Welcome to the Spring edition of the Innovator. In my first column as Director, I am pleased to report lots of positive activity within the centre. Combined with a great season to date across much of southern Australia, there is a real sense of optimism.

Our recent sheep and beef forums were a great success, with each having over 100 attendees, the majority being producers. Feedback was overwhelmingly positive - the revised format of discussing industry-wide issues rather than only focussing on the research activities of our members appeared to hit a chord with producers in particular. While such an approach will not be appropriate every year, it is worthwhile to do this periodically. The advisory committees for each forum decided this was an appropriate year for such an approach. While a major function of these forums is to showcase our research, another equally important function is to demonstrate the Graham Centre understands industry needs, which this year’s forums clearly did. This is important for industry credibility, the forums have established themselves as a ‘must attend’ day for sheep and beef producers, lifting the profile of our Centre.

For a number of reasons we did not hold the Crop and Pasture forum at the field site this year, opting to hold the event indoors with a visit to the field site in the afternoon. Producer attendance at the day was less than in previous years, although the research presentations at the day were well received. After five years of operation, it is timely to review the field site. It has clearly been a good focal point for the forum, but is a significant undertaking to maintain, so we do need to consider its purpose and use in the future. I would welcome your thoughts on this.

The Graham Centre also recently hosted a visit by ACIAR’s Policy Advisory Council (PAC) (http://aciar.gov.au/pac), as well as ACIAR commissioners. This high level delegation spent a day discussing current and future international projects of interest to ACIAR, inspected CSU and DPI facilities, and undertook a tour of Kerry and Lisa Anderson’s farm, an excellent example of a well-managed mixed farm. The Commissioners and PAC were clearly impressed by our capacity, enthusiasm, strong links with industry and our ability to make the CSU-DPI alliance work. Thanks to all
those who contributed on the day, I am sure it will stand us in good stead with ACIAR for future projects.

Our recent submission to the review of research centres at CSU was a significant undertaking, and thanks to those members who provided additional information for this process. In compiling the submission, I was struck by how well the Centre has done over the past five years, in both key metrics of income and publications there was a consistent increase over the reporting period. In esteem areas, I was also impressed by the achievements of our members, many have been granted prestigious awards or have been invited to be on expert panels. This demonstrates the high regard in which our members are held, both nationally and internationally. We will know the outcomes and recommendation of the review process by the end of the year, and I will report in the next edition of the Innovator.

I trust you will enjoy reading the Spring 2015 edition.

Professor Michael Friend

Biserrula - the new king of pastures?

A recent field day on biserrula held at the Graham Centre by Dr Jane Quinn and Dr Belinda Hackney attracted 32 farmers and advisors. Biserrula is a hard-seeded annual legume that offers flexibility for mixed farming systems through its ability to regenerate without the need for re-sowing following a cropping phase. As a consequence, this significantly reduces input costs associated with pasture establishment. In the pasture phase, it can fix significant quantities of nitrogen that can then be used by the following crop - again reducing input costs.

Biserrula has been the most widely adopted of the new generation hard-seeded annual legumes in NSW. In part, this is due to its robustness in tough seasons compared to traditional, shallower rooted species such as subterranean clover. Flexibility in establishment options, particularly the capacity to summer sow with robust new generation granular inoculants has significantly opened the sowing window compared to traditional species. This allows farmers to sow pasture at a time when it is not competing with the cropping operation. The hard seed breakdown over summer and ability to get away

Forums focus on running profitable sheep and beef enterprises

One hundred and twenty producers and industry representatives from across the region gathered at CSU on Friday 10 July for the Graham Centre’s annual Sheep Forum. The forum looked at the big picture issues surrounding running a profitable sheep enterprise.

The Centre’s annual Beef Forum on 14 August saw 112 producers and industry representatives in attendance to hear from the industry’s best and consider issues affecting profitable beef enterprises.

With many producers either looking to get back into livestock or changing their enterprise, it was timely to consider the macro factors that affect the profitability of running a sheep or beef enterprise.

Presentations and proceedings from the forums are available on the Graham Centre website:

Sheep - www.csu.edu.au/research/grahamcentre/events/sheep-forum
Beef - www.csu.edu.au/research/grahamcentre/events/beef-forum

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Producers and industry representatives heard from some of the best in the industry at the 2015 Graham Centre Sheep and Beef Forums. The forums considered the big picture issues surrounding running a profitable sheep or beef enterprise. Photo: Toni Nugent.
on early autumn rain means that significant growth can be achieved off first year pastures. Additionally, there is capacity to exploit palatability differences, particularly with the variety Casbah, to remove problem cropping weeds such as annual ryegrass before the next cropping phase.

Until recently, relatively little was known about livestock performance on biserrula. Experiments at CSU and on-farm undertaken by Dr Quinn and Dr Hackney have shown lambs can grow at over 350 g/head/day on biserrula-based pasture. However, primary photosensitisation (photosensitisation that does not involve liver damage) can be an unwanted side effect of grazing biserrula dominant pastures in the vegetative to pre-senescence growth stage in non- or very lightly pigmented animals. While not as financially impactful as conditions such as redgut on lucerne, it is nonetheless an issue that concerns many farmers. This year, experiments have been undertaken to determine:

1. The effect of adding other species to biserrula at differing densities and its impact on sheep weight gain and photosensitisation occurrence.
2. The ability to use grazing as a means of reducing weed burdens at differing weed densities.

