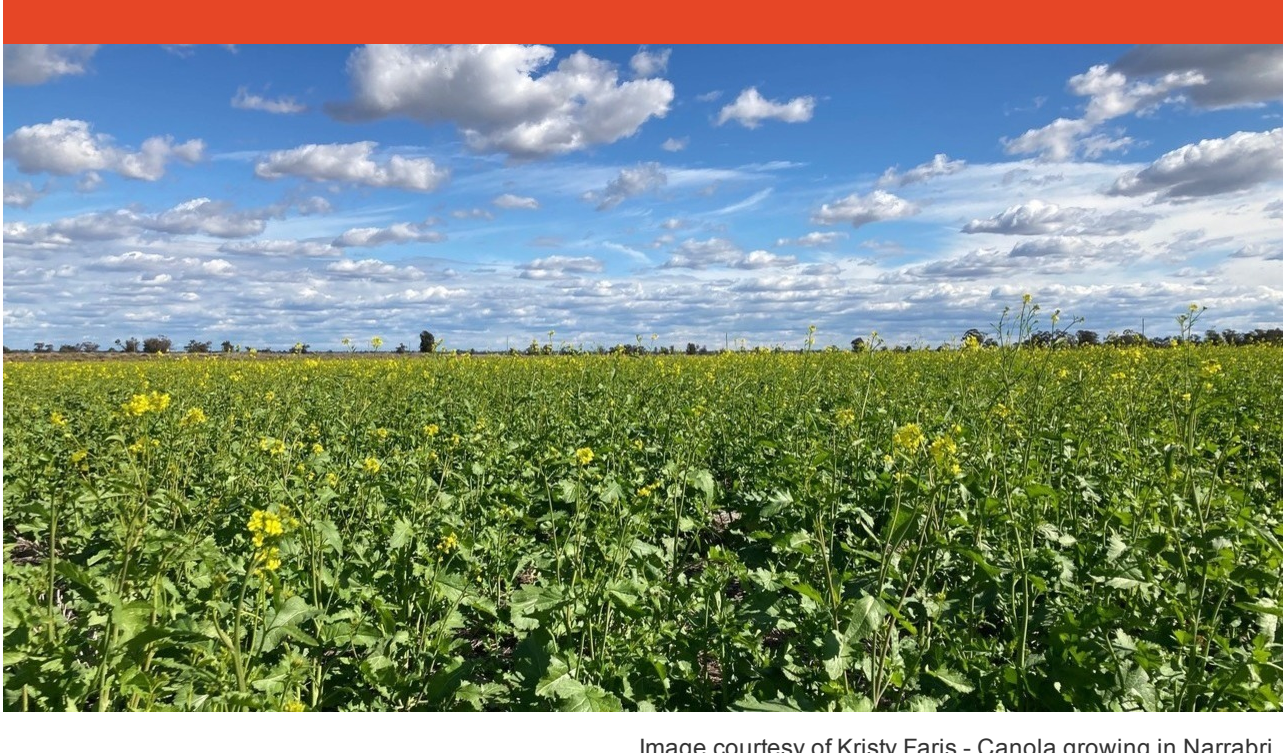


Image courtesy of Kristy Faris - Canola growing in Narrabri

Edition 9, July 2022

Georgika

Georgika - an online newsletter for those interested in academic aspects of the Ag sector

From the Director

Brent Kaiser

Welcome to this issue of Georgika.

The 2022 RD Watt Lecture was a great success. Our speakers D/Prof James Dale (QUT), Lisa and Zoe Paisley (Aggie Global) and Dr Deon Mahoney (Food Safety, International Fresh Produce Association) shared wonderful stories on their career paths and their contributions to better agricultural outcomes. I was very impressed with the diversity of discussion and in the pathways our students have triumphed in, a clear statement of the quality the University of Sydney can deliver to society.

