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Farmers inspiring farmers

2022

A selection of research relevant to agriculture in the Riverine Plains

Research for the Riverine Plains 2021

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TABLE OF CONTENTS

TRIAL BOOK YEAR IN SUMMARY

DR SARA HELY - RIVERINE PLAINS INC. DIRECTOR OF RESEARCH

Dear Members

While I have only here for 6 months at the time I am writing of this article, 2021 was an incredible year for Riverine Plains as you know!

Firstly, it's been an absolute pleasure joining the team and working for an organisation that is clearly in a very exciting phase of it's development. By way of introduction to you all, I have come from a background of climate change research where I researched the effects of climate change on native and invasive grassland species, in addition to wheat species responses. My research background originated with CSIRO, however I have also spent time over the past 15 years working for the Federal Government, GRDC (6 years) and Food Agility CRC (2 years). This is in addition to a 10 year stint with Agriculture Victoria and a time working as a consultant in organisational 'scaling up', strategy and program management. It is exciting for me to bring this mix of skills and expertise now to Riverine Plains and have already found the role a wonderful mix of challenge and reward.

It has been an incredible year for Riverine Plains. This year we have put on 3 new members of staff to the Field and Operations team. Myself as Director of Research, Kate Parker as our new Livestock Officer and I am excited to welcome our newest team member, Rhiannan McPhee as an additional Field Officer.

We have bought on 7 new projects;

- FRRR Drought Workshops - $120,000 in value for 1 year - to connect farmers with services to help them in the next drought, managed by Kate Coffey
- **Improving soils on farm** - $233,000 in value for 2.5 years – Funded by DAWE and GRDC and aims to increase farmer knowledge of soils by running demonstrations and workshops, and managed by Rhiannan McPhee
- **The FAR Pulse project** - $30,000 in value for 3 years- This is largely extension and 2 trial book articles looking at the economic yield gap using pulses.
- **The Victorian Drought Resilience, Adoption and Innovation Hubs** - $960,000 in value for 3 years. This project will provide a number of projects and delivering connectivity amongst Victorian agri-service providers and universities. This funding also has a component of this allocation to our Stock Containment project in which we have $100,000 allocated for this purpose and will be managed by Kate Parker.
- Soil water storage, access and tools for water storage assessment, Soils CRC - $40,000 in value over 3 years. This project is to improve the understanding of crop access to water and resources in the existing Soils CRC field site. (Stinking Goat and we will be receiving resources for additional staff member on top of this)
- The Liming demonstration project - $186,000 in value over 2 years and 10 months. This is funded by GRDC looking at best management practices for sub-soil acidity challenges managed by Jane McInnes.

In addition, we are at the precipice of signing onto the Southern NSW Drought Resilience, Adoption and Innovation Hub which will allow the appointment of a part time knowledge broker to Riverine Plains.

Overall, these projects represent remarkable growth in the organisations income. Given this growth we have done significant 'behind the scene's work in putting in place effective project management systems, Work Health and Safety process, and increasing our financial management.

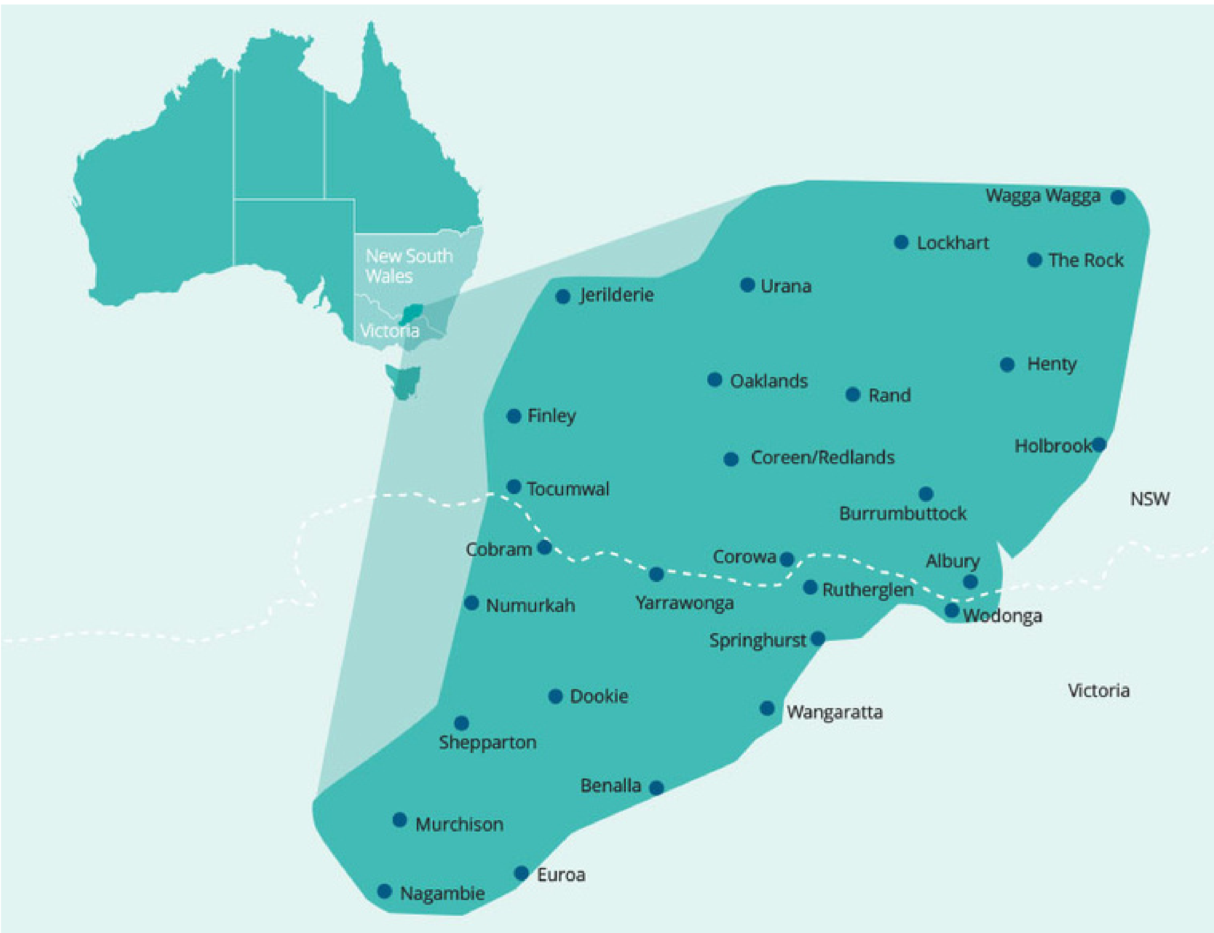
In addition to this, and to ensure ongoing alignment with what you have told us you would us to focus on, we have also established the Riverine Plains Research Advisory Council. This Council consists of 12 highly respected leaders who are farmers, researchers and agribusiness professionals. The Research Advisory Council will be instrumental in maintaining a clear strategic direction for the organisation and keeping us honest in terms of balancing our project portfolio into key themes of Soils, Grains, Livestock, Environment and Social. Across these themes we will attempt to ensure we have a good blend of economic, production, carbon, drought, traditional owners, ag-tech, biosecurity, and capacity building.

In 2022 we will see a significant expansion of Riverine Plain's field program and so we will have much report to you through our incredible communications and marketing team in the coming year. While it is an exciting phase for the organisation, it is also a critical year in terms of ensuring we are delivering value back to you as our members. To this end we will be engaging with you as much as possible to listen, learn and hopefully inform our thinking on work that needs to be done to make sure you are profitable and productive for many years to come.

I can't wait to see what the year will bring!

Sara Hely
Director of Research
Riverine Plains

RIVERINE PLAINS INC MEMBERSHIP AREA



A WORD FROM THE CHAIRMAN

IAN TREVETHAN

Welcome to the 2022 edition of Research for the Riverine Plains.

It's fair to say that 2021 was another rollercoaster year. This was in-part due to ongoing COVID lockdowns and border restrictions, as well as the on-again, off-again, on-again La Nina, which in conjunction with an Indian Ocean Dipole (IOD) negative event, saw some significant weather events and rainfall records set across the region.

Rainfall during early 2021 gave Riverine Plains farmers a welcome start on pastures and provided a good opportunity for those sowing long-season wheat and canola varieties. A dry April saw sowing conditions become marginal especially in paddocks with minimal ground cover, and there was a stark contrast between early sown crops that made use of the early moisture and later crops that sat in dry soil until follow up rains in May. By September, many farmers were feeling optimistic given a reasonable moisture profile, predictions of a solid spring and strong commodity prices and yield potential looked high as harvest approached. The rain that fell towards the end of November was quite devastating for some members who experienced crop losses due to flooding. For those that escaped significant crop damage, the wet weather led to a more drawn-out and complicated harvest, but the combination of high yields, good pricing and lower-than-expected rates of downgrading, meant the outcome was mostly positive.

Over the past year, Riverine Plains has been on a steep upwards trajectory under the guidance of CEO, Catherine Marriott, with the group having undergone a period of very rapid change and a number of new and exciting projects coming online.

COVID also played havoc with many of our planned events during 2021, however it was terrific to see so many Riverine Plains events go ahead, whether in person or online, and this speaks to the resilience and persistence of our members and staff who do what they can to learn, adapt and grow despite the challenges.

Extension Report

COVID affected the delivery of planned Riverine Plains events in 2021, with border and movement restrictions, reduced speaker availability and local outbreaks challenging the ability of Riverine Plains to deliver events in-person during the year. Despite this, Riverine Plains was able to deliver over 25 separate events to members and the wider community in a mixture of online and in-person formats.

2021 EVENTS ROUNDUP

Sykesy's Buraja Meeting

Around 80 people attended Sykesy's Buraja Day on February 4, participating in a 2020 season harvest debrief and 2021 planning session with Chris Minehan (RMS Consulting). Nick Poole (FAR Australia) spoke on learnings from the Grains Research and Development Corporation (GRDC) Hyper Yielding Crops project, including the importance of system fertility and disease management during high-yielding seasons, before Mark Richards (NSW DPI) spoke on pulse performance during 2020. Rohan Brill (BrillAg) spoke on capitalising canola performance as part of the Hyper Yielding Crops project and Dr Cassandra Schefe (AgriSci) spoke on managing high stubble-loads in 2020. Beau Longmire (farmer) and Ed Nixon (IK Caldwell) also gave an update on local delving trials before an Agronomic Panel Discussion was had with Rosie Dye (IK Caldwell), Rob Harrod (Elders) Mark Harris (RMS).

Cool Soil Initiative (CSI) workshops

Cool Soil Initiative participants attended soil health workshops during February and March at Boomahnoomoonah, Barooga, Lockhart, Brocklesby, Rutherglen and Murchison. Cassandra Schefe (AgriSci) provided a project update which included new partners Kellogg's Group, Manildra Group and Allied Pinnacle through the Sustainable Food Lab, Charles Sturt University and Food Agility Cooperative Research Centre. Jane McInnes (Riverine Plains) and John Medway (Charles Sturt University) also gave project updates, with soil health and soil acidity discussed in detail.

GRDC Irrigated Discussion Group Meeting - 15 February

An online meeting was held on February 15, with a focus on the factors contributing to more efficient and economic spring watering. Nick Poole (FAR Australia) presented the irrigated canola trial results and discussed factors contributing to high yield. Matthew Harrison (University of Tasmania) demonstrated the GRDC irrigation tool. Yield results from the 2020 local GRDC canola trials sown at Finley as part of the Optimising Irrigated Grains project were also discussed.

GRDC Hands-On Precision Agriculture Training workshop

A workshop was hosted at Yarrawonga on March 1 to provide an overview of precision agriculture (PA), hands-on experience with a range of technologies, as well as information on how PA can be used to improve the productivity and profitability of farm businesses. The event was facilitated by Adrian Roles (JMAJ Consulting), with Adam Inchbold and Ben Fleahy (Precision Agriculture) sharing their knowledge and experiences. The event was funded by GRDC and supported by the Society of Precision Agriculture (SPAA) and Birchip Cropping Group.

GRDC Nitrogen Fixation wrap-up

The Increasing the effectiveness of nitrogen fixation in pulse crops project concluded with this final workshop at Murchison on March 9. Ross Ballard (South Australian Research and Development Institute [SARDI]) discussed nitrogen fixation, pH and rhizobia numbers, as well as a new DNA soil test to help determine the response to Group E/F inoculant for paddocks sown to pulses. Kate Coffey (Riverine Plains) also presented results from a demonstration trial at Murchison.

GRDC Pulse Check meeting

The management of acid soils was discussed at the final GRDC and Riverine Plains Pulse Check meeting held at Murchison on March 9. Lee Menhenett (farmer) presented a paddock case study on the identification and amelioration of an acid layer between 5–15cm, while Tim Anderson (Advanced Ag) spoke about the identification of acid layers in bean crops using dig-stick analysis. Kate Coffey (Riverine Plains) presented an economic analysis of pulse rotations using a model developed by Pinion Advisory for the Pulse Check project, and Ben Morris (FAR Australia) discussed the results from the Dookie Southern Pulse Agronomy trial.

GRDC Rand Pulse Check Group meeting

The group met on March 10 for the final time, participating in an end-of-project survey which showed that farmers were generally positive about the potential for pulses during 2021. Mark Richards (NSW DPI) gave a sowing update while Mathew Dunn (NSW DPI), spoke on the GRDC, CSIRO and NSW DPI Farming system trial at Urana. Kurt Lindbeck (NSW DPI) discussed sclerotinia and Richard Saunders (Pinion Advisory), presented a new tool which evaluates the profitability of pulses in 4–5 year rotations.

Cool Soil Initiative Grower Summit

A meeting of CSI participants was held at Howlong on March 16. Project results from the previous year were discussed, including trends in greenhouse gas emissions and soil carbon values, as well as understanding the role of different practices in supporting sustainable systems. A soil pit discussion with Dr Cassandra Schefe (AgriSci) was followed by a Horsche Tiger paddock demonstration and a demonstration and discussion of mulching compared to retained stubble and burning. The day also provided an opportunity to meet with senior managers from organisations supporting the project in the region.

GRDC Hyper Yielding Crops and Cool Soils Initiative crop walk

On June 8, Kate Coffey and Jane Mcinnes (Riverine Plains) facilitated a crop walk which viewed a wheat and Tillage Radish crop sown at Daniel and Stirling Moll's farm (Gerogery) and a T4510 canola crop at Curt Severin's farm (Brocklesby). Curt also spoke about CSI project mapping and soil test results before Cassandra Schefe (AgriSci), addressed pH and lime incorporation. At Lilliput-Ag (Rutherglen), the group looked at Andrew Russell's Raptor canola and Andrew also explained his use of deep soil nitrogen testing and the seasonal outlook to determine nitrogen rates. Ed Harrod (Baker Seed Co) also showed the group some of the new early sown winter grazing wheat options.

Irrigated Discussion Group and Cool Soil Initiative Field Walk

Participants visited John Bruce's (Barooga) Kittyhawk wheat/tillage radish crop on July 20, examining the feed test results and discussing key aspects to consider when assessing potential effects on animal health with Katelyn Braine (District Veterinarian, Murray Local Land Services Deniliquin). Tom Price (FAR Australia) spoke on optimising irrigated canola yields and Jane McInnes (Riverine Plains) updated farmers on the Cool Soil Initiative Irrigated Maize Project.

The Horsche Tiger in paddock demonstration of stubble mulching and incorporation as an alternative to retention and burning.

Riverine Plains In-season Update

Held on August 3, this virtual event gave members a chance to consider key agronomic issues ahead of spring. Following a Riverine Plains update by Catherine Marriott (Riverine Plains), Rob Inglis (Elders) gave a run down on ruminant health and nutrition before Dale Grey (Agriculture Victoria) delivered the outlook for spring. Josh Buerckner (IK Caldwell) provided a comprehensive agronomy update and Adrian Clancy (Farmanco) spoke on local/global grain markets. The event concluded with a presentation by Brooke Sauer (Intellect Ag) on Farm Tech ahead of an upcoming AgriFutures Australia workshop.

GRDC, FAR Australia and Riverine Plains Hyper Yielding crop walk

A crop walk was held at Andrew and Sue Russell's canola focus paddock at Rutherglen on August 17. Jon Midwood (Tech Crop), spoke about Green

Area Index (GAI) technology, with Nick Poole (FAR Australia) discussing disease management. The group also toured the Baker Seed wheat variety trial.

Fodder for the Future Field Day

A virtual Fodder for the Future project event was held on September 9. Shane Byrne (Murray Dairy) introduced the project while Catherine Marriott (Riverine Plains) spoke on the benefits of forming long-term partnerships between dairy and grain farmers. Cassandra Schefe (AgriSci) talked about managing soil acidity to produce higher quality fodder and Luke Nagle (Advanced Ag) discussed fodder crop agronomy and paddock selection. David Lewis (Lallemand) also spoke on the benefits of silage as a source of readily digestible feed and nutrients for ruminants. *The Fodder for the Future project is funded by the Federal Department of Agriculture, Water and the Environment, through the Murray-Darling Basin Economic Development Program. This event was supported by the North East CMA through funding provided by the Australian Government's National Landcare Program.*

AgriFutures Farm Tech Workshop

A two-part online Farm Tech and planning workshop was held on September 7 and 14 as part of the AgriFutures Australia Producer Technology Uptake Program, presented by Rural Edge and facilitated by Brooke Sauer (Intellect Ag). The workshops covered the use of technology to monitor and evaluate data for improved productivity and efficiency. The workshops also showed participants how to apply the principles of precision agriculture to identify where productivity improvements can be made.

Soil Mapping Workshop

A virtual workshop was held on September 17 as part of the Improving Soils to Optimise Water Use project. Mark Harmer (Dookie) spoke on his experiences of soil mapping over more than 20 years, while Lee Menhenett (Murchison) and Ben Fleay (Precision Agriculture) presented case studies on soil mapping and lime and gypsum applications. Cassandra Schefe (AgriSci) also led the group through a virtual acid soils crop walk. *The Improving Soils to Optimise Water Use project. is funded by the Australian Government through the Future Drought Fund Natural Resource Management Drought Resilience Program.*

GRDC Irrigation Discussion Group meeting, Oaklands

The Nixon family hosted a field walk for around 30 farmers on September 29, with James Nixon speaking on a recent irrigation development. Pauline McDonald (IK Caldwell) talked about the different technologies available for scheduling irrigation, with Dr Cassandra Schefe (AgriSci) speaking on the causes of poor infiltration in soils, as well as the Coil Soil Initiative project. Adrian Clancy (Farmanco) discussed factors affecting Australian corn markets and the yield potential of the grazed wheat and canola focus paddocks was also discussed.

The Evan Moll Gerogery Field Day

The field day was held at the Moll family property on November 11 and attended by around 40 people. The group toured the GRDC National Variety Trials (NVT) wheat trials with Peter Matthews (NSW DPI) and NVT canola trials with Don McCaffery (NSW DPI). Kate Coffey (Riverine

John Bruce inspects his Kittyhawk wheat/tillage radish crop as part of the Irrigated Discussion Group and Cool Soil Initiative Field Walk on July 20, 2021.

Plains) also gave an overview of the GRDC Hyper Yielding Crops project canola demonstration results. The Field Day had a focus on drought preparedness and included an update by Catherine Marriott (Riverine Plains) on the Southern NSW Innovation Hub, as well as a drought workshop, facilitated by Kate Coffey. A BBQ lunch was supplied by David Leah (Seedforce) in conjunction with the *Enhancing Community Networks for Drought Resilience project.*

The attendees at the Evan Moll Gerogery Field Day toured the NVT canola trials with Don McCaffery (NSW DPI)

Enhancing Community Networks for Drought Resilience workshop, Gerogery

This workshop was the first in a series of drought-preparedness workshops and held as part of the Evan Moll Gerogery Field Day on November 11. Participants shared their experiences in managing mental and physical health during drought, business actions and implementing change ahead of the next drought. Jenn Pegler (Murrumbidgee Local Health District) spoke on stress and provided tips to improve well-being during drought and Kevin McCrum (NSW Southern Region Rural Financial Counselling Service [RFCS]) spoke on the wide range of support services available. *The Enhancing Community Networks for Drought Resilience in the Riverine Plains project is funded by the Future Drought Fund's Networks to Build Drought Resilience program, through donors the Australian Government, Foundation for Rural & Regional Renewal and the Pratt Foundation.*

Fodder for the Future Buyers workshop

A fodder buyers workshop for dairy farmers, was held in conjunction with Murray Dairy at Numurkah on December 2. The workshop had a focus on securing a reliable long-term fodder source and how to have input into the quality of fodder produced by suppliers.

