Welcome to the Spring edition of the Innovator.

In the last three months considerable effort has focussed on outreach activities and communications. Congratulations to our Industry Partnerships and Communications Manager, Ms Toni Nugent, and Ms Sharon Fuller, Administration Officer, who have planned and run a number of very successful events.

These events include Science and Agriculture Enrichment Day (13 June), Sheep Forum (4 July), Beef Forum (15 August), Future Proofing Mixed Farming Systems Forum (21-22 August) and our annual Cropping and Pasture Systems Field Forum (3 September).

The success of these days shows the increasing reputation of the Graham Centre as a source of reliable information.

The Centre’s fourth Monograph ‘Long-chain omega-3 polyunsaturated fatty acids in ruminant nutrition: benefits to animals and humans’ was launched at the Cropping and Pasture Systems Field Forum on 3 September. Dr Edward Clayton, Livestock Research Officer (Ruminant Nutrition), NSW DPI, provides an in-depth analysis of this important issue. The aim is to make the information readily accessible to a broad audience including producers, students, researchers and funding organisations. This is the first Monograph focusing on animal nutrition and production. It provides an up-to-date summary of current research, and identifies gaps for future regional, national and international research opportunities.

This Innovator covers a broad range of topics to keep you informed of our research activities.

Enjoy reading this edition of the Innovator.

Professor Deirdre Lemerle

Findings from the agri benchmark Beef and Sheep conference 2014 showed that profitability returned to beef and sheep production in countries that experienced moderate climatic conditions, while other regions, particularly in sections of the Southern Hemisphere, drought and adverse weather conditions continued to depress margins.

Photo: Karl Behrendt
New Graham Centre Monograph: how to improve omega-3 fatty acids levels in red meat

We are all interested in the potential health benefits of omega-3 fatty acids. The chemical name for these fatty acids is ‘long chain omega-3 polyunsaturated fatty acids’, abbreviated as LCn-3PUFA. Their consumption has been linked to reducing the incidence of diseases including cardiovascular disease, arthritis and mental health disorders. Much publicity has been given to two found in oily fish, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

Although EPA and DHA are only found in relatively low concentrations in red meat (including beef and lamb) compared with oily fish, the total LCn-3PUFA concentration including docosapentaenoic acid (DPA) is significant in red meat. We also know the LCn-3PUFA content of meat can be increased if sheep and cattle consume green fodder. This could mean consumers will have an alternative source of omega-3 fatty acids to fish or supplements.

Monograph No. 4 ‘Long-chain omega-3 polyunsaturated fatty acids in ruminant nutrition: benefits to animals and humans’ was launched at the Centre’s Cropping and Pasture Systems Field Forum on 3 September. The author, Dr Edward Clayton, is a livestock research officer (ruminant nutrition) at NSW DPI’s Wagga Wagga Agricultural Institute and a member of the Graham Centre.

The monograph summarises several possible health benefits of LCn-3PUFA in ruminants and humans, and outlines the effects of different production systems on the content of beneficial fatty acids in meat. The omega-3 fatty acid content of meat is improved by increasing the proportion of fresh or conserved forage into the diet of ruminants compared with grain and concentrates. The amount of omega-3 available in silage can be increased by ensuring that silage is produced under optimal conditions.

Dr Clayton also reviews the observed and recommended intakes of omega-3 fatty acids in the Australian population. Red meat contributes approximately 40% of the average daily intake of these fatty acids for adults in Australia. However, there is great potential to increase this by changing animal diets to fodder with improved availability of omega-3.

The monograph identifies opportunities for future research programs including:

- The need for a survey of the amount of omega-3 available in pastures and forages grown in Australia.
- Examination of the impact of ensiling forage on omega-3 concentrations under Australian conditions.

There is a need to determine measurable improvements in the health of those consuming meat enriched with LCn-3PUFA following the incorporation of forage into production diets.

If the consumption of meat with enhanced LCn-3PUFA can decrease the incidence of disease, producers would have an incentive to deliver this meat into the market.

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Students excel at HDR symposium

Congratulations to the following Graham Centre post-graduate students who received the prizes for outstanding presentations at the Faculty of Science HDR & Honours Symposium, held in July at Charles Sturt University, Wagga.

**Poster Presentation Prize**
Clare Flakelar  
(School of Agriculture & Wine Science)

**Honours Oral Presentation Prize**
Dione Schmutter  
(School of Agriculture & Wine Science)

Overall prospects remain positive despite challenges from rising costs and policy reform

Both beef and lamb prices as well as costs are on the rise. The *agri benchmark* Beef and Sheep network has unique data for global comparisons.

The year 2013 brought back some profitability to beef and sheep production in countries that experienced moderate climatic conditions. In other regions, particularly in sections of the Southern Hemisphere, drought and adverse weather conditions continued to depress margins. This was one of the main conclusions of the *agri benchmark Beef and Sheep Conference 2014* hosted by the Italian Research Centre for Animal Production (CRPA) in Turin, Italy from June 5-11.

Some 31 countries participate in the global network, including new members Botswana and Paraguay. The week-long event consisted of an internal workshop and a public Global Forum on the final day. Workshop topics included consumer preferences and trade, animal welfare, farm labour productivity, grasslands beef production systems, sheep production systems and seasonal lamb and sheep price patterns.

In addition, key ‘burning issues’ for cattle and sheep producers were identified, among them climate change, the lack of long-term beef enterprise profits and various government policies. The field trips showed some of the best soils in the Po river region, very high yields from maize silage, competition for land with arable and horticulture farming and subsequent high land prices and stocking rates.

High price levels depress consumption

Beef and lamb prices, and their cost of production, increased further in 2013, but at a slower rate than in the 2009-2011 period. High retail prices and the economic crises in many of the established beef and lamb markets have led to a reduction of per capita beef (and lamb) consumption in most countries.

Additional demand is mainly coming from Asia - with China being the main driver - but also from South America, where Brazil is the engine of both demand and supply. There is growing recognition within the network of China’s sudden emergence as a major beef and sheep meat importer, and its significant implications for global export demand, prices and trade flows.

**CAP reform poses challenges on some EU-producers**

Main elements of the new EU CAP-reform are further decoupling (mainly in the cow-calf and sheep sector), the transformation of single-farm payments into area payments and the production restrictions imposed by the ‘greening’ measures.

Beef finishing farms with high stocking rates will be particularly affected. Kees de Roest, Italian agri benchmark partner and head of the economic division of the Livestock Research Institute CRPA said that in the case of Italy, these farms will lose an equivalent of EURO 400-600 per hectare until 2020. In the conference’s public Global Forum, panelists representing the Italian beef supply chain concluded that industry adjustments to the challenges of the CAP-reform will have to include market development, innovation and product developments such as European branded beef products, convenience beef preparations,
and, in the case of Italy, the export of regional specialties to other EU-countries. Like in many other countries, Italian consumers appreciate local origin of food products. To further promote this, a product specification for beef of Italian origin has been set up and will be launched in the market in the coming years.

**Australian beef farms struggling**

Australian beef farms struggled in 2013, due principally to the drought, which (while lifting turnoff) lowered cattle prices and raised production costs (especially for feed and agistment).

Of the six Australian agri benchmark ‘typical’ pasture-based beef farms, two barely covered cash costs within the beef enterprise segment of their operations in 2013 and the other four made a cash (short-term) loss. Only the sole Australian cattle feedlot for which data is collected made a short-term, and long-term, beef enterprise profit.

