The UWA Institute of Agriculture

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THE UNIVERSITY OF WESTERN AUSTRALIA

MINGENEW FIELD WALK THROUGH FABA BEAN FIELD

Growing legumes: the solution to human health and sustainable food production

Wider consumption of grain legumes is the answer to improving human health and meeting the increasing global demand for food, according to research published in *Nature Plants* by The University of Western Australia researchers and collaborators.

Also known as pulses, grain legumes have a significant role because of their health, sustainability and environmental benefits, such as reducing the carbon footprint and the need for nitrogen fertiliser application.

The research was compiled by a multi-disciplinary team from the Worldwide Universities Network (WUN) and led by researchers from The UWA Institute of Agriculture's (IOA) Food Quality and Human Health research theme, including eight from across UWA's Faculty of Science and Faculty of Medicine, Dentistry and Health Sciences.

Research Theme Co-leader Dr Michael Considine from UWA's School of Plant Biology and Department of Agriculture and Food Western Australia said that although the health benefits of a grain legume rich diet are copious, they form only a minor part of current diets especially in developed countries.

"Australians eat on average less than one third of a serve (<25 g) of grain legumes a week, and only 35% of people eat grain legumes regularly," Dr Considine said.

"Consuming 20 to 40g of grain legumes per day contributes to reduced risk of mortality because of their benefits against major non-communicable diseases and their risk factors, including cardiovascular disease, diabetes, cancer, obesity and gut health."

Dr Considine proposed that increased public perception of the health and wellbeing advantages of a grain legume-rich diet may be an important driver of culture change in considering grain legumes as key to food and nutritional security.

Co-author Hackett Professor Kadambot Siddique, IOA Director who was recently named Special Ambassador for Pulses 2016 by the United Nations Food and Agricultural Organization (UNFAO), said the International Year of Pulses 2016 provides an excellent opportunity to reflect on the status of global grain legume production, consumption and potential opportunities for future expansion.

"Grain legumes provide an unparalleled solution to food and nutritional security because of their inherent capacity for symbiotic atmospheric nitrogen fixation, which provides economically sustainable advantages for farming," Prof Siddique said.

"However, grain legume crops will only achieve a competitive advantage if their profitability to the farmer is similar or exceeds that of the dominant cereal crops. To date, grain legumes have received limited attention from policy-

makers and governments despite their multiple benefits."

The current level of research and development funding for grain legumes is low and unstable. A recent global survey shows an investment of US$175 million per annum for the 13 grain legume crops, a trifling amount compared to the billions of dollars invested into three major cereal crops each year.

Prof Siddique said there are still tremendous opportunities to accelerate grain legume production and productivity.

"The use and application of innovative technologies such as, improved germplasm, conservation agriculture, integrated crop management, crop-livestock systems, rice-fallow replacement, seed and marketing systems, and value addition would help close the major yield gaps between on-farm yields and potential yields remarkably," Prof Siddique said.

"Research and development must target particular grain legume crops grown across a range of farming systems, from subsistence agriculture to sophisticated commercial production and various agro-ecologies."

To hasten the adoption of grain legume production technology by resource-poor farmers in developing countries, the researchers proposed that on-farm, farmer-participatory adaptive research and developmental approaches were required to a much greater extent than is currently being implemented.

Director's Column

Hackett Professor Kadambot Siddique
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The good winter rain over past few months for most of Western Australia's grainbelt have brought a very promising outlook for this season. I hope the ideal growing conditions continue and the risk of frost damage does not affect the crop estimate of 17.25 million tonnes (Grain Industry of WA's July estimate).

In this issue of IOA News, we continue to celebrate the International Year of Pulses 2016, not just for the role they play in farming systems for crop diversification, nitrogen fixation and availability of other nutrients in the system, but also for the numerous health benefits that can be obtained from eating just 20g to 40g of pulses each day (see cover story and pages 6 and 10).

I am especially proud of the recently published paper in *Nature Plants* (see cover story) which demonstrates the inter-disciplinary nature of IOA's Food Quality and Human Health theme which led the research. Eight researchers across UWA's Faculty of Science and Faculty of Medicine, Dentistry and Health Sciences collaborated with international researchers through the Worldwide Universities Network (WUN) to produce the exceptional work. Well done to all involved.

The seven students who presented at this year's IOA Postgraduate Showcase: Frontiers in Agriculture (see page 4) did us proud with their engaging deliveries of the diverse range of findings in agriculture related research. Congratulations to the students for a job well done! WA's chief scientist Professor Peter Klinken gave the closing address and encouraged the students to continue sharing their discoveries the same way a company shares its achievements with its shareholders.

Following the June showcase, IOA hosted the tenth annual Industry Forum discussing the China-Australia Free Trade Agreement and its impact on the agriculture industry. Thank you again to the CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship for supporting this year's event.

The next event on the horizon is the Pingelly Astrofest, at UWA Farm Ridgefield in Pingelly on Saturday, 17 September. Astrofest is an astronomy event for the young and old to learn more about the Universe and night sky. Hosting such events on UWA Farm Ridgefield is one of the ways we engage with the local community, and contribute to strong rural communities – an important aspect of sustainable agriculture. There is an exciting prize on offer to those who register to attend by 8 September at **ioa.uwa.edu.au/events/register**.

On a final note, I want to congratulate Prof Daniel Murphy and his team for the commercialisation of the new soil wetting technologies they co-developed with researchers from Swinburne University and BASF, through the CRC for Polymers (see page 3). It is a great example of research impact that helps farmers improve water efficiencies and increase crop yields, and I am pleased the achievements were recognised with CRC Polymers awarding them the Chairman's Award for Excellence in Commercialisation.

Congratulations to all involved.

UWA Farm Ridgefield hosts new demonstration site for DAFWA's eConnected Grainbelt program

DR MATTHIAS LEOPOLD ASSESSES SOIL MOISTURE PROPERTIES IN A PIT AT ECONNECT FIELD DAY ON UWA FARM RIDGEFIELD

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UWA Farm Ridgefield will house a new weather station hosted by Wheatbelt NRM, as part of DAFWA's high-tech eConnected Grainbelt project.

The Royalties for Regions funded program provides grain growers with an increasing network of local weather and soil moisture data throughout the grainbelt of WA. The growing network of instruments will harness information that will assist growers with management decisions for a profitable farm business.

A total of 11 new weather stations will be hosted in rural WA by 14 grower groups.

Dr Guy Boggs from the Wheatbelt NRM in Northam and Asst/ Prof Matthias Leopold from IOA and the School of Earth and Environment successfully applied for UWA Farm Ridgefield to be a new eDemonstration site, and instruments were installed on the farm in June 2016.

Soil moisture probes which will complete the station will be installed by the end of August with data made available online at **agric.wa.gov.au/weather-stations** for the West Pingelly region.

Part of this new venture includes hosting multiple field days and workshops over the next few years to assist with better flow of information between grain growers, their consultants, suppliers, researchers and other industry partners.

Working with project partners from Planfarm and DAFWA, the UWA Farm Ridgefield will be a focus for demonstrating how monitoring technology and decision support tools can be used to make more sustainable and profitable decisions tailored to individual wheatbelt farms.

The inaugural field day was held on 15 June 2016 at UWA Farm Ridgefield, and was attended by 25 people from the local farming community, the Narrogin Agriculture College and UWA staff and students.

Project partners from Planfarm and UWA started the afternoon with an overview presentation of the eConnected Grainbelt program followed by a presentation of available e-tools that can assist farming management decisions related to weather and soil data.

The second half of the event targeted the use of in-paddock monitoring tools to better manage frost risk in grainbelt farms and assess soil properties in the field and their relationship to soil moisture distribution to help increase and secure sustainable growing decisions.