The first of 30 Enhancing Community Networks for Drought Resilience workshops was held as part of the Evan Moll Gerogery Field Day.

2021 SCHOLARSHIP ROUNDUP

John Hanrahan and Uncle Tobys Scholarship Recipients

During June, it was announced that Jessica Ryan from Estella, NSW, was the recipient of the John Hanrahan Scholarship and that Thomas Hatty, from Tocumwal, NSW, was the recipient of the Uncle Tobys Scholarship.

2021 RESEARCH AND EXTENSION PROJECT SUMMARY

New projects

During 2021, Riverine Plains were successful in initiating a number of new projects. This included the GRDC investment *Best practice liming to address sub-soil acidity in NE Victoria* project, which aims to increase awareness of the speed of acidification and stratification of soils in the region.

The *Fodder for the Future* project, funded by Murray Dairy through Dairy Australia, is a new project investment by the Federal Department of Agriculture, Water and the Environment through the Murray Darling Basin Economic Development Program. The project is looking at how dairy farmers and fodder producers can optimise the quality and yield of fodder species and includes a demonstration trial at Boorhaman (see article on page 45)

Riverine Plains is also coordinating a new project which involves the establishment of a new discussion group for farmers in the Murchison district of Victoria. The *Improving Soil to Optimise Water Use on Farm* project is funded by the Australian Government through the Future Drought Fund Natural Resource Management Drought Resilience Program and aims to address soil quality parameters and how these are linked to storing more rainfall for crop production. A demonstration trial is also being established at Murchison in 2022.

Riverine Plains is involved in two of eight Drought Resilience Adoption and Innovation Hubs funded by the Australian Government's Future Drought Fund across Australia. Riverine Plains is leading the North East Victorian node of the Victorian Innovation Hub established by the University of Melbourne at Dookie and is also involved in the Southern NSW Drought Resilience Adoption and Innovation Hub led by Charles Sturt University (CSU) at Wagga Wagga. Both Innovation Hubs have a focus on delivering innovations to enable farmers and communities to become more drought resilient and to better respond to a changing climate.

As part of the new *Enhancing Community Networks for Drought Resilience in the Riverine Plains* project, Riverine Plains is hosting workshops across southern NSW and north-east Victoria to connect primary producers, landholders and Indigenous custodians to build capacity, share knowledge and help improve community resilience to future drought and climate challenges. The workshops are being delivered through the Future Drought Fund's Networks to Build Drought Resilience program, through donors the Australian Government, Foundation for Rural & Regional Renewal and the Pratt Foundation.

Current Projects

During 2021, Riverine Plains continued its delivery of the Cool Soils Initiative, funded by project partners Mars Petcare, Kellogg's Group, Manildra Group and Allied Pinnacle through the Sustainable Food Lab and Charles Sturt University (CSU), with additional funding through the Food Agility Cooperative Research Centre (CRC). This project aims to promote the long-term productivity and quality of cropping systems using practices that reduce on-farm greenhouse gas emissions and increase organic soil carbon. During 2021, 45 Riverine Plains region wheat farmers and 10 maize farmers were involved in soil testing, monitoring farm inputs and meetings, with a report presented on page 24.

As part of the five-year Co-Operative Research Centre for High Performing Soils (Soil CRC) project Plant based solutions to improve soil performance through rhizosphere modification, a replicated trial was again established at Burramine. The site was sown to a range of summer crop treatments in January, which were terminated ahead of sowing to a winter crop wheat or wheat-vetch mixture, with third-year results available on page 18.

A From the Ground Up project, Evaluating plant-based opportunities to increase soil carbon in cropping systems, funded by the Australian Government's National Landcare Program and led by the Goulburn Broken Catchment Management Authority, also continued. The project involves several demonstrations established alongside the Soil CRC site at Burramine in Victoria.

The GRDC Irrigated Discussion Group investment, Facilitated Action Learning Groups to support profitable irrigated farming, led by the Irrigated Cropping Council, delivered three meetings during 2021. Two irrigation focus paddock trials were also established in wheat and canola, with the reports available on page 39.

The GRDC *Hyper Yielding Crops* project, led by FAR Australia has a focus on research and extension designed to push yield boundaries in wheat, barley and canola in the higher rainfall zone. As part of the project, Riverine Plains held two meetings and established three on-farm trials at Brockelsby, Gerogery and Rutherglen during 2021, with results available on page 30.

Projects reaching full-term

Several research and extension projects were concluded by Riverine Plains during 2021. This included the very successful GRDC Pulse Check Discussion Group projects Pulse Check – *local extension and communication for profitable pulse production in South East NSW* (Rand Discussion Group) project, as well as the southern region Riverine Plains Inc GRDC Pulse Check Discussion Group through the Southern Pulse Extension Project (Dookie and Murchison discussion groups).

The GRDC investment Increasing the effectiveness of nitrogen fixation in pulse crops through extension and communication of improved inoculation and crop management practices in the southern region project also concluded, as did the GRDC project Machine learning to extract maximum value from soil and crop variability. A number of smaller projects within the Co-Operative Research Centre for High Performing Soils (Soil CRC) suite of projects, also reached the end of their term. This included the Improving the representation of soil productivity/constraints in existing decision support systems and modelling platforms, Understanding adoptability of techniques and practices for improved soil management and the Mechanistic understanding of the mode to action of novel soil re-engineering methods for complex chemical and physical constraints projects.

Replicated trial plots at Burramine as part of the Soil CRC project, Plant based solutions to improve soil performance through rhizosphere modification

ACKNOWLEDGEMENTS

The success of our research and extension program is due to the sustained efforts of our staff and the contributions made by our farmer hosts and collaborators and all those who engage with our programs. I'd like to especially thank our CEO Catherine Marriott; Director of Research, Sara Hely; Project Officers Kate Coffey, Jane McInnes and Kate Parker and our Research Advisory Council, chaired by Board Members John Bruce and Melissa Brown, for their efforts in developing, managing and reporting on projects to an extremely high standard. Organising and communicating our project events and outcomes is also an important part of our project work and I'd like to thank our Communications, Marketing and Events Director, Emily Thompson, Communications Officer Michelle Pardy and Events Manager Rebecca Berrigan for their work.

Funding partners

Riverine Plains partners with a number of organisations in delivering our research and extension programs.

We recognise the ongoing support and investment made by our funding partners including the Australian Government's Future Drought Fund, the Federal Department of Agriculture, Water and the Environment through the Murray Darling Basin Economic Development Program, the Australian Government through the Future Drought Fund Natural Resource Management Drought Resilience Program and the Future Drought Fund's Networks to Build Drought Resilience program through donors the Australian Government, Foundation for Rural & Regional Renewal and the Pratt Foundation.

We also acknowledge the investment made by the Grains Research & Development Corporation (GRDC), Cool Soil Initiative project partners, the Cooperative Research Centre for High Performance Soils whose activities are funded by the Australian Government's Cooperative Research Centre Program, as well as the support provided by the Goulburn Broken Catchment Management Authority's 'From the Ground Up' program through funding from the Australian Government's National Landcare Program.

During 2021, Riverine Plains was involved in projects led by Birchip Cropping Group, Farmlink, Irrigated Cropping Council, Mallee Sustainable Farming, FAR Australia and Melbourne University, as well as Southern Cross University, University of Southern Queensland, University of Tasmania, Charles Sturt University, Federation University, Murray Dairy through Dairy Australia and the Goulburn Broken and North East Catchment Management Authorities. We thank these organisations for their support and recognise the support received by the large number of organisations collaborating on these projects, and who are individually acknowledged in each of the trial reports.

Sponsors

A special thanks to the Gold, Silver and Bronze Sponsors who continued to support Riverine Plains during 2021. With COVID impacting the in-person delivery of many of our events, we are especially grateful for the continued support of our partners and look forward to a bigger and brighter 2022.

Through their financial support, the businesses that sponsor Riverine Plains play an important role in allowing us to deliver additional services to members. Our sponsors are also terrific supporters of our field days, seminars and other events and we sincerely value their contributions. Many of our sponsors have been with us for many years and we thank them for their continued support.

Members

My sincere thanks to our loyal members for your continued support, involvement, feedback and encouragement. We are continuing to work on improving our services to members and we are very much looking forward to having more in-person opportunities to interact with you all in 2022.

Committee

Lastly, I'd like to thank fellow Board members, Fiona Marshall, Murray Scholz, John Bruce, Melissa Brown, Alison Penfold and Brondwen MacLean for their efforts throughout the year.

We trust you will enjoy the read and find value in the reports contained within. All the best for the 2022 season.

Ian Trevethan
Chairman

2021: THE YEAR IN REVIEW

MICHELLE PARDY - RIVERINE PLAINS INC.

After an exceptional 2020 growing season and harvest, coupled with good commodity prices and a La Niña event which persisted over summer to top-up the soil moisture profile, there was a generally positive sentiment from Riverine Plains farmers' heading into the 2021 winter crop growing season.

The wet start to 2021 saw 11 out of 12 weather station sites in the Riverine Plains area record decile 7–9 rainfall during January (Table 1). February and March rainfall ranged from decile 6–10 across the region (except at Euroa), with higher totals recorded in the northern areas. As the main sowing season got fully underway, decile 1-2 rainfall totals across the region during April meant that conditions became increasingly marginal, causing issues with plant emergence. Fortunately, patchy germinations were mostly evened out by the rains that fell in May.

Despite the wet conditions in June and July (decile 7 and above for most sites) causing localized issues with waterlogging and trafficability, the relatively dry August (decile 2–4) meant that soil moisture was lower than expected for most of the Riverine Plains heading into spring. As such, most farmers welcomed signs of an emerging La Niña in September, which delivered decile 6–9 rainfalls across the region and topped up moisture profiles, just in time for high biomass crops accelerating their water use.

While much of the season seemed very wet, growing season rainfall (GSR, April–October) across the Riverine Plains was average–below average, with decile 3 rainfall at Euroa, Rutherglen and Lockhart at, decile 4 at Dookie, Albury, Corowa and Urana, decile 5 at Yarrawonga, while Cobram and Henty received decile 6 GSR.

A re-established La Niña and a negative Indian Ocean Dipole (IOD) contributed to decile 9 and above rainfall during November for all sites except Euroa (Decile 7), with higher deciles in the northern part of the region. This meant full-year deciles ranged from a low of 4 at Euroa to a high of 9 at Cobram, Corowa and Henty. This was also reflected by Bureau of Meteorology data (Figures 1a and 1b) which showed that for much of NSW, rainfall was at decile 8 or above (around 100–125 percent of the annual mean), while rainfall was at decile 4-9 for most of the Victorian part of the Riverine Plains region.

Australia's national mean temperature was 0.56 °C warmer than the 1961–1990 average, making 2021 the 19th-warmest year on record, and coolest since 2012 (Figure 2). For the Riverine Plains, mean temperature deciles for 2021 were average, with temperatures in the area around Albury slightly below average.

The long-term average number of frost days (days with a minimum temperate below 2.2°C) at Rand for July is 16, August is 12 and September is seven. Figure 2 shows the number of frost events experienced during the 2021 winter–spring period was higher than in 2020, with a total of 10 frost events occurring at Rand during July, 16 during August and 15 frost events experienced during September. There were six frost events recorded at Rand during October. Fortunately, the severity and duration of the frosts was not severe and there was no widespread damage to crops reported during 2021.

	Euroa 82016	Decile	RRI 82039	Decile	Dookie	Decile	Yarrawonga AP 81124	Decile	Cobram GM 80109	Decile
Jan 2021	99	9	87	9	70	8	46	7	57	8
Feb 2021	18	4	58	9	27	6	50	7	38	7
Mar 2021	33	6	44	7	50	7	75	9	81	10
Apr 2021	7	2	5	1	3	1	2	1	2	1
May 2021	47	5	48	6	42	5	45	6	30	5
June 2021	102	8	77	8	68	7	74	9	82	9
July 2021	103	9	45	5	64	7	63	8	49	7
August 2021	32	2	29	2	33	3	25	3	31	4
Sept 2021	61	6	61	6	73	8	61	7	73	9
Oct 2021	53	4	38	3	59	6	56	6	62	7
Nov 2021	60	7	105	9	96	9	88	9	86	9
Dec 2021	35	5	59	7	14	3	38	6	53	7
GSR^ Apr-Aug	406	3	304	3	341	4	325	5	329	6
Year to date (Jan- Dec)	605	4	657	6	599	6	622	7	644	9
Summer Jan-Mar (2021)	150	8	189	9	147	8	170	9	176	9

	Albury AP 72160	Decile	Henty	Decile	Corowa AP 74034	Decile	Lockhart RP	Decile	Urana PO 74110	Decile
Jan 2021	97	9	46	7	62	7	62	8	12	4
Feb 2021	55	7	126	10	55	7	35	6	41	8
Mar 2021	70	8	111	9	77	9	76	9	88	10
Apr 2021	2	1	2	1	1	1	0	1	1	1
May 2021	54	5	41	6	43	6	27	5	15	3
June 2021	81	6	87	9	88	9	61	8	71	9
July 2021	121	9	97	9	69	8	55	8	50	8
August 2021	40	2	39	3	26	2	26	3	15	2
Sept 2021	92	8	115	9	60	7	54	7	66	8
Oct 2021	38	3	26	1	43	4	21	2	27	4
Nov 2021	123	9	212	HOR*	114	9	131	HOR	131	9
Dec 2021	43	5	50	6	129	9	34	5	24	5
GSR^ Apr-Aug	429	4	407	6	331	4	244	3	244	4
Year to date (Jan- Dec)	817	7	952	9	768	9	582	8	540	7
Summer Jan-Mar (2021)	222	9	284	10	194	9	173	9	141	8

Table 1: 2022 Rainfall and deciles for 10 locations across the Riverine Plains

^ Growing Season Rainfall
* Highest on record

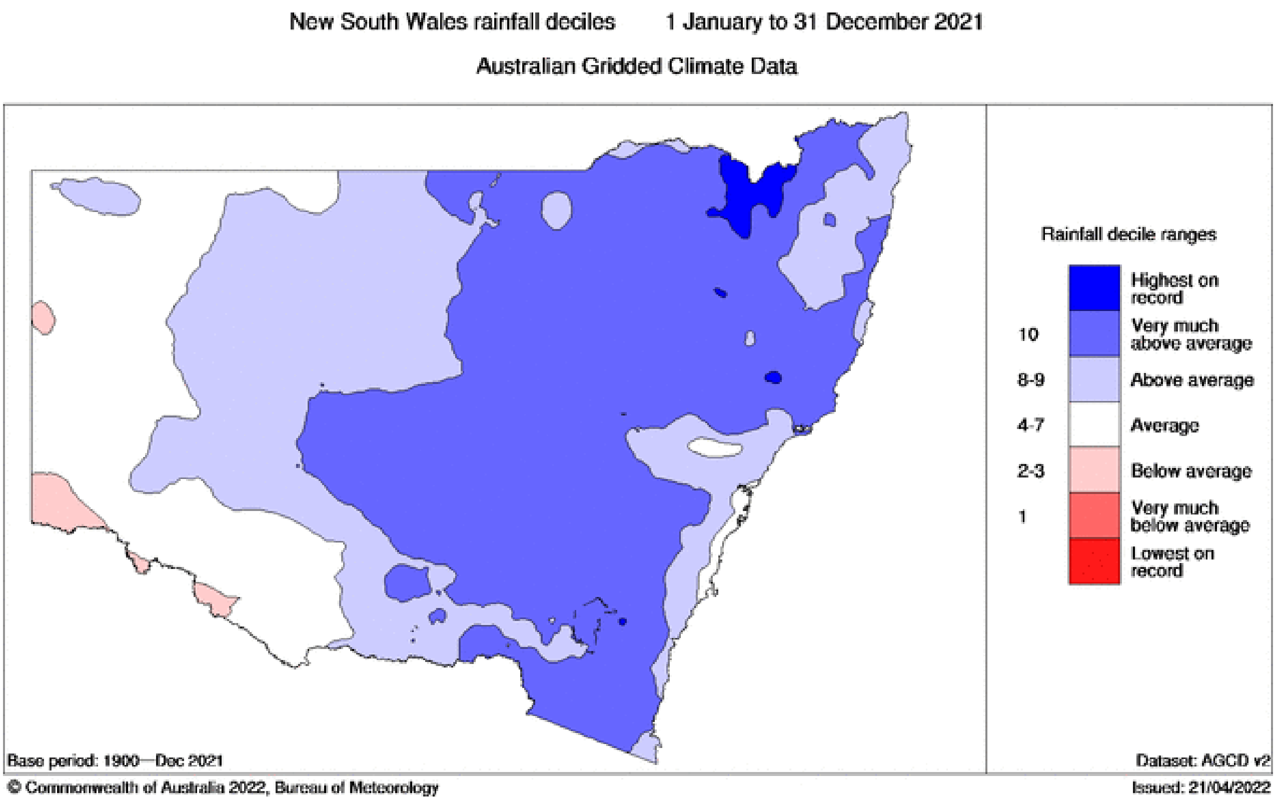


Figure 1a: Full-year rainfall deciles across NSW during 2021 (Source: Bureau of Meteorology, *www.bom.gov.au/climate/current/annual/nsw/summary.shtml*, 2021)

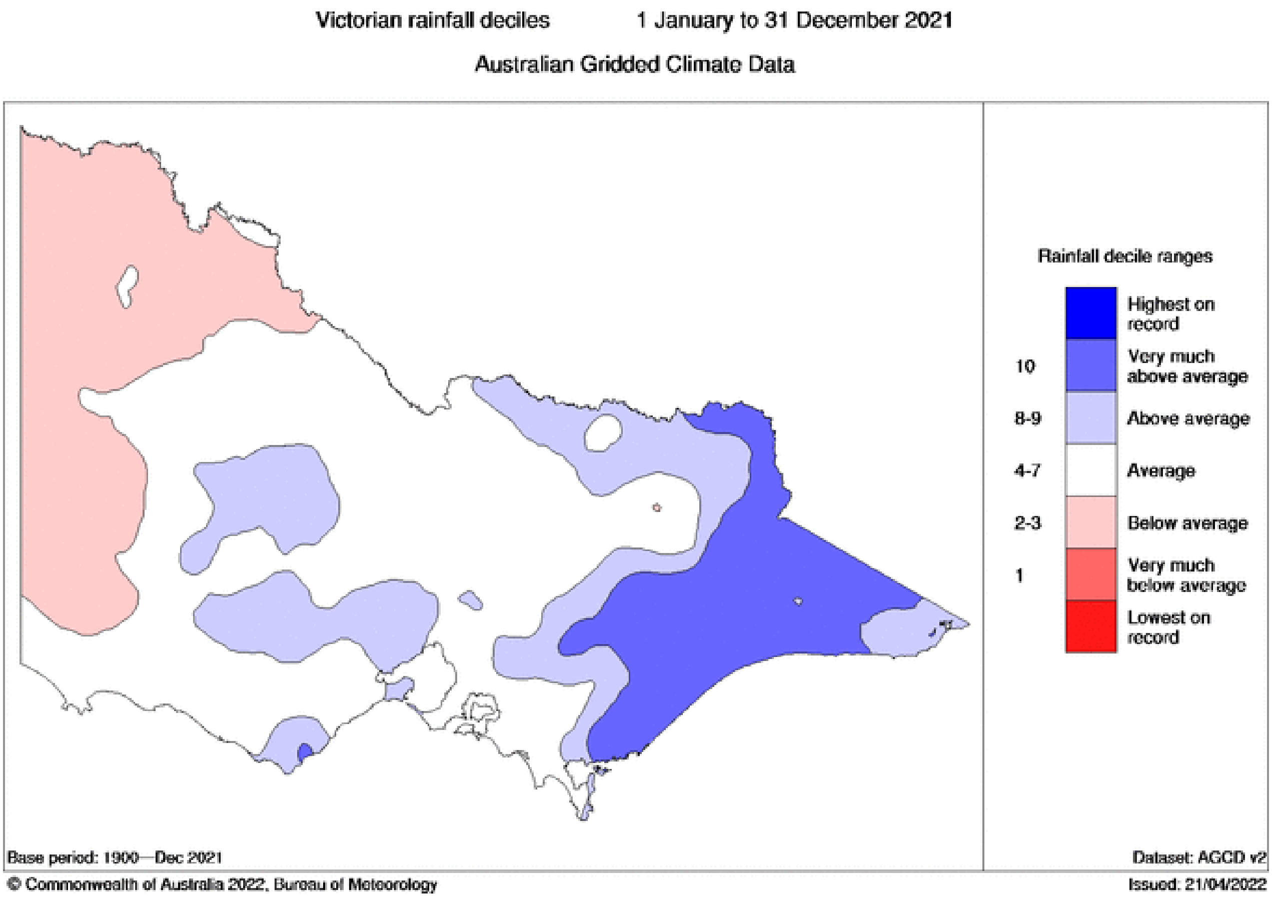


Figure 1b: Full-year rainfall deciles across NSW during 2021 (Source: Bureau of Meteorology, *www.bom.gov.au/climate/current/annual/vic/summary.shtml*, 2021)