On a whole-farm basis (including income from other non-beef enterprises and off-farm income) the situation was significantly better, with five of the six Australian pasture-based farms making a short-term profit and contributing towards opportunity costs, although only two fully covered opportunity costs to make a long-term profit. This indicates that most had significant contributions from the sale of other products (mainly crops).

The agri benchmark 2013 results confirm that Australia remains a relatively low cost producer of beef, alongside grass-based South American and New Zealand suppliers. Competitiveness was assisted in 2013 by high stock turnoff and production and some fall in the A$, though South American currencies fell significantly faster.

**Australian sheep farms profitable**

Despite the eastern drought, all seven Australian ‘typical’ sheepmeat farms made a short- and medium-term profit (covering cash costs and depreciation) in 2013, in common with sheep farms in all other major sheep producing countries, except those in Europe. Furthermore, all three western Australian ‘typical’ farms made a long-term profit (covering opportunity costs as well), and one of four Eastern Australian farms. This feat was only shared with farms in China and Uruguay, but again cropping performance was a major driver of this result.

Australia remains a low cost producer of lamb, along with New Zealand and South Africa. Australian expenditure per kilogram of lamb produced is low on feed, machinery and fuel, but higher than some on land.

The potential of grazing systems remains high

Most beef cattle and almost all sheep spend at least part of their lives on pastures, in many countries they are finished on grass. Many grassland areas are overgrazed, for example, in Inner Mongolia and parts of Africa, whereas others are underused.

More sustainable grassland management by adjusting stocking rates and grazing management practices, the gradual introduction of fertilisers, improved supplementary feeding practices, and new plant varieties could unlock the present unused potential. China, Argentina, Brazil and Colombia all have room to improve grassland productivity and as a result, animal productivity.

Silvo-pastoral systems in tropical countries seem to be able to create triple-win situations between environment, economics and animal welfare and will be investigated further within the network.

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For information about the network see the agri benchmark website www.agribenchmark.org
Intern in the spotlight

Rowan Alden describes her internship with the Graham Centre as fantastic. Rowan has been writing a literature review on phalaris toxicoses in livestock with Drs Belinda Hackney and Jane Quinn, and learning about the process of getting work published. The review is currently with the journal for publication.

Rowan has been doing practical work with lambs with Dr Quinn and her team, as well as attending Graham Centre events, meeting people and learning about the industry. The remainder of her internship is likely to consist predominately of practical work.

Rowan said her internship is helping her to get to know academics and what areas they specialise in, which will help her when the time comes to choosing a supervisor and research project for her Honours in 2015.

Other notable achievements include being student member on the University Council, student representative on the School of Agriculture and Wine Sciences Board and third year Bachelor of Science representative on the student consultative committee.

Rowan also recently received a scholarship to attend the Crawford Fund ‘Ethics, efficiency and food security’ conference in Canberra in August, as a young scholar. She has also secured funding for a group of eight undergraduate students to attend the Institute of Land Water and Society ‘Food security and the Murray darling basin conference’ in November.

In her spare time Rowan is organising an exchange at Otago University, New Zealand and an internship at Otago University Centre for Sustainability, both of which will take place during the first semester in 2015.

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New solutions needed to ensure global food security

Three CSU and Graham Centre students, Mr Aaron Preston, Ms Rowan Alden and Mrs Soumi Paul Mukhopadhyay, received Crawford Fund Travel Scholarships to attend the 2014 Crawford Fund Annual Parliamentary Conference at Parliament House Canberra in August.

The Crawford Fund Parliamentary Conference has, for more than two decades, managed to bring to focus an array of issues just as they are coming to the attention of the world and Australia. By attracting the world’s best speakers, providing an extended question and answer session and opportunities for informal exchanges, the Fund’s conferences enable participants both to contribute and place the issues into a context relevant and useful to their lives and work. This year was no exception.

Speakers in 2014 included:

- Ms Rachel Kyte, World Bank Group Vice President and Special Envoy for Climate Change
- Professor Catherine Bertini, Senior Fellow, Global Agricultural Development Initiative, The Chicago Council on Global Affairs; Professor, Public Administration and International Affairs, Maxwell School of Citizenship and Public Affairs, Syracuse University; former Executive Director, United Nations World Food Program (1992-2002)
- Dr Shenggen Fan, Director General, International Food Policy Research Institute
- Mr Luke Chandler, General Manager, Food and Agribusiness Research and Advisory, Rabobank Australia & New Zealand
Each of the students commented on the value of attending this conference, saying it provided valuable networking with opportunities with their peers and researchers from different fields, and gave them a wider understanding about the pressing issues facing modern agriculture.

The conference covered a large range of topics including: investing in women; family planning to reduce population growth; environmental change; malnutrition, micronutrient deficiency and obesity; GM technology; food wastage; biofuels, the market opportunity for high value Australian products for export; and the changing Asian market with an increased protein demand. The conference included many opportunities for Q&A with informative panel discussions focused on the challenge of feeding nine billion people by 2050.

The last day of the conference catered particularly for young agricultural scholars, who shared their experiences of visiting several developing countries as part of their coursework or volunteering. Aaron shared his experiences spending three weeks at the International Rice Research Institute (IRRI) in The Philippines and learning various facets of rice development, weed science, harvesting, quality control, sensory evaluation and traditional and molecular methods of rice breeding. The Scholars’ day was an inspirational ‘eye-opener’ to the vast opportunities of agricultural science to assist in the international development and opportunities for young students.

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**Farrer Memorial Travel Scholarship winner**

Vegetable oils, in the form of triacylglycerols (TAG), are an essential resource for various industries including, human and animal nutrition, the chemical industry and renewable energy. Currently, society is highly dependent on petroleum-based resources for many of its activities. The use of petroleum to support all these industries is now widely accepted as being unsustainable, and hence it is necessary to develop an alternative and sustainable resource. One alternative is the use of vegetable oil-based raw materials. Of particular interest is the application of biodiesel, an alternative to petroleum-derived fuels. To address increasing global demands of production, it has been proposed that high biomass crops be engineered to have increased lipid content in vegetative tissues, such as leaves.
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Research being undertaken by Mr Kyle Reynolds, CSIRO, Canberra focuses on three main areas: the investigation of increasing lipid content in leaves; the production of medium-chain fatty acids (MCFA) and their incorporation into leaf lipids, in the form of triacylglycerol (TAG); and the identification/characterisation of genes involved in the pathways of MCFA biosynthesis. The accumulation of medium-chain fatty-acids is of particular interest due to their unique physical and chemical properties making them an attractive feedstock for industrial use in jet fuel and detergent formulations. For example, the incorporation of MCFAs into fuels improves oxidative stability, ignition quality and cetane values. The production and accumulation of MCFA will be tested in both transient and stable formats using the model plant Nicotiana benthamiana.

Kyle was recently awarded a Farrer Memorial Travel Scholarship to attend the “Plant Lipids: Structure, Metabolism & Function” conference, organised by Gordon Research Conferences (GRC), in Texas, United States of America. As part of the conference he will attend the Gordon Research Seminars, which will allow him to discuss his work with other students and research leaders in an informal atmosphere. During the conference Kyle hopes to build a further understanding of plant lipid metabolism and function, gain an insight into recent developments in lipidomics technology, and also learn about current work associated with bioenergy and industrial lipids. Also during his trip to the USA, he is planning to visit some other research centres actively involved in areas of research relevant to his project. Kyle will be visiting the University of North Texas, and learning about their research in microscopy and lipid distribution. Also on the list is the University of Southern Mississippi, who are involved in cutting edge biochemistry research, including lipidomics techniques. He will also travel to New York to visit the Brookhaven National Laboratories, and learn about their current work associated with MCFA engineering.

