics and Major Epidemics Arising From New Encounters between Indigenous Viruses and Introduced Crops. *Viruses* **12** doi: 10.3390/v12121388

Khan AW, Garg V, Roorkiwal M, Golicz AA, Edwards D, Varshney RK (2020). Super-Pangenome by integrating the wild side of a species for accelerated crop improvement. *Trends in Plant Science* **25** doi: 10.1016/j.tplants.2019.10.012

Kumar J, Gupta DS,Djalovic I, Kumar S and Siddique KHM (2020). Root-omics for drought tolerance in cool-season grain legumes. *Physiologia Plantarum* 1-16 doi: 10.1111/ppl.13313

Li X and Siddique KHM (2020). Future Smart Food: Harnessing the potential of neglected and underutilized species for Zero Hunger. *Maternal and Child Nutrition* **16** doi: doi.org/10.1111/mcn.13008

Liu Y, Liu W, Yong J, Zhang S, Li S, Wu D, Pang J, Wan J, Yong H, Chen Y, Bai C,- Han X, Liu X, Sun Z, Zhang S, Sheng J, Li T, Siddique, KHM and Lambers H (2020). Exogenous Calcium Alleviates Nocturnal Chilling-Induced Feedback Inhibition of Photosynthesis by Improving Sink Demand in Peanut (Arachis hypogaea). *Frontiers in Plant Science* **11** doi: 10.3389/fpls.2020.607029

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Tshewang S, Rengel Z, Siddique KHM and Solaiman ZM (2020). Growth, Rhizosphere Carboxylate Exudation, and Arbuscular Mycorrhizal Colonisation in Temperate Perennial Pasture Grasses Varied with Phosphorus Application. *Agronomy* **10** doi: 10.3390/agronomy10122017

Verma S, Kumar N, Verma A, Singh H, Siddique KHM and Singh NP (2020). Novel approaches to mitigate heat stress impacts on crop growth and development. *Plant Physiology Reports* **25**: 627–644 doi: 10.1007/s40502-020-00550-4

Zhuang W, Wang X, Paterson AH, Chen H, Yang M, Zhang C, Sun P, Zheng Y, Wang L, Xie W, Chu W, Fu H and Varshney RK (2020). Reply to: Evaluating two different models of peanut's origin. *Nature Genetics* **52**: 560–563 doi: 10.1038/s41588-020-0627-0

Book chapters

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Vadez V, Hajjarpoor A, Korbu LB, Alimagham M. Pushpavalli R, Ramirez ML, Kashiwagi J, Kholova J, Turner NC and Sadras VO (2020). Chickpea **10:** 343-353 in: Sadras V and Calderini D (2020) Physiology Case Histories for Major Crops. *Academic Press, United Kingdom*

UWA IOA 2021 Publications
(January-April)

Peer Reviewed Journals

Aravindakshan S, Krupnik TJ, Shahrin S, Tittonell P, Siddique KHM, Ditzler L and Groot JCJ (2021). Socio-cognitive constraints and opportunities for sustainable intensification in South Asia: insights from fuzzy cognitive mapping in coastal Bangladesh. *Environment, Development and Sustainability* **323** doi: 10.1007/s10668-021-01342

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Chu TT, Henryon M, Jensen J, Ask B and Christensen OF (2021). Statistical model and testing designs to increase response to selection with constrained inbreeding in genomic breeding programs for pigs affected by social genetic effects. *Genetics Selection Evolution* **53** doi: 10.1186/s12711-020-00598-8

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Letters

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UPCOMING EVENTS

2021 Postgraduate Showcase

Frontiers in Agriculture, Wednesday, 2 June 2021, Bayliss Lecture Theatre

2021 Industry Forum

Future-proofing WA agriculture: Maximising opportunities for a resilient food production system, Wednesday, 21 July 2021, The University Club of WA Auditorium

2021 Dowerin Machinery Field Days

Dowerin WA, August 25 and 26, 2021

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