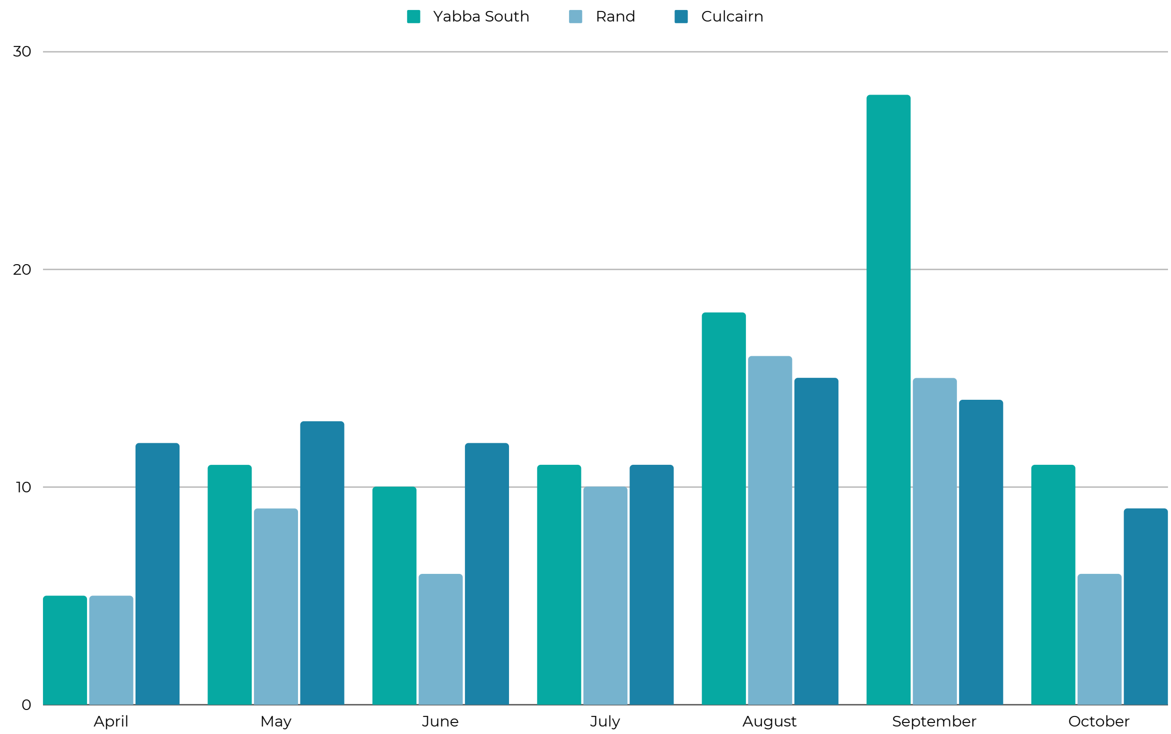


Figure 2: Number of frost days (with temperatures less than 2.2℃) at Yabba South (Victoria), Rand and Culcairn (NSW) during the 2021 growing season (April-October). (Source: Riverine Plains Inc., *www.riverineplains.org.au/riverine-plains-soil-moisture-probe-weather-station-network*, and Bureau of Meteorology, 2021)

Summary

Off the back of a stellar 2020, 2021 turned out to be the second in a row for those Riverine Plains farmers not impacted by flooding or significant quality downgrades at harvest. Given the season began with a widespread mouse-plague in NSW, which was potentially devastating to emerging crops and newly established pastures, as well as concerns over the continuing impacts of COVID on supply chains and the delivery of farm inputs, the season probably turned out to be better-than-expected for most.

While there were periods of excessive wet interspersed with periods of dry, the 2021 growing season was mostly kind overall. There was enough retained moisture from summer and early autumn to get crops established early despite the dry April, and while the wet June and July checked crop growth and interrupted some weed control and fertiliser programs, the dry August allowed crops to outgrow these limits. Timely September rains helped ensure yield potential was maintained for high-biomass crops and pastures, with the mild temperatures, lack of severe frosts and the absence of significant pest and disease issues during the growing season also contributing to high grain yields.

The late-November rains, which fell just as harvest was starting across the region, caused significant concern regarding the potential for quality downgrades and devastation for those that were impacted by flooding and crop loss. For those not affected by flooding, the rains acted to delay and extended harvest (well into the new year for some), however quality downgrades were probably less frequent than expected, and this, coupled with high yields and strong commodity prices, lead to pleasing results for many grain growers. For livestock farmers, the November and summer rains extended pasture growth and topped up dams, but also led to increased workloads in managing animal health issues, especially in relation to worms and other conditions related to grazing weather-damaged stubbles.

Following on from a good season in 2020, 2021 harvest and livestock returns should allow farmers the opportunity to consolidate and plan for the future. At the time of writing, summer rains and storms have part-filled or filled soil moisture profiles, which should further provide farmers with additional confidence heading in to sowing this autumn.

MECHANISTIC UNDERSTANDING OF THE MODE OF ACTION OF NOVEL SOIL REENGINEERING METHODS FOR COMPLEX CHEMICAL AND PHYSICAL CONSTRAINTS.

DR JASON CONDON - NSW DPI, CSU, SOIL CRC

PROJECT PARTNERS

Charles Sturt University, NSW Department of Primary Industry, Victorian Department of Economic Development, Jobs, Transport and Resources, Central West Farming Systems, Birchip Cropping Group, HART, Riverine Plains Inc.

FUNDING PARTNER

The Cooperative Research Centre for High Performance Soils (Soil CRC)

KEY POINTS

Soils often exhibit multiple constraints that limit their productivity. Collaborating staff identified a local soil that had regularly underperforming crop production. Initial soil analyses identified sodicity and subsoil salinity and alkalinity to be the likely constraints to production.

Soil was taken from the field in layers 0-10, 10-50, 50-100cm to be used in glasshouse experiments to quantify the production loss due to the constraints and record the impact on soil properties following application of a range of rates of different amendments.

Based on results of experiments in the study, a final series of glasshouse experiments have been initiated which ain to understand the mechanism of amelioration of potential soil amendments.

It appears that whilst some improvements in soil properties are possible with amendments, it may be impractical to overcome the inherent constraints of deep subsoil.

Background

Australian soils often exhibit multiple constraints to plant productivity. Soil sodicity, acidity, nutrient deficiencies or toxicities and poor structure limit root growth and therefore decrease the plant's ability to efficiently exploit soil water and nutrient reserves to achieve maximum yield potentials. Historically, attempts to address these constraints have been conducted via research that addresses constraints individually. Each problem has an industry "best practice" solution but when these are then applied in combination to handle multiple constraints, the input costs and practicality of application often become barriers to adoption and the constraint remains. An opportunity exists to introduce novel amelioration methods that seek to address multiple constraints with a single application.

Six grower groups have identified priority soil constraints and soils to be included in this project. Using predominantly glasshouse studies, the effectiveness of novel amelioration methods will be evaluated in these soils, relative to the current industry best practice methods. This work will therefore set an unconstrained benchmark of soil performance and will identify successful options for future field studies.

The project will determine the mode of action of the amelioration methods enabling CRC researchers to optimise source material and/or the development of new products to improve efficiency of amelioration and will also inform effective application technologies. Many currently used surface applied ameliorants have little effect lower in the profile where subsoils constraints exist. This project will quantify the benefit of ameliorating these constraints. The data produced during these studies will input into the development of Decision Support Systems produced within the CRC. Therefore the project services researchers, grower groups and their members and possible industry stakeholders interested in development of new products.

Method

The project is conducted in collaboration with six grower groups. Each group identified underperforming soils within their region. The project team then sampled the sites for initial detailed chemical analysis. Based on expert information from growers, advisors and collaborators "best bet" treatments were designed for testing in column studies against an untreated control. The comparison in yield between these two treatments for each soil will quantify the magnitude of the constraints.

Running in parallel to the plant column studies is a series of incubation experiments. This set of experiments tests the changes to soil conditions for a range of rates and combinations of possible soil amendments. High preforming treatments have been identified and are included in a more detailed mechanistic study recently initiated.

Soil

The soil identified by Riverine Plains Inc was located near Oaklands. The grower's experience was that the soil had poor water infiltration and poor root penetration into the subsoil. This meant that crops finished early in springs that had low rainfall, however, if small but regular rain occurred crop performance was good. These observations are consistent with poor root growth due to a subsoil layer that is impenetrable by roots. Such subsoil layers can be created by compaction (stock or machinery) or by soil chemical problems such as sodicity or low (less than 2) calcium to magnesium ratio.

Examination of the soil chemistry confirmed sodicity is a problem in the soil (Table 1). The exchangeable sodium percentage (ESP) was greater than 6% in all sampled layers. In the subsoil the ESP was greater than 16% and dispersed when aggregates were placed in water. Because the ESP was so high, the soil pH was greater than pHCa 8 and pHw 9 below 50 cm profile depth. At such high pH, carbonates form and micronutrients (eg zinc, iron and copper) often become deficient and phosphate becomes less available, this increases the nutritional importance of the topsoil. Therefore, the grower's observations relating to crop performance are the product of a sodic subsoil that limits water infiltration causing waterlogging in winter and poor root exploration of the subsoil due to high

Table 1: Soil Chemical properties Oaklands

Depth (cm)	0-10	10-50	50-100
pH (1:5) (Water)	5.9	**8.2**	**9.2**
pH (1:5((CaCl2)	5.3	**6.7**	**8.1**
EC (1:5) (dS/m)	0.3	0.1	0.215
Chloride (ppm)	86	22	16.5
Nitrate Nitrogen (ppm)	81	2.9	2.45
Ammonium Nitrogen (ppm)	15	1.1	0.73
Phosphorus – Colwell (ppm)	66	5.2	<5.0
Phosphorus Buffer Index - Colwell	58	96	120
Copper (DTPA) (ppm)	2.6	2.3	1.6
Iron (DTPA) (ppm)	100	30	13.5
Manganese (DTPA) (ppm)	78	22	3.9
Zinc (DTPA) (ppm)	0.97	0.1	0.1
Boron (ppm)	1.4	2.9	5.3
Sulphur (KCl40) (ppm)	36	11.7	14
Organic Carbon (% w/w)	1.44	0.4	0.24
Calcium (cmol+/kg)	8.5	9.2	10
Potassium (cmol+/kg)	1.7	0.7	0.8
Magnesium (cmol+/kg)	6.2	11.7	13.5
Sodium (cmol+/kg)	1.4	4.3	5
CEC (cmol+/kg)	18	26	29.5
ESP %	**7.8**	**16.3**	**17**
Ca:Mg	**1.4**	**0.8**	**0.7**

Bold values identify potential limitations to plant growth
ppm = parts per million = mg/kg = ug/g

pH and poor structure associated with sodicity. These factors explain the poor root performance and water infiltration problems experienced.

It should be noted that the major soil constraints are present well below the normal depth of commercial soil testing 0-10 cm or 10-20 cm. In-field examination of deep soil cores with simple tests: colorimetric pH field kits, emersion dispersion testing for aggregate stability and EC measurement with hand-held EC meter, would be suitable to identify the main soil constraints evident in the soil. Also, because the depth of the major limitations occur below 50 cm, the effectiveness of surface application of amendments may be questionable.

Soil amendments

To quantify the magnitude of soil constraints on plant yield, soil amendments were added directly to the layer needing amelioration and repacked to form soil columns. The treatment for the Oaklands soil includes application of chicken manure pellets, gypsum, elemental sulfur and pea hay pellets (Table 2). Chicken manure was selected to provide a source of organic matter for soil biology and nutrient release for plant growth. Pea hay is also a source of organic matter but with fewer nutrients than chicken manure. Organic matter with less nutrients may provide benefits to structure and water retention without causes excessive plant growth that growing season rainfall may not be able to sustain. Gypsum is the current best practice ameliorant for sodic soils. Elemental sulfur (S) was included to decrease soil pH in the alkaline subsoil. Elemental S is converted to plant available sulfate by the action of soil microbes (Thiobacillus) in a process that also acidifies the soil and therefore it can be used to decrease soil pH to a range that is more suitable for plant growth and availability of micronutrients.

Soil columns are maintained at 70% of field capacity until anthesis after which time the plants exist on their ability to utilise subsoil moisture. Grain harvest, above ground biomass and yield components will be recorded after harvest.

This experiment sets the boundary for what is the theoretically possible yield produced from the soils if amendments are made to the soil to overcome constraints. A secondary experiment was conducted to determine rate and combination effects of treatments in incubations conducted in the absence of plants.

Results

Column Studies

The addition of amendments did not result in increased plant performance. The wheat grown on amended soil was not significantly greater than the untreated control in terms of any measured plant parameter (Table 3). Within the soil, the amendment also did not result in significantly different root biomass than the control, nor did it result in any difference in soil moisture. Root growth restricted to the 0-10 cm layer.

The addition of amendments made no statistically significant change to the salinity of the soil in any layer (Table 4). Amendment caused soil pH to increase in the 0-10 cm layer, possibly due to alkalinity of the organic matter added and subsequent microbial mineralisation. The subsoil layers receiving elemental S experienced pH decreases of 0.5 and 0.2 units in the 10-50 and 50-100 cm layers respectively, when measured in water.

Table 2: Soil treatment for column study of the Oaklands soil

Soil Layer	Treatment	Reason
Topsoil (0-10 cm)	• Chicken Manure pellet (1 t/ha)	• Nutrient release, enhance soil biology, improve structure
Subsoil 1 (10-50 cm)	• Gypsum (5 t/ha) • Elemental sulfur (1600 kg/ha) • Chicken Manure pellet (5 t/ha) • Pea Hay Pellets (10 t/ha)	• Decrease sodicity • Decrease pH (from 7 to 6) • Nutrient release, improve structure, enhance soil biology
Subsoil 2 (50-100 cm)	• Elemental sulfur (1600 kg/ha) • Chicken Manure pellet (7 t/ha) • Pea Hay Pellets (10 t/ha)	• Decrease pH (from 8.6 to 6.5) • Nutrient release, improve structure, enhance soil biology • Improve structure, enhance soil biology

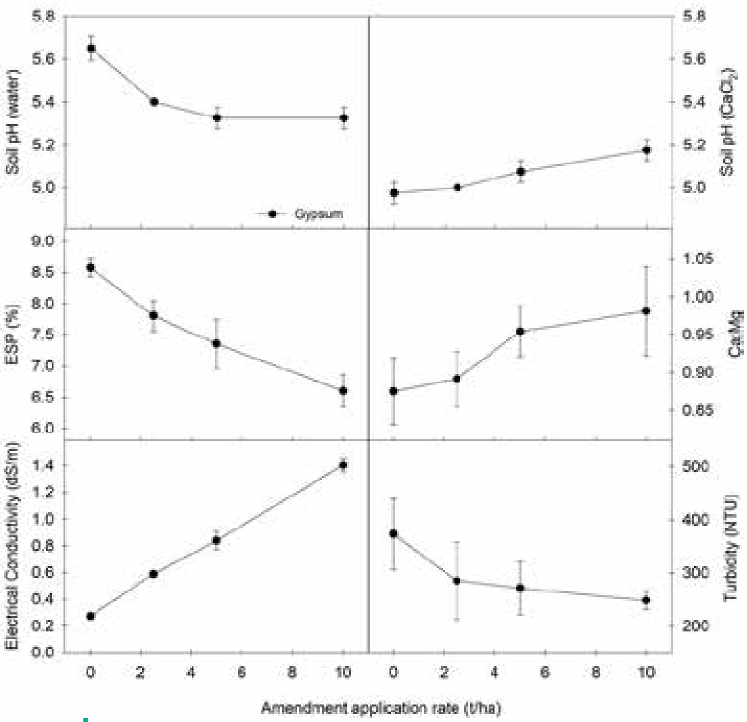
Table 3: Average shoot dry weight, grain yield, Harvest Index (HI), tiller number, number of heads and seed weight for each soil type and treatment (control and treated) (ns=not significant)

Treatment	Shoot Dry Weight (g/core)	Grain Yield (g/core)	Harvest Index	Tiller No.	Head No.	Total water use (L)
Control	9.07	4.13	0.46	5.75	5.75	1.87
Treated	11.85	4.69	0.40	7.00	7.00	1.68
l.s.d. (0.05)	ns	ns	ns	ns	ns	ns

Table 4: Soil salinity (dS/m) and soil pHCa and pHwater measured after harvest for control and amendment treated soils. Lsd was calculated at $p<0.05$. ns denoted no significant difference, *ns denotes significance at $p<0.10$.

	Soil salinity (dS/m)			Soil pHCa (1:5 CaCl2)			Soil pHw (1:5 water)		
depth (cm)	Control	Amended	*l.s.d.*	Control	Amended	*l.s.d.*	Control	Amended	*l.s.d.*
0-10	0.42	0.61	ns	5.45	5.85	0.03	6.01	6.28	ns
10-50	0.16	0.21	ns	7.02	6.79	*ns	8.37	7.87	0.16
50-100	0.25	0.34	ns	7.94	7.92	ns	9.35	9.14	0.05

Figure 1: Soil chemistry changes in the Oaklands topsoil (0-10 cm) due to amendment with Gypsum (0, 2.5, 5, 10 t/ha). Vertical bars are standard deviation of the mean (n=4).



Incubation Studies

In the laboratory incubations, which did not include growing plants, the application of gypsum to the topsoil (0-10 cm) of the Oaklands soil decreased ESP from 8.5 to 6.5% from the control to 10 t/ha gypsum, respectively (Figure 1). This change was also associated with a slight increasing trend in Ca:Mg however the maximum Ca:Mg remained less than 2 which would suggest that aggregate stability may still be compromised. However, the electrical conductivity (EC) also increased with increasing rate of gypsum application and this salt would need to be leach so as to not impair root growth when applied in the field. The combined influence of decreased ESP and increasing EC was a decreasing trend in turbidity representing improved microaggregate stability as gypsum rate increased.

Within the subsoil layers of the Oaklands soil, application of gypsum also increased EC and Ca:Mg ratio causing a decrease in ESP and turbidity.

Rate responses to the addition of S in the 10-50cm layer of the Oaklands soil was evident in the sulfate concentration, soil pH (water and CaCl2) indicating that microbial oxidation of S had occurred. The production of sulfate ions increasing electrical conductivity which may also aid flocculation, although gypsum was more effective in decreasing turbidity. The application of S to the deepest subsoil layer of the Oaklands soil did not change soil properties possibly due to a lack of the S oxidising bacteria, Thiobacillus sp., in that layer.

Conclusion

The main constraint of the Oaklands soil appears to be the sodicity and alkalinity of the subsoil (below 10 cm). Whilst gypsum was successful in decreasing the dispersion caused by sodicity, it's use did not result in greater plant performance in the column study owing to the hostile subsoil below 10 cm.

The use of elemental sulfur to lower pH was effective in the upper subsoil (10-50 cm) but largely ineffective in soil below 50 cm most probably due to a lack of the microbiology required to transform elemental S to plant available sulfate and the acidity that is required to decrease pH. Regardless, root growth and plan performance was not improved with amendments applied in this experiment. The alkalinity and structural constraints of this hostile subsoil remain challenges to overcome.