The Narrabri Field Day will make a welcome return on 14 September. After two years online, we hope you can join us in Narrabri for an afternoon of field displays (wheat, chickpeas, faba beans and Indian mustard breeding programs) and demonstrations of the latest technology in weed control and digital agriculture. A full list of activites and displays is detailed below.

We hope you can attend our upcoming events outlined below. Future-Proofing Alt Protein: a R&D Deep Dive will be held on 14 October, providing a unique opportunity for the alternate protein industry to make valuable connections and gain a deeper understanding of the nuances of the R&D landscape in Australia. The conference aims to bring together the ecosystem of research, industry, community, and government to support market-led opportunities in new protein foods and ingredients.

Events

Annual Field Day: Narrabri
14 September 2022

- Complimentary BBQ lunch (sponsored by AGT)
- Field displays of wheat, chickpeas, faba beans and Indian mustard breeding programs
- Book launch - the first 60 years, the history of Australia's first grower initiated and owned wheat research institute, L. O'Brien
- Demonstrations of innovative weed control technologies
- The release of three new AGT canola varieties
- Digital Agricultural technologies
- New and historical wheat varieties
- Soil carbon - how it works
- Native grains and plant proteins

Register to attend the Field Day

Future-Proofing Alt Protein: a R&D Deep Dive

Date: Friday 14 October 2022

Time: 9am to 5pm, followed by networking drinks

Venue: University of Sydney

Topics for discussion include:
* the alt protein industry's R&D capabilities, the value of collaborations and what we can expect to see from research providers in the future
* representatives from alternate protein manufacturers will share their experiences
* roadmap to Australia's regulatory environment for novel foods
* growth opportunities locally and abroad, with a particular focus on regional NSW and the Asian market

This event provides an opportunity for the industry to make valuable connections and gain a deeper understanding of the nuances of the R&D landscape in Australia.

View the program and purchase tickets

Theme Leader Updates

Plant Breeding and Production

Richard Trethowan

Late summer sown chickpeas
Chickpea is a cool-season legume crop in Australia, despite its domestication as a summer crop, and is usually sown in late autumn depending on moisture availability. The northern Australian grains region (extending from central Queensland to central/southern NSW) comprises 90% of the Australian chickpea cropping area. The region has a highly variable climate and production is frequently constrained by high temperatures and soil moisture deficits resulting in reduced yield.

Late summer sown chickpeas could help alleviate the impact of stress by utilizing stored soil-moisture from summer rainfall in combination with in-crop rainfall. This alternative season could give grain growers greater flexibility in their farming systems, as they can opportunistically take advantage of late summer soil moisture by sowing this highly valuable crop.

A project supported by the Grains Research and Development Corporation aims to validate high-yielding, adoption-ready, summer chickpea lines that were developed in the ARC Research Hub: Legumes for Sustainable Agriculture. While summer chickpea could potentially be used as an out-of-season crop option in parts of the northern growing region during favourable years, further assessment is required prior to direct release by seed companies. As all performance data collected so far originates from Narrabri, the project extends testing across the region from Emerald in central Queensland to Gunnedah south of Narrabri. Trials will be conducted in two years at 2 times of sowing per location. The data generated from these trials will allow the identification of the most commercially valuable lines. These lines will subsequently be released to Australian growers according to the terms of the LSA Legumes Commercialisation Agreement developed between the parties.

Experiments established well at all locations in 2022, although two southern Queensland sites were later lost to flooding. Data is being compiled and analysed and early results continue to show the distinct yield advantage of the new materials, even though the cool wet summer reduced differences between the summer selected lines and varieties bred for traditional autumn sowing.