The current research has been undertaken using both commercial varieties of biserrula; Casbah and Mauro.

Results

The experiment involved sowing ryegrass at rates of 0, 40 and 120 kg/ha into regenerating biserrula stands just prior to the autumn break. Both varieties of biserrula were very effective in competing with ryegrass at the 40 kg/ha sowing rate with biserrula contributing on average, 10 % to total feed on offer (FOO) at the first grazing in early July. At a sowing rate of 120 kg/ha annual ryegrass seed, biserrula contributed approximately 20 % and 30 % to total FOO in Casbah and Mauro respectively at the commencement of the first grazing. Biserrula appears to have significant capacity to directly compete with ryegrass, even at high simulated densities.

Considerable differences in ability to remove ryegrass via grazing was found in the first grazing with sheep reducing ryegrass density in the lower ryegrass sowing rate to less than 3 % in the Casbah, while little reduction occurred in the Mauro. At the higher sowing rate of ryegrass there was also a larger reduction in ryegrass density in the Casbah compared to the Mauro plots over the duration of the first grazing period. These findings indicate Casbah may be a better choice where grazing is to be used as a tool to reduce problematic weed density.

Growth rate of crossbred ewe lambs grazing the pure biserrula plots averaged 290 g/head/day. However, on the plots containing the highest proportion of ryegrass this rate increased by over an additional 100 g/head/day on both varieties. Photosensitisation was reduced significantly in the plots containing ryegrass, but there was a marked difference between varieties with the inclusion of ryegrass having a greater impact on reducing photosensitisation in Casbah compared to Mauro. This is likely to be a function of sheep preferentially grazing ryegrass in the Casbah that is reflected in the reduction in ryegrass density.

The experiment is ongoing with grazing undertaken again in late winter-early spring while the plant is still vegetative, and again in summer to determine its feed value at this time. The results so far indicate:
1. Casbah is the variety offering greatest potential to use for selective removal of weeds via grazing.

2. Presence of other species in the pasture, even at low to moderate levels can significantly reduce incidence of photosensitisation and/or increase daily weight gains.

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Agribusiness Today Forum - Mixed Farming Systems of the Future

Farmers from across the Central West heard first-hand about the latest innovations, future trends and opportunities in the cropping and livestock industries at the recent Agribusiness Today Forum – Mixed Farming Systems of the Future held in Forbes.

More than 150 farmers and industry representatives attended the event on 13 August with topics ranging from mega trends and their future impact on agriculture, livestock and grain market states of play and outlooks, tropical pastures, the role of dual purpose crops, adaptation and risk management under climate change, future technologies in farming, and people management. Insightful case studies were also presented on vertical integration in vegetable production from Ed Fagan, Mulyan and a Livestock Case Study from Tess Herbert, Gundamain Feedlot.

The forum included a livestock and cropping field trip on the 14th August with 80 people visiting the Wirrinya Trial site to examine lime and stubble projects, cereal and canola trials and managing mice in crops. The group also visited Mattiske’s state-of-the-art shearing shed and learnt about innovative uses for drones and developing more efficient livestock management systems.

Feedback from the forum and field trip has been extremely positive with the event heralded as a great opportunity to catch up with other farmers and gain valuable and practical information for use back on the farm.

The forum was supported and organised by the School of Agricultural & Wine Sciences, CSU, Regional Development Australia Central West and the Graham Centre, in partnership with Central West Farming Systems, Central West LSS, and the Central Tablelands LLS. The forum was sponsored by CSU Orange, Central West LLS, MLA, CWFS, Central Tablelands LLS, NAB, ADM, NSW Farmers, Achmea Australia and AgriWest Rural Supplies.

Copies of presentations and links to short speaker clips can be found at http://www.rdacentralwest.org.au/2015-agribusiness-today-forum/.

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Industry research in the spotlight

Research focusing on pasture mixes, legumes for high rainfall zones, crop sequences, and weed and disease management was the focus of this year’s Graham Centre Cropping and Pasture Systems Field Forum held on 2 September. Researchers from NSW DPI and CSU presented their trials and results to farmers, advisers and students.

The field site is an active research entity. This year several trials are investigating integrated methods for weed control, including a new five-year experiment that is looking at the dynamics of weeds in the cropping system.
While this year’s format differed from previous years, the opportunity to hear about the latest research findings, followed by a visit to the site, addressed the feedback from past forums of considering cropping and pasture issues in separate forums.

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Conference addresses the business of food security

PhD students Sahibzada Shafiullah (Shafi) and Mohammad Tufail attended the Crawford Fund Annual Parliamentary Conference in Canberra during August. Shafi said it was a great experience, providing the opportunity to network with a wide-range of people including world leaders working in international agricultural sciences. He spoke with Dr Nick Austin, CEO ACIAR, about a possible collaboration to start a project for the support of smallholders in war-affected areas in Pakistan, and is now working on developing a project in this area. Shafi also spoke with Crawford Fund officials, and will soon begin work on a pilot project for capacity building of scientists and experts working in agriculture and livestock production in Pakistan.

Listening to the experts and scholars, Shafi says he learned that one should keep oneself open to any opportunities at any time, and never cast off an opportunity just because it might be out of your comfort zone.