Acknowledgements

The project staff are grateful for the assistance of Cassandra Schefe and Lawson Grains for access to the property and willingness to be involved in the project. This work has been supported by the Cooperative Research Centre for High Performance Soils whose activities are funded by the Australian Government's Cooperative Research Centre Program. The project is funded by the Soil CRC, NSW DPI, CSU and DEDJTR with support from FarmLink, the Facey Group, HART, BCG, CWFS and Riverine Plains Inc.

COOL SOILS INITIATIVE RESULTS AND CASE STUDIES FROM THE RIVERINE PLAINS

DR CASSANDRA SCHEFE - AGRISCI PTY LTD

JANE MCINNES - RIVERINE PLAINS INC.

KEY POINTS

Analysis of soil samples from 183 paddocks participating in the Cool Soils Initiative project showed soil organic carbon (SOC) levels ranging from 0.70–4.75 per cent.

Analysis of 183 surface (0 –10cm) soil samples taken as part of the project showed that pH ranged from 4.2–7.3 (CaCl2).

Knowing what is in your soil is key to utilising nutrients, understanding limiting factors and growing sustainable yields.

Aim

The *Cool Soils Initiative* aims to increase the long-term sustainability and yield stability of the grain-producing regions of southern New South Wales and north-east Victoria, through the adoption of innovative agronomic strategies to increase soil health and related function.

Background

Increasing SOC has been globally recognised as a key driver in reducing emissions, through sequestration of atmospheric carbon dioxide (CO_2) while increasing system resilience through increased water storage and nutrient cycling. All these factors then potentially contribute to increased sustainability and yield stability. This project focuses on the adoption of on-farm practices that may increase soil carbon while maintaining production and profitability. It will do this by 45 growers selecting up to 5 paddocks each (225 sites) across the Riverine Plains region, measuring Soil and pH for inputting into the Cool Farm tool. The result from this tool is their calculated greenhouse gas emission per hectare and per tonne of wheat produced.

During 2018, Riverine Plains and Central West Farming Systems partnered with Mars Petcare to develop an industry program, the *Australian Cool Farm Initiative*, to quantify greenhouse gas emissions (GHG) from wheat production, as well as to identify avenues to support farmers in reducing emissions, with a focus on soil health.

In 2020, the program took another leap forward, being recognised as a program of value across the industry, with Kellogg's, Manildra Group and Allied Pinnacle joining the project, in partnership with Charles Sturt University and the Food Agility Cooperative Research Centre (CRC).

Also during 2020, the name of the program changed to the Cool Soil Initiative to reflect the importance of soil health as a key driver mitigating GHG emissions on-farm, while supporting increased system resilience across variable seasonal conditions. During 2021 the project has expanded into the irrigated cropping sector, with an increased focus on corn production.

The program aims to create a framework for the food industry to support grain growers through the adoption of innovative agronomic strategies to increase soil health and related function, resulting in reducing greenhouse gas (GHG) emissions, leading to increased long-term sustainability and yield stability.

To support farmers in practice change, innovation paddocks have been established. The innovation paddocks will be used to showcase different management practices, such as liming, incorporation, amendments and using pulses in the system to either increase soil health or as a greenhouse gas mitigation strategy. The paddocks provide an avenue for farmers to trial a practice and can be measured.

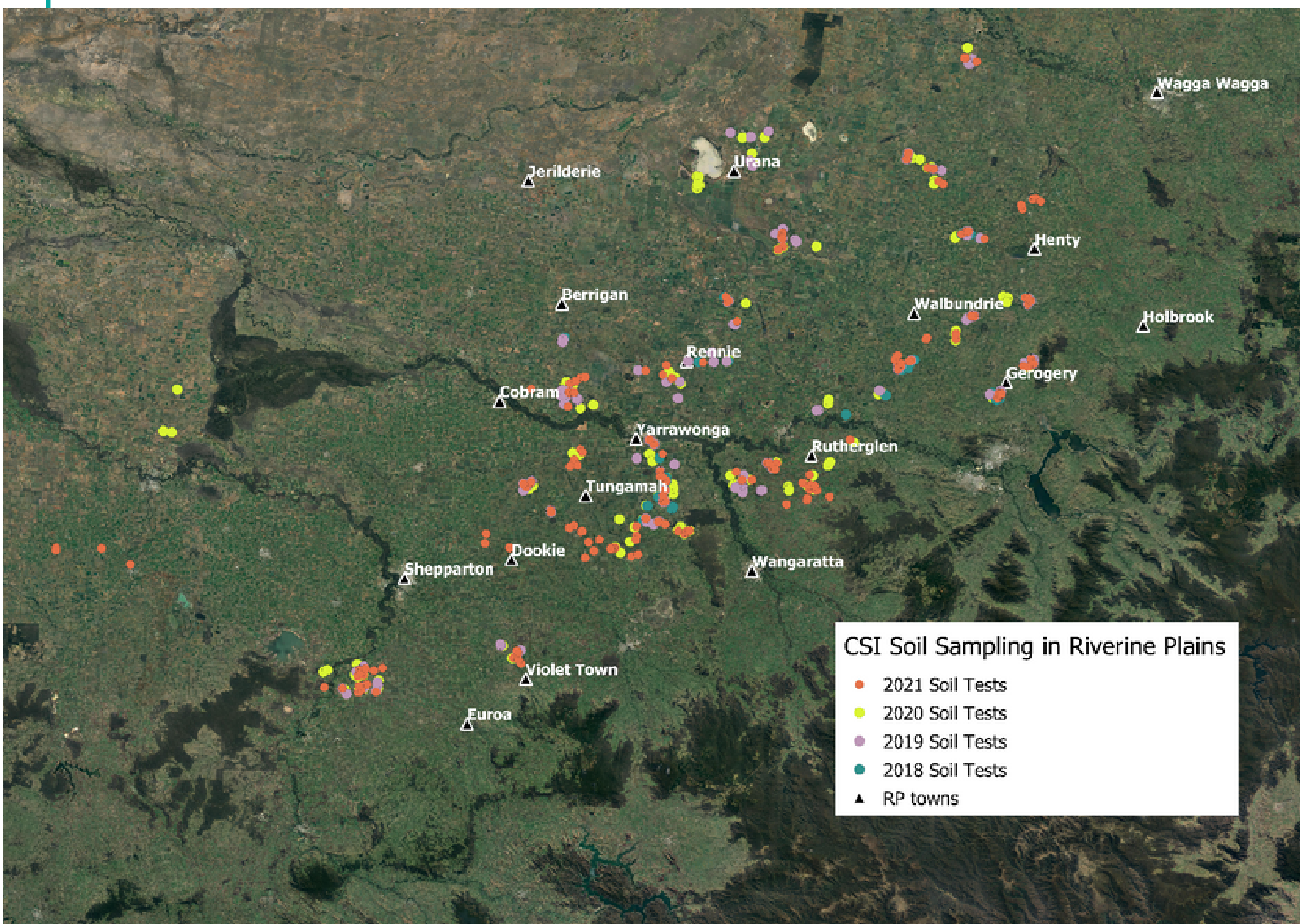
Method

During 2019, 30 growers from both the Riverine Plains and Central West Farming Systems (CWFS) region (a region centred in Condobolin and covers 14million hectares.) provided data on up to 5 wheat paddocks to participate in the project. During 2020, the number of growers participating across the project increased to 85 farmers, which included new participants from the area managed by FarmLink (An area encompassing southern NSW). There were 40 participant farmers from the Riverine Plains region during 2020, and this grew to 45 in 2021 with an additional 10 participating in the Maize part of the program. This report will focus primarily on the results of measured soil carbon for paddocks sown into wheat in the 2021 season.

The participating growers in the Cool Soil Initiative were required to identify up to five wheat paddocks each season for inclusion in the project, where GPS-located soil tests (0–10 cm) were taken for each paddock. Figure 1 shows the locations of all samples taken from across the Riverine Plains during 2018, 2019, 2020 and 2021.

Each soil sample was air-dried and analysed for a range of soil properties, including soil pH (CaCl2), soil organic carbon (SOC) percentage, cation exchange capacity (CEC) and nutrients. Soil samples were taken from specific locations in

Figure 1: Location of paddocks across the Riverine Plains area participating in the CSI project, incorporating the use of the Cool Farm Tool (CFT), during 2018–21



each paddock based on ease of access and the known location of representative soil types.

The anonymised soil test results, farm input data and yields are inputted into a simple database where it is processed through the Cool Farm Tool, generating predictions of greenhouse gas emissions for each paddock. Results are then communicated to growers as they became available, giving them accurate and update estimates of CO2 equivalence emissions per tonne of wheat produced and per hectare. Due to the late harvest of season 2021 results from the Cool Farm Tool had not yet been processed at the time of submitting this article.

During the 2021 season, farmers in the project were encouraged to test an innovative farming practice on one of their paddocks and were provided with support for additional soil sampling and measurement throughout the season. Some examples of practises being trialled included growing beans and canola, applying manure, testing stubble management (burning, mulching and direct sowing), growing summer cover crops, applying biosolids and liming incorporation. It is hoped that it will be possible to compare GHG emissions between these practises and allow farmers to make better decisions based on the results.

The project will continue with existing participants during 2022 season, however with an increased focus on getting results extracted from the Cool Farm Tool for sample sites and innovation paddocks.

Results

Rainfall

The 2021 growing season varied greatly across the Riverine Plains region, with regular and timely rains contributing to high winter crop yields. High rainfalls at the beginning of the season in some areas caused issues, while late season rains flooded crops and delayed harvest in other regions. During 2021, annual rainfall across the region ranged from 377 mm to 1064 mm, while growing season rainfall (GSR) from April to October, ranged from 224 - 348 mm. (Figure 2).

Soil organic carbon

In early spring 2021, 183 wheat paddocks were sampled, with 35% of these having been previously sampled. There are now 417 paddocks that have been sampled, 74.8 % once, 21.8% over two years, 2.8% over 3 years and 2 paddocks have been measured every year since the project started in 2018.

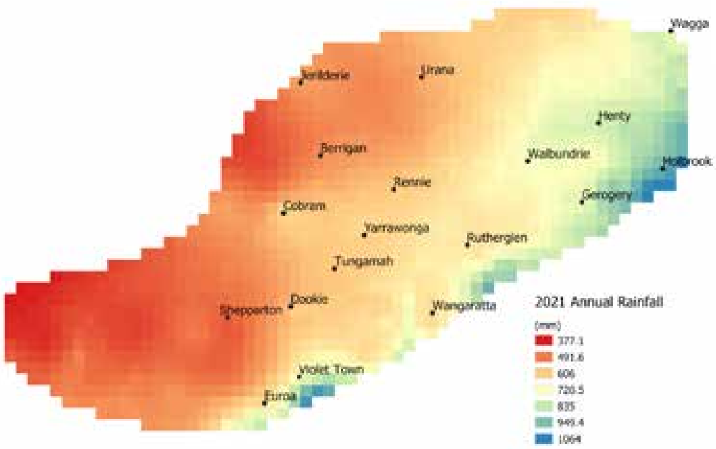


Figure 2a: Annual Rainfall for the Riverine Plains region during 2021

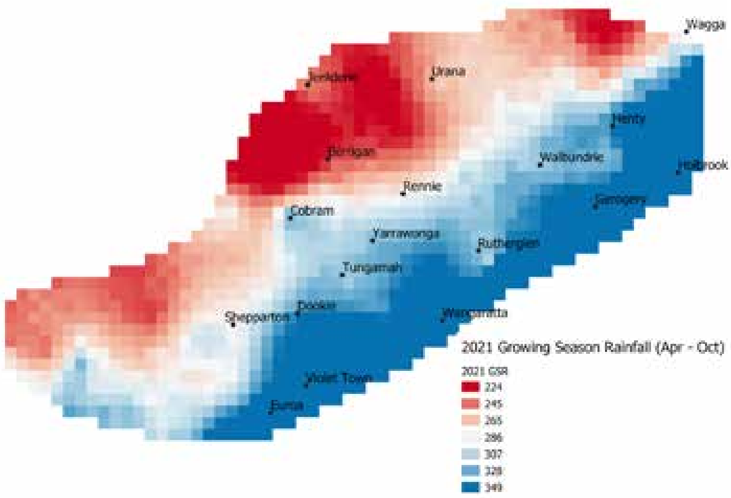
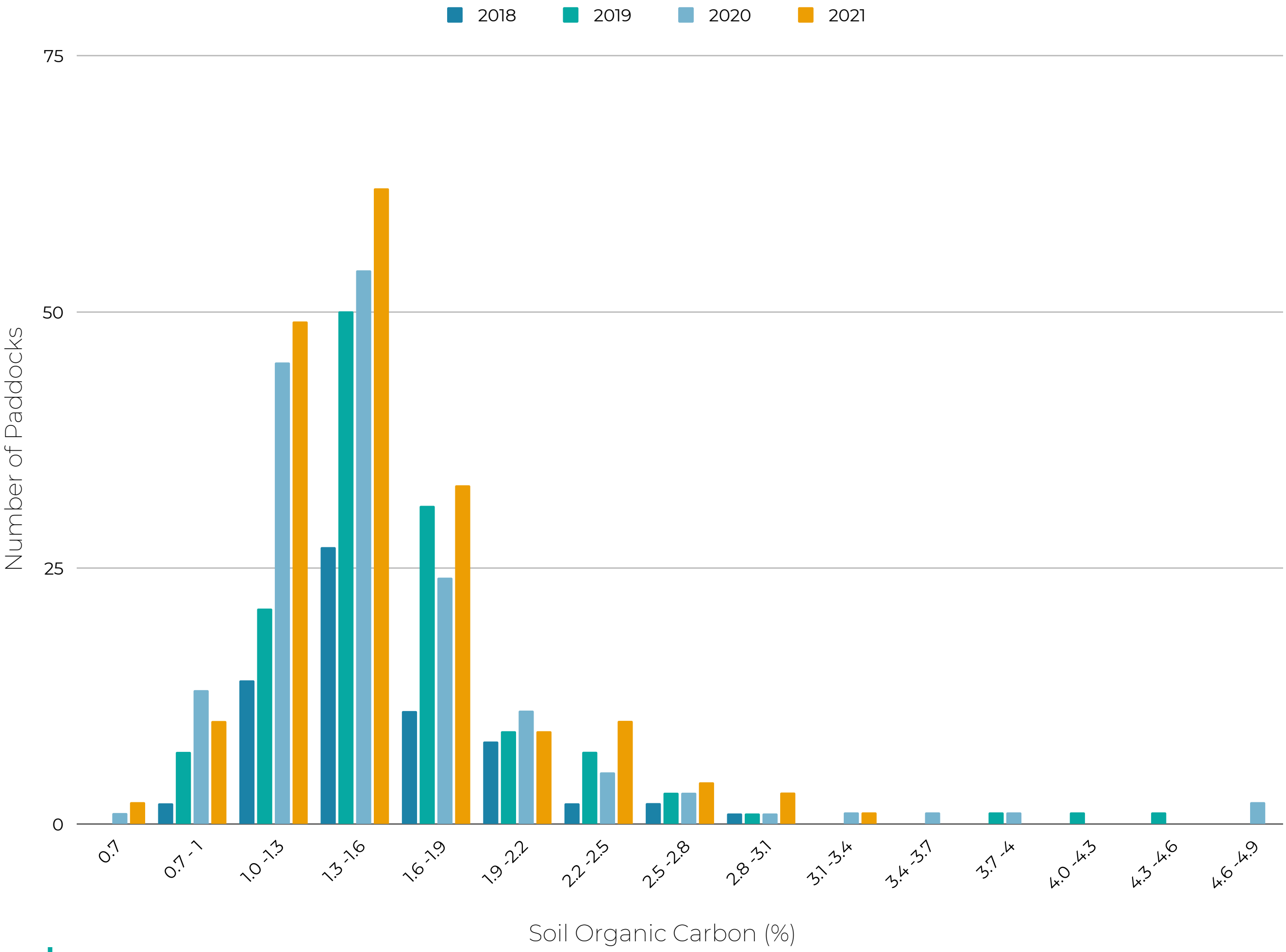


Figure 2b: Growing Season Rainfall for the Riverine Plains region during 2021

Analysis of the 2021 soil sampling results show that SOC values ranged from 0.7– 3.3 per cent across the paddocks tested (Figure 3). SOC values between 1.6 – 1.9 accounted for 34% of all soil tests. The highest value (3.3 per cent) was recorded in a paddock that has a history of grazing, with low inputs. The distribution of results from the 2021 samples was similar to those sampled in previous years.

Due to the late harvest of season 2021, yield data was not available at time of publishing.

Figure 3: Soil organic carbon distribution across paddocks sampled as part of the ACFI 2018–19 summer sampling program, ACFI 2019, CSI 2020 wheat sampling program and 2021 wheat sampling program for the Riverine Plains region



pH (CaCl2)

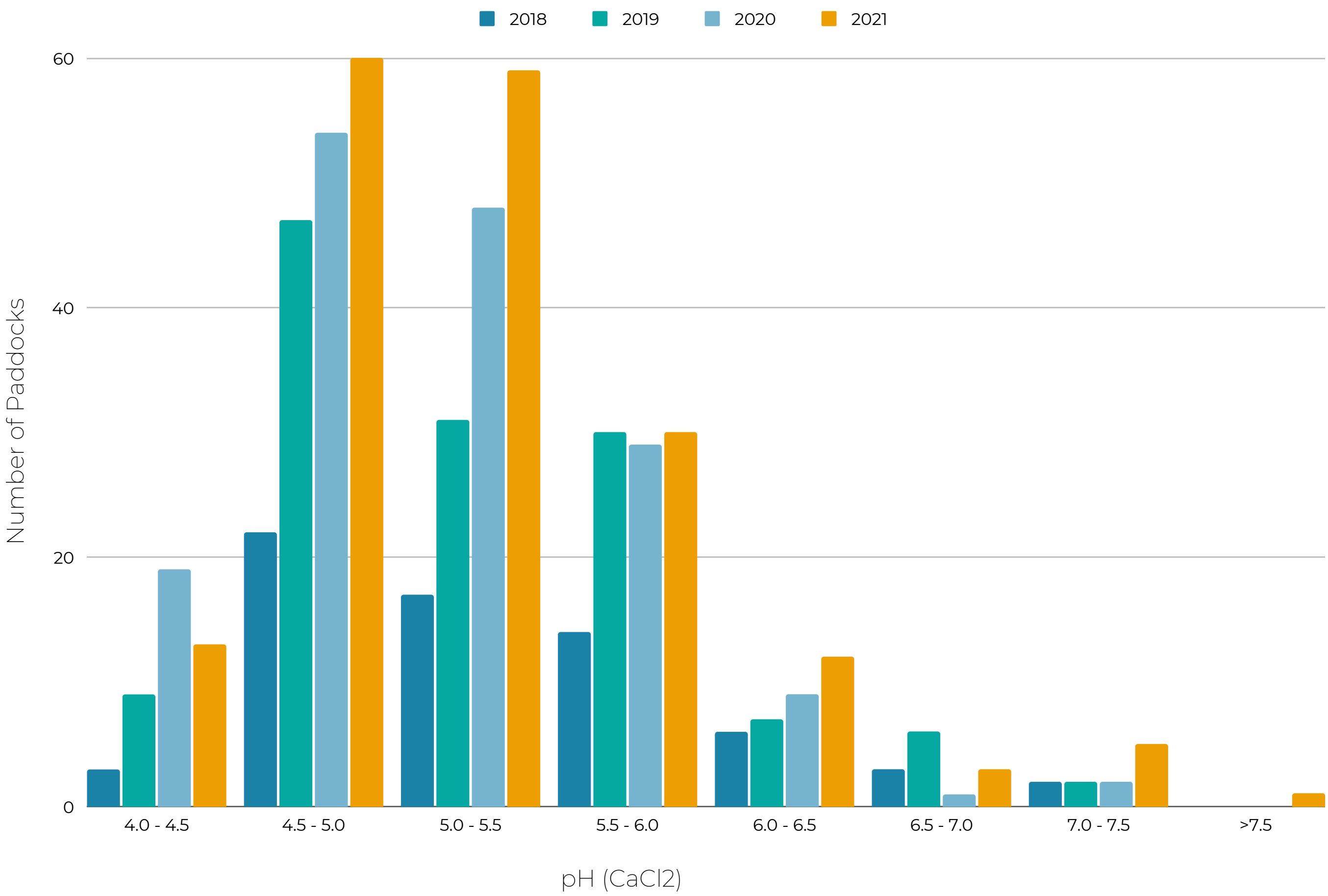
The Riverine Plains region has a diverse range of soil types. This is reflected in the pH values seen across the area, with soils ranging from naturally acid to alkaline. Soil pHCaCl2 values of greater than 5.2 is the level in which nutrient availability is not limited, high enough to ensure aluminium (Al) toxicity is not an issue. Plant toxicity effects due to increased aluminium solubility are generally seen when the aluminium saturation of cation exchange sites exceeds 6%, although different plant species have differing tolerance to aluminium.