Late summer sown chickpea trials at Narrabri

Chickpeas at Narrabri

Read further about Plant Breeding and Production

Digital Agriculture

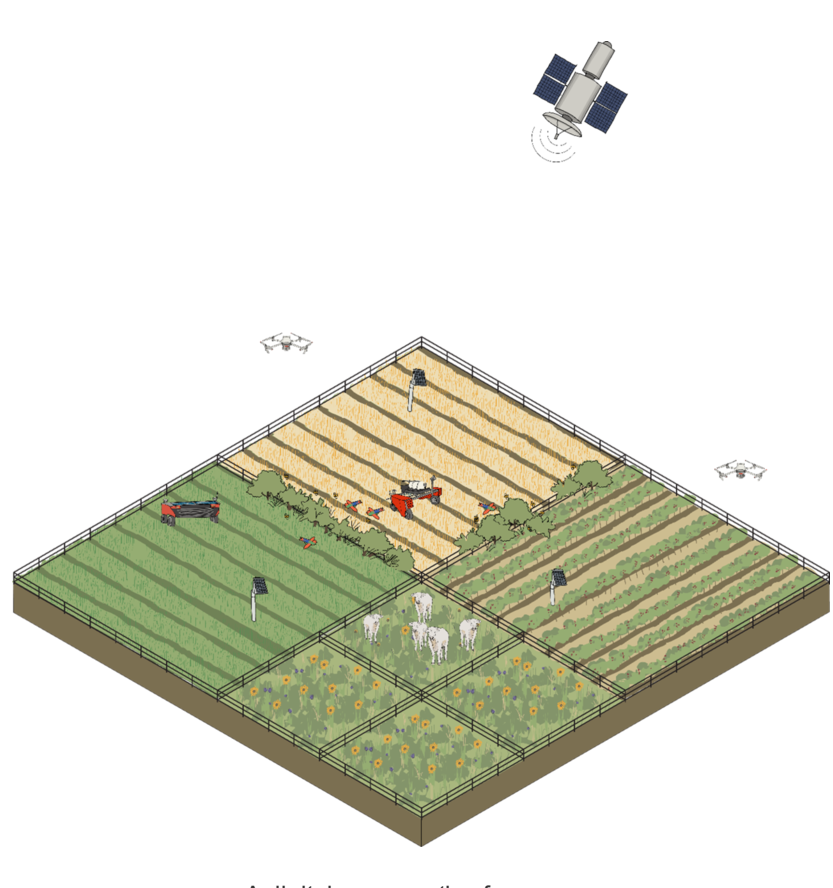
Tom Bishop

Digital Regenerative Agriculture: Thomas O'Donoghue

Farmer and consumer interest in regenerative agriculture is growing, and while extreme views exist on both sides of the fence, there are alignments between the outcomes desired by the movement, the wider agricultural sector, and international politics – increasing biodiversity and soil carbon, conserving water, and decreasing reliance on inputs while improving system resilience, etc. Commercial interests, having observed the market potential, are beginning to hitch their wagons to regenerative ideals: Harris farm, General Mills, Patagonia, Ralph Lauren.

Despite this wide-reaching interest, regenerative agriculture remains undefined (Giller et al., 2021; Newton et al., 2020; Schreefel et al., 2020). Our recent, rather lengthy, review (O'Donoghue et al., 2022) concludes with a performance based, practice guided, definition, which focuses on improving product quality and the availability of the resources agriculture depends upon: soil, water, biota, renewable energy, and human endeavour.

Digital agriculture offers many avenues to monitor change, continuously, and at resolutions that would be cost prohibitive otherwise. Mapping also presents opportunities to baseline farmscape attributes and identify similarities between systems. By measuring change, attributing it to a practice/system, and a landscape unit with an acknowledged condition and potential capacity, a digital regenerative agriculture could improve confidence in emerging ecosystem service markets, guide farmer investments, enable decommoditisation through provenance, and deliver regionally sensitive systems of management that prioritise both productive and environmental outcomes. Digital Regenerative Farmscapes could look like the one below.



A digital regenerative farmscape

So far, work on this concept has focused on monitoring change at the plot level, through cover crop trials at L'lara, completed as part of Tom O'Donoghue's PhD with Budiman Minasny and Alex McBratney. This work will continue with a post-doc, as part of the Laureate Fellowship on Soil Security and a grant from CRDC, in which collaborative monitoring will be used to develop regionally specific guidelines for the integration of cover cropping into existing cotton systems across Australia's major cotton growing valleys. This work will be carried out from the new International Centre of Crop and Digital Agriculture in Narrabri.