INDUSTRY FORUM PANELLISTS MS LILI PAN, MR BRYN DAVIS, DR TREVOR LUCAS AND DR CHERYL KALISCH GORDON

ChAFTA's impact on agriculture in the spotlight

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The China-Australia's Free Trade Agreement (ChAFTA) and its impact on the agriculture industry was in the spotlight at IOA's 2016 Industry Forum.

Western Australia's agricultural exports to China were valued at $1.7 billion in 2014-15, led by barley, wool, canola and wheat, and with numbers set to increase, industry experts came together to tackle how to use the agreement to our best advantage.

Parliamentary secretary to the WA Minister for Agriculture and Food; Transport, the Hon Jim Chown officially opened the forum, emphasizing the importance of China as a trading partner to WA.

Grain Growers trade and market access manager Dr Cheryl Kalisch Gordon gave the keynote address and described the key elements of the free trade agreement. She said the ChAFTA is timely, and provides opportunity for WA agriculture as China faces enormous challenges to meet the changing demands of the rapidly increasing urban population and rising middle class incomes.

Dr Kalisch Gordon said that whilst tariff reductions have helped level the playing fields in Australia's grain export industry, the ChAFTA does not mean all barriers to trade have been removed. Australia must nurture relationships with its trading partners to ensure commercially meaningful trade benefits.

Focusing on grains sold into China, CBH Group's head of trading Trevor Lucas painted a positive picture of the Australian grain industry but said that limited Australian grain production growth dictates that growers will align their future production and sales programs into markets providing the highest sustainable value.

"China's growing demand for grain imports will continue to provide opportunities for Australia, leveraging off its high quality products," Mr Lucas said.

"Free trade tariff concessions must be passed on by Chinese buyers to ensure they are competitive with regional Australian customers. China will need to provide value to the Australian grain industry to focus on it as a key trading partner," Mr Lucas said.

Australia China Business Council (WA Branch) executive president, and executive director of China Business at MinterEllison Ms Lili Pan agreed, saying there is strong demand for WA agricultural products but also significant challenges.

Co-presenting with colleague Mr Bryn Davis, special counsel corporate/mergers and acquisition at MinterEllison, the duo discussed specific challenges on the Chinese demand side, such as scale and commodity mix, and the need to embrace different agri-investment models that focus capital where it is most needed.

"Numerous studies have identified that WA agri-industry needs significant capital to expand to meet demand for products and potential products," Ms Pan said.

"China can be a major source of that expansion capital, if we are able to harness the potential investment. This will require productive land expansion ahead of investor capital."

Celebrating the tenth industry forum, IOA director Hackett Professor Kadambot Siddique said he was encouraged to see the event cemented in the agriculture industry calendar and the positive feedback from attendees.

The Industry Forum was supported by CSBP Fertilisers through the CSBP and Farmers Ltd Golden Jubilee of Agriculture Science Fellowship.

UWA's best agriculture postgraduate students on show

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Seven PhD candidates from four schools within the Faculty of Science presented their research in June at the tenth annual Postgraduate Showcase: Frontiers in Agriculture 2016.

From managing cabbage aphids in canola crops to how forage plants affect embryo development in sheep, the event once again showed the diversity of agriculture-related research.

Plant Biology researcher Nathan Craig presented his findings on how seasonal factors influence the benefit of break crops under long term no-tillage. Nathan studied two contrasting crop rotations, one wheat-chickpea-canola rotation, and one wheat monoculture. The results showed that the grain yield and nitrogen benefit of the crop rotation was equal to 44 kg of Nitrogen per hectare. Nathan's research is funded by the GRDC Grains Research Scholarship.

Animal Biology research Joseph Steer, whose research is funded by the Australian Wool Innovation and Department of Agriculture and Food presented his research into identifying which odours attract blowflies to sheep.

Understanding how these odours influence blowflies provides sheep breeders with an opportunity to selectively breed sheep for resistance to flystrike, a disease that costs the Australian sheep industry around $280 million dollars a year.

Ghanaian student Rebecca Owusu's study focussed on African farmer's adoption of new technology. The results of a survey of approximately 300 farmers suggested that for the adoption of modern technology to be successful, the attributes that farmers value need to be considered, as not all farmers are driven by a profit or subsistence objective. Rebecca's research is funded by an AUSAID scholarship.

DAFWA development officer Dustin Severtson is conducting his PhD studies in the School of Plant Biology in a tactical approach to managing cabbage aphids in canola crops. Currently, there is no sampling plan that growers can use to inspect plants or know what infestation level results in yield loss. They therefore use a preventative method, and spray across entire fields on a set date. Dustin's research showed that sequential sampling reduces effort and error, and stratification reduces error across large fields. He said targeted sampling can increase the likelihood of detecting the aphids, and that growers only need to act and spray once 20 per cent of plants are infested with aphids.

Taking on a challenge affecting many farmers in WA, Iraqi scholar Abdulkareem Alsih is studying the hydrology of water repellent soils. Using the distinct differences in surface temperature dynamics between water repellent and wettable soils, Abdul and is developing novel approaches to non-invasive monitoring of soils.

Agricultural economics student Jacob Hawkins presented his research on how China's changing diet is impacting greenhouse gas emissions. As millions of Chinese people have become wealthier, their diets have shifted from a predominantly vegetarian based diet, to more fresh fruit and vegetables, meat and dairy products. Jacob has analysed how much of the increases in greenhouse gas emissions were a result of increase food consumption, the types of food consumed and the technologies used to produce foods.

"Meat will always generate a disproportionate amount of greenhouse gas relative to crops. But my research is finding that while China's diet is changing with its growing wealth, innovation is limiting the rise of greenhouse gases associated with its meat consumption to levels well below what has been feared," Jacob said.

The final presentation for the day was Malaysian student Anna Amir who is researching the effect of plant extract and plant secondary compounds from grazing new legume pasture Biserrula pelecinus on reproduction in sheep. From her study, we have a better understanding on the risk of new forages on sheep reproduction, and compounds that could be used to control fertility.

WA's chief scientist gave the closing address and encouraged the students to continue communicating their research findings as often as possible. He said the onus was on scientists to promote itself to the general public, government and funding bodies to ensure they continue to prioritise science.

"Every time a listed company makes a discovery, the company makes sure it tells its shareholders," Prof Klinken said. "We need to think the same way."

IOA Director Prof Kadambot Siddique said he was pleased to see students from Curtin and Murdoch University attend the event and support their peers in their common quest to feed a growing world and the need to be environmentally sustainable.

NAGOYA UNIVERSITY DELEGATES MET WITH KEY STAFF AT UWA TO DISCUSS A JOINT PHD DEGREE

NAGOYA UNIVERSITY DELEGATION VISIT UWA

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A delegation of five academics from Nagoya University (NU) visited UWA in late April 2016, for discussions aimed at increasing research collaborations in agriculture and related disciplines, and to work towards establishing a joint PhD degree program.

The delegation from the Graduate School of Bioagricultural Sciences was made up of researchers in areas of plant and animal sciences and biotechnology. Prof Mikio Nakazono provided an impressive overview of the Graduate School of Bioagricultural Sciences at NU and Prof Tim Colmer summarised research in Agricultural Science at UWA. He also gave a brief description of his collaborations with Prof Nakazono and Prof Ashikari who each lead research groups at NU.

IOA members and UWA researchers working on complementary topics presented short talks and time was allocated to discussions to explore common interests and plans to develop joint research were established.

Prof Colmer said joint research interests across disciplines will be important to underpin a successful joint PhD degree program in agriculture and related disciplines between the two universities.

"The NU delegation and various UWA researchers, expressed high interest to collaborate in research and to pursue a joint PhD degree program. Also discussed were ways to increase undergraduate student exchanges," Prof Colmer said.

Prof Colmer, who has been collaborating with Prof Nakazono for some years visited NU in June 2016. In addition to his joint experiments at NU on root aeration of maize and its wild relative teosinte during waterlogging, he gave a lecture to introduce UWA Agricultural Science to a broader group of staff and students at NU. He also met with several laboratory group leaders interested to link with various researchers at UWA.