Another excellent part of the conference was meeting Dr Cary Fowler. His unique ideas and vigorous efforts are immensely appreciated for saving genetic diversity of crop varieties, in particular the Seed Vault.

“The scholar day was amazing and full of excitement. After listening to the stories of young scholars working voluntarily in developing countries, I am fully convinced that I will grab any opportunity for international exposure working in the agriculture and livestock sectors in developing countries. Watching the documentary ‘Seeds of Time’ on the scholar day was so inspirational and emotional,” he said.

Shafi found the concept of farm intensification (which was dominant amongst a few presenters at the conference) a bit challenging, especially for developing countries where millions of people are directly related to smallholder farming.

No doubt farm intensification could be one of the prime requisites to feed nine billion people by 2050, however, he believes it could phase out a large number of smallholders. “Ultimately, they would start moving to big cities for job hunting. So, along with agricultural intensification, we need to think about accommodating those millions of farmers and reducing the burden on our big cities and slums around those cities,” Shafi said.

He said it was good to listen to both aspects of the farm intensification debate, with some believing this concept could push producers towards hormonal and antimicrobial usage that could have unpleasant outcomes like antimicrobial resistance. The United Nations has already called antimicrobial resistance a global threat for public and veterinary health.

Shafi would like to see future conferences also cover specific topics on animal production aspects, to increase
the participation of people working with production animals such as dairy, beef and poultry.

“Food, animal and agricultural scientists together can cope with the food insecurity challenges in 2050,” he said.

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Soil carbon in the Monaro Region

Abby Jenkins and Susan Orgill from the DPI Soils Unit have put together a book on the results of research on soil carbon in the Monaro region of NSW. The book was commissioned by a regional landholder group called Monaro Farming Systems (MFS). The 100+ member group encourages farmers and researchers to work together to improve farming practice and innovation.

Monaro Farming Systems members wanted to compare the influence of soil type, rainfall and land management on carbon stocks. Practices of interest included liming, nutrient management, introduced perennial pastures and minimum disturbance cropping.

The questions landholders wanted answered included:

• What is the effect of ‘parent material’ (shale, granite and basalt) and soil fertility on carbon stocks in the Monaro region?
• Does minimum disturbance cropping influence carbon stocks over a two year period?
• Does liming introduced pasture increase carbon sequestration?

Produced by the publications team at Tocal College, the book is one of a growing range of digital publications, and is available at https://itunes.apple.com/au/book/id1035198100

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Conference explores the world of soil-plant interactions

The Rhizosphere 4 Conference held during June in Maastricht, The Netherlands brought together soil and plant scientists from across the world to address disciplines of the soil-plant interaction sciences. The conference covered around 19 critical topics in soil-plant research from nutrient acquisition to climate change and new methods and concepts.

Rhizosphere conferences are the premiere event for soil-plant interaction research and aim to provide a forum where scientists, especially early career researchers, can present their work and discuss ideas with experts in all fields of rhizosphere science.

Five hundred and sixty six people attended the conference, where Graham Centre member Dr Ehsan Tavakkoli, NSW DPI, presented a paper ‘Simultaneous use of gypsum and legume crops reduces soil pH and alters soil carbon on rhizosphere of sodic soils’. Other key issues addressed at the conference included:

• Novel ‘omics’ technologies: These technologies have provided more in depth knowledge of the diversity and functioning of the rhizosphere microbiome and significant advances are being made to uncover mechanisms, genes and metabolites involved in the multitrophic interactions in the rhizosphere. New results on how rhizosphere bacteria impact on root architecture, root growth and tolerance to soil-borne pathogens were presented.
• Microbes in the rhizosphere: Associating with microbes in the rhizosphere can have both costs and benefits for host plants. Results were presented on quantitatively...
tracking the trade of carbon and nutrients between the host and microbes. The use of quantum dot technology to track trading strategies across space and time was certainly a novel approach in this area.

• **Breeding microbes to feed the world:** It was demonstrated that naturally occurring processes in mycorrhiza fungi can be used to develop genetically novel varieties to induce enormous changes in rice growth. The power of using microbial genetics to improve food production and that this could potentially lead to more rapid improvements than conventional genetic plant improvement was discussed.

• **The role of roots in ecosystem response to climate change:** Results from a field-based mesocosm experiments in which a drought was imposed on plant communities that varied in abundance of the same four plant species with contrasting root systems were presented. It was found that plant communities modified soil communities both directly and indirectly through roots and their impact on soil abiotic properties, which has cascading effects on ecosystem processes.

• **Phosphorous acquisition by plants:** Root traits of south-western Australian species were explored that allow them to function on the world’s most impoverished soils, and compare these with what is known about campos repustres in Brazil, a region similarly low in available P and also a hotspot of plant diversity.

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### The role of a ‘farmer’ identity

Graham Centre PhD student Theresa Groth gave an oral presentation at the 21st International Symposium on Society and Resource Management, in Charleston, South Carolina, USA July 2015. Her presentation ‘The Development of a Multi-Dimensional Collective Occupational Identity Construct in a Natural Resource Context: The Role of a ‘Farmer’ Identity’ addressed the conference theme of ‘Understanding and Adapting to Change’. The presentation featured the results of a key research question of her PhD work examining the development of a theoretically sound, multi-dimensional construct exploring a ‘farmer’ occupational identity. This construct is used in the development of a landholder typology and four landholder profiles in Victoria, Australia.

