



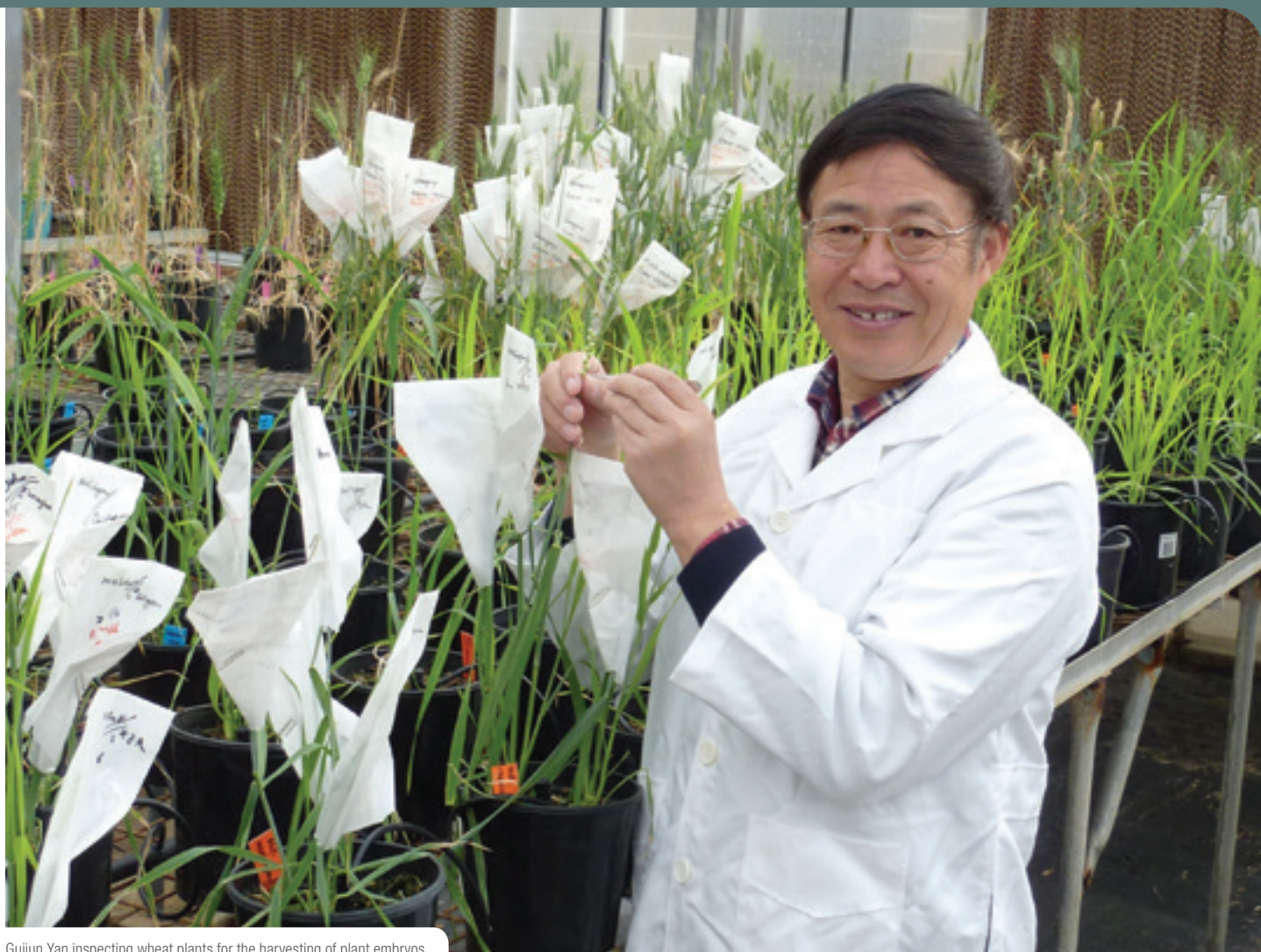
THE UNIVERSITY OF  
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1913 - 2013



# The UWA Institute of Agriculture

Number 19 April 2013



Guijun Yan inspecting wheat plants for the harvesting of plant embryos.

## Scientists 'fast-forward' plant breeding

**A team of international researchers, including a PhD student from The University of Western Australia, have fine-tuned an *in-vitro* method that can shorten the plant breeding cycle by up to 70%.**

"This represents a key milestone in the quest to increase world cereal production," explains team member Associate Professor Guijun Yan, from UWA's School of Plant Biology and the UWA Institute of Agriculture, "because breeding new plant varieties suited to cope with drought, salinity and diseases is at the heart of many plant breeding programs aimed at improving crop yields and quality. Traditionally, this has been a time-consuming activity: it involves identifying suitable lines from hundreds of crosses, followed by developing 'pure lines' of the plants, which takes at least eight generations." Pure lines are essential for commercial seed production, and

until recently, the fastest way to obtain pure lines was the so-called 'shuttle breeding' technique developed by the 'Father of the Green Revolution', Nobel Laureate late Dr Norman Borlaug. This technique involves growing plants at different places, to exploit differences in latitude or altitude. However, even this technique can achieve only two or three generations a year.

This may soon be history as a team of international researchers has developed a new technique that enables up to eight generations of wheat and nine generations of barley a year.

The team – involving researchers from UWA, China and CSIRO – has perfected a method involving *in-vitro* germination of 10-15 day-old embryos and culture of plantlets under extended light, high temperature and water and nutrient stress conditions to achieve each

generation within 40-45 days. The method has been used to generate many mapping and fine mapping populations for genetic research and breeding purposes.

While embryo culture has been used before, this team introduced a difference which delivered stunning results:

"We combined this technique with specially modified water, light, temperature, humidity and potting-mix management, and a skilled technician in the team was able to dissect 60 plant embryos per hour from the developing grains," says Yan. "By dramatically shortening times required to obtain pure-line genotypes, our method could have wide applications in breeding and biological studies."

Their study has just been published in the international journal *Euphytica*.



## Director's column

**Hackett Professor Kadambot Siddique AM FTSE** ([kadambot.siddique@uwa.edu.au](mailto:kadambot.siddique@uwa.edu.au))

As UWA celebrates its centenary this year, agriculture and related areas are upholding the University's tradition of achievement and success with a number of significant research outcomes and events. IOA researchers, in collaboration with key international partners, made significant advancements in chickpea and canola research with recent completion of the draft genome (cf page 12) which

represents a milestone in the quest to breed biotic and abiotic stress resistant varieties for increased productivity.

Another breakthrough in plant breeding research was made by Associate Professor Guijun Yan and colleagues from China and CSIRO: Their success to dramatically shorten the time required to breed new varieties of cereal crops will revolutionise commercial plant breeding.

UWA's strategy for international collaborations in agriculture was also highlighted in several symposiums and events, including the Japan-Australia Symposium on Plant Sciences for Agriculture (page 7); the fourth Australia-China Joint Symposium, held at UWA (cf page 7) and the Global Herbicide Resistance Challenge conference hosted by AHRI in February (cf page 4).

Dryland areas cover more than 40% of world's land area and are home for one third (2.5 billion people) of the global population. Sustainable food security is a major concern and this is likely to be exacerbated by projected climate change and variability. Thus improved adaptation and resilience of agricultural production and supply are high priority for drylands. UWA's commitment to developing innovative solutions to ensure sustainable food production is also reflected in the novel Environmental Research Prioritisation Framework project, led by the School of Agriculture and Resource Economics (cf page 6). Dryland agricultural production systems were featured on

mainstream television, with the ABC filming at UWA's Future Farm (cf page 3) showcasing the research and development on methane emission reduction strategies and ecological restoration.

UWA's excellence in teaching and outreach programs related to agriculture was confirmed by the popularity of its short courses (cf page 10), study exchanges and internship programs (cf page 8).

Our students continue to excel in their chosen fields as reflected in a 'swag' of prestigious prizes and awards (see also pages 9 and 10) and many of our graduates are testimony to the exciting career opportunities in agriculture and related areas (cf pages 15-16).

Last but not least, I am proud to be involved with so many high calibre scientists, whose dedication and excellence is reflected in UWA's lion share of the latest Federal Government funding under the Filling the Research Gap Program: UWA researchers have won a total of \$4.45 million (out of \$30 million) for five agricultural projects focused on helping farmers adapt to a changing climate and reduce methane emissions. Congratulations to Professor Phil Vercoe, Associate Professor Deirdre Gleeson, Professor Daniel Murphy, Professor Peta Clode, Professor Ross Kingwell and Professor Ben White, on this fantastic achievement.

(cf <http://www.news.uwa.edu.au/201304045554/awards-and-prizes/farmers-benefit-key-research-projects>).

## Climate-smart crop research bags Science and Innovation award for young UWA scientist

A young research associate at the Centre for Legumes in Mediterranean Agriculture (CLIMA) has been recognised with a Science and Innovation Award for Young People in Agriculture, Fisheries and Forestry for her research that aims to help plant breeders identify environmentally-friendly subterranean clover, a key pasture species in Australia.

Dr Parwinder Kaur conducts research with a multi-disciplinary team that will aid in identifying genes which control vital traits in this species, by sequencing the complete genome. "This research is a world-first effort and will change the way grazing is practiced," says Kaur. "Once we determine the genes that control such traits as methane release potential, the results could help address a range of emerging issues for ruminant health in a changing climate and make climate-smart crops a reality in the near future."

As the winner of the Meat and Livestock Science and Innovation Australia Award, she will initiate a collaborative research program with Japan.

Kaur is passionate about communicating her work to the scientific community and the wider public:

She regularly talks about her research on radio and plans to publish her work in scientific journals and present at key conferences.

The Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry are coordinated by the Australian Bureau of Agricultural

and Resource Economics and Sciences (ABARES), and each category is supported generously by primary industries, to provide winners with grants of up to \$22,000 each to undertake a project exploring an emerging scientific issue or innovation over a 12-month period.



Parwinder Kaur receiving her award from Peter Vaughan, General Manager MLA, Livestock Production Innovation MLA, at the Outlook 2013 conference.

Photo courtesy Steve Keough Photography



# What's new at the UWA Future Farm 2050



UWA Future Farm-Catalyst filming.

**Ms Christine Shervington**

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**Filmed November 2012 for viewing February 2013**

As part of ABC Catalyst's 'On the Road' six-week Cross-Australia tour in November 2012, the Catalyst team, including reporters Anja Taylor, Derek Muller and Simon Pampena, visited the UWA Future Farm 2050 project at Ridgefield.