Planning for the prospective UWA-NU joint PhD degree has progressed and a proposal that meets the requirements of both universities is being developed. A formal submission is then required for the Government of Japan.

"Our aim is for research collaborations to commence as soon as possible, for example via short exchanges of staff and current PhD students," Prof Colmer said.

"A MoU will be signed, and the proposal for a joint PhD degree will be developed during 2017, with the view for PhD students to commence from October 2018."

ON THE PULSE

The University of Sydney's Faculty of Agriculture and Environment hosted the 2016 Research Symposium titled *On the Pulse* on 12 July 2016 in Sydney.

The symposium brought together international and Australian experts to present their latest research and ideas on innovations to drive the industry's future. In particular, discussions around advances on future proofing pulse agriculture, pulse diversity, pulse benefits to agronomy and genetic pulse sustainability were held.

IOA Director Hackett Professor Kadambot Siddique delivered the opening address and said that whilst progress has been made in understanding drought, heat, salinity and chilling tolerance, its application in applied breeding programs is in the early stages. He also said identifying abiotic constraints in the target environment is crucial.

"Agronomic practices are available for minimising damage from several abiotic constraints," Prof Siddique said.

"Integrated physiological, genomic and breeding approaches combined with rapid and reliable phenotyping provide opportunities for developing abiotic tolerant grain legume cultivars for changing climate."

At the symposium, Prof Siddique interacted with various attendees and met Assoc/Prof Daniel Tan, Prof Richard Trethowan, Dr Helen Bramley and Assoc/Prof Brent Kaiser to discuss potential collaboration with UWA. He also met with Prof Doug Cook, University of California, Davis regarding potential collaboration on grain legumes and breeding related topics.

2016 INTERNATIONAL YEAR OF PULSES

IMPACT OF MILD (LEFT) AND SEVERE (RIGHT) SOIL WATER REPELLENCE ON WHEAT ESTABLISHMENT.
PHOTOS SUPPLIED COURTESY OF DAFWA AND GRDC

BASF licenses CRC for Polymers soil wetting technologies

BASF has licensed new soil wetting technologies co-developed with the Cooperative Research Centre for Polymers (CRCP) to help Australian farmers improve water efficiencies and increase crop yields.

The wetting agents are applied in a band to the surface soil directly above the seed, concurrently with the seeding operation, where they significantly improve water infiltration in the soil, reducing run-off losses and increasing the extent of moisture retention in the developing root zone.

More than five million hectares of Australian soils used for cropping are susceptible to water repellence. This water repellence causes rainfall run off, poor furrow efficiencies, patchy seed germination and therefore reduced crop yields.

In 2012, BASF commenced a five-year collaboration with the CRCP to develop a new range of polymers to help farmers better manage water and nutrients in soils. The collaboration, which also received funding support from the Grains Research and Development Corporation (GRDC), brought together an interdisciplinary team of material researchers, biologists and agricultural scientists from BASF with experts in physical chemistry, soil and plant science, and biophysics from Swinburne University of Technology, UWA, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the University of New England.

The research was led by Professors David Mainwaring (Swinburne University), Daniel Murphy (UWA and IOA) and Alexander Wissemeier (BASF).

"The research included laboratory studies on the effects of wetting agent formulation on the interaction of water with contrasting Australian soil types ranging from severely water repellent through to soils that showed only low water repellence. This led to the development of a new range of soil wetting agents and a diagnostic soil test, allowing farmers to select the most effective wetting agent based on the properties of their soil," Prof Wissemeier explained.

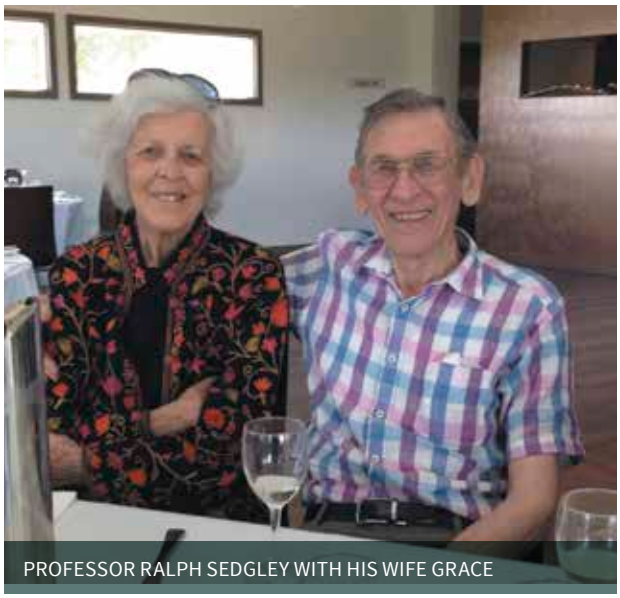
"The soil diagnostic developed in our research provides enhanced reliability to user decisions in the agricultural community based on soil characteristics and seasonal moisture expectations," Prof Mainwaring said.

The final stages of the collaboration involve further evaluation of the effectiveness of the technology in glasshouse germination trials, using a range of soil types, and field trials currently being conducted at wheat production belts in Western Australia, South Australia and Victoria.

"Throughout the grain belt production gains can still be made through improved water and nutrient use efficiency. The new soil wetting agents will aid farmers by capturing rainfall that is plant-available while the soil diagnostic improves the reliability of the wetting agent selection to soil type. Together this will benefit the Australian grains industry by narrowing the gap between actual and attainable yield," Prof Murphy said.

The CEO of the CRCP, Dr Ian Dagley said this is yet another example of the great value of the Australian Government's Cooperative Research Centres Programme.

"This project has allowed us to address a major issue for Australian grain producers by assembling the best multidisciplinary team of researchers from across five organisations, and to provide our commercial partner, BASF, with technologies that it can readily make available to interested farmers."



PROFESSOR RALPH SEDGLEY WITH HIS WIFE GRACE

VALE PROFESSOR RALPH SEDGLEY

21 February 1931 – 6 November 2015

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With a heavy heart I share the news of the passing of Professor Ralph Sedgley who passed away in Canberra on 6 November 2015 following a stroke. His family were with him by his bedside in the days leading up to his death.

Ralph was a member of UWA's Department of Agronomy from 1968 until he retired in 1991. I am one of the many students who were fortunate to have been supervised and taught by Ralph. He supervised my PhD research from 1981 - 1984, throughout which he was patient, encouraging and dedicated. He imparted on me much more than just science, but life lessons that I carry through with me today.

Ralph was appreciated by the various generations of students in the BSc in Agriculture that he taught. He was well-known as a very approachable and knowledgeable lecturer in crop physiology, imparting to students the importance of being quantitative in studies of crop adaptation.

Following his retirement from academic life, Ralph continued to contribute to science by devoting himself to his protea growing enterprise at Baldivis, south of Perth, where he undertook a plant breeding programme. He and his wife Grace played a leading hand in the business of selling cut flowers in the local and export markets.

Ralph is survived by his wife Grace, sons Patrick and Simon, granddaughter Ellen and daughter in-law Kathy. He will be sadly missed by colleagues in IOA, Faculty of Science and all around the university.

DR YINGLONG CHEN DISCUSSES RESEARCH ON ROOT PHENOLOGY WITH UWA ALUMNI

BEHIND THE SCENES TOUR OF AGRICULTURE RESEARCH

UWA Alumni were treated to an exclusive behind the scenes tour of the agriculture glasshouses on 8 June 2016.

Organised by UWA's Development and Alumni Relations team, the group of sixteen first heard a brief overview from IOA Director Hackett Professor Kadambot Siddique about what research UWA is doing to tackle some of Western Australia's biggest agricultural challenges.