Weed-AI: Michael Walsh

To facilitate the development of relevant weed recognition for Australian cropping weeds, Weed-AI (https://weed-ai.sydney.edu.au/), an open source weed image library has been established. The establishment of Weed-AI was achieved through a collaboration by the Weed Research and SIH teams that was supported by GRDC funding. The library consists of annotated weed images stored in a cropping context framework based on species names and standardised growth stages. The database is being built using prescribed data standards and meta-data suited to the development of precision weed recognition algorithms. Users can contribute to the database or download relevant weed imagery for recognition algorithm development. This creates the opportunity for growers and the wider weed control industry to utilise these algorithms for the implementation of site-specific weed control (SSWC) solutions. Since launching in 2021 the image library has expanded substantially to now include approximately 20,000 annotated weed images. This data meets prescribed standards and is stored in a structured agricultural context format that creates an ideal database for software developers to create and test recognition algorithm performance.

Machine learning (ML) based weed recognition relies on the availability of suitably collected and annotated weed images for the development of recognition algorithms. The accuracy of in-crop weed recognition algorithms is completely reliant on an appropriate image data base of the targeted weeds in the relevant crops. Weed-AI enables the weed control community to develop highly accurate in-crop weed recognition algorithms that support the use of SSWC weed control treatments. This weed recognition capability creates opportunities for the development and introduction of alternative weed control technologies that require precision targeting to allow their selective use on in-crop weeds.

Future Farm - GRDC-funded research program: Brett Whelan, Mario Fajardo, and the Future Farm Research Team

The Future Farm Project was established to re-examine and improve the way in which soil and crop sensors, and data from elsewhere, are used to inform decisions about input management and explore automation of the process from data acquisition, through analysis, to the formulation and implementation of decision options. The Project brought together USYD, CSIRO, USQ, QUT and Agriculture Victoria Research with the aim of delivering to growers, a tool which they can have confidence in as the basis for improved and less risky N fertiliser decision-making.

The project developed and/or evaluated several methods through which predictions of N requirement might be made using remote and proximal sensing technologies and other data sources (e.g. seasonal weather, historical yield, etc). Some methods followed mechanistic agronomic thinking whilst others were underpinned by new data-driven methods. The team also developed two tools that generate data layers for use in the modelling methods, and with standalone external use potential. They are a biomass estimation process using machine vision (MV) and a method for parameterisation and eventual forecasting of whole-seasonal crop reflectance index models.

An important element of the process was the use of data from an on-farm experiment (OFE) at each of the 21 sites (Figure 1) comprising 'N-rich' and 'N-zero' strips which, along with the standard rate used by a farmer at each site, enable prediction of the spatially variable crop response to N and estimation of the economically optimum N rate (EONR) based on both yield and grain protein at whole field, management class and site-specific scales.