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### International congress provides latest insights into canola research

A number of Graham Centre members and students recently travelled to Saskatoon, Canada to attend the 14th International Rapeseed Congress (IRC), 5-9 July.  

With over 900 in attendance, 350 posters and 120 speakers across the four days, there were many opportunities to network and listen to the upcoming research surrounding canola. Several posters and oral presentations by Jamie Ayton (NSW DPI), Saira Hussein and Clare Flakelar (CSU) were effective in broadcasting the current research within CSU and DPI, and conveyed a strong presence alongside other institutions.

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(Top) Rohan Brill, Harsh Raman, Audrey Leo and Jamie Ayton, NSW DPI.  
(Bottom) Poster by Rohan Brill et al, NSW DPI.  
Photos: Clare Flakeler
Strengthening links with France

Professor Leslie Weston spent three weeks in France as an invited visiting research professor at the University of Aix Marseille, Marseille. While at University of Aix Marseille Leslie performed laboratory bioassays, metabolic profiling and presented a week-long workshop to more than 30 participants on the use of metabolomics approaches to study plant secondary products for chemical ecology applications. Leslie also performed confocal microscopy and scanning electron microscopy to identify and localise plant secondary products on leaf surfaces, in root tissues and intracellular organelles. Leslie also spent some time exploring ancient archeological sites dating back to the Greek and Roman occupation and in the marine biology laboratory working on the chemical ecology of marine sponges.

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2015 Australian Cotton Research Conference

The Association of Australian Cotton Scientists, 2015 Australian Cotton Research Conference - Science Securing Cotton’s Future, was held on 8-10 September, at the University of Southern Queensland, Toowoomba Campus. There was a wide variety of presentations, covering the major areas of scientific investigation into cotton, from plant pathology and entomology to plant breeding, fibre processing, social science, weed science and aspects of plant and soil systems.

Graham Centre PhD student Joe Moore presented his findings on cotton establishment following rice in the rotation and was well received as one of the only presentations with a southern region cotton focus. Joe hopes to further establish the Graham Centre as a potential hub for cotton research in the southern region.

Conference highlights included plenary presentations by Timothy Deutsch on the challenges involved in the development and adoption of modern cotton pickers, and by Dr Iain Wilson on a Molly bolly’s (molecular biologist) guide to cotton, where he tongue-in-cheek suggested that we no longer need conventional plant breeders anymore. The interactive ‘devil’s advocate’ sessions at the end of the day allowed for debates over concepts derived from the talks of that day, all while having a glass of wine.

Awardees of 2015 Conference Support Scheme Grants, Round 2

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Researcher explores the use of Eucalyptus in the fight against herbicide resistance

The Graham Centre is pleased to welcome Dr Yuanjiao Feng from the College of Agriculture, South China Agricultural University (SCAU). Dr Feng will spend one year between August 2015 and August 2016 at the Centre, investigating the biological activities of natural compounds under the supervision of Dr Hanwen Wu, NSW DPI. Her previous research focused on the degradation of Bt toxin from transgenic Bt corn and its ecological effects on soil chemical and biological properties, and the effects of introduced Bt gene on the induced chemical defence responses in corn. Dr Feng lectures in Agroecology, General Ecology and Environmental Protection and Sustainable Development for undergraduate students, and Ecological Experimental Methodology, Literature Review and Scientific Writing for postgraduate students. Dr Feng currently supervises a number of postgraduate students at SCAU, investigating the effects of exogenous jasmonic acid and salicylic acid on the chemical defense in Bt corn.

Her visit to Australia is supported by the China Scholarship Council. Dr Feng will work closely with Dr Wu to explore Australian native Eucalyptus for its novel bioactive compounds against herbicide resistance. This project involves the biological screening of about 300 Eucalyptus species, the separation and identification of bioactive compounds from eucalyptus essential oils and the mode of actions study using modern molecular technology.

Findings from Dr Feng’s research will be published in scientific journals and her visit will facilitate further international collaboration with South China Agricultural University.

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Research shows early promise for reduced fertiliser costs of production

Australian soils are naturally low in phosphorus (P) and pastures require P fertiliser to maintain high productivity. Soil P fertility drives pasture legume growth and nitrogen fixation in most pastures, and remains a critical input for grazing enterprises. However the long-term cost of P fertiliser is presently increasing at approximately twice the rate of inflation in Australia. Consequently, there is growing interest in developing grazing systems that require less P fertiliser and achieve the same livestock production. To be able to do this, P accumulation in fertilised soil (due mainly to P-sorption reactions) needs to accumulate at slower rates under lower concentrations of soil extractable-P than at higher concentrations. Recent research by Richard Simpson and his research team has shown this to be true. The next important component is to identify pasture legumes that have a similar or the same potential dry mater production as subterranean clover but can achieve this production at significantly lower soil extractable-P levels. With this in mind a small team of scientists set out to (i) determine the soil extractable-P levels of a range of alternative pasture legume species recently developed for southern Australia and (ii) identify the plant traits that control improved P efficiency.