Prof Siddique then led the group through two glasshouses, where researchers Dr Yinglong Chen, Dr Sheng Chen, Dr Gulam Abbas, and PhD Candidate Candy Taylor shared the novel techniques they use to ultimately increase crop production in the changing and variable climate.

"We hear a lot about UWA's big picture achievements in agriculture through the media, but today we saw the hard work that goes into getting to that point," said one participant.

"Increasing future food supplies is such an important issue and I'm grateful to the researchers for taking the time to share the process with us, and of course for doing the research!"

GREENHOUSE GAS REDUCTION RESEARCHERS MARIT KRAGT (LEFT) AND NIKKI DUMBRELL AT THE UNIVERSITY OF WESTERN AUSTRALIA PHOTO: EVAN COLLIS

GRAIN GROWERS WELL SET FOR POSITIVE GREENHOUSE ROLE

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Agriculture remains a target in the world's push to reduce greenhouse gas emissions, but local studies show the industry here has ready-to-hand options that should not compromise production or profitability.

In research looking at ways to reduce cropping's contribution to greenhouse gas emissions, common management practices such as no-till and stubble retention have emerged as ready-made tools.

However, the extent to which these practices and other management changes help to reduce carbon dioxide and nitrous oxide emissions will vary across climate zones and soils.

Early results from a joint CSIRO and UWA research project show that emissions reductions from practice changes are achievable, but growers will need to know which options are relevant in their region and the possible effects on profitability.

The modelling study was part of the Carbon Farming Futures Filling the Research Gap program funded by the Department of Agriculture and Water Resources and the GRDC. It was conducted to predict the trade-offs between yield, farm profitability and greenhouse gas reductions under different management and conditions for representative case-study farms across Australia.

Focusing on WA, representative case-study farms were defined for the Dalwallinu and Kellerberrin areas. The modelling suggests that greenhouse gas reductions could come mainly from practices that help to increase carbon in the soil, namely:

- retaining stubble;
- using improved legume pastures instead of volunteer weedy pastures in winter fallows;
- opportunistic summer cropping with a short-term green manure legume; and
- regular applications of feedlot manure (if available).

The maximum predicted emissions reduction in these areas, compared to not retaining any stubble, is about 0.8 tonnes of carbon dioxide equivalents (CO_2-e) per hectare per year over a 100-year period. For a 1000ha farm, this emissions reduction would offset the emissions produced from burning about 270,000 litres of diesel every year.

The impact of manure on profitability also varies. Averaged over time, the results indicate the use of manure could help to at least maintain and potentially increase profitability in these case-study areas. However, there would be considerable year-to-year variability.

Overall, the results show it is possible to reduce greenhouse gas emissions on Australian grain farms by adopting practices that increase soil carbon and/or reduce soil nitrous oxide emissions.

Additionally, the results show that feasible changes to farm practices (for example, retaining stubble or reducing over-fertilisation with nitrogen) can reduce net greenhouse gas emissions, and may not necessarily reduce profitability.

This article was abridged from GRDC Ground Cover, Issue 123, July-August 2016. For the full version visit **grdc.com.au/media-centre/ground-cover**

SUE DODIMEAD WAS UWA STAFF FOR 35 YEARS

VALE SUSAN DODIMEAD

18 October 1941 – 18 July 2016

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Susan Dodimead, born in Torquay on 18 October 1941 in the South of England, died peacefully on 18 July 2016 after a brief illness.

Sue joined UWA in 1981 and the Centre for Legumes in Mediterranean Agriculture (CLIMA) in 1992, where she continued working through its various manifestations until June this year.

Sue was a trained accountant, and very well organised. She will be sorely missed for her warm, welcoming human and helpful attitude to all aspect of the Centre's administration in her service to agriculture at UWA.

She leaves behind Chiron, and four loving daughters Kim, Tracey, Caroline and Louise, 11 grandchildren and one great grandchild.

SCIENTISTS ARE ATTEMPTING TO BREAK THE BOTTLE NECK OF LUPIN GENETICS TO ENSURE LONG TERM PRODUCTIVITY INCREASES FOR FARMERS ACROSS THE STATE. PHOTO: CLEMENTS

Breakthrough in lupin genetics secures legume's future

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BREAKING the genetic bottleneck of the domesticated lupin plant could open up a world of possibilities for the legume in the global food industry.

Lupins, now well known for their high protein, high fibre and zero gluten content could be the next superfood if scientists could only improve their climate resilience, allowing WA farmers to consistently supply world markets.

Unlike its major competitor, the soybean, lupin varieties are completely GM-free.

But with 80 per cent of the world's narrow-leafed lupins grown in WA's grain belt, one poor season could cripple the industry and send interested consumers rushing back to the soybean for reliable supply.

Scientists now have a huge challenge in front of them to produce a lupin plant that is more adaptable to variable climatic and soil conditions and can be grown and yield more widely across the continent.

Adjunct Senior Lecturer Dr Matthew Nelson is one researcher who has been on a mission to improve the genetic diversity of the plant, which could allow it to be grown right across Australia's agricultural areas, thereby securing long term global markets.

In a four-year study, funded by the GRDC, and completed through UWA, Dr Nelson has discovered the gene that determines vernalisation response, or the requirement for the plant to have a cold period before flowering.

This now means breeders can more easily tinker with the length of the lupin life-cycle to produce longer season varieties suitable for larger agriculture areas across the country.

"Currently, growers only have access to short season lupin varieties, or very long season varieties, but there isn't really anything in between, which is deterring growers in the central and southern grainbelt from considering lupins in their rotation" he says.

"This research is the start of bridging that seasonal length gap."

The research has utilised genetic traits from wild lupins found predominantly in the Mediterranean region, which Dr Nelson says has a similar climate to southern Australia.

"The genetic diversity within the current domesticated pool is extremely narrow compared to what is available in the wild," he says.

Dr Nelson says the recent research findings now mean the future of the lupin, as a relatively cheap human consumption and stock feed protein and fibre source, is much more secure.

"Productivity levels in the cereals industry have plateaued in the last decade, and its critical that this doesn't also occur in the legumes industry," he says.

2016 INTERNATIONAL YEAR OF PULSES

GUSTAVO STRIKER (CENTRE) AFTER DELIVERING A MASTERCLASS AT UWA

ARGENTINIAN SCIENTIST SHARES KNOWLEDGE WITH UWA RESEARCHERS AND THE WIDER COMMUNITY

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Dr Gustavo Striker, from the University of Buenos Aries (UBA), visited Prof Tim Colmer in the School of Plant Biology and IOA during 2015. Dr Striker is an expert on the ecophysiology of forage plants – legumes and grasses – with research for improved pasture productivity. This was his second visit to UWA, and he is an Adjunct Lecturer in the School of Plant Biology. Dr Striker's visit was supported by a UWA Institute of Advanced Studies (IAS) short-stay grant.

Dr Striker delivered an IAS Public Lecture 'Agricultural changes in the Argentinean Pampas'. He introduced the Argentinean Pampas region of approximately 420,000 km2, describing the historical development and present challenges for agricultural industries within the Rolling Pampa and the Flooding Pampa areas where, respectively, crop production and cattle are the main enterprises. A recording of Dr Striker's lecture is available at **ias.uwa.edu.au/archived/striker**

UWA plant scientists, and collaborators, participated in the IAS Master Class 'Flooding tolerance of pastures' led by Dr Striker. Dr Striker surveyed physiological traits contributing to tolerance, as identified from his research and the work by others. This set the scene for the talks which followed from UWA staff, Dr Lukasz Kotula and Dr Imran Malik, and DAFWA collaborators and UWA Adjuncts, Dr Phil Nichols and Dr Ed Barrett-Lennard. All five talks were excellent and highlighted the rapid progress in understanding flooding stress responses and breeding for increased tolerance of forage and crop plants. The group engaged in discussions and identified potential areas of future collaborations.