Their report was aired on 7 February 2013 and covered an overview of the vision for the Future Farm project. The Catalyst team also examined the research on methane abatement that is being done in the UWA-CSIRO Alliance for Versatile Livestock Systems. Professor Phil Vercoe (IOA) and Dr Dean Revell (CSIRO) are collaborating to address the challenge of reducing the greenhouse gas footprint of extensive grazing systems for livestock without adversely affecting productivity and profitability.

One strategy is to develop grazing systems that are based on mixtures of plants that offer good nutritive value whilst also reducing methane emissions. There is also the possibility that 'anti-methanogenic' plants could become a methodology for the Carbon Farming Initiative but, for this to occur, the researchers need to quantify the impact of the novel forage systems on livestock productivity and GHG emissions, and there needs to be certainty that new systems persist to provide long-term benefits.

The Catalyst crew assisted in inflating a 'poly tunnel', CSIRO's plastic tent in which groups of sheep can be kept for 24 hours while their methane emissions are measured. In this endeavour, the Catalyst crew was aided by Nathan Philips and Andrew Toovey (CSIRO). Dr Samantha Bickell (IOA) then gave instruction on low-stress stock handling as the test animals were brought into the 'poly-tunnel' for measurements. Extra

interest was added when a 'sheep cam' was used to observe flock behaviour from the perspective of an individual sheep.

To view the Catalyst footage, visit <http://www.ioa.uwa.edu.au/future-farm-2050/news-and-events>.

Another exciting development relates to a new project '*Ensuring sustainable and responsible production of healthy food from healthy animals*', awarded to the University of Bristol and UWA and supported by the Worldwide Universities Network's (WUN) Development Fund. The UWA Future Farm is also a key resource in this project which addresses the **WUN Global Challenge: Adapting to Climate Change** with the immediate strategic objective of safeguarding food security for the growing human population.

IOA Deputy Director Winthrop Professor Graeme Martin emphasises the significance of these developments: "The UWA Future Farm joins two other unique and visionary research farms – one in England and one in southern India – and this will allow us to compile a global assemblage of data and ideas that will help ensure sustainable and responsible production of healthy food from healthy animals."



The Catalyst crew arriving at UWA Future Farm to film a segment for the 'On the Road' program.

## Agriculture on Youtube

[youtube.com](http://youtube.com)

TOPIC	ACCESS FROM
Catalyst interview about UWA Future Farm, 7 Feb 2013 (with Prof Phil Vercoe and W/Prof Graeme Martin)	<a href="http://www.abc.net.au/catalyst/stories/3685323.htm">www.abc.net.au/catalyst/stories/3685323.htm</a>
Extended Catalyst interview, discussing the use of native shrubs to reduce methane emissions (with Prof Phil Vercoe)	<a href="http://www.abc.net.au/catalyst/stories/3685236.htm">www.abc.net.au/catalyst/stories/3685236.htm</a>
Extended Catalyst interview about the broad scope of research being conducted at Future Farm 2050 (with W/Prof Graeme Martin)	<a href="http://www.abc.net.au/catalyst/stories/3685256.htm">www.abc.net.au/catalyst/stories/3685256.htm</a>

# UWA 'Legal Eagles' keen to improve water use compliance

Ms Uly Fritsch Email: [uly.fritsch@uwa.edu.au](mailto:uly.fritsch@uwa.edu.au)



Madeleine Hartley and Alex Gardner in the grounds at UWA's Law Faculty.

Three 'legal eagles' at UWA are doing their bit to improve the sustainable use of Western Australia's limited water resources which are essential to safeguard our future food security and quality of life.

As the WA government drafts new water resource management legislation to implement WA's commitments under the National Water Initiative (NWI) ([www.nwc.gov.au/nwi](http://www.nwc.gov.au/nwi)), Associate Professor Alex Gardner (Faculty of Law and IOA), PhD student Madeleine Hartley and honours graduate Sarah Robertson have identified serious deficiencies with the state's water access rights legislation and regulatory compliance system, and have developed proposals to address these issues.

Problem areas include lack of rigour and transparency in the metering, recording and reporting of water extraction and use (i.e. water accounting), which makes it difficult to monitor and enforce water access rights in Western Australia. "Much of the data necessary to ensure compliance with water licences and access entitlements is not publicly available in Australia," says Gardner. "This means, water licence and entitlement holders are not kept accountable for the amounts of water they extract, trade and use." In Gardner's view, deficiencies in the statutory frameworks together with current privacy and confidentiality legislation are to blame for this situation. In an article co-authored with Bachelor of Laws honours graduate, Clare McKay, he calls for legislative and policy reforms to create a presumption that water accounting data will be publicly available and only withheld from publication if the case for privacy or confidentiality is made specifically in relation to the particular data.

"Transparency in water accounting is essential to secure environmental and other public benefit outcomes and to meet the NWI objectives for water accounting reform, namely to support public and investor confidence in the amount of water being traded, extracted for consumptive use, and recovered and managed for environmental and other public benefit outcomes."

Sarah Robertson's work highlights the importance of extending the NWI reforms to the compliance and enforcement system. Her research into the monitoring and enforcement of water access rights in the South-West of WA found problems with the State's compliance monitoring system, departmental

continued on page 13

# Conference highlights the 'need to love the herbicides we have'

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The emergence and alarming increase of 'superweeds' in cropping systems world-wide has made herbicide resistance in weeds one of the biggest threats to global food security, and a key obstacle to increased yields and farming productivity.

In February this year, more than 300 delegates from around the world congregated in Fremantle to debate this issue at the *Global Herbicide Resistance Challenge* conference.

The multidisciplinary program included 100 speakers and 66 poster presentations and delivered a clear message: there are no new herbicides to be released in the foreseeable future, and this means we need to fully appreciate the value of existing ones and preserve their efficacy through an integrated weed management approach.

Conference highlights included the launch of the upgraded Ryegrass Integrated Management (RIM) bio-economic model, developed by AHRI researcher Ms Myrtille Lacoste with funding support from GRDC. RIM, a user-friendly free software, allows growers to experiment, through simulation, with a range of weed management options including soil preparation, timing of crop seeding, herbicides, grazing, crop sacrifice, topping and harvest weed seed control. RIM can be downloaded free of charge from [www.ahri.uwa.edu.au/rim](http://www.ahri.uwa.edu.au/rim)

Another highlight was the announcement of a new design for the Harrington Seed Destructor (HSD), a harvest weed seed control tool designed by Darkan grower and inventor Ray Harrington and progressed to commercialisation by AHRI with GRDC funding. The new design will incorporate the original tow-behind unit into the harvester itself and thereby reduce the cost to growers. It is expected to be available for purchase in two years.

A third highlight of the conference was the launch of 'Weedsmart', an industry-led initiative to enhance on-farm practices and promote the long term sustainability of herbicide use. 'WeedSmart' aims to appeal to a large number of farmers with its user-friendly 'app' designed to measure a farmer's susceptibility or threat of resistance on farm. Further information can be found at [www.weedsmart.org.au](http://www.weedsmart.org.au)

The Global Herbicide Resistance Challenge conference was hosted by the Australian Herbicide Resistance Initiative (AHRI) at The Esplanade Hotel, Fremantle, and sponsored by BASF, Bayer CropScience, CBH Group, Dow AgroSciences, GRDC, Kumiai Chemical Industry Co., Monsanto, Syngenta and UWA (gold sponsors), along with the Council of Australasian Weed Societies and Sumitomo Chemical (bronze sponsors).



(LtoR) Bayer CropScience weed resistance research team leader Roland Beffa, together with colleagues Hermann Stuebler (Bayer CropScience), Stephen Powles (AHRI and IOA), Harry Strek (Bayer CropScience) and Todd Gaines (Bayer CropScience and AHRI) announced a major breakthrough at the Global Herbicide Resistance Challenge international conference in Fremantle, Western Australia.

Photo courtesy Bayer Crop Science



# IOA scientist cruises to plant breeding improvements

Winthrop Professor Wallace Cowling  
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Winthrop Professor Wallace Cowling was on long service leave in early 2012 when he was fortunate to “hitch a ride” with wife Kellie on the newly launched “Disney Fantasy” ship from Germany to New York. This provided an opportunity for Cowling to read numerous text books in quantitative genetics and its application to plant breeding, and he was inspired to write the recently published review article titled “Sustainable plant breeding” for the international journal *Plant Breeding*. He was invited speaker on this subject at the German Plant Breeding Society in Giessen in early March 2012.

As Cowling now remarks, “The 2-week sail from Bremerhaven to New York City provided the time to think about issues that affect plant breeders during their careers. We spend most of our professional careers “keeping busy”, but we often fail to critically review the best way to breed plants. As a result of this paper, I have now changed the way I breed canola in our company Canola Breeders. The goal is to avoid the “yield plateau” that sometimes limits what breeders can achieve in their careers due to diminishing genetic diversity. After making a few small changes to my breeding program, I am confident that Canola Breeders can release superior commercial varieties into the long term, and maintain or increase genetic diversity in the program. In the past, breeders have made improvements in the short term, at the cost of genetic diversity. By increasing migration into the program, and expanding the population base through a greater number of parents (chosen on the basis of superior estimated breeding value), breeders can accelerate their genetic progress and improve breeding efficiency. Modern biometrical and molecular techniques can help us achieve these goals, but the primary changes need to be made by the breeder at the coal face of selection and crossing.”



Wallace Cowling (right) with his host, Wolfgang Friedt (left), Head of Plant Breeding Dept at Justus-Liebig-University, Giessen, Germany, during the visit and presentation at the German Plant Breeding Society conference.



A worker (left) feeding a young drone (male honeybee) with nectar.

Photo courtesy Barbara Baer-Ihmhoof

## Honey week highlights ‘More than Honey’

Dr Barbara Baer-Ihmhoof

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Western Australia is about to celebrate Honey Week (29 April – 5 May) and this year's highlights include the award-winning documentary ‘More than Honey’, made by Oscar-nominated movie director Markus Imhoof, with scientific assistance from researchers at UWA's Centre for Integrative Bee Research (CIBER).

About a third of what we eat, including most fruit and vegetables, requires pollination by honeybees. Einstein once predicted that if bees were to die out, mankind would follow four years later.