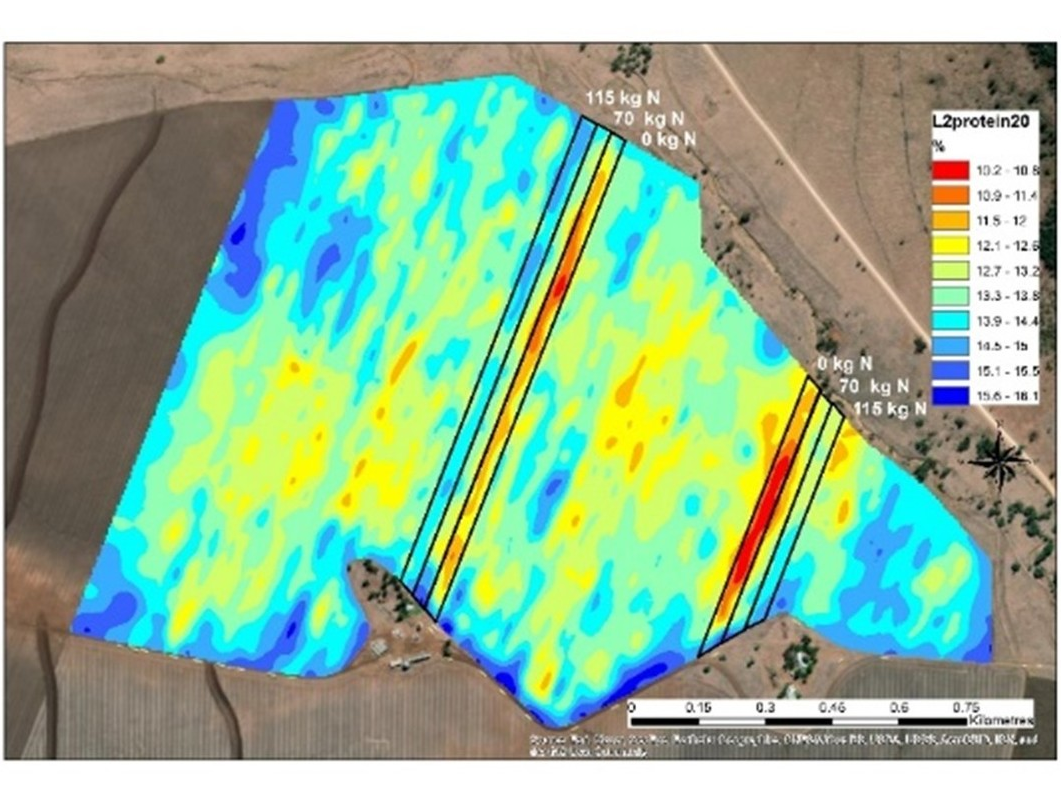


Figure 1. Protein response to changing N rates at L'lara field L2 in 2020

General Results:

Methodologies based on data-driven methods and machine learning (ML) algorithms performed better than the more mechanistic approaches, reducing the recommendation error by up to 60% and increasing profitability by 5% on average when compared to farmer practice. The data-driven approach relies on data availability to ensure the method performs at its optimum. Its success at all management scales in this assessment provides a significant pointer towards a future where farm businesses that collect and maintain relevant production response and resource data will be able to push closer towards season- and site-specific economically optimum operations. However, this means it is not an approach that can currently be employed by every farmer. The more mechanistic methods, drawing on remote and proximal crop sensing may be productively used by growers as they gradually acquire sufficient data to drive the data-driven approach

The collaborating farmers were all operating near the optimum management level at the whole field scale for the seasons under study, so a move towards site-specific decisions through the increased adoption of PA would be required for them to improve their management. More detailed results will be available when the Project Final Report is released in August.

Read further about Digital Agriculture

Animal Agriculture

Cameron Clark

MerinoLink - University of Sydney showcases SIA: Gregory Sawyer

On 6th and 7th June the SIA was showcased to leading sheep and wool producers, wool research funding organisations, wool and livestock agents and other industry participants from right across the supply chain at MerinoLink. MerinoLink is a not for profit organisation that aims to facilitate a link for sheep growers and service providers to information, knowledge and research.

Held in Wagga this year, the annual Merinolink conference showcased to over 230 delegates from around Australia many key current research activities. Of key interest to many of those that attended were the new and upcoming fly treatments and extension programs, the complexity of soil carbon and the sheep producer, lifetime merino reproduction trials and measuring pregnancy of the animal via breath testing. This year also saw Professor Simon de Graaf talk about his passion of sexing semen (who, what, how and where it all occurs), and Dr Jess Rickard on the predictability for artificial insemination success.

A/Prof Om Dhungyel and PhD student Greg Sawyer represented SIA at our industry stall and received many enquiries about what SIA is doing for sheep and wool research. Of key interest also was the group of undergraduate students from Sydney University that attended, with many of them having the opportunity to engage with industry leaders and movers and shakers in the sheep and wool industry.