To determine the P efficiency of a range of alternative pasture legumes, two sites (Yass and Burrinjuck) with naturally low soil extractable-P were sown to 12 pasture legume species, each with six different phosphorus rates. Dry matter yields were gathered and the results analysed to determine critical P for each species. The critical P in this case is defined as the rate of P fertiliser or soil P test value at which 90 % of maximum dry matter yield is achieved (Figure 1).

Research findings

Four legumes (pasture types, French serradella and yellow serradella; forage types, purple clover and crimson clover) and the two grasses (phalaris and cocksfoot) had lower critical P requirement than subterranean clover (Figure 2). Only one ‘pasture type’, French serradella, had a lower critical P requirement whilst yielding as well as subterranean clover. The critical P requirement of yellow serradella was also consistently lower than that of subterranean clover, however it did not achieve an equivalent maximum dry matter yield compared to subterranean clover.

Two forage types had lower critical P requirements and equivalent (purple clover) or higher (crimson clover) yields than subterranean clover at Burrinjuck. Of these two, only purple clover was sown at Yass where it again had a low
Figure 1: Diagrammatic representation of critical P (the Colwell extractable P concentration of soil that corresponds with 90% of maximum dry matter yield) for two pasture species where, species B represents the main legume used presently (subterranean clover) and species A represents an alternative legume with a lower critical P requirement (e.g. French serradella).

Figure 2. Yield of herbage DM grown in spring by species that had established adequately at the Yass (a, c and d) and Burrinjuck (b) sites. The result for *T. subterranea* (sub clover) is repeated in panels (c) and (d) for easy comparison with the other species. The Mitscherlich asymptotic function was fitted to the data using GenStat. For the year of establishment at each site, pasture yields are plotted relative to the P application rate. In the subsequent year (at Yass), soil P levels were topped up by adding a maintenance dressing of P and yields are plotted relative to the original P application rates, now designated (panels c and d) as the "nominal rate of P application". B. pelecinus = biserrula, O. compressus = yellow serradella, T. incarnatum = crimson clover, M. sativa = lucerne, T. hirtum = rose clover, L. corniculatus = birdsfoot trefoil, O. sativus = French serradella, P. aquatica = phalaris, T. purpureum = purple clover, D. golmerata = cocksfoot and T. spumosum = bladder clover. Error bars = 2xSE.
critical P requirement but did not yield as well as subterranean clover. There has been no evidence that the maximum yield of lucerne was achieved even at the highest soil P fertility levels in these experiments (~60 mg P/kg; Colwell 1963).

The experiments demonstrated there are at least some alternative pasture legumes that can yield as well as or higher than sub clover with substantially lower critical P requirements. For example, the amount of P applied for equivalent yield by French serradella at Burrajnuck was less than half that needed for sub clover. However, it was also noted that many of the alternative species were poorly suited to the cool, wet Southern Tableland’s seasonal, or soil conditions. This, more than any other factor, restricted the comparisons of P requirements that could be made for species such as bladder clover and birdsfoot trefoil. The most promising species have now been grown for a further season at a wider range of sites confirming the observations made here. Soil samples are being tested for Olsen P and Colwell P to facilitate specification of critical soil test P levels.

The research team has also examined how P efficient legumes can grow so well with lower soil test P concentrations, and these legumes have been shown to possess longer finer roots with longer root hairs that allows them to more efficiently explore the soil for P. This also shows us a clear pathway for selecting and breeding other legumes for P efficiency.

The next step in the development of low-P pasture options is to test whether the most promising legumes continue to produce well and require less fertiliser when grown in mixed pastures under grazing.

**Acknowledgements:** The work was funded by Meat and Livestock Australia and Australian Wool Innovation Limited. Thanks to Edward Story and Peter Southwell for providing the land used in this experimentation.

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**Assessing options for finishing lambs on pasture in spring**

Grazing lambs on pastures during spring may provide a cheap option for producers seeking to finish lambs at the end of the pasture growing season. Research by scientists at the Graham Centre in 2013 and 2014 sought to compare lamb growth on a number of different pastures, including the new-generation legumes biserrula, French serradella and bladder clover, and a high-value pasture mix of chicory + arrowleaf clover.

**Year 1 (2013)**

Lambs grazed replicated plots (0.7 ha) sown to either lucerne, biserrula (cv. Casbah), subterranean clover, or a treatment with half the plot sown to subterranean clover and half to biserrula, from 17 October - 17 December 2013 (61 days). Stocking rate was varied to maintain similar feed on offer across treatments. Due to the exceptional hot and dry conditions pastures were irrigated to maintain the green phase later in the season before allowing pastures to senesce. A core group of five White Dorper (Dorper) and five White Suffolk x Merino (WSM) lambs from each plot were weighed weekly during the experiment after an overnight curfew. Pluck samples were collected on five occasions from each plot to estimate diet quality and nutritive value tested using NIR spectroscopy. All lambs were killed at a commercial abattoir and carcase weights and GR fat depth recorded.