The soil pHCaCl2 in the surface (0–10cm) soil samples taken during 2021 showed a wide range of pH CaCl2 levels ranging from pH CaCl2 4.2–7.8 (Figure 5). The four years of results (2018–21) show a similar distribution of soil pH CaCl2. A detailed analysis of paddock history and management data collected as part of the project in 2021 (data not presented) suggests that this wide range of pH values is likely to reflect the use of amendment practices being used in the region. Practices such as applying lime, can take a long time to show a response in the soil profile contributing also to the variation. The number of paddocks with pH CaCl2 less than 4.5 has decreased from 12% in 2020 to 7% in 2021 is likely to be a result of more lime is being applied.

Greenhouse gas emissions

Data from each paddock will be analysed to determine the greenhouse gas emissions per hectare (kg CO2e/ha) as well as greenhouse emissions per tonne of grain produced (kg Co2e/tonne wheat) using the Cool Farm Tool. This analysis however was not completed at time of printing.

Figure 4: pH (CaCl2) distribution across paddocks sampled as part of the ACFI project 2018–19, 2020 and 2021 CSI project.



Observations and comments

During 2021, the *Cool Soils Initiative* project in the Riverine Plains area involved 45 participants in the wheat program and 10 Maize growers, who collectively managed an area of over 130 000 hectares.

The Cool Soil Initiative continues to evolve, whereby better access and interpretation of paddock scale spatial data, reviewing of the GHG emission calculators, and understanding the economic value of practice change to increase soil health will be key to its success.

There is now 4 years of GPS referenced soils data that can be compared and analysed along with paddock data. Understanding the emissions created by these paddocks and the impacts each farming practice has is the next step.

The 2021 emissions data will be published in the 2023 trial book article.

Acknowledgements

Riverine Plains acknowledges the investment by Mars Petcare, Kelloggs', The Manildra Group, Allied Pinnacle, Charles Sturt University and Food Agility CRC, as well as the project support from the Sustainable Food Lab (SFL). Thank you also to all our farmer co-operators, whose support for this project is greatly appreciated.

GRDC SOUTHERN GRAIN LEGUME AGRONOMY 2021 – BURAJA AND BUNDALONG SPOKE SITES

BEN MORRIS - FAR AUSTRALIA

TOM PRICE - FAR AUSTRALIA

KEY POINTS

2021 seasonal conditions were favourable for indeterminate crops such as beans, with yields approaching 8t/ha possible under dryland and irrigated conditions.

There was evidence that N inputs at sowing increased Faba bean yields, but may trade-off reduced nodulation

The more susceptible cultivar PBA Bendoc increased from 3.1 – 3.97 t/ha at Buraja when disease was managed.

Disease management had little impact on yields in resistant cultivars despite disease present in the canopy, this contrasts with the southern environments.

This is the first season of results and responses to fungicide and nutrition will need to be conducted over multiple seasons in the region.

The legacy impacts (N fixation) for following crops in the context of increasing urea prices will be important considerations in future research in the region.

Background

A new Grains Research & Development Corporation (GRDC) investment across eastern Australia aims to close the economic gap in grain legume production. NSW is led by Brill Ag, Victoria by Agriculture Victoria, and South Australia is led by SARDI. Other regional partners are contributing to the investment, including FAR Australia who managed a pulse spoke site at Buraja/Coreen and Bundalong in 2021. As part of the GRDC Southern grain legumes project we are targeting 6-8 t/ha dryland yields in faba beans in NE Victoria, and 4 – 6 t/ha at Buraja in NSW.

Legume nutrition

The use of grain legumes has the potential to reduce N inputs and increase N use efficiency in following crops and improve overall soil quality. Research has demonstrated that bagged (synthetic) N alone is not necessarily capable of supplying the crop with enough to achieve hyper yielding crops (canola yields >4t/h, and cereal yields >8t/h). As a rule of thumb, on average 20 kg of shoot-N per tonne of dry matter is fixed by grain legumes and the actual amount of N fixed will vary depending on soil type, management, species, and season in the order of 15 — 25 kg (Peoples et al. 2009). However, a very important consideration that is often overlooked is the fact that the N fixation component provides much of the N demand of the grain legume crop itself, and a large part of the fixed N is exported in the grain. Nodulation may also be reduced on acid soils and thus additional N maybe required.

Disease Management for Faba Beans

This is the key question FAR Australia is addressing in the GRDC Grain Legumes projects in SA, Vic, and NSW. Fungicide products and timing should target the leaves most critical to yield determination. Given beans are indeterminate, pod number is determined in the period prior and post flowering, whereas the number of seeds per pod are determined post flowering (Figure 1) It is important to think about the difference between growth and development and how this links with disease management. Development rate of branches and leaves, the progression towards flowering, pod set and disease development are all influenced by temperature. Whereas humidity and rainfall influences disease development. A key feature of the Vic NE environment is that humidity and frequency of rainfall events are typically lower than the South, and thus growers may be able to apply a more practical and flexible approach to disease management. This should include protecting segments of the canopy that are most likely to contribute to yield. The key question we will address in the fungicide trials is ***When should we apply fungicides in the canopy to offer the greatest return on yield?***

Site Description

	Bundalong	Buraja
Soil Type		
Sowing Date	20 April 2021	7 May 2021
Sowing Fert	80kg MAP/ha	80kg MAP/ha
Harvest Date	23 December 2021	23 December 2021
Growing Season Rainfall (mm) (Apr-Oct)	325.6	330.7
0-10cm Soil		
pH (CaCl2)	5.3	4.6
Organic Carbon %		1.1
Colwell P mg/kg	72	55
Aluminium %		3.9
Calcium %	79.68	61
Magnesium %	8.8	24
Sodium % (ESP)	2.17	3.2
Potassium %	9.27	8.2

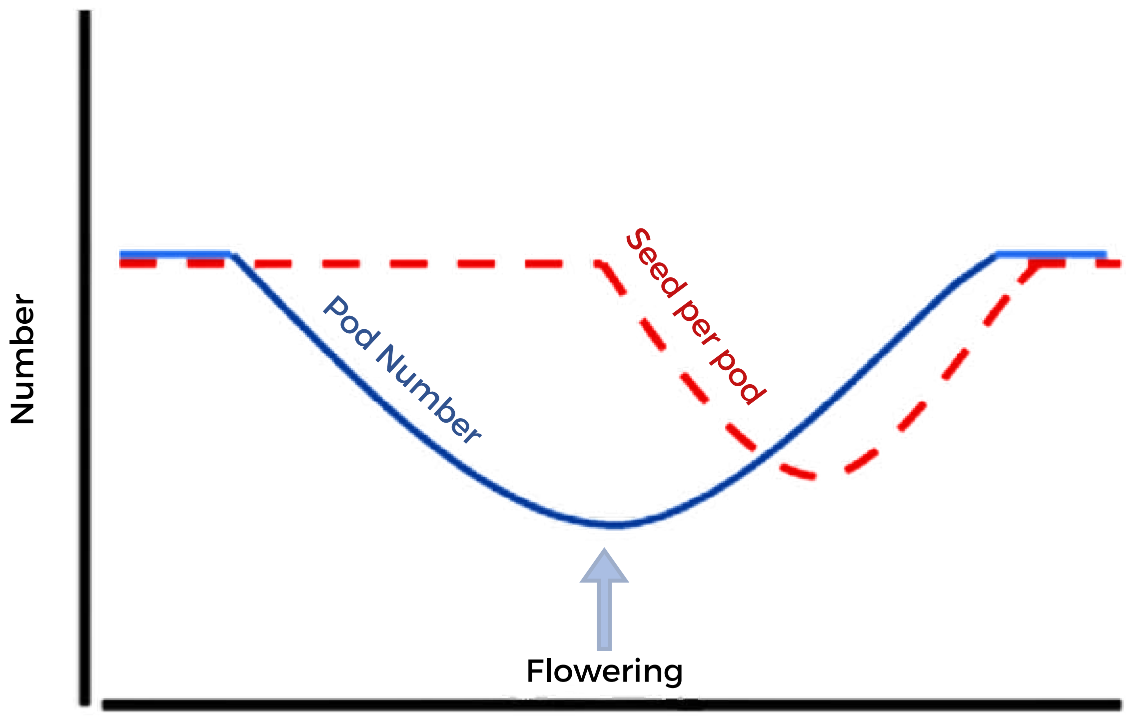


Figure 1: Effect on the timing of stress on (a) pod number and (b) seed per pod. Adapted image and based on shading experiments conducted and published by Lake et al 2019.

Faba Bean Disease Management Trial

A disease management trial was established at both sites.

Treatments

At the Buraja spoke, a disease (Chocolate spot) susceptible faba bean cultivar (PBA Bendoc) and a moderately resistant faba bean cultivar (PBA Amberly) were sown on 7 May. Five different fungicide strategies were implemented on each cultivar with the aim of protecting key segments of the canopy from a physiological perspective (Table 1).

At the Bundalong spoke, a faba bean cultivar (PBA Samira) was sown by the host farmer (20 April) in which small plots were marked out and 6 different fungicide strategies were implemented and are aimed at critical growth stages and protecting key segments of the canopy from a physiology perspective (Table 2).

At each fungicide timing, the canopy was tagged at the newest emerged leaf to allow assessment of disease-based spray timings.

Table 1: Fungicide treatments applied at Buraja spoke site.

Treatment No	1st Flowers open on main stem – GS 61 (26 Aug)	1st Flower (GS 61) + 14 days (14 Sept)	1st Flower (GS 61) + 28 days (14 Oct)
Active Ingredient	Mancozeb 750 2.0l/ha + Procymidone 240g/ha	Chlorothalonil 2.3l/ha + Carbendazim 0.5l/ha	Chlorothalonil 1.5l/ha + Carbendazim 0.5l/ha
Untreated	-	-	-
1 F (Fungicide units)	-	-	✔
2 F (Fungicide units)	-	✔	✔
3 F (Fungicide units)	✔	✔	✔
Flexible Program (2 Fungicide Units) *		Miravis Star 0.75l/ha*	Veritas 0.75l/ha*
	-	✔	✔

*Chlorothalonil and Carbendazim excluded

Table 2: Fungicide treatments applied at Bundalong spoke site

Treatment No	4 nodes – GS 14 (28 June)	1st Flowers open on main stem – GS 61 (26 Aug)	1st Flower (GS 61) + 14 days (14 Sept)
Active Ingredient	Tebuconazole 145ml/ha	Mancozeb 750 2.0l/ha + Procymidone 240 g/ha (Nosclex 800 300g.ha)	Chlorothalonil 2.3l/ha + Carbendazim 0.5l/ha
Untreated		-	-
1 F (Fungicide units)		-	✔
3 F (Fungicide units)		✔	✔
4 F (Fungicide units)	✔	✔	✔
1 F Early		✔	
Active Ingredient			Veritas 0.75l/ha*
Flexible Program (2 Fungicide Units) *		-	✔

*Chlorothalonil and Carbendazim excluded

Results

Disease levels varied between sites and between cultivars. At Bundalong, despite having dense canopy which is usually conducive for disease, disease levels were low with less than 5% leaf area infected in mid-November. At Buraja however, disease pressure was higher (Figure 1). PBA Bendoc showed higher levels of chocolate spot due to its poorer genetic resistance to the disease. Both cultivars showed a reduction in disease infection as a result of a single fungicide application.

At Buraja where two cultivars were used, there was no significant yield differences between the susceptible and resistant cultivars when disease was controlled (Table 3). PBA Amberly showed no yield response to fungicide despite there being evidence of reduced disease infection. The disease susceptible cultivar, PBA Bendoc, showed a yield response to the application of fungicide. Yields were maximised with the application of 2 fungicides on the 14th of Sep and 14th of Oct.

Figure 1: Effect of fungicide strategy on disease infection (chocolate spot) at different canopy levels. Assessed 11 Nov. Lower canopy layers not assessed due canopy senescence.

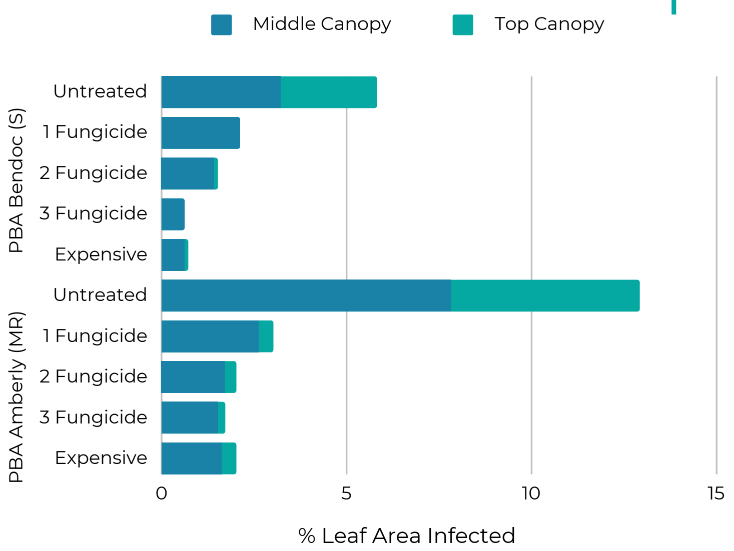


Table 3: Influence of faba bean cultivar and disease management on grain yield (t/ha)

	Grain Yield (t/ha)		
	PBA Amberly (MR)	**PBA Bendoc (S)**	**Mean**
Untreated	3.75 ab	3.17 c	**3.46**
1 Fungicide	3.61 ab	3.40 bc	**3.50**
2 Fungicide	3.78 a	3.80 a	**3.79**
3 Fungicide	3.72 ab	3.97 a	**3.84**
Flexible	3.76 ab	3.75 ab	**3.76**
Mean	**3.72**	**3.62**	

Cultivar	LSD p=0.05 ns	P val	0.169
Fungicide Strategy	LSD p=0.05 0.26	P val	0.013
Cultivar x Fungicide	LSD p=0.05 0.36	P val	0.033

There was no yield response to fungicide at Bundalong under lower levels of disease pressure at the site.

Faba Bean/Vetch Nutrition Trial

A nutrition trial was established at both sites with the aim to investigate whether yields of pulses may be limited by nitrogen and or micronutrients.

Treatments

At the Buraja spoke, a faba bean cultivar (PBA Nasma) and a Vetch cultivar (RM4) were sown 7 May. Six nutrition treatments were applied to each pulse species, with the aim to compare relative yields and biomass production of the two species using treatments designed to manipulate plant growth and maximise nutrition (Table 4).

Table 4: Nutrition treatments, products and nutrient contents, and application rates and timings at Buraja

	Treatment	Inoculation (7 May)		6-8 Leaf (28 June)		Early Flowering (29 August)	
		Product	Rate (kg/ha)	Product	Rate	Product	Rate
1	**Untreated**	Nodulator	4.6				
2	**Trace Elements**	Nodulator	4.6	Smart Trace Triple Boly	**2.5L/ha 2L/ha**	Smart Trace Triple Boly	**2.5L/ha 2L/ha**
3	**Trace Elements + 100kg N/ha**	Nodulator	4.6	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**
4	**Trace Elements + 100kg N/ha + PGR**	Nodulator	4.6	Smart Trace Triple Boly Nitrogen FAR21 PGR1 or FAR21 PGR2	**2.5L/ha 2L/ha 50kg N/ha *Applied 29 July**	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**
5	**Trace Elements + 200kg N/ha**	Nodulator	4.6	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha a**	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha a**
6	**Untreated Nil Inoculant**						

Table 5: Nutrition treatments, products and nutrient contents, and application rates and timings at Bundalong.

	Treatment	Pre-sowing (20 April)		6-8 Leaf (28 June)		Early Flowering (29 August)	
		Product	Rate (kg/ha)	Product	Rate	Product	Rate
1	**Untreated + Lime**	Lime					
2	**Macronutrients (Standard) + Lime**	Lime		Smart Trace Triple Boly	**2.5L/ha 2L/ha**	Smart Trace Triple Boly	**2.5L/ha 2L/ha**
3	**Macronutrients (Standard) + N + Lime**	Lime		Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**
4	**100N Split + Lime**	Lime		Nitrogen	**50kg N/ha**	Nitrogen	**50kg N/ha**
5	**100N Early + Lime**	Lime		Nitrogen	**100kg N/ha**		
6	**100N Late + Lime**	**Lime**				Nitrogen	**100kg N/ha**
7	**Untreated**						
8	**Macronutrients (Standard)**			Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**	Smart Trace Triple Boly Nitrogen	**2.5L/ha 2L/ha 50kg N/ha**
9	**Macronutrients (Regional)**	**Lime**		Rapisol 321	**1kg/ha**	Rapisol 321	**1kg/ha**
10	**Macronutrients (Regional)**	**Lime**		Rapisol 321 Combi 7	**1kg/ha 1.5kg/ha**	Rapisol 321 Combi 7	**1kg/ha 1.5kg/ha**

Results

The Bundalong site produced exceptional yields with the trial averaging 7.7t/ha, demonstrating that yields approaching 8t/ha are possible to achieve in a dry land faba bean crop. Nutrition treatments applied resulted in significant yield increases compared to the control (Figure 2). The application/exclusion of lime produced no differences throughout the growing season and is likely due to the already high pH of 5.3 at the site.

The application of additional nitrogen early in the season produced significantly higher yields compared to the control (see Figure 2). When nitrogen was split or applied late there was no increase in grain yield. The application of any of the trace elements products on their own also didn't produce any significant yield responses (Figure 2). However, we saw our highest yield when trace elements and nitrogen were applied together.

Similar results were seen in faba beans at Buraja. Although not significant there was a trend showing that the combination on addition nitrogen and trace elements gave you an increase in yield while application of only trace elements did not (Figure 3).

Figure 2: Influence of nutrition on faba bean grain yield at Bundalong. P=0.005, LSD=0.34t/ha.