Om Dhungyel, Simon de Graaf, Jess Rickard and Greg Sawyer

University of Sydney researchers and students at MerinoLink

Read further about Animal Agriculture

Urban Agriculture

Floris Van Ogtrop

Professor Brian Jones, one of the founders of the Urban Agriculture theme at The University of Sydney, will provide insights into how we might apply what we are learning about the soil microbiome in traditionally soilless vertical farms.

Re-thinking soil-free vertical farming
To gain the full water saving advantages of controlled environment plant systems (CEPS) (aka vertical farms) the hydroponic solution and evapotranspired water are recycled back into the main irrigation tank for continued reuse.

When necessary, the nutrients are then topped up and the pH readjusted. Careful and continuous management is essential as this nutrient rich irrigation water and the recirculating nature of the system can support the development and rapid spread of a variety of plant pathogens (eg Fusarium, Phytophthora and Pythium).

To minimise the risk of pathogen spread, the irrigation solution is regularly decontaminated via chemical (eg ozone, sodium hypochlorite, hydrogen peroxide) or physical (eg UV radiation or heat treatment) treatments.

Although these treatments are designed to reduce the risks associated with pathogenic microorganism spread, they similarly affect any beneficial microorganisms that have populated the system.

Non-pathogenic microorganisms such as Bacillus spp. Trichoderma spp. and Pseudomonas spp. typically develop in hydroponic systems, but the need to avoid the growth and spread of pathogens means that the overriding aim is generally to restrict the development of complex microbiology.

Soil science has in recent decades begun a return to its roots, thinking of soils as a complex system, with fertility an important emergent property of its bio-geochemistry.

The renewed interest in soil microbiology has led to a rush of research studies examining the microbiomes of agricultural soils and their association with fertility and improved crop growth.

This has been matched by the emergence of research into the importance of human microbiomes and the roles they play in human health and wellbeing.

A third element that can be thought of as linking the soil and human microbiomes is the plant endosphere microbiome. Similarly, to human microbiomes, these internalised microbial communities can be considered as essential partners in regulating metabolism and performance.

It is not unreasonable to think that these three microbiomes could ideally exist in an optimised soil-plant-human microbiome continuum. Much of the research into microbiomes is, however, still at the cataloguing stage, so our understanding of composition, connections and causality remains rudimentary, if not completely unexplored.

Just as there are companies spruiking the value of so-called beneficial microorganism treatments (BMOs) for field agriculture, it is now possible to purchase BMO products for hydroponics and other soil-free systems.

But in systems like these that rely on suppressing or at least suppressive microbiology, it is difficult to imagine that interlinked, complex microbial communities, comparable to those that can be observed in soil-based agriculture, can be formed and maintained.

Despite the many attractions of clean, soil-free vertical plant production systems it may be that as our understanding of microbiomes grows, we come to appreciate more and more clearly the benefits of embracing the complexities of growing in healthy living soils.

Save the Date: Thursday 10 November
The 2022 SIA Research Showcase will focus on the theme of Urban Agriculture. Further details to come.

Read further about Urban Agriculture

Quality Food

Tom Roberts

SIA hosted our RD Watt lecture on Thursday 16 June in the Great Hall, with this year's topic being "Food Safety and Security: Australia and Beyond." Quality Food Theme Leader Tom Roberts organised an excellent line-up of speakers: Distinguished Prof. James Dale spoke on "Bananas: a major world food crop in crisis"; Lisa and Zoe Paisley told us about their business, "Aggie Global: using business to address food security"; and Dr Deon Mahoney's talk brought home the importance of "Food safety – securing our future." The evening was hosted by Dr Claudia Keitel who coordinated a lively Q&A session. The recording is available on our website.

Read further about Quality Food

Social Media

The Sydney Institute of Agriculture is on Instagram (Sydney_Sia) and we are also on Twitter (Sydney Agriculture). Follow us at the links in the box below.