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CSU animal and veterinary science students evaluate the Indonesian meat industry

Ten CSU adventurous students enrolled from first to fourth year lead by Professor Peter Wynn, School of Animal and Veterinary Science, were provided with a truly unique and detailed tour of all aspects of the Indonesian beef industry over the past two weeks.

The tour was funded by the Colombo plan implemented by the Coalition federal government to increase Australian students’ exposure to the Asian region. Our relations with Indonesia were severely disrupted when the live cattle export trade to Indonesia was halted three years ago by the Gillard Government following revelations of animal cruelty in Indonesian abattoirs shown on the ABC.

The trade has gradually resumed reaching levels that exceed export numbers shipped prior to the ban. The tour was hosted by Mr Robi Agustiar, who is heavily involved in the beef feedlot and marketing chain sector in Java.

The students were given a rare insight into major feedlots fattening cattle from Northern Australia, the ritual halal slaughter technique and slaughter facilities used to process cattle and the wet markets through which most beef moves to the consumer in Indonesia. The team were also shown how beef cattle are reared in villages across Java. It is interesting to note, these production systems involve share farming between an urban investor and the small holder farmer, whose job it is to feed and look after the animals. The profits of the sale of animals are then shared roughly on a 50:50 basis.

The system of marketing animals in an informal village market, where up to 1000 cattle are transported on hundreds of small trucks to a central location, and sold individually to over 100 buyers in any one sale was eye opening.

The marketing of beef is truly unique, with 80% of Indonesia’s beef ground and made into meat balls, called bukso balls. Spices are added to the mix during their production. Housewives are still able to purchase meat that has been slaughtered just hours before sale, typically paying the equivalent of $A9 per kg irrespective of whether the meat comes from the shin or the tenderloin. Meat quality as we know it in Australia is very different to the understanding of our Indonesian neighbours.

While on tour our students led workshops discussing animal welfare issues with students from Padjadjaran and Gadjah Mada Universities. Staff from both universities are keen to develop closer ties through student and staff exchange and research collaboration.

The students were addressed by Australia’s ambassador Greg Moriarty, who pointed out the strategic importance of the new Colombo plan and our visit to Indonesian - Australian relations. Foreign Minister Julie Bishop also mentioned the importance of our mission in a press conference.

There are now 10 students with a detailed knowledge of how meat is produced and marketed in Indonesia. This will help our ongoing co-operation in trade and development of the beef industries of both countries.

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Showcasing Graham Centre research

Science and Agriculture Enrichment Day (13 June) showcased the research of four PhD students with 10 participating regional schools and 80 students from years 10 and 11. The aim is to showcase interesting and productive careers in science.

Livestock Forums (Sheep - 4 July; Beef - 15 August) were each attended by over 100 people and addressed nutrition, grazing management and animal welfare issues.

Future-Proofing Mixed Farming Systems Forum held on 21-22 August hosted a dinner, field tours and forum that attracted over 100 participants. The forum included presentations from growers and industry players, outlining their challenges, opportunities and vision for the next 30 years for agricultural industries and the paddock-to-plate, or the whole of the food supply chain. A ‘think-tank’ session provided participants with an opportunity to contribute their ideas. A three-four page document will be prepared during the next month with a summary of the outcomes; and this will be available for government, as well as a potential framework for a future R, D, E & T proposal.

The Cropping and Pasture Systems Field Forum (3 September) was attended by around 100 farmers, researchers and advisers, and provided an opportunity to help identify gaps in our knowledge and set research and development priorities. Two Q & A panel sessions focused on ‘Farming with stubble’ and ‘Livestock and the feedbase’, addressing weed, disease, pest and frost management; and matching livestock requirements with the feedbase, biosecurity and risk management. Dr Tony Fischer, Honorary Research Fellow with CSIRO delivered the keynote address, commending the Graham Centre for its research in mixed farming systems and encouraged people to continue to challenge new ideas and innovations in agriculture to ensure food security globally in the future.

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Clockwise from top left: 1) PhD student Stephanie Fowler discussing meat quality with students at the 2014 Science and Agriculture Enrichment Day. 2) Dr Edward Clayton addresses the crowd at the launch of the Centre’s monograph ‘Long-chain omega-3 polyunsaturated fatty acids in ruminant nutrition; benefits to animals and humans’. 3) Participants at the Cropping and Pasture Systems Field Forum heard from researchers as part of the field tour. 4) Dr Tony Fischer, Honorary Research Fellow with CSIRO delivered the keynote address, at the Graham Centre Crop and Pasture Systems Field Forum. Photos: Toni Nugent
The business of beef

Beef producers from across the Central West of NSW gained major benefits after attending ‘The Business of Beef’ forum at Blayney on 7 August 2014.

More than 200 producers and industry representatives attended the day that saw a wide range of speakers discuss issues from marketing through to genetic improvement. The Graham Centre’s Dr Karl Behrendt, Senior Lecturer in Agribusiness, CSU, Orange, said the feedback from those who attended was extremely positive with all producers stating they gained valuable information for their enterprise during the day.

Field forum highlights key issues for mixed farming systems

Two Q & A sessions at this year’s Graham Centre Cropping and Pasture Systems Field Forum discussed pest, weed and disease problems associated with stubble farming and the feedbase for livestock production.

The stubble forum highlighted problems caused by slugs and insect larvae in crops grown in stubble with minimum tillage. Farmers reported using up to three baiting treatments for slug control in canola, at a cost of up to $150/ha, but they do not know what losses the slugs are causing. In contrast to South Australia, there are no local reports of snails causing concern. False wire worms and cut worms can cause bare patches in crops with minimum tillage but are not a problem after tillage. Yellow leaf spot can be obvious during winter but usually fails to develop in spring so losses are probably small.

Farmers, farm advisers and researchers debated the benefits and problems associated with stubble farming, agreeing that no one system should be used exclusively. Decisions on whether to maintain stubble, burn it or incorporate it should be based on the paddock situation. The chief benefit of stubble retention appears to be water retention.

The livestock forum highlighted key issues including economics of summer feed gaps including discussion around...
the use of forage brassicas; nutrition and its effects on fertility and ewe mortality; twin lamb mortality and issues with mismothering.

Grazing crops were also topical with discussion centred on weed management, the removal of nitrogen through grazing and their use as potential feed budgets. Grazing stubbles as part of the system was debated with one of the biggest issues faced being the ability to convince people to graze their stubbles.

In a trading operation the ability to purchase quality stock can be difficult at times. Animal health issues and biosecurity are front of mind in trading operations (e.g. footrot, internal parasites), and it is important sheep are quarantined for a period of time when they are bought onto the property and animal health programs are adhered to.

Some people asked that the Field Forum next year consider the mixed farm system. Mixed farming is the most common farming in this area, with decisions needed on the proportion of crop and pasture, animal enterprise, and the relative financial returns from each enterprise to give the best mix for a particular farm. We are basing our plans for the 2015 Field Forum around these ideas.