Scarily, this scenario is not as far-fetched as it might sound: Millions of bees are dying worldwide. ‘More than Honey’ explores the reasons for this global catastrophe in a theatrical, internationally acclaimed documentary: we come eye-to-eye with bees in a hive; we follow one beekeeper who transports 15,000 hives on the back of his trucks all over the United States to pollinate endless monocultures of almond trees, where many of his “ladies” die of pesticides and parasites; we visit the idyllic Swiss Alps where a traditional beekeeper loses his hives to foulbrood, while in Southern China the bees have vanished completely and farmers hand-pollinate their apple trees.

But there is hope as well: we accompany the film crew on their visit to researchers at CIBER in Western Australia, where the bees are still healthy and scientists closely collaborate with local beekeepers in the search for solutions to safeguard honeybees.

CIBER, together with the Goethe Institute and the Swiss Embassy, will bring ‘More than Honey’ to an Australian audience at the Audi Festival of German Films 2 May, Cinema Paradiso, Perth. To view the trailer, visit: [www.ciber.science.uwa.edu.au/blog/?page\\_id=121](http://www.ciber.science.uwa.edu.au/blog/?page_id=121).

Other events for Honey Week 2013 include a bee exhibition at Scitech with daily visits (11am-2pm) by beekeepers and scientists and, on the last day (5 May, 11am – 4pm), a big Festival at the House of Honey in the Swan Valley. For further details visit:

Honey Week on facebook [www.facebook.com/HoneyWeek](http://www.facebook.com/HoneyWeek)

# Workshop kickstarts 'Environmental Research Prioritisation Framework'

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The need for environmental research is widely accepted, since our finite natural environment and resources have come under increasing pressure from man's efforts to meet the demands of a growing population in a changing climate.

This is where Winthrop Professor David Pannell, from UWA's Centre for Economic and Environmental Policy comes in: "To date there has been surprisingly little information available to help assess environmental research proposals, and what literature does exist, has largely focused on ad-hoc identification of gaps and shortcomings in completed projects," explains Pannell. "I decided to do something about this and secured the collaboration of eminent scientists from UWA, interstate and overseas with the aim to develop a framework that could be used by research organisations and funding bodies to examine and evaluate environmental research proposals."

At the end of February 2013, ten scientists and economists met in Brisbane for a one-week workshop on environmental research evaluation, including Professor Julian Alston (University of California-Davis) who is widely regarded as a world-leader on the topic of 'priorities of agricultural research'.

Participants identified key factors to take into consideration, including a proposed project's benefit for the community as a whole; feasibility of completing the environmental research; scale of the problem and of its effects; time lags until benefits would be generated; and the likelihood that research results will be adopted by decision makers or other users. There are plans for a joint publication on the outcomes of workshop, which could qualify as a milestone in the development of a scientific framework for the evaluation of environmental research proposals.

Given that some of the benefits of environmental research are intangible and therefore difficult to evaluate systematically, this is an ambitious quest, but if successful, a systematic framework for evaluation is likely to produce significant benefits. "One aim is to help environmental research funding organisations to select research that is ultimately likely to deliver the most valuable environmental benefits," Professor Pannell said.

The workshop was conducted as part of the ARC Centre of Excellence for Environmental Decisions and the National Environmental Research Park(NERP)-Environmental Decisions hub, funded by the Australian Government.

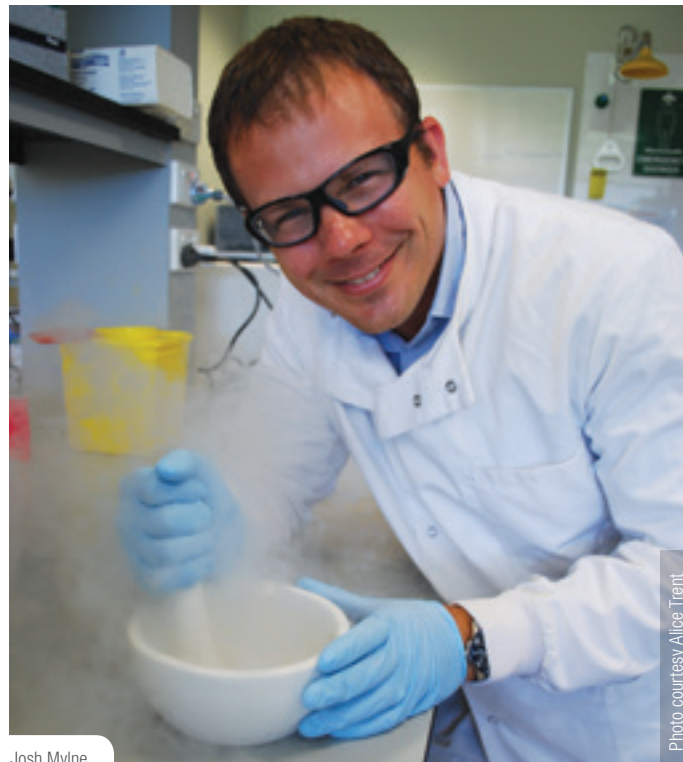
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(LtoR): Scott Jeffrey, Jonathan Rhodes, Eve McDonald-Madden, Garry Goucher, Terry Walshe and Julian Alston.

# Anti-cancer drug discovery in sunflowers brings new focus to research at UWA

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Josh Mylne

**Meet new Perth resident and winner of Australia's highest award for young plant scientists (the Peter Goldacre Award), Dr Josh Mylne. Dr Mylne has recently arrived from Brisbane to further his research on drug discovery in plants. His research follows on from his 2011 finding of how a cancer treatment drug-like protein called SFTI-1 could be made in sunflower seeds.**

Besides earning him the Peter Goldacre award in 2012, this discovery represents a big step forward in the quest to manufacture cheap and effective cancer drugs in plants – a process called "pharming".

The drug potential of the SFTI-1 protein comes from its ability to block a digestive enzyme that breast cancer cells use to destroy healthy tissue nearby, allowing the breast cancers to grow. If cancers can't multiply – they eventually die. Typically, cancer treatment involves an arsenal of drugs designed to target various weaknesses of the cancer cell and usually include an enzyme blocker such as this.

Mylne's further experiments showed something even more interesting; SFTI-1 is cut out of a larger protein segment and locks onto itself to form a tight protein 'ring'. This makes SFTI-1 ultra-stable and very difficult for any enzyme to attack it.

"This structural information on how ultra-stable molecules form could open the doors to creating a host of ultra-stable enzyme blockers," explains Mylne. "On top of this, further research has shown that SFTI-1 can be modified to block a variety of cancer proteins."

An ARC Future Fellowship has allowed Mylne to pursue this research in his own, new laboratory at UWA in collaboration with the ARC Centre for Excellence in Plant Energy Biology and the School of Chemistry and Biochemistry, and he is excited about the prospect of unlocking further benefits over the next five years.





## Symposium enhances links between Japanese and Australian plant scientists

Participants at the fourth Japan-Australia Symposium 'Plant Sciences for Agriculture IV' held at Murdoch University, Perth.

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**Winthrop Professor Tim Colmer** Email: [timothy.colmer@uwa.edu.au](mailto:timothy.colmer@uwa.edu.au)

Plant physiology, ecophysiology, molecular biology, pathogens and symbioses were topics discussed in a two-day (11-12th December 2012) Japan-Australia Symposium, titled 'Plant Sciences for Agriculture IV' held at Murdoch University. This was the fourth Japan-Australia Symposium organised by the joint hosts Associate Professor Derek Goto (Hokkaido University) and Professor Mike Jones (Murdoch University).

The symposium attracted fifty participants from eminent scientific organisations and universities of Japan and Australia. Eleven delegates were from UWA including four speakers from the School of Plant Biology, and several other UWA researchers and PhD students who presented posters.

Winthrop Professor Hans Lambers emphasised the significance for phosphate acquisition of cluster roots and massive carboxylate exudation by Proteaceae species, highlighting the value of this strategy in both young and old landscapes of Chile and Australia. He highlighted opportunities to learn from native plants to identify traits for crop improvement in nutrient acquisition and efficient use.

Winthrop Professor Tim Colmer presented recent findings on internal  $O_2$  transport via aerenchyma and the role of the inducible barrier to radial oxygen loss for the functioning of roots of rice in waterlogged soils, including collaborative work with scientists from Nagoya University (Japan). He also summarised recent findings on the ability of rice to photosynthesize when completely submerged during overland floods.

Dr Ricarda Jost described the role of phosphite action in protection of plants against the root rot pathogen (*Phytophthora cinnamomi*) that threatens natural ecosystems, and the emerging picture of the molecular and metabolomic responses of plants to phosphite. Interactions of phosphite with plant phosphate homeostasis were also considered.

Adjunct Senior Lecturer Dr Xinhua He discussed complex interactions among plants, mycorrhizal fungus and soil resources. Data presented were from his work conducted with collaborators at UC Davis (USA) on nitrogen transfer via networks of arbuscular mycorrhizas (AM) and ectomycorrhizas (EM) between oaks, and for the AM networks also with grasses/forbs.

The broad range of topics presented and expertise in the room resulted in lively discussions. Goto announced that he plans to organise the fifth Japan-Australia symposium, to be held in Japan.

## UWA hosts fourth Australia-China Joint Symposium on Science, Technology and Education



Executive Committee members of the Federation of Chinese Scholars in Australia (LtoR): Mingxing Zhang (UQ), Yonggang Zhu (CSIRO) Dongke Zhang (UWA), Huijun Zhao (Griffith Uni), Shaofang Wang (WA Chemistry Centre), Shaoqing Zhang (Griffith Uni).

**Ms Uly Fritsch** Email: [ully.fritsch@uwa.edu.au](mailto:ully.fritsch@uwa.edu.au)

**In December 2012, UWA hosted the fourth Australia-China Joint Symposium on Science, Technology and Education – the first time the event has been held in Western Australia.**

The four day symposium attracted more than 40 delegates from renowned Chinese institutions, including North China University of Electric Power (NCUEP), Chinese Academy of Sciences (CAS), Tsinghua University, and China University of Petroleum.

They were joined by representatives from Australian universities and government, as well as by top Chinese dignitaries, including Madam Wang Yin'er, Consul General of the People's Republic of China in Perth.

Among the plenary speakers were CAS Vice President, Professor Jinghai Li, UWA Nobel Laureate Professor Barry Marshall, UWA Vice Chancellor Professor Paul Johnson and NCUEP Vice President Professor Yongping Yang.