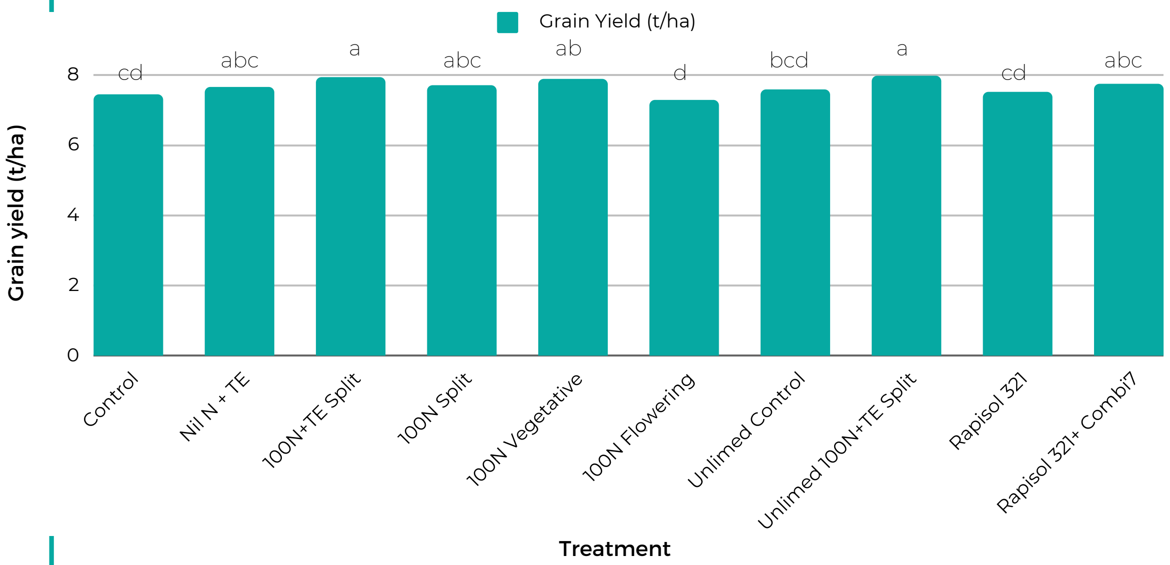
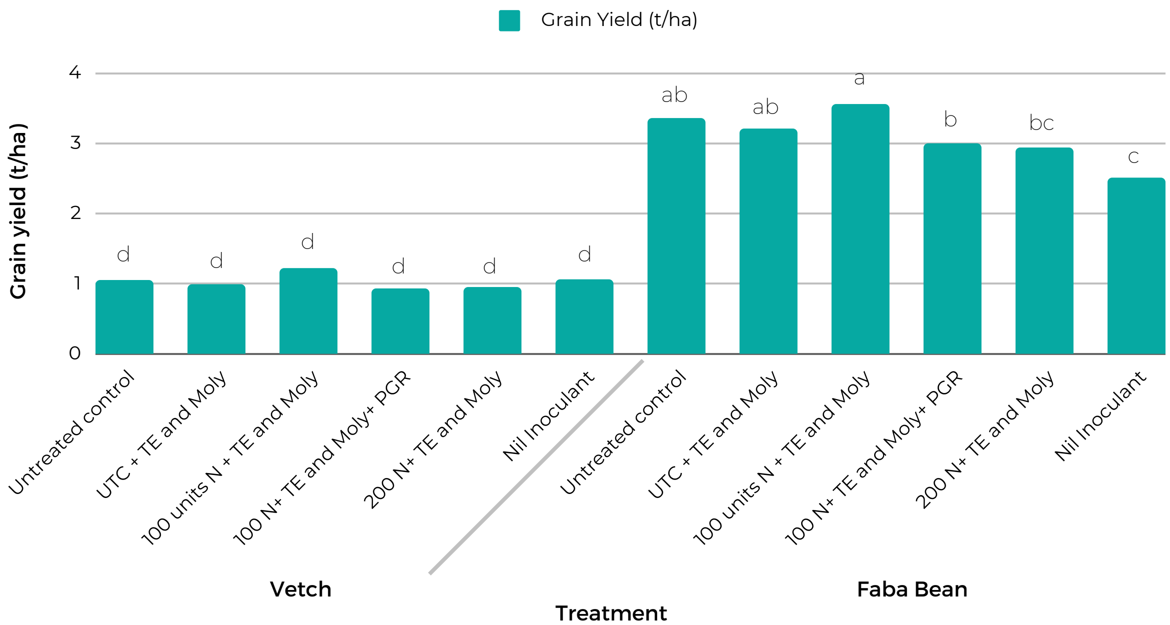


Figure 3: Influence of nutrition on grain yield of Vetch and Faba beans at Buraja. P<0.001, LSD=0.43t/ha.



Nodulation was assessed 14 Sep using 0-5 scale based on distribution and number of active nodules on the roots. Figure 4 clearly shows the effect of good inoculation when comparing the control to the nil inoculant treatment. There was a large reduction in the number and distribution of nodules where no inoculant was applied, the effects of this can be seen in Figure 3 where there is a significant reduction in grain yield of Faba beans of 0.85t/ha.

The application of additional nitrogen had a significant effect on nodule scores. Unlike grain yield, the addition of nitrogen had a negative effect on nodulation which would reduce the crop's ability to fix its own nitrogen. The fact that there was no reduction in grain yield or biomass suggests that we were able to replace fixed nitrogen with nitrogen from a bag (Urea). However, it is not known until we do follow up measurements how much N is available for following crops.

What makes up a 7t/ha Faba Bean Crop?

Hyper yielding pulse crops are achievable in Northern Vic/Southern NSW. When looking at what makes up a 7t/ha faba bean crop (Table 56), biomass at harvest seems to be a driver for high yields. At Bundalong in 2021, early sowing and a favourable growing season allowed for a biomass production of 14t/ha and with a harvest index of close to 50% was able to convert most of this to yield. At Dookie in 2020 however, a late sowing date didn't give the crop the opportunity to produce the biomass needed to generate hyper yields.

While N content has yet to be calculated, based on our estimates (and using 20kg N fixed per tonne of dry matter rule of thumb) the dry matters achieved equates to between 180 – 280kg N fixed between the lowest and highest treatment, and shows the importance of crop nutrition for N fixation. This is not factoring in how much N would be exported in the crop nor the result of poor nodulation on lower pH. soils, or under higher N treatments. Grain yield, harvest index, and nitrogen removal results have not been processed at the time of publication.

Finley being our irrigated research centre, we are able to sow slightly later than dryland as we have the ability to supply water when the crop needs it. This allows biomass production during the growing season and for the best ability to fill pods come the end of the season.

Figure 4: Influence of nutrition on grain yield of Vetch and Faba beans at Buraja. P<0.001, LSD=0.43t/ha.

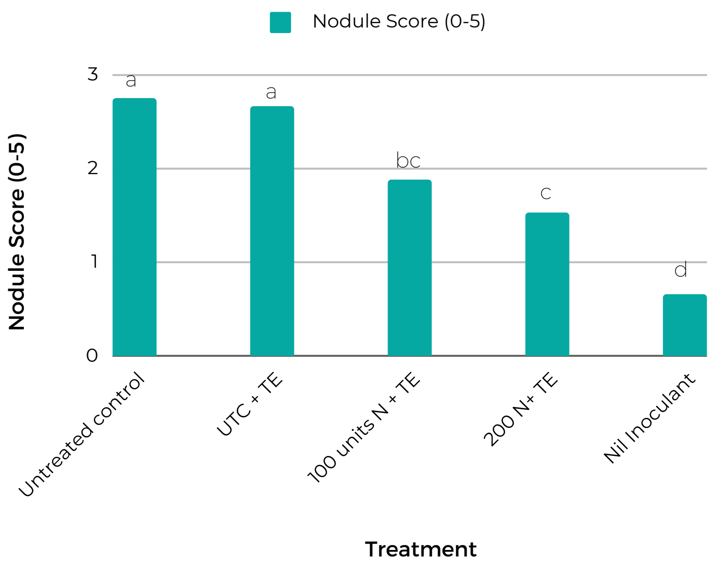


Table 6: Yield components of faba bean crops. Dookie and Bundalong cv. PBA Samira, Finley cv. PBA Bendoc.

Yield Component	Dookie 2020 (Sown 14 May)	Bundalong 2021 (Sown 20 April)	Finley 2020 (Sown 28 April, Irrigated)
Plants/m2	22	19	20
Stems/m2	77	58	60
Pods/stem	5.4	8.8	7.6
Pods/m2	404	491	453
Harvest Dry Matter (t/ha)	9.4	14.0	13.6
Grain Yield (t/ha)	4.0	7.4	7.5
Harvest Index (%)	38.7	47.7	47.4

Acknowledgements

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These provisional results are offered by Field Applied Research (FAR) Australia solely to provide information. While all due care has been taken in compiling the information FAR Australia and employees take no responsibility for any person relying on the information and disclaims all liability for any errors or omissions in the publication.

Out line of the Buraja NSW pulse spoke. Image taken 17th October.

Differences in faba bean (below left) and vetch (below right) nodulation due to the removal of inoculant or the addition of nitrogen.

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IRRIGATION FOCUS PADDOCKS 2021

KATE COFFEY - RIVERINE PLAINS INC.

KEY POINTS

In wet and cold conditions, grazing irrigated wheat and canola will require more intensive management, and a stock containment area would be helpful remove stock from paddock if water logging conditions are predicted.

A more even grazing can be obtained by crash grazing a large mob of sheep on a small area compared to a small mob of sheep on a large area.

Sow the variety suited to your environment early, with sufficient seeding rates to establish desired plant density in the vicinity of 150 plants/m2 wheat and 30 plants/m2 canola.

Remove stock prior to wheat growth stage 31 and canola two weeks prior to stem elongation to preserve yield potential.

Monitor livestock growth rates and feed test grazing crops to identify any deficiencies or toxicities and provide additional roughage to compliment the grazing crop.

Aim

In 2021, members of the GRDC Riverine Plains Irrigation Discussion Group tested the practical and financial implications of grazing irrigated wheat and canola.

Background

GRDC have invested in a suite of irrigation research projects across the southern irrigation zones. These included projects looking to develop and validate soil amelioration and agronomic practices for irrigated grain crops as well as maximising the dollar return per megalitre of water.

To tie these research projects more closely with farmer needs, farmer-driven irrigation discussion groups have been established across the southern region. The discussion groups enable farmers to be more actively involved in the irrigated grains research process.

The Riverine Plains Irrigation Discussion Group has been established to help farmers learn from one-another, build new peer and industry networks, gain access to the latest research data and provide the opportunity to shape project trial work to ensure it is relevant and meeting local needs.

Method

Two farmers, who are part of the Discussion groups, hosted the focus paddocks and recorded grazing, water application and yield data. One farm hosted a grazing wheat paddock at Barooga and the other farmer hosted a grazing canola paddock at Boorhaman.

Results

Focus Paddock 1 - Barooga

Paddock Details	
Row spacing	250mm
Paddock Size	22ha
Sowing Date	18 March 2021
Sowing Rate	80kg Kittyhawk wheat 1kg tillage radish
Soil mineral nitrogen	7 June 2021 0-30cm: 27.4kg N/ha 30-60cm: 14.4kg N/ha
Nitrogen applied	10kgN/ha (MAP 18 March 2021) 31kgN/ha (sulfate of Ammonia 28 April 2021) 69kgN/ha (urea 23 June 2021) 46kgN/ha (urea 20 August 2021)
Soil mineral N:	6 January 2022 0-30cm: 28.5kgN/ha 30-60cm: 10.5kgN/ha
Irrigation border check	130mm 10 March 2021 90mm 5 May 2021 60mm 21 September 2021
Rainfall	103mm (Jan – Mar) 249mm (Apr – Oct)
Plant counts	76/sqm

Nitrogen

The total nitrogen required for a target yield of 6t/ha for wheat was 276kgN/ha. The total nitrogen available, including soil was 198kgN/ha. Assuming that the soil mineralised 50kgN/ha in the growing season, the paddock then had a 28kgN/ha deficit for the targeted yield of 6t/ha. The post-harvest soil N tests taken in the same GPS located site, showed that the soil nitrogen levels were close to the pre-sowing levels, indicating that applied fertiliser was utilised by the crop.

Grazing

Cuts were sampled and dried from the wheat prior to grazing. The total dry matter sampled on the 26 May 2021 was 0.84tDM/ha (Table 1). The total dry matter sampled on the 30 June 2021 was 1.60tDM/ha. The estimated crop growth rate crop was15kg/DM/day.

Measuring growth rates of lambs

1100 ewes and 900 lambs started grazing the paddocks on Thursday 8 July until Monday 19 July. This formed a total of 12 days on the focus paddock. The estimated growth rate (lambs) 0.160kg/day

Feed test results.

Feed test samples were taken from the wheat paddock on the 26 May 2021 (Table 1). Mixed cereal and/or brassica crops can have a low fibre content. Fibre is important to maintain normal rumen function, saliva production and ruminal pH. Providing continual access to hay may provide a more balanced diet, improve weight gains and reduce effects on animal health (Braine, K, Riverine Plains newsletter, September 2021). Hay was provided to the ewes and lambs on the wheat paddock.

Grazing Results

The returns from lambs were calculated by measuring gains from grazing across all the irrigation area (120ha) and calculating the gain per hectare. A total of 900 lambs grazed the area for 28 days and gained 0.160kg/head/day, a total of 4.48kg/hd liveweight. Accounting for a dressing percentage of 48, and lamb hook price $8.60 per kg the gain was $18.50/hd or $138 per hectare.

Wheat yield

The wheat yielded 4.5t/ha with 11% protein.

Table 1: Feed test results grazing wheat

Paddock	Neutral Detergent Fibre %	Crude Protein %	Metabolisable Energy %	DOMD %	DM/ha measured prior to grazing t/ha
Barooga Wheat and tillage radish mix	40	29.4	13.0	79	0.84 (26 May 2021) 1.60 (30 June 2021)

DOMD: Digestibility of the Organic Dry Matter This value is calculated to represent the amount of organic matter that is digested by the animal.

Discussion

The focus paddock yielded 1t/ha lower than other irrigation areas of the farm, with a water use efficiency of 9.92kg/mm/ha Appendix 1) below a target of 15kg/ha/mm. Potentially the paddock got too wet: exacerbated by a very dry summer/autumn followed by a wet winter after the paddock had been irrigated. In addition, the plant numbers were lower than the target of 150plants/m2 and the tillage radish was quite competitive with the wheat.

Lamb growth rates of 0.160kg/hd/day were acceptable by industry standards and returns were good due to current high lamb prices. The grazing did require careful management to ensure that the ground did not get too pugged up by the sheep during the wet winter. The farmer is planning to sow a combination of wheat and tillage radish again this year for grazing but will probably halve the rate of the tillage radish and increase the seeding rate of wheat, to ensure that the irrigated wheat yield can reach its potential.

Results

Focus Paddock 2 - Boorhaman

Paddock Details	
Row spacing	250mm
Paddock Size	70ha
Sowing Date	6 April 2021
Sowing Rate	Canola 970CL
Soil mineral nitrogen	50kgN/ha (estimate)
Nitrogen applied	10kgN/ha (MAP 6 April 2021) 37kgN/ha (urea 8 May 2021) 37kgN/ha (urea 15 June 2021) 46 kgN/ha (urea 1 July 2021) 46kgN/ha (urea 19 August 2021)
Irrigation spray	32mm (3 applications 10-26 April 2021)
Rainfall	204mm (Jan – Mar) 311mm (Apr – Oct)
Plant counts	56/sqm

The total nitrogen required for the target yield of 3.3t/ha canola was 264kgN/ha. The total nitrogen available, including estimated starting soil nitrogen was 226kgN/ha. Assuming that the soil mineralised 50kgN/ha in the growing season, this brought the total nitrogen available to 276kgN/ha, which was sufficient to meet the targeted yield.

Grazing

Dry matter samples were taken on 2 June 2021 and were measured at 1.05tDM/ha (Table 2).

Measuring growth rates of lambs

Two hundred and 22 merino lambs were grazed from 17 June 2021 to 31 July 2021, which was 47 days. These were averaging 45kg in weight when they commenced grazing in the focus paddock. The estimated growth rate was 0.82kg/head/day.

Feed test results

Feed test samples were taken from the canola on the 2 June 2021 (Table 2).

Table 1: Feed test results grazing wheat

Paddock	Neutral Detergent Fibre %	Crude Protein %	Metabolisable Energy %	DOMD %	DM/ha measured prior to grazing t/ha
Boorhaman 970CL Grazing Canola	29	24.2	13.4	81	1.05 (2 June 2021)

DOMD: Digestibility of the Organic Dry Matter This value is calculated to represent the amount of organic matter that is digested by the animal.

Canola Yield

The whole paddock yielded 2t/ha, which was well below the dryland average of 3t/ha. The majority of the paddock was an irrigated circle while there were dryland areas in the corners. It was estimated that the irrigated section yielded 2.5t/ha with a water use efficiency of 8.31kg/ha/mm (Figure 1 and Appendix 1), which is below the target of 12kg/ha/mm.

Discussion

One of the reasons for the lower than expected yield in canola, was that the paddock had some wet areas which were exacerbated by the paddock being cultivated to incorporate lime. The

Discussion

sheep heavily grazed the northwest quarter of the paddock (see top left corner in Figure 1), which was quite wet at the time, and this impacted the final canola yield. The cold conditions which caused the animals to huddle in the corner of the paddock may have also affected lamb growth rates. It was estimated that the canola yield loss in this area, representing about 30% of the paddock, was 50% of the total yield. Grazing yield loss was due to a combination of dry matter removal as well as pugging and plant loss caused by the wet conditions.

Another potential issue in the paddock was sclerotinia. The paddock was not sprayed with a preventative fungicide, as the grazing canola was later flowering, and the conditions were less favourable for the disease.These wet conditions were also not conducive to spraying from the ground at the optimal time. This combined with regular late rain events meant sclerotinia was evident and significant.The yield map shown in Figure 1 shows the better areas topping out at 3-3.5t/ha rather than 4t/ha+ in other crops on the farm.

Another limiting factor may have been stress at flowering which impacted on canola grain fill. The farmer concluded that this was because the variety of canola used was a long season type, not suited to the local environment and it did not fully develop. Because the canola was harvested late, this delayed the planting of the subsequent maize crop and also limited the maize's yield potential.

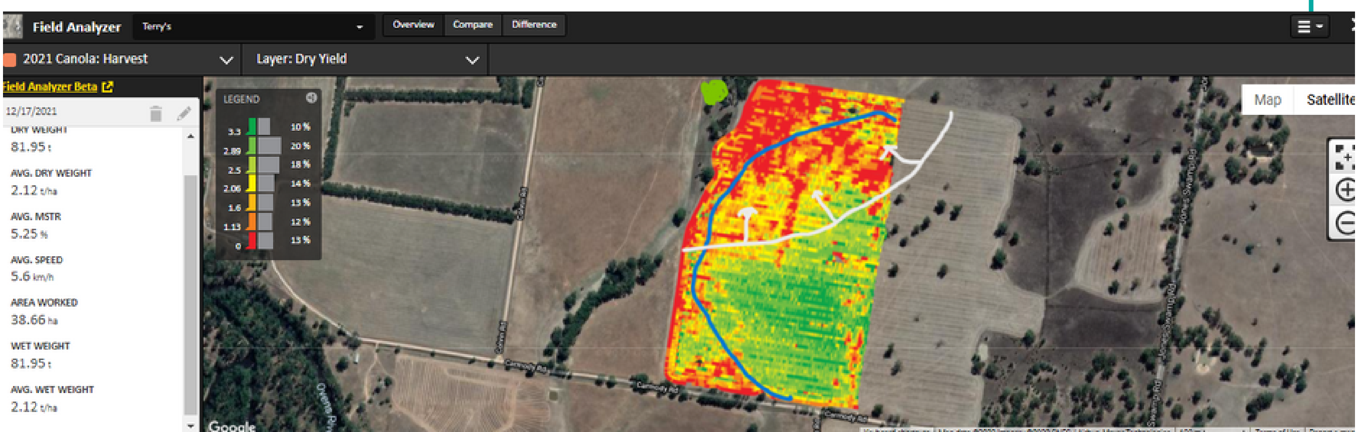
Conclusion

The two Focus paddocks had lower water use efficiency than expected (Appendix 1). On the canola paddock, the lower water use efficiency was in part due to sheep grazing causing reduced biomass production in one part of the paddock. This was due to the sheep pugging the soil in wet conditions. The lower water use efficiency on the wheat paddock was believed to be due to lower wheat plant numbers, the competitive nature of the tillage radish and water logging conditions.

The lower water use efficiency was offset by the grazing returns, which in the wheat paddock were estimated at $132/ha. The grazing returns in the canola paddock were less, and this was partially a result of the sheep requiring time to adjust to the different diet of grazing canola. The grain and graze project (Kirkegaard et al, 2022) has shown that dryland grazed winter wheat and canola crops are $300 to $1,000/ha more profitable than grain only crops. In these trials, the key driver to profitable returns were stock utilising the dry matter produced by the crop (2.1 – 3.1t/ha). These focus paddocks produced between 1.05 and 1.6t/ha of dry matter, which indicates that there is room for improvement to achieve higher returns from grazing on these winter irrigated dual purpose crops. One of the ways this could be achieved is by earlier sowing.

The wet season and waterlogged conditions meant that the livestock were more prone to causing pugging in the soil. Therefore, more management was required to move stock around prior to heavy rainfall events. In addition, it was found that more even grazing of the crop could be achieved by crash grazing a large mob of sheep on a small area compared to a small mob of sheep on a large area.

Figure 1: Yield Map Irrigated Canola Paddock



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Acknowledgements

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Riverine Plains would like to thank the Bruce family and Uebergang family for hosting the focus paddocks.