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French interns

Mathieu Roux. Mathieu came to the Graham Centre from Lyon, France, in April as an intern in the ARChE_Net project (CIRAD). His focus was on continuing the development of calibrations for a portable Near Infrared Spectroscopy device. Mathieu focussed on pasture and crop samples collected in autumn, and also collected soil samples from the same paddocks to see whether calibrations could be developed for soil samples using the same device. Mathieu was sharing the device with a colleague working with CSIRO in South Australia, necessitating several trips to Adelaide. He completed his time at the Graham Centre in August.

Emmanuelle Haslin. Emmanuelle came from Dijon in France and was keen to learn about sheep production in Australia and gain experience in sheep husbandry. Emmanuelle arrived in April and worked with researchers in the Graham Centre until August. She worked firstly with Susan Robertson and Michael Friend on their project with embryo mortality at sites on the CSU farm at Wagga Wagga and with a collaborator at Junee. In the latter part of her internship, Emmanuelle worked with Shawn McGrath and Michael Friend on their project comparing Merino and Dorper production in mixed-farming systems. In particular Emmanuelle was actively involved in doing lambing rounds during the lambing period as ewes grazed wheat and canola crops.

Audrey Bonhomme. During her three months at the Graham Centre (April - June), Audrey worked on the Environmental Trust funded project ‘The adaptive capacity of native shrub and herbaceous legumes’. Audrey conducted a germination trial on the effects of pH and aluminium on the germination of a range of shrub legumes and also analysed data from a previous experiment on germination-salinity. This was followed by two hydroponic experiments looking at acidity/aluminium and salinity on seedling (shoot and root) growth.

Audrey worked closely with Bev Orchard (biometrician, DPI) in the design and analysis aspects of the experiments and the soil section of DPI (Graham Poile and Mark Conyers) in determining treatments. David Orchard, Technical Assistant with the project, provided advice on species selection and experimental procedures. These trials formed part of larger ongoing studies on the genetics of a range of species, their feed value and landscape adaptation.
Evaluation of canola (Brassica napus) allelopathy: from laboratory to field

Canola (Brassica napus L) is a major oilseed crop widely grown in Australia. The concern about herbicide-resistance weeds is encouraging to include non-chemical weed management tactics such as allelopathy.

The impact of crop allelopathy on weeds can be demonstrated under controlled conditions, but field studies are required to confirm the commercial impact of this phenomenon. It is difficult to prove this phenomenon in field studies, but laboratory to field linking provides an overall assessment of the allelopathic effects on crop species.

Graham Centre PhD student Md Asaduzzaman undertook research to validate laboratory allelopathic outcomes of several canola genotypes under field conditions. He presented his findings at the 7th World Congress on Allelopathy in Vigo, Spain from 28 July - 1 August.

Results from his laboratory studies using the equal compartment agar method on annual ryegrass (Lolium rigidum), were linked with the suppression of Shepherd’s purse (Capsella bursa-pastoris), Indian hedge mustard (Sisymbrium orientale), barley grass (Hordeum leporinum) and annual ryegrass in the field using the ecological parameter of Simson’s diversity index (%SDI). A strong correlation co-efficient of 77** was observed between the laboratory and field suppression outcomes. The allelopathic genotypes in the laboratory bioassay, such as Av-opal, Sardi603, Rivette and Atr-beacon, also performed well in the field, whereas cv. Barossa and X-06-6-3725 performed consistently poorly in the field.

It is recognised the specificity of allelopathy only results in effects from certain genotypes against a specific weed. These results do not imply that allelopathic potential in canola will negate the necessity to apply chemical herbicides, but rather that allelopathy can be a valuable component in an integrated weed management program.

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Evaluation of canola allelopathy: from laboratory to field
7th World Congress on Allelopathy

Professor Leslie Weston, Dr Xiaocheng Zhu, Mr Dominik Skoneczny, Mr Md Asaduzzaman (CSU) and Ms Alexandra Garcia Duran (a PhD student co-advised by Leslie Weston and Francisco Macias, University of Cadiz, Spain) attended the 7th World Congress on Allelopathy in Vigo, Spain 28 July - 2 August. The conference titled ‘Complex Interactions in a Changing Climate’ was attended by more than 150 participants from 35 countries. Participants heard from invited speakers in the field of chemical ecology including Consuela de Moraes, University of Zurich, and also travelled locally on interesting field trips to Baiona, Cies Islands and the local palace.

For the past three years Leslie has served as the IAS president and has now completed her term. She will serve as ex-officio on the executive board. Leslie also presented a keynote address on new techniques for the study of secondary plant product localisation.

Dominik, Asad and Xiaocheng all gave high quality oral presentations that were well received.

In the student paper awards contest, Dominik Skoneczny received an award of merit for his presentation titled ‘Metabolic profiling of secondary products in Echium plantagineum and Echium vulgare, two exotic invaders in Australia’.

In the student poster awards contest, Alexandra Garcia Duran received an award of merit for her poster presentation ‘Isolation of bioactive naphthoquinones from the roots of Echium plantagineum L. (Paterson’s curse) and other related species’.

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Branching out in China

Graham Centre member Professor Geoff Gurr recently commenced a prestigious ‘Thousand Talents Fellowship’ at Fujian Agriculture and Forestry University (FAFU) in China. This Chinese Government scheme, aimed at attracting overseas talent to work in China, has awarded Geoff around $2M to develop ecological solutions for agricultural pests.

Geoff said the Fellowship will allow a great leap for his research. As the funding is not tied to specific projects, Geoff has the luxury of being able to pursue some ‘blue sky’ ideas that would otherwise be difficult to get substantial funding for.

Geoff will spend periods of time at FAFU over the next three years, an institution he knows well from previous collaboration as a visiting professor. A notable output of the earlier work was publication in the high-impact journal ‘Nature Genetics’, of the complete genome of diamondback moth, the world’s most serious pest of brassica vegetables and oilseeds including canola.

The publication of the diamondback moth’s genome opens-up huge opportunities for understanding its biology and developing completely new methods for its control that can be used in China and Australia.

Already three new PhD students have started work with Geoff on projects examining the pests’ ability to detoxify plant defence chemicals, its response to plant odours, and interactions with biological control agents.

In another initiative on rice pests, Geoff is working with a postdoctoral scholar to explore the recently discovered phenomenon of certain forms of silicon that boost the ability of plants to ‘recruit bodyguards’ by releasing volatile signals that are attractive to predatory insects.

Graham Centre PhD student Dominik Skoneczny received an award of merit for his oral presentation at the 7th World Congress on Allelopathy. Geoff Gurr at a presentation ceremony in Fuzhou with the Vice Governor of Fujian Province.
Building collaborations in food science research

With a world-wide increase in obesity and diabetes, research is focussing on discovering bioactivity associated with plants and food extracts, and how these health benefits can be incorporated into foods during processing. These themes are being further investigated by the Functional Grains Centre (FGC) at CSU using novel cell culture based assays to examine anti-adipogenic activity in canola extracts.

In July Dr Padraig Strappe had the opportunity to spend two weeks in China visiting Research Institutes in Shandong province, and the College of Food Engineering and Biotechnology at Tianjin University of Science and Technology (TUST).

CSU and the Graham Centre have a strong connection with the Food Science Department at TUST, with Head of Department, Professor Zhong Kai Zhou having previously worked on the original Rice CRC project at CSU. More recently Associate Professor Fang Wang of the same department visited CSU in November 2013 and spent over three months using novel cell culture based assays to assess bioactivity in Chinese coloured rice extracts, specifically looking at anti-adipogenic activity.