Food security, water, medicine, energy, culture and commerce were some of the agenda topics and the conference was a big success on all fronts: "UWA and NCUEP signed a research collaboration agreement, and many other research collaborations were initiated, with two of them already active," says Professor Dongke Zhang, Director of UWA's Centre for Energy and IOA and (then) President of the Federation of Chinese Scholars in Australia (FOCSA). "The program also included a postgraduate workshop for the first time which was well received by the participants."

The symposium was hosted by the Federation of Chinese Scholars in Australia, a consortium of 13 Chinese professional associations in Australia whose aim is to promote links and cooperation between the two nations sponsored by UWA, the Chinese Consulate General in Perth, NCUEP, BHP, CAS, Griffith University and the University of New South Wales.

The next symposium will be held in Wollongong in June 2014.

# UWA Turf Research Open Day a winner



Louise Barton with visitors at the UWA Turf Research Open Day.

**An Open Day at the UWA Turf Research Facility drew a crowd of local government and industry representatives, keen to see how turfgrass can be managed most effectively on a water allocation.**

During the Open Day at UWA's Shenton Park Field Station, a series of trial plots demonstrated how different water allocations, in combination with a wetting-agent, have influenced turfgrass quality and development of soil water repellence, or "dry-patch".

Associate Professor Louise Barton, from UWA's Turf Research Program, provided a brief overview and update about the Water Allocation Project that is investigating a range of turfgrass irrigation schedules, in combination with wetting agent treatments, in the quest to retain quality public parks and sporting ovals while using water efficiently.

Participants were then invited to view the turfgrass plots, and to evaluate the effectiveness of the various water allocations and irrigation schedules, combined with different rates of wetting agent applications.

Barton said the Open Day was a huge success: "The large number of participants confirmed that government and industry are keen to understand how to use their water allocation most effectively. Local Government recognises both the important role of parks and sporting ovals for community well-being, and also the importance of sustainable, effective turfgrass management to ensure we can maintain the quality of our parks and sporting ovals now and in the future."

The Water Allocation Project is supported by Horticulture Australia Ltd in collaboration with the turf industry and state and local government agencies.

## French intern impresses growers and scientists alike

**Assistant Professor Michael Considine**  
Email: [michael.considine@uwa.edu.au](mailto:michael.considine@uwa.edu.au)



Izzy Desmons demonstrating dissection and diagnosis of bud necrosis to Carnarvon table grape growers.

**In Late 2012, French Masters student Isabelle "Izzy" Desmons spent a three month internship at IOA and made a great contribution in an ARC-Linkage Project that investigates grapevine bud necrosis and flower abortion.**

The focus of Desmons' visit year was a research project to survey the incidence and severity of bud necrosis and flowering disorders in Carnarvon and the Swan Valley, across several properties. She spent six weeks in Perth honing her skills and knowledge of vine physiology, followed by five weeks in Carnarvon and a final week in Perth.

"Izzy gained a great rapport with the grape growers and impressed everyone with how quickly she took not only to the dissecting microscope, but also to gumboots, secateurs and the art of table pruning," says Assistant Professor Mick Considine, Desmons' mentor on the project.

Desmons was the second student from the French institution 'l'Ecole d'Ingenieurs de Purpan' in Toulouse, to do an internship with the UWA/DAFWA project team. Each year, students enrolled in a 5-year Master of Agriculture course in France spend an internship with an academic or industry partner, including two international visits to English-language countries.

If you are interested in hosting a student between July and September please contact Michel de Rancourt via email ([michel.derancourt@purpan.fr](mailto:michel.derancourt@purpan.fr)).

## Inaugural Alan Robson Medal awarded to UWA Plant Biologist

**Late last year, UWA plant biologist Associate Professor Michael Renton became the winner of the inaugural 'Robson Medal for Research Excellence in Agriculture and Related Areas'.**

With the retirement of UWA's former Vice Chancellor, Emeritus Professor Alan Robson, in 2012, the Science Faculty established this new annual award to acknowledge Robson's significant contributions over the decades during his time within the Faculty and the University at large.

Staff and PhD students from UWA, DAFWA and CSIRO, were invited to submit peer reviewed papers for assessment for this award. Only papers whose first or last authors had completed their PhD within the past ten years were included. The call attracted 27 applicants competing for the medal and prestige only – there was no cash prize.

Members of the UWA Institute of Agriculture shortlisted six papers for review by Robson who selected the winning entry *Does cutting herbicide rates threaten the sustainability of weed management in cropping systems?* The article was published in the *Journal of Theoretical Biology* (2011) **283**: 14-27.

Runners up were UWA scientists Dr Imran Malik (Centre for Legumes in Mediterranean Agriculture) and Dr Roberto Busi (Australian Herbicide Resistance Initiative).

Robson praised the high standard of entries and commended the multi-disciplinary approach used to synthesise different types of knowledge in Renton's paper. Since winning the award, Renton has given a plenary presentation on the topic at the Global Herbicide Resistance Challenge conference held in Fremantle in February, and been invited to give a similar presentation at the European Weeds Conference to be held in Samsun, Turkey, in June this year.

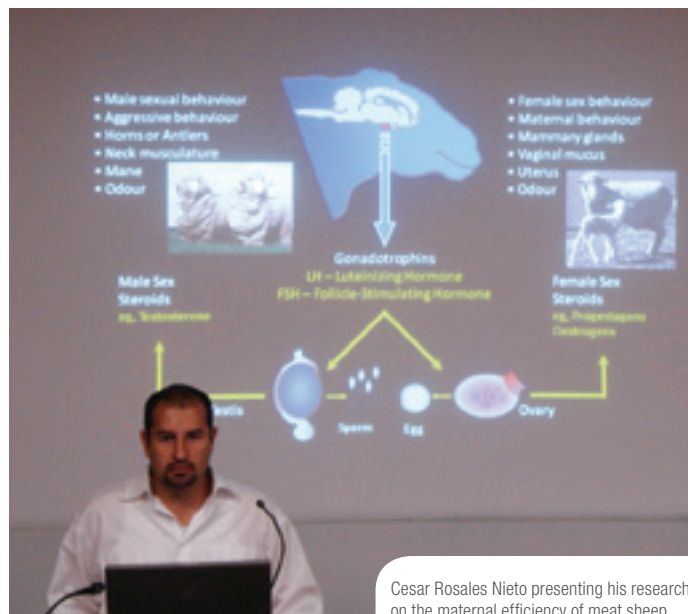


Michael Renton receiving his medal from Alan Robson.



# PhD project sets new direction for sheep breeding research

Winthrop Professor Graeme Martin Email: [graeme.martin@uwa.edu.au](mailto:graeme.martin@uwa.edu.au)



Cesar Rosales Nieto presenting his research on the maternal efficiency of meat sheep.

A project by PhD student Cesar Rosales Nieto is exploring ways to breed sheep at one year of age and challenging a five-decade old dogma in the process.

If successful this would address the two most urgent needs of the Australian sheep-meat industry: to reduce its carbon footprint, and to increase the size of the sheep flock. Winthrop Professor Graeme Martin, Deputy Director of IOA, explains: "These two goals are most readily achieved if we can breed sheep at a younger age – obviously, reproduction is fundamental to increasing flock size but, equally important, meat sheep that are not reproducing are only producing greenhouse gas, thus increasing "emissions intensity (the amount of greenhouse gas emitted per kilogram of product)."

Delayed breeding represents a major inefficiency in reproduction – traditionally, farmers do not breed their female sheep until they are two years old, wasting a year of productivity and also adding a year of greenhouse gas production; delayed breeding also lengthens the generation interval and thus slows down genetic progress.

In his project, UWA PhD student, Cesar Rosales Nieto, is working towards practical ways to breed sheep at one year of age. "I am focusing on the genetics of body composition, particularly muscle development, and was able to show that in ewe lambs, genetic improvement for rapid muscle development can advance puberty and increase the reproductive efficiency of the ewe lambs."

As Martin points out, this is a whole new direction in reproductive physiology and poses the question how muscle can affect the onset of puberty and fertility.

"Nieto has evidence that a muscle protein, follistatin, might trigger this onset and he presented his findings to the annual conference of the European Association of Animal Production in Bratislava, Slovakia (27-31 August 2012). After the conference, he visited laboratories in Austria, France and Spain to discuss his work and potential collaboration with UWA. His travel was funded by a Postgraduate Research Travel Award from Convocation, the UWA Graduates Association."

# UWA students recognised for successes in agriculture and related disciplines

Students in agriculture and related areas at UWA have been on a roll, claiming several prestigious prizes and awards for their outstanding achievements (cf page 10).

IOA congratulates the following students:

NAME	PRIZE/AWARD
Ms Louise Fisk	Best presentation by a scientist under 35 years, at the <i>Joint Australian and New Zealand Soil Science Conference in December 2012</i> . Title of her presentation: <i>Soil solutions for diverse landscapes. The effect of temperature and organic carbon availability on the relative rates of microbial nitrogen immobilisation and nitrification in a semiarid soil.</i>
Ms Karlia Meitha	Winner of a Grape and Wine Research and Development Council travel award for her project <i>Investigation of respiratory control in dormant grapevine bud.</i>
Mr Bidhyut Banik	Winner of the CSIRO Sustainable Agriculture Flagship 2013 Postgraduate Scholarship within the theme of <i>Plants, ruminants and methane: it's pure chemistry.</i>
Ms Genevieve Massam	Winner of the Undergraduate Prize for the WA branch of the Australian Agricultural and Resource Economics Society (AARES) for her thesis: <i>Community Values for the Benefits of Carbon Farming: a Choice Experiment Study.</i> Presented at the 57th AARES conference in Sydney in December 2012.
Ms Nhan Tran	Winner of the Outstanding Master's Thesis Award for her thesis: <i>Determinants of Investment in Rural Households in Vietnam</i> Presented at the 57th AARES conference in Sydney in December 2012.

## Careers Night for Agriculture students: Wed 22 May

[www.facebook.com/events/426578277422539/?ref=14](http://www.facebook.com/events/426578277422539/?ref=14)

The Ag Institute of Australia (WA Division) presents its annual Careers Night on Wednesday 22 May at Curtin University, Chemistry Building.

The event is open to all university students in WA enrolled in Agriculture and related disciplines. Students will have the opportunity to engage with a wide range of employers across the industry, including agribusiness, agronomy and animal science.