A major goal of the visit by Dr Striker was for a period of focused joint work on a review paper. The scope of the review on flooding stress tolerance of forage legumes was mapped out, and work on data compilation was achieved. Writing occurred during the first half of 2016, via email exchanges and online discussions, and the review has been completed and published on-line: Striker GG & Colmer TD. Flooding tolerance of forage legumes. *Journal of Experimental Botany.*

Finally, Dr Striker's visit enabled further discussions regarding increased collaboration of UBA and UWA, for which a MoU between the two universities was signed in mid-2016. We look forwarded to increased interactions with Dr Striker and new collaborative opportunities with staff and students at UBA.

AT 13 DAYS AFTER INOCULATION WITH TURNIP MOSAIC VIRUS SHOWING SYSTEMIC HYPERSENSITIVE PHENOTYPE (LEFT) AND A NON-NECROTIC PHENOTYPE (RIGHT)

PHD STUDENT MAKES BREAKTHROUGH IN OILSEED BRASSICA DISEASE RESEARCH

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As part of her UWA PhD research, Malawian student Eviness Nyalugwe studied a serious leaf disfiguring and plant stunting disease of *Brassica juncea* caused by *Turnip mosaic virus* (TuMV). *B. juncea* or Indian Mustard is a promising oilseed species because of its excellent tolerance to high temperature and drought conditions. It is however very susceptible to the disease.

Systemic hypersensitive resistance (SHS) is an important virus resistance trait in crops because infected plants rapidly die, removing them as possible sources by which insect vectors can acquire virus from and spread it to healthy plants. A plant that eliminates itself is a good thing.

Eviness demonstrated that some lines of *B. juncea* carry a TuMV resistance gene which controls expression of SHS. She named this gene *TuRBJU 01,* and published three research papers about it in the prestigious research journals, *Plant Disease* and *European Journal of Plant Pathology.* It is the first virus resistance gene found in *B. juncea*.

Eviness studied segregation ratios with F2 progeny plants from a cross between *B. juncea* TuMV resistant and susceptible parents. *TuRBJU 01* proved to be a single dominant gene.

TuRBJU 01 was effective against seven Australian TuMV strains and partially effective against two others. It therefore has great potential for breeding virus-resistant *B. juncea* cultivars.

Eviness was supervised by Prof Roger Jones of DAFWA and IOA.

Business as usual not enough to meet zone's food security challenges

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'Business as usual' in agricultural production was not enough to meet the increasing challenges of climate change, water security and changing consumer appetites in the zone, according to Professor Gordon Flake, CEO, Perth USAsia Centre, speaking at the In the Zone 2016: Feeding the Zone forum in Jakarta in May 2016.

"We must do things differently,' he said. "If we look at economic, consumption and production trends, there are some very real challenges in the zone, which gives us a strong case for action and fundamental change. The zone also holds the solutions and we will need co-operation, innovation and investment into the future. Big issues require big thinking."

Prof Kadambot Siddique, IOA Director, who provided commentary on economic and demographic trends in a panel discussion urged young people to embrace science and technology and to find solutions by studying overseas and then bringing the best knowledge back to the zone as an investment in the future of the region.

Professor Siddique said the food system was buckling under intense pressure from factors such as climate change, ecological degradation, population growth and rising demand for meat and dairy products.

Other contributing factors, he said, included rising energy prices and competition for land from biofuels, industry and urbanisation. "We have surging and unstable food prices and growing conflicts over water and the increased exposure of vulnerable population to drought and floods. Food prices are forecast to increase in the rage of 70 to 90 per cent by 2030 before the effects of climate change, which will roughly double the prices again" Professor Siddique said.

An internationally leading scientist in the field of legumes and crop science, Professor Siddique said the world had the potential to feed up to 10 billion people but we needed to take responsibility for the planet's boundaries and sustainability.

Professor Siddique highlighted the plight of the poor and hungry, specifically in sub-Saharan Africa and Southern Asia. He said the opportunity to reduce hunger, malnutrition and poverty could be achieved through agriculture and social protection-led strategies combined with targeted nutrition intervention.

SPEAKERS AT THE FEEDING THE ZONE CONFERENCE IN JAKARTA


RACHEL FLETCHER TRANSPLANTING CANOLA SEEDLINGS IN THE GLASSHOUSE AT UWA

USA STUDENT AT IOA ON STUDY TOUR

Professor Wallace Cowling
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Rachel Fletcher is a final year undergraduate Biology Major at Xavier University, Cincinnati, Ohio, USA, and won the Xavier University Winter-Cohen Brueggeman Fellowship to study sustainable cropping systems in Australia.

She visited Prof Wallace Cowling in IOA for three weeks in May-June 2016, where she learned about canola breeding techniques and the value of Brassica in crop rotations.

She also visited several researchers in the School of Plant Biology and IOA UWA Institute of Agriculture where she learned aspects of their research in crop physiology, drought tolerance, heat tolerance and molecular genetics. Rachel's student mentor at UWA was Plant Biology and IOA PhD student Candy Taylor.

Rachel said she absolutely loved her experience at UWA and was especially grateful to the academics who went out of their way to help her learn about the research going on at UWA.

"I am so glad to be exposed to a vast array of agricultural research and really begin to understand some of the issues modern farming faces," Rachel said.

"I expect that it will greatly enrich my further studies and research when I return."

When she returns to Xavier University, Rachel aims to complete her research project on the potential of Brassica crops to provide biofumigation benefits in rotation with cereals and other annual crops or perennials.

DR MICHAEL MILLAR FROM ARGONNE NATIONAL LABORATORY, ILLONOIS USA PRESENTING AT THE MYCORRHIZAL SYMPOSIUM IN APRIL 2016

MYCORRHIZAL EXPERTS GATHER AT UWA

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Mycorrhizal fungi have diverse roles in soil and they hold a central position at the interface between chemical, physical and biological components of soil fertility. This was the focus of a symposium supported by IOA in April 2016 when international and interstate visitors gathered with students and researchers from Western Australia to discuss advances in knowledge of the diverse roles that mycorrhizal fungi contribute to the efficient function of ecosystems.

The ubiquitous occurrence of arbuscular mycorrhizal fungi and their capacity to form associations with most plants means that they have the capacity to contribute to ecosystem function in highly weathered WA soils as well as in agricultural systems.

The 2-day symposium was held at the University Club of Western Australia and provided an opportunity for participants to review how well mycorrhizal fungi are being managed with international, interstate and experts from Western Australia.

Researchers from Murdoch University, Curtin University and UWA have had a distinguished history of research on mycorrhizas. Keynote presentations from Associate Professor Miranda Hart from the University of British Columbia, Canada and Dr Michael Miller from Argonne National Laboratory, Illinois, USA significantly enriched the Symposium discussions.

Participants also benefited from contributions from Assoc/Prof Jeff Powell (Western Sydney University) and Assoc/Prof Tim Cavagnaro, The University of Adelaide, as well as Christina Birnbaum, Murdoch University, Mark Brundrett, WA Department of Parks and Wildlife, and Assoc/Prof Megan Ryan and E/Prof Lyn Abbott from IOA. The Symposium was opened by E/Prof Alan Robson.

Dr Hart's visit to UWA was supported by a UWA Gledden Fellowship and Dr Miller's visit to UWA was supported by the Rio Tinto – UWA Masterclass program.

MBA STUDENTS DARREN GLASS, JOEL TURCO, CAMERON LEVITZKE AND MICHAEL DOUGLAS. PHOTO: MATTHEW GALLIGAN

MBA students shake up agri-food industry

UWA MBA students are set on doubling the value of Western Australia's pork exports by 2025.

Completing an industry project for the Department of Agriculture and Food WA (DAFWA), a team of four MBA students investigated the international agri-food market last year.

Catherine Lyons, the Acting Director of Strategy and Governance at DAFWA, said the MBA team provided new insights into the future of the pork industry.