The average feed on offer remained above 2000 kg DM/ha throughout the experiment, so the amount of feed should not have restricted the lambs’ intake. The digestibility (digestible organic matter digestibility; DOMD) of lucerne was significantly higher than subterranean clover from 28 October and biserrula from 15 November, while digestibility of biserrula was significantly higher than subterranean clover at the end of the experiment (Figure 1). Crude protein content of lucerne was significantly higher than other pastures from 28 October and crude protein content of biserrula was significantly higher than subterranean clover at the end of the experiment (Figure 1).
Biserrula was flowering at the commencement of grazing. Some symptoms of photosensitisation were observed in lambs grazing biserrula after four days, however symptoms quickly resolved after a cooler change arrived and did not re-appear. The growth rates of lambs grazing biserrula were highest during the first eight days of grazing, but lamb growth rates then declined, and the average final weights of lambs grazing biserrula were lower than those grazing other treatments (Figure 2).

Final weights of WSM and Dorper lambs were highest when lambs grazed lucerne. Final weights of WSM lambs grazing subterranean clover did not differ significantly to lambs grazing subterranean clover + biserrula, however the final weights of Dorper lambs grazing subterranean clover were significantly higher than Dorper lambs grazing subterranean clover as a monoculture (Figure 2).

Year 2 (2014)
Lambs grazed plots (0.4 ha) sown to either lucerne, forage brassica (cv. Stego), bladder clover (cv. Bartolo), French serradella (cv. Margurita), lucerne + phalaris and arrowleaf clover + chicory, with the latter two treatments sown in 1:1 alternating sowing row (tyne) arrangement. Each pasture treatment had three replicates. Plots were grazed from 15 October - 2 December 2014 (48 days). Feed availability was maintained above the level that would limit livestock intake. Rainfall received July - November was approximately 100 mm below the long-term average, and plots were irrigated on four occasions from late September to early November to extend the green pasture phase. Five Dorper, five WSM and three White Suffolk x White Dorper (WSD) lambs grazed each plot and were weighed weekly during the experiment after an overnight curfew. Lambs grazing French serradella lost weight in the week ending 26 November and were subsequently removed from plots.

Digestibility of chicory + arrowleaf clover, lucerne and forage brassica treatments were high compared with the other treatments at the commencement of grazing (Figure 3). Digestibility was lower by the end of the experiment (2 December) in all treatments. Crude protein was highest in the lucerne and chicory + arrowleaf clover treatments at the commencement of the experiment and lucerne had the highest crude protein at the conclusion. The crude protein concentration in forage brassica and French serradella was lower than other treatments at the end of the experiment (Figure 3).

Initial growth rates of lambs grazing bladder clover or French serradella were as high as lambs grazing chicory + arrowleaf clover (Figure 4). Growth rates of lambs grazing bladder clover and French serradella declined later in the experiment as these pastures senesced. Lambs grazing bladder clover continued to grow later in the experiment compared to lambs grazing French serradella that lost weight as digestibility and crude protein content of the pasture declined. Final average liveweight was highest for lambs grazing the chicory + arrowleaf clover and lowest for French serradella and lucerne + phalaris across all lamb genotypes (Figure 4).

Genotype comparison
Average final weights of WSM and Dorper lambs grazing biserrula did not differ significantly in 2013. Average final weights of WSM lambs were higher than Dorper lambs when grazing lucerne, subterranean clover or the subterranean clover + biserrula pasture (Figure 2). Average carcass weights of Dorper lambs were significantly higher than WSM lambs in 2013 (average 22.4 kg v. 21.4 kg) due to the higher dressing percentages of the Dorpers, and GR fat depth was also significantly higher in the Dorper lambs compared to the WSM lambs (average 15 v. 12 mm).
Average final weights of WSD were heavier than other genotypes when grazing chicory + arrowleaf clover or lucerne in 2014 (Figure 4). Final average weights of Dorper lambs grazing bladder clover, French serradella and lucerne + phalaris were significantly higher than WSM lambs on these pastures (Figure 4), suggesting some advantage for Dorpers as the quality of these pastures declined late in the season. A higher proportion of Dorper and WSD lambs reached slaughter weight in 2014 compared to WSM lambs, as dressing percentages of Dorper (52.1%) and WSD (51%) were higher than WSM lambs (47.8%).

So what does this all mean for producers?

Lucerne is a valuable forage for feeding lambs, with lambs continuing to grow late in the season after many annual pastures have senesced. A mixed pasture consisting of arrowleaf clover and chicory can produce

![Photo: Shane Hildebrand](image)

**Figure 3.** Digestible Organic Matter Digestibility (DOMD) and Crude Protein content of chicory + arrowleaf clover (chic/arrow), lucerne, bladder clover, French serradella, forage brassica and lucerne + phalaris (luc/phal) grazed by lambs in 2014.

![GraphImage](image)

**Figure 4.** Average liveweight of (a) White Suffolk x Merino (WSM), (b) White Dorper and (c) White Suffolk x White Dorper lambs grazing chicory + arrowleaf clover (chic/arrow), lucerne, bladder clover, French serradella, forage brassica and lucerne + phalaris (luc/phal) during spring.
higher growth rates and finished weights compared to lucerne, and can maintain high quality and growth rates late in the season compared to lucerne, providing there is sufficient soil moisture available. Lamb growth rates on bladder clover and French serradella are high in mid-Spring but will decline later in the season as pastures senesce.

These results indicate that bladder clover may maintain lamb production slightly later in the season compared to French serradella. The in vitro digestibility and crude protein content of biserrula is higher than subterranean clover later in the season, however the higher apparent quality did not result in higher lamb production, with final weights of lambs grazing biserrula being lower than lambs grazing subterranean clover. The reasons for the poor performance of lambs grazing biserrula in late-Spring require further investigation.