Appendix 1: Water Use Efficiency Calculation

Potential Yield Calculation		
	Barooga	Boorhaman
	Border check	Spray
	Kittyhawk Wheat	Canola 970 CL
Actual yield (t/ha)	4.5	2.5
Jan- March Rainfall mm	103	204
April - October Rainfall (mm)	249	311
Irrigation Water applied (mm)	280	32
Less Evaporation (mm)	110	110
Total available water (mm)	454	301
Actual Water Use Efficiency (kg/mm/ha)	9.92	8.31
Target Water Use Efficiency (kg/mm/ha)	15	12
Water Use Efficiency % of actual (WUE)	66%	69%

Note: Canola should normally have a WUE of 12, wheat WUE of 20mm on spray and 15mm on border check.

FODDER FOR THE FUTURE – RIVERINE PLAINS BOORHAMAN DEMONSTRATION SITE

JANE MCINNES - RIVERINE PLAINS INC.

KEY POINTS

If growing a mixed fodder legume/cereal, preparation is key as weed control is limited during the season.

Only a small amount of cereal is needed to help the legume stand up. Too much will compete and choke the legume out.

Sowing time depends on when it fits into the individual farmer's operation. The seasonal break can have an impact, as can the finishing of the season.

Within a dairy system pure cereal hay or silage can be used as a feed with supplements added. Mixed species hay or silage needs to be grown with the buyers nutritional needs known.

Project Background

The Fodder for the Future project is designed to assist agricultural communities adapt to a water limited future. The use of fodder in dairying systems has become an increasingly important component of the industry across the Southern Murray Darling Basin (MDB) for both dairy businesses and grain producers. This project will highlight the value of 'closed loop' fodder production systems, which involve the transfer of high-quality fodder between businesses within the Southern MDB, whilst retaining the value of production locally. The project will also aim to increase the knowledge and skills of dairy farmers who are increasingly growing fodder to support their overall feedbase systems.

The project's intent is to be a cross-sectoral collaboration to support the development of complementary farming systems that optimise the use of both irrigated and dryland forages across the Southern MDB by:

- Increasing the quality and yield of fodder produced on both dairy, hay and grain farms and;
- Brokering long term relationships between dairy and hay producers to increase risk management options, diversification of income and resilience in business management.

Riverine Plains together with Birchip Cropping Group, Irrigated Cropping Council, Melbourne University, Southern Growers and Agriculture Victoria are working with Murray Dairy to deliver the project by:

- Establishing six demonstration sites which will provide farmers and service providers an opportunity to look at economic and biophysical performance of different cereals and under a range of climatic and market conditions in Murray region. This includes wheat, barley, oats, triticale, vetch, sorghum and maize, comparing the suitability of varieties within each species for fodder production.

- Working directly with 400 – 500 farmers and service providers to deliver a range of communication and engagement activities, extension resources, workshops and other activities centered around a number of demonstration sites across the region, with further dissemination of learnings into the broader community and wider southern MDB.

Aim

To demonstrate the impact of sowing date, sowing rate and cutting time on quality and yield of fodder at Boorhaman, North East Vic.

Site Description

The demonstration occurred in a 4ha paddock, that had previously been sown to a clover-based pasture. The paddock acted as a small feed paddock for sheep, with very little history of fertiliser or liming. There were 4 plots, two at 220m x 50m and two at 280 x 50m. The plots took up most of the paddock and the surrounds were planted with the early sown plots at the same rate as plot 1.

Demonstration Details

A demonstration site was sown to oats/vetch with two sowing times. The site had two sowing dates, with two sowing rates in each (Table 1). The sowing dates were 16/04/2021 and 14/05/2021. This allowed differences in growth stage to be seen. In 2021 the site had 718mm of rainfall with 354mm during the growing season (May – October).

Table 1: Species and variety with target sowing rates

Species	Variety	Sowing Rate (plants/m2)	Sowing Rate (kg/ha)
Oats/Vetch	Brusher/Volga	18/26	10/25
Oats/Vetch	Brusher/Volga	67/33	37/31

Results

Soil Samples

Prior to sowing, a soil sample with full chemical analysis was taken from two locations in the demonstration site (Table 2). One at each sowing time's plot.

Emergence

Plants counts were completed, counting oats and vetch in 0.5m2 sections in each plot (Table 3). These were measured on 21 June 2021.

Yield

From taking harvest dry matter cuts, we can predict the yield per plot. Table 4 indicates the silage and harvest yields.

Nutrition

For each plot the silage and hay sample were ground and sent for analysis. Table 5 displays a selection of nutritional results. The samples contained oats only as there was not enough vetch for analysis. *TDN – Total digestible nutrients.

Observations and Discussion

The soil testing showed pH values less than 5, close to 4.5 which means it's acidic. Pulses do not like acid soils, and this would have made it tough for the vetch to get established. Oats are more tolerant to soil acidity so would have been much less likely to be limited at these levels. The organic carbon levels (1.8 and 2.4 per cent) are standard in this region for a dryland pasture paddock.

Due to delay in confirmation of the trial, the site preparation was not ideal. Spraying was not possible prior to sowing so weeds caused significant issue. In addition, the combination of pulse and cereal crops meant that spray options were limited post- sowing.

Table 2: Key indicators from the soil test results taken in two locations

Sample Name	pH (1:5 Water)	pH (1:5 CaCl2)	EC* (dS/m)	Nitrate Nitrogen (mg/kg)	Phosphorus (Colwell) (mg/kg)	PBI^	Organic Carbon (W&B) (%)	Soil Colour	Soil Texture
FFF 1	5.4	4.5	1.2	36.0	20	73	1.8	Brown	Clay Loam
FFF 2	5.5	4.6	1.1	33.0	22	87	2.1	Brown	Clay Loam

*Electrical Conductivity (Sat. Ext.) ^Phosphorus Buffering Index (PBI-Col)

Table 3: Plant count analysis taken on 21 June 2021

	Plot 1 (Plants/m2)		Plot 2 (Plants/m2)		Plot 3 (Plants/m2)		Plot 4 (Plants/m2)	
	Oats	Vetch	Oats	Vetch	Oats	Vetch	Oats	Vetch
Location 1	100	80	248	112	164	48	272	96
Location 2	100	108	240	64	136	68	292	112
Average	100	94	244	88	150	58	282	104
Std Dev	0.0	19.8	5.7	33.9	19.8	14.1	14.1	11.3

Table 4: Silage and Harvest yields, calculated from dry matter cuts. Samples taken on *28 September 2021, ^14 October 2021, ~22 October 2021

	Plot 1		Plot 2		Plot 3		Plot 4	
	Oats	Vetch	Oats	Vetch	Oats	Vetch	Oats	Vetch
Silage Yield (t/ha)	13.98*	0.28*	13.62*	0.04*	3.09^	0	4.44^	0
Hay Yield (t/ha)	6.63^	0	4.89^	0	3.07~	0	9.33~	0

Table 5: A selection of nutritional results from dry matter cuts for each plots at silage and hay timing.

Plot #	Harvest Stage	Harvest Date	% Crude Protein	Degradable Protein of CP	ME 1X (MJ/kg)	Net Energy Lactation (MJ/kg)	% TDN*	% Ash	% Crude Fat	% Acid Detergent Fibre	% Neutral Detergent Fibre
1	silage	28/09/2021	10.9	69	9.13	5.17	59	7.4	1.9	30.3	54.3
1	hay	14/10/2021	12.4	76	9.1	5.19	58	11.4	2.2	31.2	52.6
2	silage	28/09/2021	9.8	68	8.07	4.26	53	8.9	2.1	38.5	63.3
2	hay	14/10/2021	9.3	89	9.21	5.1	60	8.1	1.5	35.9	57.3
3	silage	14/10/2021	5.5	72	7.99	4.18	54	6.8	1.7	39.2	65.4
3	hay	22/10/2021	10.4	88	7.96	3.93	52	8.6	1.4	44.6	67
4	silage	14/10/2021	7.2	79	8.12	4.16	54	5	1.6	39.1	65.9
4	hay	22/10/2021	6.6	74	9.17	5.3	60	5.9	1.3	33.9	53.8

Earlier sown plots were placed into the dry paddock, and subsequently had very little rain on them. The later sown plots conversely had limited time to establish before it rained. Rain then continued throughout the season with June being very wet leading to the vetch seed being inundated with water.

Due to the wet season, and hence high weed load, application of Urea was not possible or economically viable given there would be a likely reduction in fodder quality.

During the season, plots 1 and 2 were always visibly more advanced. The vetch was present until the oats reached a height where it out competed it. Vetch in plots 3 and 4 struggled from the beginning. At harvest, the plots varied in height dramatically, but in the East of the paddock where the crop seemed to thrive, plot 2 always had the tallest oats. The stems of the oat plant in plot 3 seemed to be the thickest.

Varieties of vetch and oats are commonly used together and are often grazed, keeping the oats at a manageable level and gives the vetch a chance to compete. The impact of grazing was not considered at the time of deciding rates and varieties, resulting in the oats smothering the vetch.

In summary, the overall quality of the fodder in this demonstration would suit dry stock or as a supplement for lush, high quality grass. It would however make low quality feed for a milking herd. The best quality visually and nutritionally was from plot 1, which was consistent with both hay and silage. Plot 4 was very wet throughout the season and had little vetch growth which could explain the very low (6.6,7.2) crude protein %. The nitrogen was possibly leached and had a water logging effect.

Knowing the end user of the fodder crop being grown is a key outcome from this year's demonstration site at Boorhaman. If a mixed crop is being grown then spray options need to be known and prepare accordingly for that. Hay and silage quality depends on what crop and variety, is grown and then the timing of the cut.

Image 1: *Vetch and oat emerging 10 June 2021 (photo credit: Shane Byrne Murray Dairy)*

Image 2: *Plots 1 & 2 early sown on right, plot 3, late sown on left 27 July 2021 (photo credit: Jane McInnes Riverine Plains Inc.)*

COOL SOILS INITIATIVE – CASE STUDY, BOWEYA

JANE MCINNES - RIVERINE PLAINS INC.

Describe your farming enterprise

Our enterprise is approximately 75% continuously cropped, broadacre crops consisting of canola, wheat, pulses and oats. The remaining 25% is a prime lamb breeding enterprise and bought-in prime lambs to a finishing operation if the season dictates.

Describe your cropping sequence/rotation

Canola, wheat, wheat, canola, wheat, pulse

If there are any pulses, what are they and what are your perceived and real benefits (quantified) from including a pulse?

We grow peas as a break crop to assist in weed management and also to fix nitrogen. Crops that follow the year after, have increased harvested yields by up to 0.5 tonnes to the hectare

If there are any pastures used, what is the composition of the pasture, and how long does your pasture phase go for?

Our pastures are long-term (not suitable for broadacre crop) paddocks which consist of ryegrass and sub, balansa and white clovers. In some years we direct sow in an oat or grazing wheat for a winter feed wedge.

What range in soil carbon values do you have across your property (0-10cm)? How have these changed in recent years?

Our soil carbon values range from 1.1% through to 3.3%. In the past, when we were bringing in pasture paddocks into cropping phases, the soil carbon values were at the higher end of the range but continual cropping has seen them around the 1.5% mark. These historical records are most likely not valid as soil tests were not GPS located and repeated exactly in the same spot in subsequent years.

What value do you place on maintaining/improving soil carbon in your cropping system?

We value maintaining and improving soil carbon in our cropping system as it is important for boosting yields, keeping the soil healthy, increasing soil fertility levels and encouraging the flora and microbial actions in the soil.

Are you likely to change your management practices to attempt to improve soil carbon (if not unprofitable)

Yes, we would change management practices to improve soil carbon if it were practical and cost effective and not cost prohibitive.

What benefit do you see this project (CSI) having to your enterprise?

This project keeps us informed and engaged about how we can increase our production whilst staying sustainable. It also allows us to converse with other growers whilst taking on an understanding of how livestock/ broadacre mixed farms contribute to greenhouse gas emissions.

Have you trialled any new ideas or approaches regarding plant systems, rotations, novel

Have you trialled any new ideas or approaches regarding plant systems, rotations, novel

At present we have not trialled any new ideas or approaches.

Have you changed any practices to reduce your greenhouse gas emissions?

Not all of our crop paddocks are burned now. If we think that we can get the seeder through we will leave stubbles to encourage soil health and microbial action.

ENHANCING COMMUNITY NETWORKS FOR DROUGHT RESILIENCE IN THE RIVERINE PLAINS

KATE COFFEY - RIVERINE PLAINS INC.

KEY POINTS

Riverine Plains will be hosting drought preparation workshops across the region looking at enhancing farmers, business operators and community groups capacity to prepare and building drought resilience into the future

Themes emerging from the consultations show that the rural communities in the Riverine Plains region have significant resources to draw on to prepare and build resilience for future drought

By the end of the project, it is hoped that knowledge sharing from the workshops will make these resources more readily available to others.

Background

Farmers, business operators and Indigenous custodians in the Riverine Plains region experience drought differently to other regions in Australia and thus individuals have used a vast range of strategies in dealing with these uniquely regional effects, but with mixed results. The *Enhancing Community Networks for Drought Resilience in the Riverine Plains* project, uses a series of workshops to help people in this region make personal and business connections that better prepare them for future droughts. It's aim is to build capacity, share knowledge and help improve community resilience to future droughts.

The approach being used is that a series of workshops will be held across the regions where a series of facilitated discussion allow the collection of information to identify gaps in knowledge and help position the community for future climate conditions. To date workshops with facilitated discussions have been held at Gerogery, NSW (35 participants), Noorongong, Victoria (16 participants), Lowesdale, NSW (19 participants), Rennie, NSW (23 participants) and Burramine, Victoria (17 participants).

Gerogery and Burramine are mixed grain and livestock areas in a medium to high annual rainfall zone. The Noorongong area is primarily beef and dairy with some horticulture in a more reliable rainfall area. However, this area is prone to an autumn- winter drought when there is a failed autumn break and cold ground temperatures prevail. Lowesdale is a mixed grain, livestock and irrigation region. Given the range of enterprise mixes being covered by attendees and with the help of facilitated discussion, clear themes have emerged.

Themes that have emerged to date

What worked in the last drought?

LIVESTOCK MANAGEMENT

Planning

Early weaning

Knowing what to do with animals and when to sell off surplus stock and keeping breeding stock.

Progressive destocking

Drought containment feeding or having a sacrifice paddock.

Burying fodder

Knowing the cost of feed ($/MJ)

Getting information

Setting priorities, especially around fodder and water management.

Maintaining water quality

Making a decision early and sticking to it

Projects such as maintenance

GRAINS & PASTURE PRODUCTION

Planning and getting information using support networks such as agronomist, Local Land Services, Landcare groups and Farming Systems groups

Summer sprays to limit weed growth and conserve moisture)

Good agronomy and good rotations

Making decisions early, such as making hay

Maintaining soil health

Planting a drought-tolerant pasture

Switching markets to take advantage of higher grain prices in the drought

Double cropping irrigation paddocks.

Adjusting the irrigated area sown

Storing grain and fodder on farm and selling grain all year round

Grazing crops that were not going to make grain

Brown manure weedy crops

Projects such as maintenance

BUSINESS / FINANCIAL

Planning, including small group workshops

Keeping an open mind

Maintaining a relationship and getting information and support from an accountant, rural counsellor, agronomists, local land services and banks to make decisions

Taking opportunities during and coming out of drought

Robust financial reserves

Improving financial understanding

Spending time on the business

Having a financial plan when you go to the bank

Knowing your own skills and which things you need to outsource

Communication with the family and within the business

Benchmarking the business

Off farm income and how it fits

Making a cashflow budget and keeping it updated to forewarn of cashflow problems

Making a decision and moving on

Focus on your own business

PERSONAL (MENTAL AND PHYSICAL HEALTH AND WELL-BEING)

Maintaining community connection through community sport and events

Using social media, phone calls and having a chat to keep in touch and realise you are not on your own

Surrounding yourself with positive people

Communicating with family

The children of the families felt some of the negativity in the drought and said that social events targeted for them were really good

Getting away

Looking after yourself and exercise

Acknowledge there is a lot of pressure, worry and relationships are stretched

Acknowledge that a lack of water can cause stress

Try to keep spirits up to encourage younger generation

Managing anxiety with things like music or writing things down

WHAT DIDN'T WORK IN THE LAST DROUGHT?

Some baled canola was not good quality.

Weeds brought in with hay

Selling hay and not getting paid.

Cutting hay when the crop was too light and it wasn't worthwhile baling.

Waiting and seeing

What do we need to start doing now to prepare?

LIVESTOCK MANAGEMENT

Improve stock water by updating water system to every paddock

Fencing off dams to improve water quality and increase biodiversity

Updating farm layouts and managing zones

Fire management and pathways around house and sheds

Strategies to stop paddocks eroding

Make decisions earlier to offload stock

Update sheepyards

Create a stock containment area, a small paddock with good water and shade

Increase silage/pasture stores

Good dogs for ease of stock management

Maintenance

GRAINS & PASTURE PRODUCTION

Focus on soil health, soil fertility, testing your soils and crops to identify the most limiting factor and address that

Multispecies and cover crops

Strategies to stop paddocks eroding

Silage/hay planning

Maintain high phosphorus levels

Building/upgrading on-farm grain storage

Upgrading weigh bridges and trucks

Maintenance

Have bores rather than relying on irrigation water allocation from the river

Carrying over irrigation water to the next year when you don't need it

Building a water storage to take advantage of off allocation irrigation water

Buying more water for irrigation

Consider crop choice and water use of irrigated summer crops

Improve the uniformity of application and infiltration of water from the irrigation system

BUSINESS / FINANCIAL

Spending money to get a good, longer term, strategic plan and then implement it.

Small farmer groups to help plan

Succession transition and starting a conversation about the next generation as a family

Have tough chats

Get rid of “just in time” supply chain, storage and inventory

Conversation with your bank now

Review if the business has the appropriate management structure

Communicate with family members

Spend money on new or existing infrastructure using low interest loans

Put money aside, considering taxes and what is needed now

Strategically diversifying locations of farms

Knowing when it is time to exit farming

Making key decisions when times are good

Consolidating debt

Restructure loan repayments

Carry over financial reserves by using products such as Farm Management Deposits (FMDs) to ensure repayments can be made in a bad year

FMDs can be also be utilised for retirement planning

Consider off farm investment versus on farm

Utilising houses on the farm for younger generation or additional income.

Expanding the operation or taking on a new enterprise for diversity

Identifying different streams of income such as off farm income (eg: contracting)

Looking for opportunities during a drought eg: carting hay, carting water, making hay, feeding lambs, carting livestock

Utilise government grants that can help prepare for future droughts.

Better equity due to high land values provides an opportunity to invest in drought management strategies.

PERSONAL (MENTAL AND PHYSICAL HEALTH AND WELL-BEING)

Enjoy the good years

Find something that you enjoy doing

Staying connected and keeping communication open

Nourishing food and sleep

Round robin phoning people

Planning a holiday to get away

Keeping physically and mentally fit

WHAT SUPPORT IS NEEDED?

Support with drought planning from other farmers, farming system groups and the internet. Also, organisations such as Agriculture Victoria, Local Land Services (NSW) regional development, Murray Dairy, Dairy Australia, MLA, Australia Young Farmer Network, Landcare Group, Local Government (Shire), AgBiz Assist and Rural Financial Counsellors.

Bank manager, accountant, stock agent, agronomist and nutritionist (for livestock producers) and other advisors

Employment: encouraging youth to stay in regions through scholarships

Being able to ask for help and not feel stigmatised

Knowing where to access help when needed

Other farmers

Analysis of efficiency of system

Mobile phone towers; poor reception is affecting mental health, businesses and community connection.

Council to maintain roads

Understanding how the drought affects people around you

The flow on effect to retail and local businesses

Maintaining momentum and connection of agriculture to the wider community that has occurred through COVID

Local sporting clubs, gym and exercise groups.