"With DAFWA's role in enabling the agriculture and food sector to double its value by 2025, we were excited to have such an energetic and driven UWA team to focus on one of the State's livestock industries," Ms Lyons said.

"The team's analysis of export-led growth in the WA pork sector provided insights into global competiveness and market analysis. Staff and industry members appreciated their methodology for asking and answering the tough questions: 'What does the solution look like? What does it NOT look like? What role should Government play? And, can we develop a transferable framework for analysis?'"

Cameron Levitzke, one of the MBA students who grew up in a farming community said the project was particularly rewarding because they were able to contribute to the diversification of the State's economy.

"As a project that contributes to the overall vision of doubling agri-food by 2025, it is also of vital importance for the State's future prosperity. This, along with the freedom DAFWA provided us to define our own scope whilst still being very supportive, created an opportunity where we felt our project could make a meaningful difference."

Completing the project in just seven weeks, the MBA students spoke to a wide range of industry experts, before narrowing their focus to China and Asia, where an emerging middle class is driving a huge appetite for safer and higher quality foods.

Soil carbon storage – a major challenge for WA soils

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For the past three years Dr Deirdre Gleeson from the School of Earth and Environment and IOA has been working in collaboration with colleagues from DAFWA, CSIRO and La Trobe University to provide options for WA farmers to overcome constraints to soil carbon storage.

Their project, *Managing biological, physical and chemical constraints to soil carbon storage,* formed part of the Federal Government National Soil Carbon Program which aimed to provide practical strategies for Australian farmers to increase soil carbon while maintaining farm productivity and profitability.

The research team assessed the potential to increase soil carbon via existing practices such as liming, and emerging practices such as one off soil inversion. DAFWA collaborator Mr Chris Gazey said that soil acidity is a major constraint to productivity in the western Australian grainbelt and requires on-going monitoring and management to avoid irreparable degradation of the soil systems and production potential.

Dr Gleeson said the results show that liming to the correct level is crucial for managing soil pH and productivity, but it did not lead to increased soil organic carbon (SOC) stocks after relatively long timeframes (> 10years).

"Additional measures such as green manuring or other organic amendments in addition to liming may be required to increase soil carbon where lime is applied to very acidic soils with a pH greater than 4.4," Dr Gleeson said.

The team also assessed the effect of a one off soil inversion (spading) on soil carbon. While practices such as spading can be used to improve immediate productivity and redistribute soil carbon in the soil profile, Dr Gleeson said the results showed that total soil carbon stocks did not significantly differ within the medium term (5 years).

The researchers also found that there was no negative effect of spading on soil microorganisms responsible for nutrient cycling.

"There was a re-distribution of microorganisms and their functions in the soil profile immediately after spading but the effect was not long lived and generally speaking spaded treatments were not different to non-spaded treatments after just 1 year," Dr Gleeson said.

"This is good news for those farmers who have already implemented this practice on farm."

The research suggests that higher quality (green) plant residue addition could be a beneficial management practice in the long term as we found that addition of green plant material resulted in less carbon loss though production of carbon dioxide.

"This resulted in more carbon being stabilised compared to when we added brown plant residue."

"Increasing carbon stocks in sandy soils of the Western grainbelt is likely to remain difficult without significant changes to inputs of organic residues/materials."

CHRIS GAZEY (DAFWA); DR SAM GROVER (LTU); KIRSTY BROOKS (UWA); DR CLAYTON BUTTERLY (LTU) AND DR DEIRDRE GLEESON (UWA) RUNNING SOME IN-FIELD PH MEASUREMENTS DURING SOIL SAMPLING CAMPAIGNS AT WONGAN HILLS

COLLABORATIONS IN AGRICULTURE BETWEEN UWA AND YANGZHOU UNIVERSITY

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Assoc/Prof Dominque Blache and Research Assoc/Prof Shimin Liu spent two weeks at the College of Animal Science and Technology, Yangzhou University (YZU) in May this year for an intensive teaching program on an animal science course for postgraduate students, organised by YZU.

This is part of collaboration in multiple areas developed between UWA and YZU over the past few years. The first agreement on collaboration was signed between the IOA and the College of Animal Science and Technology, YZU in 2009.

Following Assoc/Prof Blache and Dr Liu's visit to YZU, A/Prof Mengzhi Wang came to UWA for 12 months to explore the immune components that lead to the development of diarrhoea in wool-producing sheep in Australia, which is a joint UWA-DAFWA research project.

Diarrhoea in wool-producing sheep causes faecal contamination sheep breech, inducing flystrike, which cost the Australian sheep industry $147 m for breech flystrike and $80-160 m for breech soiling.

UWA has hosted many students from YZU. In 2013-2014, nine undergraduate students attended the UWA Study Abroad programs, and ten PhD students spent two weeks at UWA to learn our research in agricultural and related areas. We are expecting 20 undergraduate students in agriculture to attend a two-week study program in August.

MR HABTAMU TAMIR WORKING ON HIS DROUGHT TOLERANT WHEAT

Prestigious postdoctoral fellowship for UWA PhD student

Agriculture PhD Candidate Habtamu Tamir at the School of Plant Biology and IOA, has recently been awarded a prestigious Japanese Society for the Promotion of Science Postdoctoral Fellowship.

Mr Tamir has been working on drought resistance breeding and genetics of common wheat during the past three years for his PhD studies. Upon the completion, he will work at the Institute of Crop Sciences, National Agriculture and Food Research Organization (NARO), Japan for two years for his postdoctoral fellowship where he will to continue his research on abiotic stress tolerances of wheat with Dr Youko Oono.

Originally from Ethiopia, Mr Tamir started his PhD in plant breeding and genetics at UWA in January 2013 under the supervision of Prof Guijun Yan and Dr Helen Liu. He earned a Bachelor of Science in crop production and a Master's degree in plant breeding from Jimma and Bahir Dar Universities, in Ethiopia.

Passionate about the issue of drought resistance improvement, Mr Tamir evaluated more than 800 world-wide wheat collections to understand the genetic control of drought stress resistance in wheat. He also mapped drought tolerant QTLs in different chromosome regions of bread wheat using GWAS and bi-parental mapping techniques. He has successfully introgressed two major QTLs into other wheat cultivars thereby improving their drought resistance through marker assisted selection.

Mr Tamir has published four papers with two more under review based on his PhD research which was supported by the Australian Development Scholarship.

FARMERS OBSERVE IMPROVED SEED OF LIFE MAIZE VARIETIES AT A FIELD DAY

UWA takes large steps to eradicate hunger in Timor-Leste

The number of people experiencing hunger in Timor-Leste has reduced dramatically thanks to an enormously successful agricultural project led by UWA.

Prof William Erskine from UWA's Centre for Plant Genetics and Breeding and IOA led the Seeds of Life Project to address food security in Timor-Leste, a small country ranked the fourth lowest on the Global Hunger Index in 2015.

The project was funded by the Australian Centre for International Agricultural Research (ACIAR) and the Department of Foreign Affairs and Trade (DFAT) in partnership with the Timor-Leste Ministry of Agriculture and Fisheries.

New varieties of staple foods – maize, rice, sweet potato, cassava and peanuts – were introduced and over 4000 on-farm trials were conducted between 2005 and 2014.

The recently released analysis has shown that approximately one in two of all rural households in Timor-Leste have adopted a new Seeds of Life variety, that growing the improved varieties has helped farmers grow more food, and that they were less hungry than before.

"Under farmer management, productivity increased by a staggering 25% to 100% depending on the variety. The fact that one in two of all rural households in Timor-Leste have adopted a Seeds of Life variety is simply incredible," Prof Erskine said.

Professor Erskine presented the project highlights at a public lecture at UWA on 14 June 2016. Timor-Leste Ministry of Agriculture and Fisheries Director General for Agriculture, Mr Deolindo Da Silva gave the closing remarks at the public lecture and thanked UWA, ACIAR and the Seeds of Life team for the lasting research impact in his country.