Dr Strappe gave a research presentation to students and staff at TUST, and took part in a round table discussion on development of future collaborative projects.

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Financial impact of Ovine Johne’s Disease on the processing sector in Australia

Johne’s disease causes considerable economic loss to the livestock industries, however, the financial impact of Ovine Johne’s Disease (OJD) in sheep at slaughter has not been previously investigated.

Monitoring under the National Sheep Health Monitoring Program (NSHMP) for OJD at an abattoir in Tasmania in 2011 confirmed an increasing prevalence of infected flocks, with many consignments having greater than 10% lesions.

Subsequent research undertaken by the Graham Centre in collaboration with Tasmanian researchers aimed to estimate the financial loss to producers and processors attributable to OJD by monitoring in a Tasmanian abattoir; to investigate potential associations between OJD carcass lesions with carcass quality and economic cost of the disease; and to

Advances Geoff and his team make in these fundamental studies lay the foundation for new, more applied projects that can run in Australia to address various pest species of broadacre and horticultural crops.

Geoff said he is really excited about the synergies between the new initiatives in China and his ongoing work with the Graham Centre. With the team of new personnel and collaborators they have a great opportunity to crack some of the really tough nuts in pest control.

Contact: Professor Geoff Gurr
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investigate producer attitudes towards abattoir disease feedback and OJD management practices.

Interpretation of the results for OJD infection was difficult due to the small number of OJD positive consignments identified. Possible explanations included diversion to other abattoirs due to better prices or a desire to avoid monitoring, retention of sheep for an extra year due to losses from OJD impacting flock size, increased availability of grazing land due to opening up of forest areas in Tasmania or a reduction in regional OJD prevalence.

Nonetheless the project was successful in developing procedures to better define the economic impact of OJD vaccination lesions (and a range of other conditions) on an individual animal and consignment basis.

However, results from the retrospective data from 2011-2012 contrast with results from the current study and suggest there is significant economic impact of OJD on the processing sector and on returns to producers particularly due to smaller carcases and lower skin values.

Smaller carcases take the same time to process as larger ones but result in lower throughput of meat per unit of time and hence less efficient use of capital resources. Abattoir management would be likely to pass these costs onto the individual producer through sheep fitting a lower weight grid price. Alternatively they could spread the cost over all producers by a general reduction in prices paid.

The initiative and interest of the participating abattoir in the current study, indicates the magnitude of the financial concern for the industry, both producers and processors, particularly in circumstances where OJD prevalence had been escalating and there were concerns that OJD was not being effectively controlled. Feedback to producers on the presence of conditions in combination with processing/financial information should act as a catalyst for altered management, as well as provide an ongoing assessment of sub-clinical disease prevalence in the flock as a result of management changes or continued within flock spread.

**NSW scientist talks meat quality in South America**

Australian lamb featured on the program when a NSW Department of Primary Industries (DPI) scientist addressed an international audience of meat science and technology researchers in Uruguay in August.

DPI livestock systems director, Delia Dray, said Dr David Hopkins had been invited to present a paper on the science which backs Australian sheepmeat and lamb production.

“Co-written with DPI research scientist, Dr Sue Mortimer, Sheep quality - effect of breed, genetic type, gender and age on meat quality was presented by Dr Hopkins along with a case study illustrating how producers use research to fortify their breeding and production systems,” Ms Dray said.

“The paper reviews important factors which impact on meat quality and examines how the dramatic growth in the production of high quality lamb in Australia has been underpinned by solid scientific research.”

A total of 10 DPI papers from the Cowra Agricultural Research and Advisory Station and Trangie Agricultural Research Centre were accepted by the 60th International Congress of Meat Science and Technology (ICoMST) which ran from August 18 to 22.

Three doctoral candidates who are supervised by Dr Hopkins including the Graham Centre’s Stephanie Fowler also presented papers during the congress.

The collaborative work in producing these papers has linked local DPI researchers with a global network of scientists from the Victorian Department of Environment and Primary Industries, Sydney University, Deakin University, Murdoch University, Charles Sturt University, Monash University, University of Milan - Italy,
Otago University - New Zealand, Federal University of Lavras - Brazil and the University of Bayreuth - Germany.

In recognition of the DPI team’s contribution, Dr Hopkins co-chaired a session at the ICoMST and sat on a four-member expert panel to provide summary comments on the congress.

During his time in Uruguay Dr Hopkins also attended an editorial board meeting for the International Journal Meat Science in his role as chief editor of the journal.

Dr Hopkins returned to Cowra via Nanjing University in China where he delivered two guest lectures and explored the potential for future collaborative projects.

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Top: Tharcilla Alvarenga with Cowra-based NSW DPI scientist, Dr David Hopkins, Dr Grandin, and fellow PhD candidates, Stephanie Fowler and Melanie Smith, presented papers at the 60th International Congress of Meat Science and Technology. All three PhD students are supervised by Dr Hopkins.

Bottom: NSW Department of Primary Industries senior principal research scientist, Dr David Hopkins, measures meat quality in the laboratory at the Cowra Agricultural Research and Advisory Station with PhD candidate, Tharcilla Alvarenga, Federal University of Lavras - Brazil. Photo: Bernadette York
The Graham Centre was well represented at the recent 19th Australasian Weeds Conference in Hobart, Tasmania (Left to right: Mr Md Asaduzzaman, Dr Hanwen Wu, Professor Deirdre Lemerle, Dr Bruce Auld and Professor Jim Pratley).

### 19th Australasian Weeds Conference

The Graham Centre was well represented at the 19th Australasian Weeds Conference in Hobart in early September. In particular there was a strong contingent of papers presented by our postgraduate students.

It was fantastic to see Aaron Preston presented with the GRDC award for Best agricultural weeds presentation delivered by an Early Career Researcher 2014. Well done Aaron.

Here are the abstracts of their papers.

**Allelopathic potential of root exudates of lucerne on annual ryegrass**

*Hasan Zubair*

Lucerne (*Medicago sativa* L.), also known as alfalfa in other countries, is a highly productive forage legume producing high quality feed for livestock. Yields deteriorate due to weed infestation. Herbicides are a key strategy for weed control, but the evolution of weeds resistant to herbicides requires consideration of alternative option such as the allelopathic potential of lucerne for weed suppression. To evaluate the allelopathic prospects of lucerne, a laboratory based root exudates bioassay was conducted using the equal-compartment-agar method (ECAM). The allelopathic effects of different growth period (0, 2, 4, 6, 8, 11, 15) and density (0, 5, 10, 15, 20, 30, 40, 50 pre-germinated seeds/beaker) of lucerne (var. Genesis) against annual ryegrass (*Lolium rigidum* Gaudin) were investigated. The root and shoot length of annual ryegrass were measured. Results indicated that lucerne growth for 4-8 days had the most inhibitive effect on root growth of annual ryegrass. The root inhibition of annual ryegrass was increased with increasing the density of lucerne. Growth period and density of lucerne however did not affect shoot growth of annual ryegrass.