Providing lambs a choice of biserrula and subterranean clover resulted in lamb growth rates at least as high as lambs grazing subterranean clover a monoculture. It is recommended that lambs should be provided with a choice of feed if grazing biserrula late in the growing season to maintain high livestock production.

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**Tantalising tastebuds**

On the 10 - 11 September, Shawn Mc Grath (CSU) and Steph Fowler (NSW DPI Cowra) along with Gerlane Brito and Jordan Hoban (NSW DPI) ran a lamb sensory trial at the Wagga Wagga NSW DPI Conference Room. The lamb samples were collected as part of a Graham Centre experiment (see previous article) that evaluated the impact of different forages on lamb growth rates and subsequent meat quality.

Sixty two (62) mixed sex White Dorper lambs were grazed on bladder clover, hybrid forage brassica (Rape Kale X), Chicory + Arrowleaf clover, Lucerne + Phalaris and Lucerne for 48 days. At processing a number of carcass traits and yield characteristics were measured including carcass weight, dressing percentage, eye muscle area, GR tissue depth, pH and meat colour. Meat samples were also collected to test a range of meat quality traits including shear force (mechanical measure of tenderness), ultimate pH, sarcomere length, nitrates, myoglobin content and fatty acid composition.

The final test was the sensory panel that included 64 untrained consumers from CSU, NSW DPI and Graham Centre staff along with CSU students. More than 600 loin samples were consumed over four sessions in two days of testing. Participants ranked the samples depending on tenderness, juiciness, flavour, how much they liked them overall and also classified them based on their overall quality.

Running such a large sensory panel is no easy feat and the organisers are extremely grateful to those who participated and volunteered as waiters for the sessions.

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IN THE LIMELIGHT

Dr Angel Abuelo

POSITION: Lecturer in Ruminant Health and Production

ORGANISATION: Charles Sturt University - School of Animal and Veterinary Sciences (SAVS)

CAREER BRIEF: I have recently joined the Production Animal group at SAVS. I graduated as a veterinarian from the University of Santiago de Compostela (NW Spain) in 2010, where I also completed a MRes (2011) and a PhD (2015). I have combined these postgraduate studies with a residency of the European College of Bovine Health Management, splitting the time between the Spanish Veterinary Faculty, an associated private practice and the Clinic for Ruminants with Herd Health Services of the University of Munich (Germany). During this time I also completed short-term research and clinical externships at Cornell and Michigan State Universities in the US, and the Royal Veterinary College in the United Kingdom, which gave me not only the opportunity of gaining experience in different settings, but also broadened my connections. I completed a MSc in Veterinary Education (2015) at the Royal Veterinary College (UK), being recognised as a Fellow of the UK Higher Education Academy in 2013.

I started my undergraduate studies with a specific interest in dairy cattle, an interest that was maintained and increased throughout these years. My PhD focused on the adaptation processes that take place around calving, comparing dairy cattle in intensive and organic farms, with a particular focus on negative energy balance and oxidative status. I hope to follow this research through the Graham Centre, aiming at reducing the incidence of subclinical diseases that besides affecting animals’ health status, produces pre-harvest economic loses in the Australian dairy enterprise.

RESEARCH ACTIVITIES: I am particularly interested in how dairy cows adapt to the transition from late gestation to the onset of lactation and how this impacts their health and productivity. Specifically, I tend to focus on the interplay of nutrition, inflammation and immune system at this time, as a better understanding of these relationships will help establish preventive measures early in the dry period to prevent periparturient diseases.

TEACHING ACTIVITIES: At SAVS, I participate in several teaching activities related to cattle production and medicine throughout the curriculum; delivering lectures, facilitating PBL packages, helping in practical sessions with live animals and participating in the students’ clinical rotations.

PROFESSIONAL LINKS
- American Association of Bovine Practitioners -AABP- (US)
- British Society for Animal Science -BSAS- (United Kingdom)
- British Veterinary Association -BVA- (United Kingdom)
- Higher Education Academy -HEA- (United Kingdom)
- Spanish Association for Buiatrics -ANEMBE- (Spain)
- Spanish Association for the Development of Agriculture -AIDA- (Spain)
- Spanish Association of Veterinarians in Academia -VetDoc- (Spain)

A TYPICAL DAY FOR ME INCLUDES … To be honest, despite having been in Wagga for more than two months now, I cannot say that I have established a daily routine. The alarm usually starts sounding at 6.50 am, but I usually avoid getting up for some (several) minutes. After I have convinced myself that it’s time to get up, I check overnight emails, then I have breakfast, prepare something for lunch and get ready for work. After a short drive I arrive at work and head to my office to start preparing for teaching and work on research projects. Other more fun options are when I start the day going with students and colleagues to livestock enterprises as part of their internal rotation. I usually stay at work until 5-6 pm, when I head back home. This is a good time to prepare dinner, do some housekeeping chores and interact with family and friends through Skype or Facebook. Usually this time also involves going through tasks related to the projects that I left open in Spain, as it’s the time when my collaborators start working. The day ends with me watching a chapter or two of a series on Netflix. I also like to include some time to keep fit by practising some sport and going to the gym.