Part 2: Reflections on being taught research at the Institute of Agriculture, 1957–1965

Professor Ivan Kennedy
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In this second part of my brief essay reflecting on my training at IOA, I focus on my more recent activities since I retired from postgraduate teaching in August 2011.

Since then, I have extended the critical approach gained at IOA to climate change, after developing with colleagues a simple method of doing thermodynamic computations, based on a theory that I call action mechanics.

This requires logical algebra based on realistic physical molecular models as favoured by Boltzmann and Gibbs, rather than the differential calculus encountered in most text books, that I find too difficult.

Ten years ago I generally agreed with the IPCC's thesis that increasing content of carbon dioxide and other greenhouse gases might cause a warming trend in the Earth's atmosphere. But on testing the global circulation models I found that their "governing Euler equations" have poor predictive ability, i.e. they are merely instruments as defined by Karl Popper, with so many adjustable factors that they are designed not to fail. So is a huge mistake being made by the IPCC, confusing *correlation* regarding increasing carbon dioxide and a warming trend for *causation*?

The recent 15-20 year plateauing in atmospheric temperature (as measured by satellites) shows how weak this correlation is, given a 9% increase in C02 (367 to 400 ppmv) with no significant increase in air temperature. It is no surprise that NASA/NOAA now include adjusted ocean surface temperature for measurements of air temperature in their trend reporting, since the latter is failing is failing to confirm their models.

They claim that heat is now disappearing into the oceans rather than warming air. In the virial action hypothesis (see Kennedy IR (2015) *Int.J. Energy Environment 9*, 129-146), I propose that carbon dioxide (mw 44), being heavier than air, may actually oppose the effect of lighter water (mw 18) that is considered as the major cause of warming.

Thus, at sufficient number density in air (mw 29), by partially collapsing the atmosphere, carbon dioxide may reverse an elevating effect of water vapour; according to the IPCC, by increasing opacity or optical depth of the atmosphere, water should cause less radiation to space, thus warming the surface. Instead, in action theory at a sufficient density carbon dioxide could cool by slightly depressing the atmosphere, thus radiating to space warmer with slightly greater intensity, cooling the surface.

The Stefan-Boltzmann law (radiation intensity varies with the fourth power of temperature) then becomes a regulating factor for radiation, allowing either transient warming or cooling, depending on the altitude of radiation. This novel thermodynamic effect of carbon dioxide, increasing the virial lapse rate, would be a linear function of its number density, whereas its effect on the opacity of the atmosphere increases much more slowly in a logarithmic fashion – a result well accepted by the IPCC.

Thus one effect of carbon dioxide (increasing collapse, redistributing greenhouse gas opacity lower causing cooling) might eventually overtake another (increasing greenhouse gas opacity from increased concentration causing warming). Acting oppositely, water and carbon dioxide could then form a thermostat, governing temperature change.

Possibly, this partly explains the reversible temperature trends of the ice ages and the deglaciations, as reflected in the Vostok ice cores; these are consistent with the lag of carbon dioxide release in warming and reabsorption in the cooling ocean following temperature changes, rather than carbon dioxide preceding warming. This suggests heating causes increase and cooling decrease in atmospheric carbon dioxide as a result rather than a cause. I can now model this process algebraically, so that's good material for a new paper.

Greenhouse gases still have an important role in rapid radiant heat transmission from the surface and in convection, but that role is much diminished for controlling surface temperature, given the weak forces exerted by quanta compared to molecular collisions in the troposphere.

This hypothesis is not idle speculation but is supported by my exact computations of virial action thermodynamics, its algebra giving accurate plots of atmospheric profiles for temperature, pressure and number density, all predictions shown first on Earth and closely matching reality, then confirmed on Venus, Mars, Jupiter, Saturn and even its satellite Titan (with

a heavy atmosphere of nitrogen, so cold that it rains methane).

Of course in the modern era we've been consistently pumping extra water and carbon dioxide into the atmosphere, increasingly as world population mounts. Shades of IOA's late Ralph Slatyer and his equations for evapotranspiration! Every formation of one molecule of carbon dioxide from burning fossil fuels such as oil and gas results in two water molecules being released (although coal releases less water); we've been extracting ground water from bores and mines for irrigation so that the amount of rainfall worldwide has measurably increased by several percent. There are droughts, but also floods. IPCC assumes that extra water in the warmer atmosphere comes mainly from the ocean; but could this be just another case of reversing cause and effect?

Time will tell if Paris's rhetoric and the UN succeed in significantly reducing carbon emissions worldwide in the 21st century. But be aware that it could get even hotter as a result! No experiment is estimated to cost so much globally, yet rarely has a proposal been so poorly controlled with respect to its objectives.

Fortunately, most of the funded agricultural research conducted in the name of adapting to climate change has inherent value, independent of any mechanism of a warming trend. Agriculture has always been adapting to such changes. Less methane means more productive sheep and cattle (our extended family still has a polished handpiece that my father used to shear daily tallies under union rules in the Kimberley(s) before 1955 of up to 289 a day – but he never encouraged me to shear one sheep). Less nitrous oxide emission means fixed nitrogen for more productive crops. More carbon in soil improves nutrient and water holding capacity as well as its dynamic structure and permeability. Even new inert carbon in soil as biochar can provide nutritive and structural value.

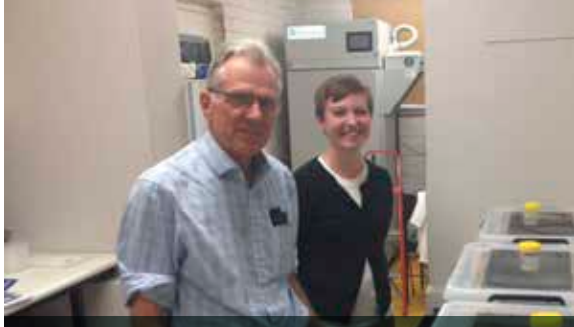
If the virial action hypothesis survives objective testing, as conjecture without refutation as defined by the late Karl Popper, I recommend a symbiotic linkage of the combustion of fossil fuels by power stations to reforestation (i.e. rapid turnover farm-forestry such as mallee and N2-Fixing casuarinas in Australia).

This would give a cash-generating means of carbon capture, in contrast to energy-wasting geo-sequestration; such photosynthetic sequestration is also perfectly consistent with the second law of thermodynamics, driven by Schrödinger's flow of negative entropy from the Sun.

Longer time scales would be available for managing climate change, with less economic panic, allowing us to determine if carbon dioxide levels can be managed – but only if needed to ameliorate the approach of the expected Milankovitch cycle ice age. That could require fighting climate change in earnest, against contracting farmlands, dryer atmospheres and less rain! Note that high quality coal is favoured over oil and gas, given its lower water emissions.

So this is where my research training at the IOA in hypothesis testing has taken me. Now that basic and applied Faculty degrees in agricultural science have been practically eliminated from Australian university curricula, I wonder if future graduates will be equipped to meet the multidisciplinary challenges of agricultural and environmental science.

I sincerely hope so.



DR BEKKA BRODIE WITH SENIOR RESEARCH OFFICER MR TONY SCHLINK WITH THE FLY CAGES

FLYING VISIT TO MAKE SCENTS OF BLOWFLY BEHAVIOUR

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IOA welcomed a short visit from Dr Bekka Brodie, supported by Australian Wool Innovation, to use her expertise to help our Flystrike team better understand the behavior of the Australian blowfly, *Lucilia cuprina*.

Dr Brodie is an adjunct faculty member in the Department of Biological Sciences at Ohio University with experience in identifying odour chemical components that attract flies to different substances.