**The effect of summer heat and stubble load on endophyte viability in annual ryegrass**

*Joe Moore*

Annual ryegrass (*Lolium rigidum* Gaudin) is a significant and persistent weed of southern Australian cropping systems, costing farmers in excess of $300 million and infesting over 12 million hectares. Its propensity to evolve herbicide resistance to nearly all chemicals applied to control it has made it a formidable weed to manage. Annual ryegrass has also co-evolved with the fungal endophyte, Neotyphodium occultans. Neotyphodium species of cool season grasses such as perennial ryegrass and tall fescue provide their hosts with relief from biotic and abiotic stresses through known and unknown mechanisms respectively.

The contribution of *N. occultans* to the success of annual ryegrass as a weed still remains to be elucidated. This study examines the effect of summer heat and stubble load on the viability of the *E. occultans* in annual ryegrass seed. Plots were set up in a rain shelter to stop premature germination of samples due to summer rain. Seed was placed in mesh bags and where applicable secured to the ground using plastic stakes to exclude invertebrate and vertebrate predation. Treatments included seed that was kept at ambient temperatures in lab, on soil surface, buried at 5 cm soil depth and also placed under simulated stubble at 3 and 6 t ha−1 Seed was sampled over the February-April period three times to examine endophyte viability. We found that: endophyte viability declined in all samples; endophyte viability continued to decline with time; and field samples lost endophyte viability faster than those in the lab treatment. The implications for the endophyte in annual ryegrass under varying cropping regimes are discussed.

**Loline alkaloids produced by Epichloë occultans in Australian Lolium rigidum**

*Joe Moore*

Annual ryegrass (*Lolium rigidum* Gaudin) is the most significant weed of southern Australian farming systems, causing an estimated $300 million in yearly losses to the grains industry (Pratley, pers. comm.). Annual ryegrass is frequently found in association with the endophytic fungus Epichloë occultans (C.D. Moon, B. Scott and M.J. Chr.). Fungal endophytes are known to provide ecological fitness benefits to many cool season grasses in part through production of different classes of bioactive compounds. However, it is unknown if *E. occultans* causes benefit or detriment to annual ryegrass through this association. This study examines the production of the most prevalent alkaloids known to be produced by *Epichloë* spp., the lolines, in 15 Australian ecotypes of annual ryegrass. Loline alkaloids are known to enhance host survival in other cool season grasses through protection from insect damage. A broad geographic selection of Australian biotypes of
Management of Paterson’s curse (*Echium plantagineum*) through canola interference
Md Asaduzzaman (Asad)

Canola is a major oilseed crop in Australia but weeds reduce yield and quality. Paterson’s curse (*Echium plantagineum* L.) is an aggressive winter weed in Australia and often causes yield losses in canola crops. The prospects of herbicide resistance in weed species necessitate the search for alternative weed control options, such as canola interference (crop competition and allelopathy). A field experiment was conducted with two different sowing times, to investigate the interference ability of six canola genotypes. The results showed that canola genotypes had an effect on the number of *E. plantagineum* plants in the early sowing. Genotypes that display strong interference such as Av-opal, Pak8388-502 and Av-garnet significantly reduced the rosette diameter of *E. plantagineum* at both early and late sowing times, while genotypes Atr409, Cb-argyle and Barossa showed much weaker interference ability. Combined with early sowing, strong canola interference seems likely to have a major effect on seed production and recruitment of Paterson’s curse.

A new method for determination of herbicide resistance: using diversity array technology to determine annual ryegrass resistance to trifluralin
Aaron Preston

Annual ryegrass (*Lolium rigidum* Gaud.) is considered the worst winter crop weed of Australia. This is due in part to its propensity to evolve resistance to herbicides, having evolved resistance to 11 different herbicide groups. As levels of herbicide resistance in Australia are increasing, new methods are needed to assist in the early identification and treatment of resistant weeds. Conventional methods for the determination of resistance involve glasshouse pot trials, Petri dish assays or enzymatic determination, all of which consume considerable time and resources. A pilot study was conducted to determine the feasibility of utilising diversity arrays technology (DArT) as a faster and cheaper method for herbicide resistance testing. DArT is a high throughput genotyping technology which utilises microarrays for the discovery of genetic markers. The aim was to identify genetic markers in resistant and susceptible biotypes of annual ryegrass and to assess the ability of DArT to discriminate between herbicide resistant phenotypes.

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A student’s perspective on the Australasian Weeds Conference 2014

The Graham Centre presence was huge at the 19th Australasian Weeds Conference held at the Hotel Grand Chancellor, on the picturesque Hobart seaside in September 2014. It was particularly beneficial for students attending as support for early career research was amazing, giving ample opportunity for networking and exposure.

We were led by our three eminent Professors, Jim Pratley (Chair of Agriculture), Leslie Weston (Chair of Plant Biology) and Deirdre Lemerle (Director of the Graham Centre).

Professor Jim Pratley (CAWS medal winner) accompanied four of his postgraduate students, Aaron Preston,
Md Assaduzzaman, Hasan Zubair and Joe Moore. They presented a total of four papers and a poster presentation. Jim continually encourages his students to think outside the box by challenging problems with novel solutions.

Aaron Preston did us proud, winning the GRDC Award for Best Agricultural Weeds Presentation by an Early Career Researcher, with his explanation of Diversity Arrays Technology and its application to detecting herbicide resistance in annual ryegrass.

Professor Leslie Weston accompanied students James Mwenda, Karen Alpen and Joe Moore (co-supervisor). She also presented the paper ‘Comparison of grain crops and their associated residues for weed suppression in the southern Australian mixed farming zone’. Professor Weston summarised the progress, range and strengths of the Graham Centre weeds group highlighting our potential. Professor Weston continues to inspire her students with her tireless work ethic and tenacity for science.

Professor Deirdre Lemerle’s warm presence was welcome at the weeds conference (Co-supervisor, Md Assaduzzaman). Professor Lemerle is, as always, the glue that makes our professional networking stick. Thank you Professor Lemerle for making our professional development a pleasure and proving that science can be occasionally boring but scientists like you never are.

Our conference group also contained several top researchers from the Graham Centre. Mr John Broster, veteran weedy, gave a presentation of his survey work on resistant broadleaf weeds in NSW, highlighting the possibility of wild radish resistance and not to grow complacent with current low levels of resistance amongst broadleaf species tested.

Senior researcher Dr Hanwen Wu gave two presentations looking at Who’s who in the fleabane (Conyza spp.) family? A pictorial and phylogenetic exposé of the three fleabane species present in NSW triggering significant interest. His second presentation looked at a study on wild oats species titled ‘Wild oats seed bank dynamics: a long-term study in southern New South Wales’. Thank you Dr Wu for supporting all the students that attended.

Postdoctoral fellow Dr Xiaocheng Zhu (Diego) gave his presentation ‘ Selection of DNA barcoding regions for identification and genetic analysis of two Echium invaders in Australia: E. plantagineum and E. vulgare’.

Dr David Gopurenko and Dr Aisuo Wang also represented the Graham Centre, showcasing their expertise in genetics, presenting origins and diversity of exotic silverleaf nightshade (Solanum elaeagnifolium) present in Australia as determined by sequence analysis of a chloroplast intergenic spacer region and DNA barcoding for identification of exotic grass species present in eastern Australia respectively.

All in all, Graham Centre participants presented a total of thirteen papers; an estimated almost 10% of the entire weeds conference delegation. In conclusion, Tasmania was a great experience for Graham Centre students and we thank our great group of weed scientist peers for making it that way for us.