The event will commence at 6pm. For further information visit the Ag students' facebook page at [www.facebook.com/events/426578277422539/?ref=14](http://www.facebook.com/events/426578277422539/?ref=14)

# Two UWA Ag Science graduates claim top awards at Young Professionals in Agriculture Forum



Young Professionals in Agriculture Forum award winner Emma Downsborough, (centre) with runner-up Caris Jones, (right) and third prize winner Chloe Bairstow (left), Don Burnside (far left) of Ag Institute Australia (WA Division) and Department of Agriculture and Food Director General Rob Delane (far right).

**Ms Uly Fritsch**

**Email:** [ully.fritsch@uwa.edu.au](mailto:ully.fritsch@uwa.edu.au)

**UWA Agricultural science graduate Emma Downsborough has taken out the highest award at the Young Professionals in Agriculture Forum, followed by Caris Jones, another UWA Ag Science graduate who claimed second prize and was also recognised for delivering the best presentation.**

The annual Young Professionals in Agriculture Forum is hosted by the Department of Agriculture and Food, WA (DAFWA) and Ag Institute Australia (WA Division), and recognises the work of tertiary students who have completed an undergraduate degree and are studying agriculture-related subjects at Western Australian universities. Finalists are required to submit a research paper and deliver a presentation.

Emma Downsborough who is from a farm at Burracoppin and moved to Perth to study Agricultural Science and Commerce at UWA, achieved the top award for her work on consumer preferences and willingness to pay for local food products.

Before graduating with first class honours from her double degree, she had already worked two years part-time as a Marketing Officer for agricultural business 'Grain Assist'. "I am really interested in becoming more involved in local food marketing if the opportunity arises," says Downsborough.

"My honours studies at UWA have prepared me well and they were really exciting; I owe a big thank you to my supervisors Professor Michael Burton and Assistant Professor Amin Mugeru (both from

the School of Agricultural & Resource Economics and IOA) for their fantastic support throughout my honours year."

Caris Jones, from a wheat and sheep farm near Dowerin, took out second prize for her work on feed-use efficiency and its impact on the fertility of Merino ewe lambs, and her presentation was judged second to none. Her honours project supervisors were Professor Phil Vercoe, School of Animal Biology and IOA, Associate Professor Andrew Thompson, Murdoch University and DAFWA, and Ms Beth Paganoni, DAFWA.

Department Director General, Mr Rob Delane, said the outstanding work carried out by the six finalists indicated the high standard of young professionals entering the agriculture and natural resources sectors.

"I have really loved my time at UWA," says Jones, "especially the hands-on approach and the opportunities to visit the UWA Future Farm and see first-hand what's going on in terms of the latest research."

Since graduating, Jones has returned home to put the knowledge she developed at UWA to the test on the family farm for a while. After that, she plans to look further afield and pursue a professional career related to agriculture, which should not pose too much of a problem, according to Mr Delane: "The diverse range of careers in the agriculture and food sector provides exciting opportunities for such talented and motivated graduates and the range is expected to increase further with the ever-growing global demand for food."



Participants and presenters of the Microspore Culture and Flow Cytometry Short Course.

## UWA conducts training courses in plant breeding techniques

**In 2012, the International Centre for Plant Breeding Education and Research (ICPBER) at UWA shared its expertise and state-of-the-art facilities with three diverse training groups who had come to learn new skills and methods related to plant breeding.**

The *Microspore Culture and Flow Cytometry Short Course* was held 9 – 13 July 2012 and attracted researchers from the public and private sector in Indonesia, Bangladesh and India, keen to learn this technique that can shorten the plant breeding cycle from nine years down to one year. Participants developed practical skills in flow cytometry and learned the theory behind successful microspore culture and doubled haploidy.

Presenters included Dr Janine Croser (CLIMA) and Dr Kathy Heel (CMCA). The course was supported by the Crawford Fund WA.

The Workshop *Experimental Design and Application of Linear Mixed Models in Plant Research* was held 5 and 12 of October for PhD students from WA universities and for scientists working in the industry. The aim of the course was to introduce more advanced experimental designs and the latest statistical techniques (such as linear mixed models) for the analysis of field and glasshouse experiments.





Short Course held on UWA campus by ICPBER.

## Popular courses in new plant technologies

The course was presented by Associate Professor Katia Stefanova (IOA and Statistics for the Australian Grains Industry – SAGI, supported by GRDC).

A two-day course in plant breeding *Knowing Your Customer: Breeding for value-added traits and new crop opportunities* was held 11-12 December 2012.

The concept of value-added trait breeding was illustrated with examples of crop varieties which are bred for specific ethnic markets, such as in the Seeds of Life project in Timor-Leste. Among the crops bred for specific ethnic markets are soybean, wheat for udon noodles, and certain vegetables. The course participants included interstate and WA-based breeders as well as several PhD students from WA universities.

The course was led by Professor Istvan Rajcan, a soybean breeder and geneticist from the University of Guelph in Canada.

The three courses were a big success which Professor William Erskine (Director, ICPBER) attributes to the enthusiasm of participants and presenters alike, and their commitment to develop new skills, insights and knowledge.

## Lessons from aphid-study for oil exploration, agriculture and virology

Associate Professor Christian Nansen  
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**A novel procedure which allows observation of aphid-feeding has revealed lessons for oil exploration, and introduced a new direction for research in virology, applied entomology and agriculture.**

As part of a GRDC-funded project '*Detection and epidemiology of spring aphids and redlegged earth mites*', UWA Entomologist Associate Professor Christian Nansen (IOA and Animal Biology) and colleagues used a simple chemical staining procedure and succeeded in observing the 'leaf-drilling' by aphids, that is, aphids in the process of feeding.

In Western Australia (and many other parts of the world) aphids are economically important pests on crops like wheat and canola. Their feeding stresses crops and stunts growth, resulting in lower yield and less profit.

"Often, crop loss due to aphid feeding is attributed mainly to disease-transmitting (plant pathogenic) viruses, which are transferred by aphids to the crop plant in the feeding process," explains Nansen.

"Management of aphid pests has traditionally focused on killing them, because 'a dead aphid doesn't feed', but killing the aphids should actually be considered secondary to suppressing its feeding."

"Aphids are fluid feeders (like other piercing sucking insects) and don't have mandibles for chewing. Instead, they feed by inserting their

complex mouthparts (stylets) into the living tissue that carries organic nutrients (phloem) in the vascular system of plants."

Phloem-feeding, however, is a risky business, as the vascular system in plants is under a very high positive pressure (approximately 500 times higher than the blood pressure in humans). "Aphids face a challenge which is quite similar to explorers drilling for oil or gas," explains Nansen. "When their mouth parts reach the phloem – the target resource – in the vascular system, they must control the pressure to avoid an explosion."

Aphids have solved this challenge by secreting a cement-like material (a stylet sheath) around their mouth parts, and it immediately hardens and works like a catheter or pressure valve, protecting the aphid from blowing up.

Using a simple chemical staining procedure, Nansen and colleagues were able to observe and visually record the stylet sheath being secreted (as indicated on the photo by the arrow), i.e. the moment of 'leaf-drilling' / feeding .

Arguably the most significant benefit of this staining/visualisation procedure (of 'leaf-drilling') is that it allows quantification of how many times crop leaves are being fed on by aphids. "We are now able to count the number of stylet sheaths and determine to what extent different agro-chemicals (including pesticides) affect the risk of virus transfer to crops and how aphid feeding varies among crop varieties," explains Nansen, "and this represents a big step towards effective control of aphids and improved profitability of crop production."



An aphid feeding on a canola leaf. Chemical staining of the stylet sheath secreted around the mouth parts can be used to quantify the number of feeding events and possible risk of virus transfer.

# Chickpea improvement for a changing world: collaboration with India on abiotic stress tolerance

Winthrop Professors Tim Colmer and Neil Turner  
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UWA Plant and Agricultural Scientists visited India during February 2013 for chickpea project discussions and participation in a Consultative Group in Agricultural Research (CGIAR) planning meeting on grain legumes.

UWA and International Crops Research Institute for Semi-Arid Tropics (ICRISAT) have collaborated for several years on disease resistance and abiotic stress tolerance pre-breeding in chickpea. Recently, the collaboration has been expanded by an ACPFG-led Australian consortium as part of an Australia-India Strategic Research Fund (AISRF) *Grand Challenge Project* with ICRISAT as the lead organisation in India. The project interacts closely with the *Pulse Breeding Australia* chickpea program.

Winthrop Professors Neil Turner, Tim Colmer and Kadambot Siddique visited India for discussions on a project finishing in 2013 on salinity and drought tolerance, while the activities in the new AISRF *Grand Challenge Project* gathered momentum. "This was the final meeting scheduled for our current project on salinity and drought stress, for which the focus at UWA has been on salt tolerance," said Colmer. "Although chickpea is a salt-sensitive species, we have identified useful variation in partnership with our colleagues at ICRISAT and made progress on understanding the impact of salinity on reproductive success. We still have a way to go to fully understand the mechanisms of tolerance and to improve knowledge on the genetics. We have a launching pad to enable these further discoveries in collaboration with the expanded partnerships available via the AISRF *Grand Challenge Project*.

Presentations by members of the project team highlighted the substantial progress made during the previous six months. In particular, discussions focused on a large joint data set obtained in collaborative experiments which involved research officer John Quealy sampling tissues at ICRISAT with chemical analyses conducted at UWA and experimental work by ICRISAT PhD student Pushpavalli. Pushpavalli had visited UWA on a Crawford Fund award. Turner summarised the success of the project meeting: "It was very pleasing to see how this team work involving short exchange visits between UWA and ICRISAT has enabled joint data sets. We now plan to write up this work for a joint publication."

The visit to ICRISAT also enabled the UWA team to participate in a CGIAR workshop *Global Research Program on Grain Legumes*. The *Grain*



(Back row from left) Neil Turner, Harsh Nayyar (Panjab University) and Kadambot Siddique with two PhD students examining heat damage in chickpeas at Panjab University.

*Legumes Program* is a partnership between four CGIAR Centres: ICRISAT as lead Centre, Centro Internacional de Agricultura Tropical (CIAT), International Center for Agricultural Research in the Dry Areas (ICARDA) and International Institute of Tropical Agriculture (IITA), along with a number of representatives from various national programs and selected university collaborators. The Grain Legume Program will focus on increasing productivity, both via breeding and improved management practices, of: chickpea, groundnut, faba bean, lentil, pigeon pea, common bean and soybean. The priority pulse crops vary for the target regions in Asia, Africa and Latin America.