MY MAIN PROJECT AT THE MOMENT IS: I arrived here with three main pending research projects. The most advanced one relates to the mechanisms of skeletal muscle atrophy during negative energy and protein balance in transition cows. We hope to be able to submit the manuscript by the end of September. The other two relate to the impact of oxidative...
status and inflammation with lameness and nutrient partitioning through insulin resistance in dairy cattle, as both have consequences in terms of animal wellbeing and productivity. I’m now drafting the lameness paper, and hoping to get my Spanish honours student to start analysing the data for the insulin resistance study. I am looking forward to starting to undertake projects here.

**MY FAVOURITE PART OF MY JOB IS:** I particularly enjoy teaching practical skills related to cattle medicine and production to veterinary students, it’s rewarding seeing how they progress throughout their training. In addition, my current position gives the opportunity of combining these teaching activities with research and clinical work. I believe this puts me in a privileged position to help develop the industry further and translate research findings onto farm applications.

**WHEN I AM NOT IN THE OFFICE I LIKE:** I’m still trying to find out what things I can do here in Wagga. Back in Spain, refereeing basketball kept me busy during the weekends that I was not on-call. Besides that, having a beer with friends and visiting other European countries were things that I really enjoyed and that I hope to be able to continue doing Down Under.

**WHEN I AM DRIVING I LIKE TO LISTEN TO:** Any music that plays on the radio station.

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**Sahibzada Shafiullah, PhD Student**

**SUPERVISOR(S):** Dr Jane Heller (CSU), Dr Marta Hernandez-Jover (CSU), Dr David Jordan (NSW DPI Wollongabar)

**THESIS TITLE:** Comparing, contrasting and identifying risk factors for antimicrobial resistance in humans and animals in Australia

**FUNDING BODY:** CSU and APL

**RELEVANT CURRENT EMPLOYMENT:** You can’t do anything if you are a full time PhD student.

**CAREER AND STUDIES TILL NOW:** I completed a M Phil (Animal Sciences) from CSU in 2012. I have got three Bachelor degrees: DVM (Doctor of Veterinary Medicine), B Sc (Honours) Animal Husbandry and BA (Political Sciences & Law). Before joining CSU in 2009 I was a lecturer in animal production at the University of Veterinary and Animal Sciences, Lahore, Pakistan. I have also worked as a research associate in WTO-QCL laboratory, working on the development of milk adulterants testing kits.

**CURRENTLY STUDYING:** PhD in veterinary epidemiology, public health and biosecurity. I am working on antimicrobial resistance and my focus is MRSA (Methicillin-resistant Staphylococcus aureus). I am looking at the prevalence and associated risk factors of livestock associated MRSA in animals as well as in humans in Australia.

**RESEARCH INTERESTS:** My main interest is antimicrobial resistance in animals and humans. I always get fascinated by zoonosis and reverse-zoonosis especially bacterial infectious diseases. I also love to be involved in and have toiled in international agriculture and livestock research for development projects.

**PROFESSIONAL LINKS:**
- Focal point for Dairy Science Park, Pakistan (DSP) in Australia
- Member of the Australian Society of Animal Production (ASAP)
- Member of Australasian Pig Science Association (APSA)
- Member of Pakistan Veterinary Medical Council (PVMC)

**A TYPICAL DAY FOR ME INCLUDES:** My target is to get up before 6 am which I hardly achieve. My day starts at 7, get some exercise, have a quick breakfast and start a long drive to uni (just 2 km) where I either start playing with my little cute super bugs in the lab which sometime goes late into the night, or I start hitting the computer, trying to convince myself to get more writing done with little procrastination! In the evening, I try to get to the gym or swimming but most of the time I manage to find excuses to stay in front of the computer. At least one hour a night belongs to watching news on the TV or reading online newspapers. Weekend nights are for watching TV shows and movies. My typical day usually finishes around 11 pm. **continued on page 18**
**My main project at the moment is:** Livestock associated Methicillin-resistant Staphylococcus aureus (LA-MRSA) has been well established as a potential zoonotic pathogen in Europe and other parts of the world. However, limited studies to date have assessed the carriage of these bacteria among animals and farmers in Australia. Despite this, there are reports of recurrent MRSA outbreak in workers in rural Australia. The main focus of my study is to conduct an investigation of this outbreak and determine potential risk factors for MRSA carriage in animals and workers. I usually go to pig farms and collect nasal swabs from volunteer workers, animals and the environment, and grow them in the lab hoping to find the super bugs (MRSA).

**My favourite part of my studies is:** I am loving my whole project! I really enjoy working in the lab and learning new skills. The next step is to improve my skills in biotechnology and gene sequencing, which might be a long journey but I will finally get there.

**When I am not studying I like to:** Behave socially like a normal human being (not a typical PhD student), visiting friends and increasing my social network. I usually invite friends over dinner, it’s a good tactic to improve my cooking skills as they don’t have any other option but to try my dishes, and I love traveling. Sometimes I also go out for a random road ride on my motorbike. I am working on my bucket list that includes skydiving, scuba diving, para gliding, bungee jumping and a trip to Europe and the US. I have only ticked off one in the last few months (skydiving), and my aim is to tick off at least another three during my PhD.

**When I am driving I like to listen to (music):** Random music but not heavy metal and noises. I mostly tune to news channels but this depends on my mood.