Contact: Mr Joe Moore
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Poets Corner

Seeds
I hold a forest in my hand
See it standing proud
Leaves whispering in the wind

I lift two fields of grass
rice, wheat
Topaz steamed
Aroma
Loaf baking
Rising to feed the day

I grasp tightly
A red, red rose
No thorns
Potential in
My closed palm

Sleeping
Life
To Grow

Earth
Power
Waits

By John Harper

Farm Sense...
Farming’s bloody tough - there’s no doubt that it’s true

Yet most people in the city, they haven’t got a clue
They get their milk and eggs from cartons, the butcher makes their meat
Don’t really know how cotton grows, never seen a crop of wheat
See that’s on the far side of the mountains and even interstate
So they rarely ask the question how food gets from gate to plate
But they know that farmers whinge, it’s either drought or flood
And they’ve always got their hand out to battle dust or mud
And sure sometimes they’ll feel sorry for Cousin Joe or Farmer Bob
But don’t understand why they don’t just get a proper job
And here lies their confusion, here’s the sharp end of the knife
Farming’s not a job, it’s a bloody way of life

You’re either drawn to it or born to it, either way it’s all the same
And while the dice are sometimes loaded you still have to play the game
In a country where statistics show we don’t get too much rain
Then there’s the political conditions which are pretty much insane
See most pollies they all swim in pools of ignorance and myth
And sadly for the farmers, this is what they’re dealing with
Rural export dollars help to keep this joint afloat
While the cockies bat above the average they still only get one vote
No matter how much they contribute to the Nation’s wealth
It’s barely recognised so they have to help themselves
In the ag world overseas Aussie farmers have great status
Because when all is said and done they’re fantastic innovators

And as new challenges arise they join as one to make a stand
To income-proof and drought-proof and future-proof their land
They’ve learnt they must diversify if they’re to survive
In a climate that may only give them two good years in five
Cheap imports do their heads in, not much protection there at all
And while squeaky wheels get the attention our farmers never drop the ball
All they want’s a level playing field, surely that’s not much
Still it’s hard to preach to people who are just so out of touch
Who eat their chops and eggs each morning, put on their fancy woollen suits

Pour milk into their tea and then grab a piece of fruit
Drive to work and, if it rains, complain about the weather
Without one thought for the farmers who put it all together
Okay, now I’m whingeing, but it’s all so bloody true
And farmers, as you well know, the future’s up to you

By Murray Hartin

www.murrayhartin.com.au
Understanding growers’ knowledge and practices around stubble management

Group interviews were conducted in June, July and September 2013 with a sample of landholders from each of the six grower groups involved in the Centre’s ‘Enabling landholders to adopt profitable and sustainable carbon cropping practices’ project. Individual in-depth grower interviews were generally timed to coincide with group interviews. Two growers from each group were interviewed.

The group interviews aimed to provide baseline data on landholders’ knowledge, understanding and practices of stubble management. Individual in-depth interviews enabled more detailed exploration of, as well as insights into, stubble management practices. A number of key themes emerged from the interviews including; pressures to reduce burning and adopt full stubble retention; motivations for continuing to burn stubble; sources of grower information about stubble management; benefits of stubble retention; disadvantages and challenges associated with stubble retention; and disadvantages of carbon farming.

Key findings include:

- Personal, biophysical and cost-related motivations are more important to growers than external pressures in making decisions on whether to burn or retain stubble.

- Growers have a high level of awareness of the economic and environmental benefits associated with stubble retention. However, there a range of reported technical, biophysical, biological and cost/workload challenges and constraints that contribute to problems in achieving these benefits.

- Consequently, growers partially adopt stubble retention and continue to burn selectively as part of their stubble management ‘toolkit’.

- Growers rely predominately on local agronomists and advisors for their stubble management information.

- Retaining stubble to sequester soil carbon is not a priority for growers due primarily to the lack of perceived benefits. Many growers are sceptical about the trade-offs involved as well as the problems with measuring and accounting for soil carbon across diverse geographical regions and farming systems.

Pressures to reduce burning and adopt full stubble retention

Most participants recognised the need to reduce stubble burning and increase stubble retention on their property. Motivations to do so were related mainly to growers’ personal goals and values. Pragmatic/business reasons and the observed biophysical impacts of burning were also viewed as important. While peer and community pressure
to reduce burning were mentioned by some growers, this was not recognised as being a significant driver.

**Motivations for continuing to burn stubble**

Despite widespread interest in, and use of, stubble retention, many growers favoured the burning of stubble where appropriate. In most cases, growers considered themselves reluctant stubble burners who burned only when it was absolutely necessary. For those growers in the group interviews, this was due primarily to the observable production benefits associated with burning, lack of social pressure to change, and the need to retain flexibility in farm management practices. The individual interviews revealed additional reasons including, dealing with difficult stubble loads and improved weed and/or soil management.

**Sources of grower information about stubble management**

As part of the individual in-depth interviews, growers were asked where they source information on stubble management. Growers overwhelmingly mentioned private agronomists/advisors as their main source of information. In many cases, growers had been working with an agronomist for some time, and see their advice as being trustworthy. Other sources of information included, personal observation (trial and error), other growers and field days.

**Benefits of stubble retention**

Lower cost and labour intensity as well as improved soils and soil moisture emerged as the most significant benefits of stubble retention. Timeliness and water use efficiency were also listed as benefits.

**Disadvantages and challenges associated with stubble retention**

Despite the observed benefits of retaining stubble, growers reported numerous disadvantages in retaining stubble, as well as challenges in moving towards full adoption of stubble retention. These included technological/technical constraints, biophysical constraints, pest, weed and disease problems, higher workloads and costs, and increased use of chemicals and pesticides. As a consequence of these challenges, many growers continue to selectively burn stubble.

**Disadvantages of carbon farming**

Growers were asked about their views on carbon farming, and whether they would change their stubble management practices if they could get paid for sequestering soil carbon. Growers overwhelmingly viewed carbon farming as a low priority, and treated potential payment for sequestering soil carbon with scepticism. Scepticism centred on four inter-related issues: unclear economic benefits for the farm business; possible trade-offs with other existing environmental practices; problems of accurately measuring soil carbon; and lack of conclusive scientific evidence.

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**Minimising herbicide resistance in broadacre crops in Southern Australia**

Graham Centre members Professor Leslie Weston (CSU), Dr Hanwen Wu (NSW DPI) and Mr John Broster (CSU) have been awarded a $1.8M project award from GRDC from 2013-2019. They will study weed management systems for minimising herbicide resistance in broadacre crops in the Southern Region. Chris Preston, University of Adelaide (UA) is managing the UA portion of the project.

In 2014, CSU received an additional $1.7M from MLA and GRDC to conduct similar research from 2014-2019 in mixed farming systems and pasturelands. Professor Leslie Weston, Mr John Piltz (NSW DPI), Professor David Falepau (CSU), Dr Belinda Hackney (CSU) and Dr Karl Behrendt (CSU) will work to develop a HACPP based risk management tool for producers to assist in decision making when considering weed management strategies for reduction of herbicide resistance in pastures.

An important objective of the work will be an assessment of the incidence of herbicide resistance in pastures and broadacre crops. John Broster will conduct regional surveys in both broadacre and pasturelands across NSW, Victoria and Tasmania to determine the incidence of herbicide resistant weeds, resistance levels to various herbicide families and potential new and emerging weeds of importance across surveyed areas.