"We had two days of intensive small group discussions on specific issues. The workshop provided an opportunity to learn about the CGIAR Grain Legume Program and its directions for the next 3 to 10 years. There are plenty of opportunities for collaboration with the program on areas of mutual interest. The meeting involved about 100 legume scientists, so it was good to catch up with old friends and to meet new colleagues," said Siddique.

This is an exciting time for chickpea research in Australia and more widely, with the recent completion of the draft genome (see also [www.news.uwa.edu.au/201301295388/business-and-industry/chickpea-breakthrough-aims-feed-millions](http://www.news.uwa.edu.au/201301295388/business-and-industry/chickpea-breakthrough-aims-feed-millions)), the new *Grand Challenge Project* commencing in 2012 in Australia (Australian Centre for Plant Functional Genomics, UWA,

University of Queensland, Royal Melbourne Institute of Technology, University of Melbourne), several PhD research student projects underway, international collaborations, and the planned interactions of molecular geneticists, physiologists, crop scientists, and breeders focused on chickpea.

From ICRISAT in Hyderabad, Turner and Siddique went to Panjab University in Chandigarh to visit Professor Harsh Nayyar who is a collaborator on the AISRF project on abiotic stress tolerance in chickpea. Nayyar and his students have been studying the effects of heat and salinity on the biochemical and hormonal balance of chickpea. In an interactive session at the university, the visiting scientists were impressed by the quality of the research being conducted by the students. Joint papers between ICRISAT, Panjab University and UWA are underway.

Siddique and Turner then travelled to Punjab Agricultural University (PAU) in Ludhiana which has been involved in previous collaborations with UWA and ICRISAT on ascochyta tolerance and salinity in chickpea and canola. After visiting the field at PAU where extensive agronomic, breeding and pathology evaluation of chickpea is being conducted and lupins from WA are being trialled, Siddique and Turner each gave a public lecture in the university and discussed future collaboration with Professor B.S. Dhillon, Vice-Chancellor of PAU. "These visits are important in both continuing collaboration and attracting students to UWA," concluded Siddique at the end of the visit.



# Young Agricultural Economist a rising star



Marit Kragt

Assistant Professor Marit Kragt has become the latest winner from UWA's School of Agricultural and Resource Economics (SARE) to claim an international essay prize that is open to young agricultural and resource economists worldwide.

Her winning essay "Comparing stated and inferred attribute attendance models

in environmental choice experiments" looks at respondents' choice behaviour in environmental non-market valuation surveys. Choice experiments use such non-market valuation surveys to estimate what values people attach to environmental assets.

Kragt is passionate about her research on economic valuation of environmental changes: "If we can present policy-makers with sound economic data, they are more likely to be convinced about the importance of improving environmental management."

Previous winners of the competition from the UWA School of Agricultural and Resource Economics are Michael Burton (1982), Ben White (1985), David Pannell (1989), Abbie Rogers, nee McCartney (2006) and Graeme Doole (2010).

Australian Research Council Federation Fellow, Winthrop Professor David Pannell, said Kragt's achievement highlighted the global relevance and the high level of research at SARE.

To read about further innovative environmental research at SARE, refer to page 6.

# Promising field pea and lentil innovations in Bangladesh

Professor William Erskine

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(LtoR): Zainul Abedin (IRRI), Matiur Rahman (IRRI), William Erskine (UWA) and Eric Huttner (ACIAR) speaking to the media at a field day on relay-sown lentils in Bangladesh.

UWA's Centre for Legume Research in Mediterranean Agriculture (CLIMA) in collaboration with Bangladesh Agriculture Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI) is aiming to intensify cropping in the rice-based system with short-duration food legumes in Western Bangladesh. The project is funded by the Australian Centre for Agricultural Research (ACIAR). Three legumes, lentil, field pea and mung bean are target crops for the project.

"Relay sowing of lentil into the standing preceding monsoon rice crop is looking a highly promising technology," says Professor William Erskine, Director of CLIMA. "Last winter season in a village of western Bangladesh we conducted a 2 ha area demonstration of relay sowing of lentil on farmers' fields. This season farmers in the same area have expanded the use of the technology to ~30 ha."

As Erskine points out, this is not the only success: "Cultivation of field pea as a vegetable is also gaining momentum in the project. In the western districts of Bangladesh a new early flowering field pea for a green pod harvest can be profitably grown between successive rice crops by farmers."

On a travelling workshop (11-19 February, 2013) to the project area, the team were accompanied by ACIAR staff – Dr Eric Huttner and Ms Simrat Labana. The feedback from farmers about relay sowing lentil and green pod production in peas were very encouraging.

The project also organised a training course on *Disease Epidemiology and Disease Forecasting*, funded by the Crawford Fund and ICARDA, as part of capacity building in the project. Dr Moin Salam and Mr Bill Macleod (Department of Agriculture and Food WA) were trainers for the course which ran from 3-10 February 2013 at BARI. The course was held because Stemphylium blight was identified as a key issue in lentil production in 2012. There were 16 course participants, comprising 13 from Bangladesh, two from Nepal and one from India.

## UWA 'Legal Eagles' keen to improve water use compliance

continued from page 4

enforcement policy, administrative measures and criminal enforcement provisions. She discovered that, although non-compliance with water restrictions has been wide-spread, little use is made of the current enforcement mechanisms in the *Rights in Water and Irrigation Act 1914 (WA) (RIWI Act)*.

Key reforms proposed by Robertson to address these issues include more extensive metering and auditing of water entitlements; strengthening of the criminal enforcement law by closing gaps in the offence provisions; increasing penalties and introducing provisions that make it easier to prosecute offenders.

As WA faces increasingly drier climatic conditions and moves to implement the NWI regime, Sarah believes the timing is right: "The drafting of the new water resources management legislation presents a good opportunity to reform the enforcement system, and it is important that Government have the ability to enforce the law when it is appropriate."

Madeleine Hartley's research underscores the deficiencies in the *RIWI Act*, which also provides the regulatory framework for water extracted from Perth's principle underground water supply: the Gnangara groundwater system. Besides compliance issues (at the Department of Water and the stakeholder level), she blames negligent governance for the present scenario: "Limited stakeholder engagement is undermining the legal and policy measures designed to ensure that water is used efficiently and sustainably." She believes that reform of the *RIWI Act* could provide the foundations for more stringent enforcement of the policy framework: "Tighter legal mechanisms which enhance prescribed methods of WUE in law and policy are required to ensure WA's long-term water security under a drying climate and decline in groundwater availability."

All of this work has been funded by the National Centre for Groundwater Research and Training: [www.groundwater.com.au/](http://www.groundwater.com.au/)

# Harnessing microbes to release the P 'bank' in soil

Associate Professor Deirdre Gleeson Email: [deirdre.gleeson@uwa.edu.au](mailto:deirdre.gleeson@uwa.edu.au)



Deirdre Gleeson with visiting PhD student, Pu Shen (Chinese Academy of Agricultural Science) who is conducting the glasshouse trials.

**Researchers at UWA are working to provide grain growers with practical management options that harness soil micro-organisms to unlock part of the fixed phosphorus bank in Australian arable soils.**

Australian grain producers apply \$1 billion worth of phosphorus (P) fertilisers each year, but only 50% is taken up by plants. Much of the remaining fertiliser P becomes fixed in soil and the P 'bank' in Australian arable soils is estimated to be worth \$10 billion.

Gleeson, from the UWA's Institute of Agriculture (IOA) and School of Earth and Environment says, "We are aiming to identify management practices that farmers can use to make soil micro-organisms

release phosphorus from the bank in soil so that it is available for their crops to take up."

The research is being funded by GRDC, as part of its second Soil Biology Initiative, and ARC.

"Soil micro-organisms have a range of processes to release phosphorus from the bank in soil," explains Gleeson. "We're investigating whether manipulating organic matter inputs can cause soil micro-organisms to make phosphorus stored in the soil bank available for crops to take up. In our research we are assessing two ways in which the amount of carbon and nitrogen in the organic matter – known as the carbon to nitrogen ratio – could cause soil micro-organisms to release phosphorus from the bank in soil."

Firstly, the researchers are determining whether applying organic matter with a *low* carbon to nitrogen ratio causes soil micro-organisms to release phosphorus from the bank in soil.

Gleeson explains, "Applying organic residues with low carbon-to-nitrogen ratios to soil may cause soil micro-organisms to become starved of phosphorus. This may cause the micro-organisms to release phosphorus from the bank of fixed phosphorus in soil, which will later become available for plants to take up."

The second way in which applying organic matter to soil may cause soil micro-organisms to release phosphorus from the bank of fixed phosphorus in soil, is by applying organic materials with a *high* carbon-to-nitrogen ratio.

Gleeson says, "Applying organic materials with high carbon-to-nitrogen ratios may result in a microbial community in soil that is smaller, but more diverse – and a more diverse microbial community may have more ways to release phosphorus from the bank in soil."

The project combines cutting edge technology – such as the use of a CT scanner and UWA's powerful NanoSIMs microscope – with glasshouse experiments.

Researchers are currently analysing the data from the first experiment of ryegrass grown in a glasshouse and treated with different carbon-to-nitrogen ratios and Gleeson says, "There have been promising results from the first sixteen weeks of the experiment and they will help us determine how influential the carbon to nitrogen ratio is in terms of releasing fixed phosphorus from soil."

## Distinguished Professor from Lanzhou University visits UWA

UWA's thriving collaboration with Lanzhou University, China, received another boost last November when Professor Feng-Min Li, Changjiang Scholar and Director of LZU's Institute of Arid AgroEcology, paid a one-week visit to UWA.

During his visit Li held discussions with Winthrop Professor Kadambot Siddique, IOA Director, and Winthrop Professor Neil Turner, on a proposed joint workshop to be held in Beijing later this year.

He also visited the UWA Future Farm 2050 in Pingelly, and the CSIRO facilities in Floreat, where he met with senior scientists from the joint UWA-CSIRO Animal Production Research Unit and from the UWA-CSIRO Plant Genome Initiative.

He deepened his understanding about the way UWA steers and supports its research and Postgraduate Programs during meetings with Winthrop Professor Robyn Owens, Deputy Vice-Chancellor (Research).

"Professor Li's visit was very productive and generated ideas for new initiatives that will strengthen our collaboration further for the benefit of dryland agricultural systems in China and Australia."