She combines her knowledge of fly behavior and electro-antennogram technology to determine which compounds cause a response in the flies. Of particular interest to our team was how she has used this experience to make better predictions about the foraging and egg-laying (oviposition) behaviour of flies, which depends on their physiological state, such as gravid or non-gravid flies, and type of food. It is this type of information that could lead to better control and management strategies to dramatically reduce the incidence of flystrike in Australian sheep.

The current breech strike project at UWA is a collaborative project that involves the Department of Agriculture and Food WA and CSIRO in Armidale. The team is using the electron-antennogram technology to identify odour components in wool that stimulate a response in the Australian blowfly *Lucilia cuprina*.

Dr Brodie's work has been focused on the common green bottle fly, *Lucilia sericata*, but her experience in general fly behavior and preparation of flies prior to testing their responses was transferrable to *Lucilia cuprina*.

During her three week visit in May 2016, Dr Brodie advanced the understanding of how best to prepare the Australian blowfly to distinguish between fly feeding and egg laying behavior, and getting them in the best physiological state for testing their response to different wool odour and moisture conditions.

AWARDS AND INDUSTRY RECOGNITION

NAME	AWARD
Mr Benjamin Congdon	Best student Oral Presentation Award at the 13th International Plant Virus Epidemiology Symposium, Avignon, France
Dr Parwinder Kaur	AW Howard Research Fellowship Award
Prof Daniel Murphy and team	CRC for Polymers Chairman's Award for Excellence in Commercialisation
Dr Louise Barton	2016 Parks and Leisure Australia WA Research Award
Adjunct Assoc/Prof Muhammad Farooq	(COMSTECH) Outstanding Researcher Award, Ministerial Standing Committee on Scientific and Technological Cooperation of the Organization of Islamic Cooperation
Adjunct Assoc/Prof Muhammad Farooq	Best Young Research Scholar Award from Higher Education Commission of Pakistan

VISITORS TO IOA

NAME OF VISITOR	VISITOR'S ORGANISATION AND COUNTRY	HOST DETAILS	DATES OF VISIT
Dr Yongen Zhang	Chinese Academy of Agricultural Sciences, China	Prof Kadambot Siddique, Dr Yinglong Chen	3 July 2016 – 2 July 2017
Dr Cao Pinghua	Henan University of Science and Technology, Henan, China	Prof Graeme Martin	1 September 2016 – 31 July 2017
Dr Cui Cui	Southwest University, Nanjing	Prof Kadambot Siddique, Dr Yinglong Chen	1 November 2016 – 31 October 2017
Dr Xiao xia Li	Henen University of Science and Technology, Henan, China	Prof Graeme Martin; Dr Shimin Liu	
Dr Erwin Paz Munoz	Universidad de la Fontera, Temuco, Chile	Prof Graeme Martin, Assoc/ Prof Dominique Blache; Dr Joahn Greef	26 September 2016 – 25 September 2018

NEW RESEARCH GRANTS

TITLE	FUNDING PERIOD	FUNDING BODY	SUPERVISORS
Effects of Poultry Litter Biochar on Cucumber Production & Soil Microbial Activity in a Fertigation System on Sandy Soils	2016	Energy Farmers	Dr Zakaria Solaiman
Characterising structural variation in the canola genome	2016-2018	ARC Linkage	Prof David Edwards, Prof Jacqueline Batley
Soil microbial processes associated with retention of soil carbon after application of composted manure to dairy pastures	2016-2017	South west catchments council (NHT)	E/Prof Lynette Abbott, Dr Sasha Jenkins, Mr Ian Waite, Dr Zakaria Solaiman
Prediction in complex acquatic environments: response models for key south-west estuaries	2016	WA Department of Water	Dr Matthew Hipsey
Water quality changes in Vasse-Wonnerup estuary system in response to surge barrier	2016	WA Department of Water	Dr Matthew Hipsey
CBH Research Program	2016	Co-operative Bulk Handling Limited	Dr Elena Mamouni Limnios, W/Prof Timothy Mazzarol, Prof Kadambot Siddique, W/Prof Geoffrey Soutar

NEW POSTGRADUATE RESEARCH STUDENTS

STUDENT NAME	TOPIC	SCHOOL	SUPERVISOR(S)	FUNDING BODY
Victoria Francisca Figueroa Bustos	Heat stress in wheat	School of Plant Biology and IOA	Prof Kadambot Siddique; Adjunct Prof Jairo Palta; Dr Yinglong Chen	CONICYT Scholarship, Chile

MEMORANDA OF UNDERSTANDING (MOU) WITH EXTERNAL ORGANISATIONS

ORGANISATION	DATE
Tottori University	MOU Signed June 2016
Dandaragan Camel Dairies PTY LTD	MOU Signed August 2016

IOA 2016 Publications
(May – July)

Refereed Journals

Akter S, Erskine W, Branco LV, Agostinho OF, Imron J and Spyckerelle L (2016). Gender in crop production in Timor-Leste. *ACIAR Proceedings* **146**: 158-164

Ashworth MB, Han H, Knell G and Powles SB (2016) Identification of triazine-resistant *Vulpia bromoides*. *Weed Technology*. 30: 456-463

Ayalew H, Liu H and Yan GY (2016). Quantitative analysis of gene actions controlling root length under water stress in spring wheat *(Triticum aestivum L.)* genotypes. *Crop and Pasture Science* **67**:

Ayalew H, Dessalegn T, Lui H and Yan G (2016). Performance of Ethiopian break wheat *(Tritium aestivum L.)* genotypes under contrasting water regimes: potential sources of variability for drought resistance breeding. *Australian Journal of Crop Science* **10** (3): 370-376

Azeem MM, Mugera AW, Schilizzi S and Siddique KHM (2016) An assessment of vulnerability to poverty in Punjab, Pakistan: Subjective choices of poverty indicators. *Soc Indic* Res DOI 10.1007/s11205-016-1419-x

Banik BK, Durmic Z, Erskine W, Revell CK, Vadhanabhuti J, McSweeney CS, Padmanabha J, Flematti GR, Algreiby AA and Vercoe PE (2016). Bioactive fractions from the pasture legume *Biserrula pelecinus* L. have an anti-methanogenic effect against key rumen methanogens. *Anaerobe* **39**: 173-182

Barbetti MJ, Li CX, You MP, Singh D, Agnihotri A, Banga SK, Sandhu PS, Singh R and Banga SS (2016). Valuable new leaf of inflorescence resistances ensure improved management of white rust *(Albugo candida)* in mustard *(Brassica juncea)* crops. *Journal of Phytopathology* **164**: 404-411

Barker SJ, Si P, Hodgson L, Ferguston-Hunt M, Khentry Y, Krishnamurthy P, Averis S, Mebus K, O'Lone C, Dalugoda D, Koshkuson N, Faithfull T, Jackson J and Erskine S (2016). Regeneration selection improves transformation efficiency in marrow-leaf lupin. *Plant Cell Tiss Organ Cult* **125** (2): DOI 10.1007/s11240-016-0992-7

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Browne M, Goncalo L, Ximenes A, Lopes M and Erskine W (2016). The place of ceremonial observances in sustainable livelihoods of crop in Timor-Leste. *ACIAR Proceedings* **146**: 128-134

Erskine W, Ximenes A, Glazebrook D, da Costa M, Lopes M, Spyckerelle L, Williams R and Nesbitt H (2016). Wild plant food in Timor-Leste. *ACIAR Proceedings* **146**: 99-104

Ferasyi TR, Barrett PHR, Blache D and Martin GB (2016). Modeling the male reproductive endocrine axis: potential role for a delay mechanism in the inhibitory action of gonadal steroids in the regulation of GnRH pulse frequency. *Endocrinology* **157**: 2080–2092. DOI: 10.1210/en.2015-1913

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UPCOMING EVENTS

PINGELLY ASTROFEST
SATURDAY, 17 SEPTEMBER
UWA FARM RIDGEFIELD, PINGELLY

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