Dr Bill Brown (CSU) will lead the research in broadacre cropping systems to develop chemical and non-chemical strategies for weed management in broadacre cropping systems, including the evaluation of weed suppressive crop cultivars and optimal rotations for weed suppression over time. MLA funded research will focus on the selection of annual and perennial legume crops for weed suppression in pasture rotations, and the evaluation of chemical and non-chemical approaches for weed management in pastures including the evaluation of ensilage techniques for weed suppression. A post-doctoral researcher will be appointed to lead this research.

Contact: Professor Leslie Weston
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Life Cycle Assessment helps benchmark environmental impacts in cropping systems

Consumers are increasingly demanding more information of the environmental credentials of the systems that produce their food. In addition, some jurisdictions are implementing environmental targets (e.g. greenhouse gases (GHG) emitted per tonne of cropping product) that must be met if Australia is to continue accessing that market. Accordingly, the Grains Research and Development Corporation (GRDC) has funded a project, ‘Identifying national opportunities for grains emissions mitigation and other environmental improvement using Life Cycle Assessment (LCA)’, that started July 2014. The project funds researchers from NSW DPI, in conjunction with CSIRO and Life Cycle Strategies Pty Ltd, to benchmark the environmental impacts of Australian cropping systems using a method called LCA.

LCA usually assesses the environmental impact of a product that results from all stages of production. This extends from the extraction of raw materials (cradle) to disposal of the product (grave), however this project analyses the production of cropping products from cradle to the gate of the farm. For example, the assessment of a wheat crop takes into account the impact of all stages of production from the manufacture and transport of inputs such as fertiliser and herbicide through to the point the grain leaves the farm gate. The environmental impacts the project will benchmark include GHG emissions intensity and aspects of soil health such as erosion and salinity.

The ability to assess impacts on soil health will be developed as part of the project however published studies have shown the dominant source of GHG emissions in cropping systems is the application of nitrogenous fertilisers. Nitrogenous fertilisers are a core component of conventional cropping strategies but their application is associated with the emissions of GHG such as CO₂ and N₂O.

The project builds on an existing GRDC-funded project led by Dr Sally Muir at Tamworth. When complete, Dr Muir’s project will have used LCA to estimate the emissions intensity of wheat grown in SE NSW, NW NSW and NE NSW preceded by canola. It will also have estimated the reduction in emissions intensity by preceding the wheat crop with a legume crop that biologically fixes atmospheric nitrogen, reducing the need for, or a reduction in, the amount of nitrogenous fertiliser applied.

The ‘Identifying national opportunities for grains emissions mitigation and other environmental improvement using LCA’ project will replicate this approach for all other major grain producing regions across Australia. The first phase of the project will use data from the GRDC Farm Practices Survey and the Australian Bureau of Statistics to...
identify representative cropping rotations for each region. Once these rotations have been identified the project will benchmark the environmental impacts of these rotations, seeking advice from expert panels. The final phase of the project will be to examine possible methods to reduce the environmental impacts of these rotations.

Researchers have actively engaged farmers and other researchers throughout Australia to provide input through a national steering committee, and will continue to engage farmers and consultants to collect and ground truth data for each region. The analyses from the project will be publically available through published papers and extension material. Data will also be made available for the Australian Agricultural Life Cycle Inventory, allowing other LCA practitioners to utilise project outputs.

Contact: Dr Aaron Simmons
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In the Limelight

Geraldine Lammers, PhD Student

Supervisors: Dr Jane Heller (CSU), Dr Craig McConnel (Colorado State University), Dr David Jordan (DPI Wollongbar)

Thesis title: *Escherichia coli* O157 shedding in beef cattle

Funding body: Meat and Livestock Australia

Career and studies till now

- Bachelor Animal Sciences, Wageningen University, The Netherlands
- Course on animal welfare and protection, Swedish University of Agricultural Science, Uppsala, Sweden
- Master Animal Sciences, Wageningen University, The Netherlands

During my MSc I specialised in Animal Health Management, and graduated with a major thesis in Veterinary Epidemiology looking at the prevalence and risk factors of Livestock-Associated MRSA in broiler farmers and their family members.

Currently studying: Doctor of Philosophy, School of Animal and Veterinary Sciences

Research Interests: My main interest is zoonotic disease transmission, (e.g. the transfer of pathogens between animals and humans). Infectious diseases and antimicrobial resistance are also on my list of interests.

A typical day for me includes: Unfortunately I’m done with all my field work, so these days it’s data analysis and writing.

My main project at the moment is: I’m looking at *Escherichia coli* O157, which is found in the digestive tract of cattle, and is harmless within these animals. However, in humans infection can lead to death or life-long kidney damage. People can get infected through consuming contaminated meat or produce, or by direct contact with infected animals. The US formally recognised *E. coli* O157 as an adulterant of raw beef products since 2002 and has required port-of-entry testing from then on. Control of this pathogen in the food chain is important in order to prevent export issues and to protect public health.

My PhD is part of a bigger study, funded by Meat and Livestock Australia (MLA) in which we collaborate with the University of Sydney. I divided my research into three components. During the first part I performed two field studies, looking at the excretion dynamics of *E. coli* O157 in a pasture fed beef herd. The second part consists out of an expert opinion exercise in which national and international researchers with experience in the area of *E. coli* O157 in cattle were asked for their opinion on risk factors and super shedding. During the last part I will gain some experience in simulation modeling, in which I want to look at the sensitivity and cost effectiveness of pooling samples to overcome the cost-disadvantage associated with testing faeces from individual animals.

My favourite part of my studies is: I really enjoyed the cattle work and the time I spend at the cattle yards with James and Hobbo. Next to this, realising how much I learn during my research, whether this is through making mistakes or achieving new goals, gives a great boost.

When I am not studying I like to: Have dinner with friends (especially the ones with great cooking skills), visit different farms around Wagga, play tennis and try to do as much travelling as I can before heading back to The Netherlands after my PhD.

When I am driving I like to listen to: I enjoy listening to Triple J, but after a stressful day I might play an album of Ludovico Einaudi to relax a bit.
Dr Camilla Vote

Position: Research Fellow
Organisation: Charles Sturt University

Career Brief
With a background in winemaking and viticulture, previous research interests led me to the investigation of water productivity of viticultural systems through my Honours dissertation in 2006. Since then my research interests have expanded further into agricultural water resource management and climate change adaptation. My PhD research focused on the investigation of terrestrial water and carbon fluxes of irrigated broadacre crops and the atmospheric processes that drive them through the application of eddy covariance technologies. Currently, I am employed as a Research Fellow investigating soil, water and nutrient constraints for dry season agricultural production in Laos and Cambodia.

Research Activities
• Abatement of greenhouse gases and carbon storage within the landscape, with a particular focus on agricultural systems
• Agricultural research for development in South East Asia

Professional Links
• Member - Australian Meteorological & Oceanographic Society
• Member - American Geophysical Union

A typical day for me includes: Feeding babies, maybe going to the gym or for a ride on my treadly, going to work, feeding and bathing babies, bed; or tramping around the countryside of southern Laos being bitten by the most fearsome ants.

My main project at the moment is: Improving water and nutrient management to enable double cropping in the rice growing lowlands of Lao PDR and Cambodia [ACIAR project SMCN/2012/071]
# EVENTS CALENDAR

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Ovary and feathery stigmas of triticale. Although triticale is self-pollinated it has a typical grass stigma that is adapted for wind pollination. The stigmas of grasses are much branched to capture pollen grains that travel on the wind.

Photo: Geoff Burrows

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