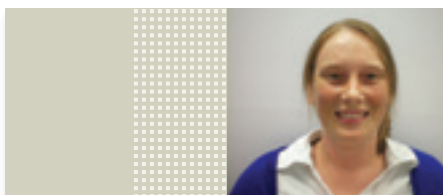
For more information about LZU-UWA collaborations visit [www.news.uwa.edu.au/201110074025/research/no-turning-back-uwa-relationship-china](http://www.news.uwa.edu.au/201110074025/research/no-turning-back-uwa-relationship-china) and (page 12) [www.ioa.uwa.edu.au/\\_\\_\\_data/assets/pdf\\_file/0004/1891534/final-Dec-Newsletter-for-web.pdf](http://www.ioa.uwa.edu.au/___data/assets/pdf_file/0004/1891534/final-Dec-Newsletter-for-web.pdf)



(LtoR): Dan Murphy (Chair in Soil Biology, Earth and Environment), Graeme Martin (Deputy Director IOA and Head of School, Animal Biology), Feng-Min Li (Director, LZU), Kadambot Siddique (Director, IOA), Tim Colmer (Head of School, Plant Biology and IOA), Guijun Yan (Plant Biology and IOA).



# New staff



## Kathleen DeBoer

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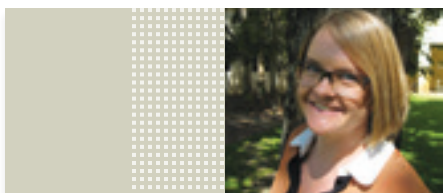
The Joint UWA-CSIRO Molecular Plant Pathology and Crop Genomics Group led by Winthrop Professor Karam Singh (IOA and CSIRO) has appointed new Research Associate Dr Kathleen DeBoer, to help deliver novel strategies for enhanced resistance to diseases in Australian agriculture.

Dr Kathleen DeBoer completed a PhD in molecular genetics at Monash University, where she examined the genetic regulation of pyridine alkaloid metabolism in *Nicotiana* plants. For the past three years she has held a post-doctoral research position in Professor Moira O'Bryan's laboratory, Monash University, where she used mouse models to understand the genetics of male infertility in humans.

In her new role Kathleen will work on a GRDC-funded project '*Strategies to Provide Resistance to the Economically Important Fungal Pathogen, Rhizoctonia solani*, a pathogen common in most soils and able to cause disease in a large number of cultivated plants.

She will apply molecular biology and genomics to investigate the plant side of the interaction with the pathogen; in addition, she will use comparative genomic and transcriptomic analysis to explore the fungal side of the interaction.

"This is a fantastic opportunity for me," says Kathleen, "and I am excited to be working with world-class scientists on this cutting-edge research to help combat the large economic impacts of *R. solani* in Australian agriculture."



## Cara Allan

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In March this year, the UWA Institute of Agriculture welcomed Cara Allan in her role as Graduate Research Assistant, a newly created position within IOA, working with Dr Ken Flower and Winthrop Professor Kadambot

Siddique on an ACIAR/AusAID funded conservation agriculture project between Australia, ICARDA and Iraq.

Cara completed a Bachelor of Animal Science degree with Honours at Murdoch University in 2012.

Her interest in agricultural research was sparked during a stint of compulsory on-farm Industry experience, undertaken as part of her degree.

"I really look forward to finally being able to apply the years of university education I have received and to work within the UWA Institute of Agriculture," says Cara.

She will also be involved with a joint long term no-till project between UWA and the WA No-Tillage Farmers Association (WANTFA) to measure the insects and diseases and a CSIRO led crop stubble cover project. Both form part of the above ACIAR project.



## Matthias Leopold

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Assistant Professor Matthias Leopold has recently arrived from Germany to join the Soil Science team within School of Earth Science and Environment. Matthias came from the Science Centre of Weihenstephan at the Technical University of Munich.

As a highly qualified soil-geomorphologist he focuses on different aspects of soil development and soils as archives of the landscape history. Thus, he integrates knowledge from the study of soils in their natural environment (pedology) and geoscience to research and understand near-surface processes at various scales and environments.

Matthias is involved in the new 'CRC for Polymer' program where he intends to focus on the spatial distribution of soil water using shallow, high resolution geophysical techniques. He developed expertise in these methods during previous projects such as monitoring the spatial water infiltration of artificially created soils during mine site rehabilitation and estimating potential depth of root penetration in agricultural duplex soils.

Matthias has also worked on projects related to radionuclide contamination (Cs-137) in forest soils. He was part of a team developing monitoring concepts with respect to regional changes in clay mineralogy, organic matter and texture composition.

Matthias is a member of the Critical Zone Observatory at the University of Colorado at Boulder USA, where he studies the complexity and connectivity of soils with the underlying subsurface, recently known in science as the "critical zone".

"With the excellent facilities and support at UWA, I am keen to establish new connections between Soil Science and Geoscience as well as Archaeology and to make a meaningful contribution within established collaborations with Agriculture and Plant Science," says Matthias.

# Alumni

Ms Anke van Eekelen

Email: [ankev@iinet.net.au](mailto:ankev@iinet.net.au)



## Caris Allen, BSc, Grad Dip

In 2010, Caris Allen completed a Bachelor of Science with a double degree in Environmental Science and Land & Water Management, followed by a Graduate Diploma in Science Communication at the University of Western Australia. She is currently Research Account Manager at the WA-office of Kalyx.

Following her graduation, she found employment with national contract research company Kalyx.

Her initial role was to administer the field trials provided to clients, ranging from the University of Adelaide to international companies like Monsanto. It tested her insight knowledge of research design and data handling as much as her ability to communicate project progress and outcomes to clients within the breeding portfolio of Kalyx.

With Australia currently being the market place for research on genetically modified (GM) crops, Caris was recently given a new challenge. She now oversees the compliance to protocol in GM-trials conducted by Kalyx in this heavily regulated sector of agriculture.

Caris thrives at Kalyx and is set for a career in modern agriculture, which she attributes to her high-quality education in a multi-disciplinary degree at UWA, accompanied by an exceptional work ethic fostered throughout her studies at UWA.

# Alumni<sub>continued</sub>

## Robert Haddrill, BSc (Hon)

In 2007, Rob Haddrill completed a Bachelor of Science (Agriculture) with Honours (Science Communication) at UWA. He is currently State Manager for Glencore Grain Australia in Western Australia.

Better known to the average Western Australian as number 42, a full-back AFL player for the Fremantle Dockers, he retired from national football around the time he finished his degree.

His sporting career may have stretched his time at university but combined with his rural background, it also provided the ideal opportunity to engage in a fourth year research project concerned with the social capital of sporting clubs in country towns. A blend of science communication and agriculture allowed Rob to develop networking skills, which he admits have become essential to his successful way of doing business with farmers for Glencore Grain.

The challenge that internationalisation of agricultural products brings to farmers feeds Rob's passion for communicating with them about what happens with grain beyond their farm gate. A recent field trip to Europe has strengthened his understanding of the new face of agriculture: quality assurance of sustainably grown grain.

Rob sees a bright future for himself in the free trade of agriculture between farmers and market and enjoys the opportunities that Glencore Grain can offer him.



## Agriculture 1962 Reunion Dinner

(LtoR) David Highman, David Biggins, Mike Page, John Morrissey, Graham Walton, Jim Malcolm, Ian Alexander, Peter Eckersley, Wally Cox, David Cannon.

**Mr David Cannon Email: [dac@inet.net.au](mailto:dac@inet.net.au)**

In November last year, a Reunion Dinner was held to bring together students who began their course in the then Faculty of Agricultural Science in 1962. Around 46 Agricultural Science students started that year with around 15-16 students graduating in 1965-66. Since then, all had headed off in a variety of directions, and in a large number of cases lost contact with each other.

The University's Office of Development assisted with names and contact information, and from the list provided, fourteen former students were tracked down, of whom ten were able to attend with their partners, while apologies were received from another four. Winthrop Professor Kadambot Siddique (Director IOA) and his wife Almaz joined them as their guests, to reminisce about the past, and what they had done over the intervening years.

Among the academic staff fondly remembered were Professors Underwood, Reg Moir, Lex Parker, Henry Schapper, Roger Mauldon, Jack Longergan

and Jim Quirk, all of whom had a significant influence on students and development of the State's agriculture.

After the dinner, Siddique provided an overview of the existing agriculture courses and research activities and the changes and challenges facing the future.

Most of the attendees had spent their working life with the Department of Agriculture (David Highman, Mike Page, John Morrissey, Graham Walton), while others had ventured into areas such as philosophy (Dr David Biggins), teaching (Ian Alexander), business and IT (David Cannon), public service (Jim Malcolm) and consulting (Peter Eckersley, Dr Wally Cox). Clearly, a course in Agriculture at UWA provided excellent foundation for careers in a variety of disciplines!

All enjoyed the catch-up after so many years, and resolved to have another reunion dinner in four years' time to celebrate 50 years since graduation.

## New postgraduate students

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Mr Bidhyut Banik	The mechanism of antimethanogenic potential in <i>Biserrula pelecinus</i>	Animal Biology Plant Biology and IOA	Prof William Erskine; Res/Asst/Prof Zoey Durmic; Dr Clinton Revell (DAFWA)	University Postgraduate Award
Ms Rasika Kankanamalage	Racial status of <i>Pseudocercospora capsellae</i> in Western Australia, the identity and mechanisms of host resistance in oilseed Brassica	Plant Biology and IOA	W/Prof Martin Barbetti; Dr Mingpei You	UWA SIRF
Ms Yupin Li	Pythium root rot of Phaseolus bean – interactions of host resistance with water availability	Plant Biology and IOA	W/Prof Martin Barbetti; Dr Mingpei You; W/Prof Tim Colmer	IPRS
Mr Hieu Sy Tran	Black spot disease complex in field pea – pathogens involved and interactions with host resistance	Plant Biology and IOA	W/Prof Martin Barbetti; Dr Mingpei You; Prof Tanveer Khan	AusAID
Ms Louise Fisk	The balance between microbial nitrification and nitrogen immobilisation rates and variation in a Western Australian semiarid soil	Earth and Environment and IOA	Prof Dan Murphy; Assoc/Prof Louise Barton	Australian Postgraduate Award; UWA Establishment/Relocation Award; UWA Safety-Net Top-Up Scholarship
Mr Habtamu Ayalew Tamir	TBA	Plant Biology and IOA	Assoc/Prof Guijun Yan; Dr Xuanli Ma	AusAID



## New research funded projects

TITLE	FUNDING PERIOD	FUNDING BODY	SUPERVISORS
Australia- India Grand Challenge genomic approaches for stress tolerant chickpea'	2012 – 2015	Australian Centre for Plant Functional Genomics (ex DIISR Australia India Strategic Research Fund)	W/Prof Timothy Colmer; W/Prof Kadambot Siddique
Maintenance of soil organic carbon levels supporting grain production systems the influence of management and environment on Carbon and Nitrogen turnover	2012 – 2014	DAFWA Ex DAFF Carbon Farming Futures 'Filling the Research Gap'	Prof Daniel Murphy
Economic analysis of gene deployment strategies for high priority exotic pests and chemical supply to manage pest incursions	2012 – 2014	CRC Plant Biosecurity	Prof Benedict White
Enhancing WA's chickpea industry through targeted demonstration and extension of new aschocyta-resistant improved varieties and lines in partnership with grower groups	2013 – 2014	Council of Grain Growers Organisation (COGGO)	W/Prof Kadambot Siddique; Prof Tanveer Khan
Polymers for improving soil moisture management and cropping productivity	2012 – 2014	CRC for Polymers	Prof Daniel Murphy; W/Prof Anthony O'Donnell; Assoc/Prof Louise Barton; Asst/Prof Deirdre Gleeson
Valuation of economic, social and ecological costs and benefits	2012 – 2015	CRC for Water-Sensitive Cities	Asst/Prof James Fogarty; W/Prof David Pannell
Better regulatory frameworks for water-sensitive cities	2012 – 2016	CRC Plant Biosecurity	Assoc/Prof Alex Gardner
Research and technical support for the project empowering farmers to adopt behavior change in a carbon economy	2012 – 2014	South Coast Natural Resource Management Inc (NHT)	Assoc/Prof Barbara Cook
New technologies and enhanced techniques for water resource assessment in a changing climate	2013	Worldwide Universities Network (WUN)	Prof Neil Colesl; Prof Mark Rivers
The value of carbon and biodiversity services provided by native shrubs on farmland	2013	UWA-UQ bilateral Collaboration Award	Asst/Prof Marit Kragt
Development of a web-based tool to interpret and quantify spray coverage obtained from commercial pesticide applications	2013 – 2014	COGGO	Assoc/Prof Christian Nansen
Facilitating NRM planning for climate change - baseline climate change knowledge for the southern and southwestern flatlands	2013 – 2015	Department of Climate Change & Energy Efficiency NRM Impacts & Adaptation Program	Assoc/Prof Barbara Cook; Asst/Prof Peter Speldewinde; Mr Benjamin Ford; Mr Simon Neville; Miss Rebecca Davies
Investigation of respiratory control in dormant grapevine bud	2013	Grape and Wine Research Development Corporation	Asst/Prof Michael Considine
Identifying the biochemical and molecular bases of 2,4D herbicide resistance in the economically important weed <i>Raphanus raphanistrum</i> (wild radish)	2013 – 2015	Nufarm	W/Prof Stephen Powles

## Current and upcoming visitors to IOA

VISITOR	VISITORS' ORGANISATION, COUNTRY	HOST DETAILS/PURPOSE	DATES
Prof Scott Nissen	Colorado State University	W/Prof Stephen Powles	Jan – Aug 2013
Miss Haiyan Kong	MOE Key Laboratory of Arid and Grassland Ecology, Lanzhou University, China	W/Prof Kadambot Siddique; W/Prof Neil Turner	Mar 2014 – Feb 2014
Ms Jocelyne Christelle	Director of Studies and Research, Rural Development National Organization, Gabon	W/Prof Kadambot Siddique	13 – 20 April 2013
Prof Ron Madl	Department of Grain Science & Industry, Kansas University	W/Prof Kadambot Siddique	July 2013

# Research and industry recognition

NAME	AWARD
Prof Michael Burton and Adj/Assoc/Professor Dan Rigby	Won the 'Quality of Research Discovery award' for their paper: <i>Supply Uncertainty and the Economic Value of Irrigation Water</i> . Presented at the 57th annual Australian Agricultural and Resource Economics Society (AARES) Conference in December 2012
Prof Ben White, Adj/Senior Lecturer Rohan Sadler	AARES-Wiley Blackwell Australian Journal of Agricultural and Resource Economics Best Paper Award for their article: <i>Optimal Conservation Investment for a Biodiversity-rich Agricultural Landscape</i>
Dr Muhammad Farooq Adj/Lecturer	Top cited paper award for 2012, from the University of Agriculture, Faisalabad, Pakistan

## UWA IOA Publications 2012 (November – December)

### Refereed journals

Abiko T, Kotula L, Shiono K, Malik AI, Colmer TD and Nakazono M (2012). Enhanced formation of aerenchyma and induction of a barrier to radial oxygen loss in adventitious roots of *Zea mays* ssp *mays*. *Plant, Cell and Environment* **35**: 1618-1630.

Bazihizina N, Barrett-Lennard EG and Colmer TD (2012). Plant growth and physiology under heterogeneous salinity. *Plant and Soil* **354**: 1-19.

Bazihizina N, Barrett-Lennard EG and Colmer TD (2012). Plant responses to heterogeneous salinity: growth of the halophyte *Atriplex nummularia* is determined by the root-weighted mean salinity of the root zone. *Journal of Experimental Botany* **63**: 6347-6358.

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Borger C, Renton M, Riethmuller G, Hashem A (2012). The impact of seed head age and orientation on seed release thresholds. *Functional Ecology* **4**: 837-843.

Bramley H, Ehrenberger W, Zimmermann U, Palta JA, Rüger S and Siddique KHM (2012). Non-invasive pressure probes magnetically clamped to leaves to monitor the water status of wheat. *Plant and Soil*. DOI 10.1007/s11104-012-1568-x.

Chai TT, Simmonds D, Day DA, Colmer TD and Finnegan PM (2012). A GmAOX2b antisense gene compromises vegetative growth and seed production in soybean. *Planta* **236**: 199-207.

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Cowling WA (2012). Sustainable plant breeding *Plant Breeding* DOI 10.1111/pbr.12026.

Djajadi, Abbott, LK and Hinz C (2012). Synergistic impacts of clay and organic matter on structural and biological properties of a sandy soil. *Geoderma* **183-184**: 19-24.

Fan J-W, Du Y-L, Turner NC, Li F-M and He J (2012). Germination characteristics and seedling emergence of switchgrass with different agricultural practices under arid conditions in China. *Crop Science* **52**: 2341-2350.

Farrell C, Hobbs RJ and Colmer TD (2012). Microsite and litter cover effects on seed banks vary with seed size and dispersal mechanisms: implications for revegetation of degraded saline land. *Plant Ecology* **213**: 1145-1155.

Foster K, Ryan MH, Real D, Ramankutty P and Lambers H (2012). Drought resistance at the seedling stage in the promising fodder plant *tedera* (*Bituminaria bituminosa* var. *albomarginata*). *Crop and Pasture Science* **63** (10): 927-943.

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Goggin DE, Powles SB and Steadman (2012). Understanding *Lolium rigidum* seeds: the key to managing a problem weed? *Agronomy* **2**: 222-239.

Greenway H, Kulichikhin KY, Cawthray GR and Colmer TD (2012). PH-regulation in anoxic rice coleoptiles at pH 3.5: biochemical pHstats and net H<sup>+</sup> influx in the absence and presence of NO<sub>3</sub><sup>-</sup>. *Journal of Experimental Botany* **63**: 1969-1983.

Islam S, Ma W, Buirchill BJ, Appels R and Yan G (2012). Genetic and environment interactions of seed storage proteins in narrow-leaved lupin (*Lupinus angustifolius*). *Crop and Pasture Science* **63**: 1066-1074.

Kalra RK, Anil B, Tonts M and Siddique KHM (2012). Self-help group in Indian agriculture: a case study of farmer groups in Punjab, northern India. *Agroecology and Sustainable Food System*. **37**: 1-22.

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Mugera A (2012). Sustained competitive advantage in agribusiness: applying the resource-based theory to human resources. *International Food and Agribusiness Management Review* **15**: 27-48.

Mugera A, Langemeier M and Featherstone AM (2012). Labor productivity growth in the Kansas farm sector: a tripartite decomposition using non-parametric approach. *Agriculture and Resource Economics Review* **41**: 298-312.

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Nansen C, Trostle C, Angadi S, Porter P, Martini X (2012). Abiotic factors affecting canola establishment and insect pest dynamics. *International Journal of Agronomy*, Article ID 838903. DOI:10.1155/2012/838903.



Nichols PGH, Revell CD, Humphries AW, Howie JH, Hall EJ, Sandral GA, Ghamkhar K and Harris CA (2012). Temperate pasture legumes in Australia—their history, current use, and future prospects. *Crop and Pasture Science* **63** (9): 691-725.

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Vila-Aiub MM, Gundel PE, Yu Q and Powles SB (2012). Glyphosate resistance in *Sorghum halepense* and *Lolium rigidum* is reduced at suboptimal growing temperatures. *wileyonlinelibrary.com* DOI 10.1002/ps.3464.

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## Book Chapters

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## UWA IOA Publications 2013 (January – March)

### Refereed journals

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Ahmad-Hamdani MS, Yu Q, Han H, Cawthray GR, Wang SF and Powles SB (2013). Herbicide resistance endowed by enhanced rates of herbicide metabolism in Wild Oat (*Avena* spp.) *Weed Science* **61**: 55-62.

Arpiwi NL, Yan G, Barbour EL and Plummer JA (2013). Genetic diversity, seed traits and salinity tolerance of *Milletia pinnata* (L.) Panigrahi, a biodiesel tree. *Genetic Resources and Crop Evolution* **60**: 677-692.

Barton L, Murphy DV and Butterbach-Bahl K (2013). Influence of crop rotation and liming on greenhouse gas emissions from a semi-arid soil. *Agriculture, Ecosystems and Environment* **167**: 23-32.

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## Book Chapters

Nansen C, TJ Ridsdill-Smith TJ (2013). Chapter 7: The performance of insecticides – a critical review, In: Trdan S (Ed.): *Insecticides – Development of Safer and More Effective Technologies*. ISBN: 978-953-51-0958-7, InTech, DOI: 10.5772/53987.

## UPCOMING MEETINGS AND EVENTS

### Local events

The Ag Institute of Australia Careers Night  
22 May, 6pm  
Curtin University, Chemistry Building  
www.facebook.com/  
events/426578277422539/?ref=14

### International event

InterDrought-IV Conference  
2–6 September  
Perth, Australia  
www.interdrought4.com

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