Summary of Key Messages

The engagements clearly show that the community has a deep collective knowledge of how to prepare for drought. However, there is a range of individuals skill's and preparedness for future droughts. While some landholders have started implementing feed and water upgrades (infrastructure) and business and financial management strategies, other farmers have been prompted by the workshop to use the ideas from the workshops to start planning. The participants have identified various support networks for future droughts, including Rural Financial Counselling Services, other farmers, Farming Systems Groups, Landcare groups, agronomists, stock agents, accountants, friends and family. This project will continue with workshops to be held with different landholder groups in the region over coming months. The outcomes from the project will be circulated via social media and through the Riverine Plains newsletter.

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Thanks to our Gerogery event hosts Daniel and Stirling Moll and speakers Kevin McCrum (NSW Rural Financial Counselling Service) and Jennifer Pegler (Murrumbidgee Local Health).

Thanks to the Noorongong Landcare Group for hosting at the Noorongong CFA shed and speakers Carl Fraser (AgBiz Assist) and Greg Ferrier (Agriculture Victoria).

Thanks to our Lowesdale hosts, the Taylor family and speakers Alison Gregory (Rural Financial Counselling Service) and Denis Watson (Department of Economic Development, Jobs, Transport and Resources).

Thanks to our Rennie hosts, the Marshall family and our speakers Alison Gregory (Rural Financial Counselling Service), and Bernadette McKenzie (Belmores Chartered Accountants).

Thanks to the community for participating at the Burramine Hall event at Burramine. Speaker notes were provided by Maryanne Black (AgBiz Assist), Bernadette McKenzie (Belmores Chartered Accountants), and Eric Nankivell (Farmanco).

Participants at the Drought Preparation Workshop hosted by the Noorongong Landcare Group at the Noorongong CFA shed

HYPER YIELDING CROPS FOCUS PADDOCKS

KATE COFFEY - RIVERINE PLAINS INC.

JANE MCINNES - RIVERINE PLAINS INC.

JON MIDWOOD - TECHCROP

NICK POOLE - FAR AUSTRALIA.

KEY POINTS

Focus Paddock 1. Early lodging resulted in yield loss in the DS Bennett wheat. This was caused by several factors, including: very early sowing of a weak strawed variety, high levels of soil and applied nitrogen and grazing that had to be stopped early due to animal health issues.

Focus Paddock 2. Soil testing in 5cm increments identified extremely acid areas (pH CaCl2 of 3.90 -4.6) between 5 and 15cm. The lime was incorporated to target the subsurface acidity. Areas incorporated had an increase in yield compared to those that weren't. Incorporation is a long term investment.

Focus Paddock 3. With the current price of urea, consider the amount and timing of nitrogen (N) in canola to optimise profitability and yield. The Green Area Index (GAI) can be used to quantify the size of the canopy and may be a better way of being more accurate with rates and timings of N application.

The Hyper Yielding Focus paddocks provide an opportunity for farmers and advisors to evaluate Hyper Yielding Research results in a paddock situation.

Background

The GRDC Hyper Yielding Crops project, led by FAR Australia, is a research and extension project designed to push the boundaries of wheat, canola and barley yield in the higher rainfall zones of Australia. Under the guidance of Jon Midwood, TechCrop, Riverine Plains is engaging with local farmers, through focus and award paddocks, to benchmark and push yield potential based on research results.

Some of the causes of the crops not achieving their yield potential were identified as: inherent soil fertility, nitrogen levels, low soil pH in the root zone and variety (winter vs spring wheats).

The project will look in detail into these potential limitations and provide recommendations on how they can be managed. The results presented in this paper are from demonstration strips only and are indicative only. The results will be presented in more detail once statistical analysis has been completed.

Focus Paddock 1. DS Bennett wheat: Nitrogen application

Aim

To ascertain the impact of prior year nitrogen application on the yield of the current years crop.

Method

DS Bennett wheat was sown with Tillage Radish at Gerogery, on the 18th March 2021. Soil nitrogen was measured prior to sowing in 2021, following the application of different rates of nitrogen to canola during the previous year 's strip trials. The paddock was grazed by sheep and cattle for a period of approximately 6 weeks and stock were removed by the end of July. A total of 210kg/ha of urea was applied to the paddock in three applications.

Results and Discussion

Deep soil nitrogen testing, which was sampled from 0-30cm and 30-60cm, returned results from 137–176kgN/ha, which did not appear to correlate with nitrogen applied to canola in 2020 (Table 1). However subsequent NDVI analysis on 3rd December 2021 indicated higher biomass (green strips in the middle of the paddock, Figure 1) which correlated to the previous years higher rates of nitrogen). A conclusion on the impact of prior year nitrogen applications will be made once the yield map data has been analysed.

There was a problem with the grazing ewes going down (cast) in the paddock. The mineral feed test of the wheat (Appendix 1) indicated that potassium levels were above the maximum tolerable limit (pers. comm Katelyn Braine, Murray LLS). This can reduce the absorption of other key minerals such as calcium and magnesium from the diet. While the calcium and magnesium levels in the feed test results are just above the normal requirements for lactating ewes (calcium 0.38, magnesium 0.12), the ewes might not have been absorbing enough calcium and magnesium due to the excess potassium in the feed. This may have caused a low calcium/magnesium in their in their body causing the ewes to go down due to hypocalcaemia and/or hypomagnesaemia. (Note the mineral test was of the wheat plant only and did not include the tillage radish, which may have increased calcium and magnesium ratios). It is recommended to monitor lactating and pregnant animals grazing cereal crops and provide appropriate nutritional supplements.

The paddock yielded 6.5t/ha with 12.4% protein. The DS Bennett wheat started lodging at flowering, which resulted in yield loss compared to other paddocks on the farm. The high protein levels and early lodging at head emergence suggests there was excess nitrogen available to this crop. This was likely to be a result of very early sowing of a weak strawed variety and high levels of nitrogen. Although grazing of the paddock reduced crop height, this paddock was not grazed as heavily as other paddocks and was therefore more prone to lodging.

Figure 1: NDVI taken on 3 December 2021

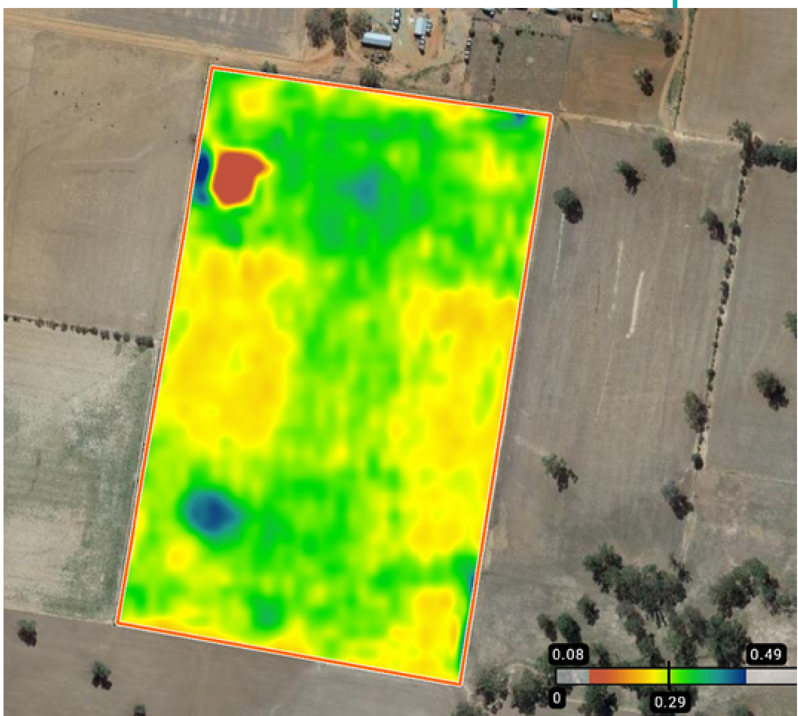

Table 1: Urea applied 2020 to Hytec Trophy and Deep N and Plant counts Bennet 2021

	2020 Canola			2021 Wheat	
	Urea applied* kg/ha	DM Harvest (t/ha)	Yield **(t/ha)	Soil N 0-60cm (kgN/ha)	Plant counts (plants/m2)
Treatment 1 Target 2.5t/ha	217 (100)	12.86	2.73b	176	142
Treatment 2 Target 2.95t/ha	296 (136)	9.63	2.86a	137	110
Treatment 3 Target 3.41t/ha	376 (173)	15.18	2.87a	153	137

*Total nitrogen applied shown in brackets

** Yields were analysed using a paired T test. Yields with a different letter are statistically different from each other.

Focus Paddock 2. T4510 Canola: Lime Incorporation

Aim

To ascertain the impact of ameliorating sub-surface acidity by incorporation of lime.

Method

The paddock was identified by the grower as having limitations that he suspected were subsoil acidity. Maps of average crop vigour over a 5 year period gave an indication that there were under performing zones of the paddock and can be seen in Figure 2. Sites 1 and 2 were in the high performing area, 3 and 4 in the low performing area with 5 and 6 in the medium area. The paddock was then extensively soil tested through the Cool Soil Initiative project to gain an understanding of the limiting soil conditions. The mapping and soil testing identified soil acidity at 5–15cm depth as shown in Table 2.

Figure 2: Average crop vigour in the paddock from 2016-2020.

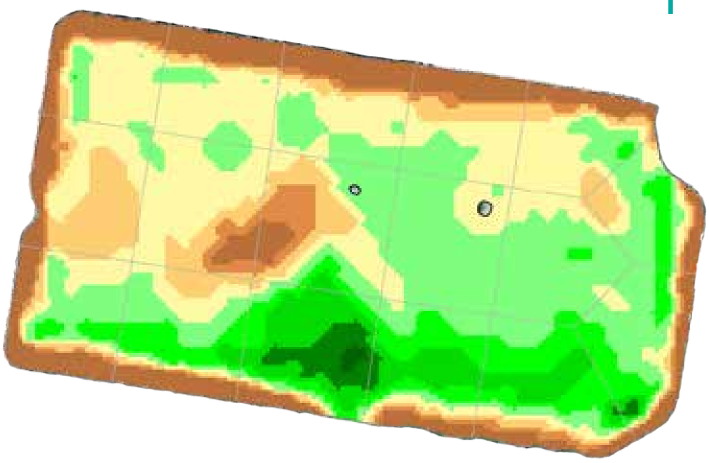

Table 2: Soil test results for paired sampling sites across Brockelsby paddock. ~Electrical Conductivity, ^Cation Exchange Capacity, *Aluminium Saturation

Sample Name	Sample Depth From	Sample Depth To	pH (1:5 CaCl2)	EC~ (1:5 water)	C.E.C.^	Al Sat*
	cm	cm		dS/m	cmol(+)/kg	%
SV-1a	0	5	4.6	0.11	5.2	4.6
SV-1b	5	10	4.1	0.05	3.7	34
SV-1c	10	15	4.2	0.04	3.2	28
SV-1d	15	20	4.7	0.03	3.8	6.9
SV-2a	0	5	4.7	0.4	6.4	3.6
SV-2b	5	10	4	0.05	3.2	36
SV-2c	10	15	4.1	0.04	2.6	35
SV-2d	15	20	4.3	0.04	4.2	15
SV-3a	0	5	4.1	0.15	3.9	22
SV-3b	5	10	3.9	0.06	2.9	53
SV-3c	10	15	3.9	0.04	2.8	59
SV-3d	15	20	4.1	0.03	2.4	42
SV-4a	0	5	4.4	0.14	4.3	10
SV-4b	5	10	4	0.05	3	41
SV-4c	10	15	4.1	0.04	2.8	33
SV-4d	15	20	4.4	0.03	2.6	20
SV-5a	0	5	4.5	0.13	5.5	5.6
SV-5b	5	10	4.1	0.07	4.6	22
SV-5c	10	15	4.4	0.06	5.2	10
SV-5d	15	20	4.9	0.05	5.6	3.7
SV-6a	0	5	4.3	0.16	5.1	9.7
SV-6b	5	10	4.1	0.09	4.2	23
SV-6c	10	15	4.3	0.07	4.5	14
SV-6d	15	20	4.8	0.07	5.5	5.3

A Lemken Rubin 12 was used to incorporate variable rates of lime (rather than just leave it as surface applied), targeting a pH (CaCl2) of 5.8 in the top 10cm. (The NSW DPI pH (CaCl2) target of 5.8, ensures there is sufficient lime applied to address acidity in the 0-10cm layer, as well as allowing for some lime to penetrate below 10cm). The lime was variable rate applied with a range of 2.5t/ha to 4.5t/ha and an average application rate of 3.4t/ha. Three areas were left uncultivated, to test the benefit of incorporating lime compared to surface application. Figure 3 illustrates the trial design with the black boxes representing the area where no incorporation took place. The paddock was sown to T4510 Canola at Brocklesby, on the 30 April 2021. Throughout the season a total of 162kgN/ha was applied to the paddock in 4 applications: 8kgN/ha at sowing, 37kgN/ha on the 20 April 2021; 25kgN/ha on the 20 May 2021, 46kgN/ha on the 9 July 2021 and 46kgN/ha on the 9 August 2021.

Figure 3: Surface (0-10cm) pH (CaCl2) values with the sampling sites and incorporation areas (black boxes).

Results and Discussion

The cultivation took place shortly before sowing. As a result of the soil disturbance, the seeder had trouble sowing the seed at the correct depth. The variable depth of seed placement impacted on the canola germination, causing lower numbers than expected. Throughout the season, the NDVI showed that the small areas of surface applied lime had less dry matter compared to the incorporated areas (surface applied areas are located inside the squares in Figure 4).

The whole paddock yielded an average of 3.4t/ha. The incorporated vs non incorporated areas were

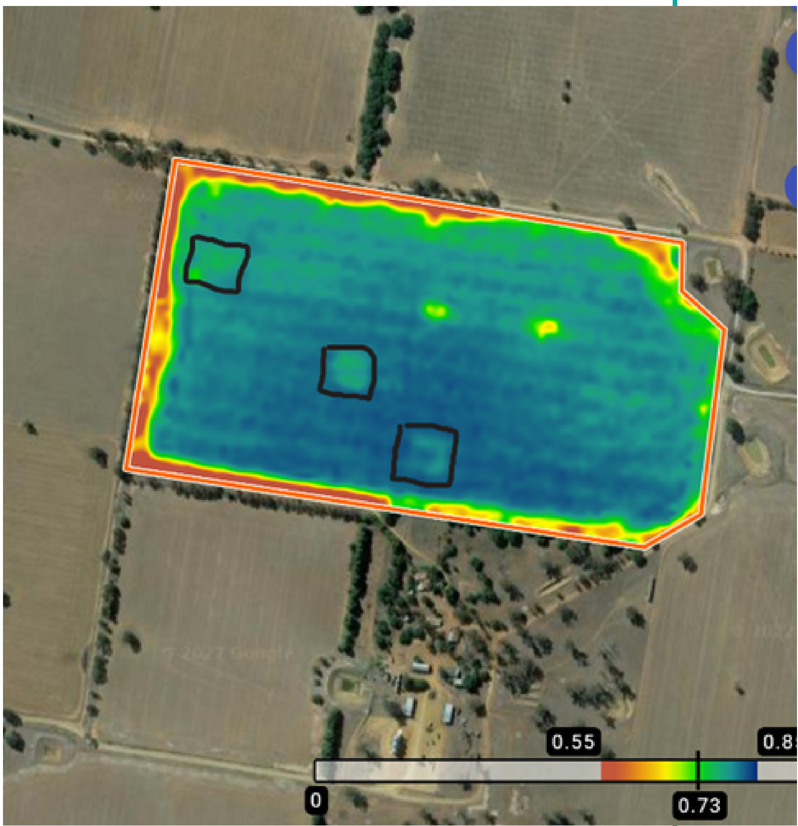

Figure 4: NDVI of canola (10 August 2021)

visible in harvest yield maps (data not available at time of printing) and indicated that the incorporated areas yielded 0.5t/ha higher.

The impact of the incorporated lime on ameliorating sub-surface acidity will be measured by soil testing through the Cool Soil Imitative in 2022 and 2023. Lime incorporation is a long term solution and is it is expected that the benefits of the lime will improve production in the years following the year of incorporation.

Focus Paddock 3. Raptor Canola, Nitrogen Rates

Aim

To Determine the optimum rate of Nitrogen for canola.

Method

The paddock was sown to Raptor Canola on the 26 April, 2021. The demonstration (Figure 5), based on farmer input, included 5 treatments with varying rates and timings of nitrogen application (Table 1). The Green Area Index (GAI) method, trialled by Jon Midwood (TechCrop) used soil N measurements and drone technology to assess the amount nitrogen required. GAI is the ratio of green leaf and stem area to the area of ground on which the crop is growing. The GAI protocols are based on a target of 5t/ha dry matter, which equates to a GAI of 3.5 at early flowering to optimise yield. It takes 50 – 60kgN/ha to make 1 GAI, therefore 3.5 GAI equates to 175 – 210kgN/ha. The GAI is measured at set growth stages in the season, to enable nitrogen rates to be adjusted to ensure the dry matter target is reached (Tables 3 and 4).

Figure 5: Paddock Treatments Canola Nitrogen Demonstration.

Table 3: Nitrogen Treatments Raptor Canola

Treatment	Urea At Sowing kg/ha	Urea Mid July kg/ha	Urea 9 August kg/ha	Total N to date kg/ha	Dry Matter Start of Flowering t/ha
Paddock Control	80	100	100	129	3.0
ON	0	0	0	0	0.4
37 N	80	0	0	37	0.8
GAI 147 N	80	150	90	147	3.0
N Rich 175 N	80	200	200	221	3.1

Table 4: Target GAI levels based on sowing canola in 3rd week of April

Growth Stage	Target GAI	Actual GAI Focus Paddock
Mid-late June	0.8	0.45 (2 June 2021)
Mid July	1.6	0.88 (range 0.41 - 1.48) (6 July 2021)
Early green bud mid to late July	2.3	
Yellow Bud	3.0	
Mid Flowering	4.0	

Table 5: Calculation of Nitrogen application

Calculation		Focus Paddock (kg N/ha)
Deep N test result (ideally at same time as GAI photo)	(a)	55
GAI in mid-June		0.45
Crop Nitrogen content in June = GAI x 50	(b)	23
Nitrogen supply (a) + (b) = (c)	(c)	78
Target Nitrogen needed in crop at flowering (3.5 GAI)	(d)	175
Shortfall for optimum canopy	(d-c)	97
Nitrogen fertiliser required to be applied by flowering, assumes 60% uptake efficiency (97/ 0.6)		162
Subtract mineralisation estimated at 50kgN/ha (162 – 50)		112
Urea application (46% N) kg/ha		242

Calculations for nitrogen application on the focus paddock (Table 5), indicated that 112kgN/ha was required for optimum yield. The GAI of the focus paddock taken the 6 July 2021 was below the target of 1.6. As such, more nitrogen was applied earlier at green bud (69kgN/ha targeting a GAI of 2.3) and less at the yellow bud stage (42kgN/ha targeting a GAI of 3.0) as shown in Table 4.

Results and Discussion

The paddock had variable germination due to dry sowing conditions. Deep soil N, taken from 0-30cm and 30-60cm prior to sowing was 55kg/ha. The dry matter at flowering ranged from 0.4t/ha in the nil treatment to 3.1t/ha in the N Rich treatment (Table 3). The dry matter did not reach the GAI target of 5t/ha, which was mainly due to poor crop germination in the dry conditions.

The NDVI showed a clear relationship between urea rate and biomass production (the dark blue strips relate to the GAI and N Rich treatment, while the red strip relates to the 0N and 37N treatments Figure 6). The impact of treatments on yield will be analysed to ascertain the optimum nitrogen rate.

Figure 6: NDVI Raptor canola 25 August 2021.

Appendix 1: Mineral Feed test

Element	Unit	Limit of Reporting	Wheat Sample
Aluminium	mg/kg	5.0	280
Arsenic	mg/kg	5.0	<5
Boron	mg/kg	4.0	4.6
Calcium	%	0.001	0.41
Cadmium	mg/kg	0.2	<0.2
Cobolt*	mg/kg	0.05	0.085
Chromium	mg/kg	0.2	0.53
Copper	mg/kg	0.2	7.0
Iron	mg/kg	0.6	210
Potassium	%	0.0004	4.3
Magnesium	%	0.001	0.16
Manganese	mg/kg	0.1	51
Molybdenum*	mg/kg	0.1	51
Sodium	%	0.0005	0.016
Nickel	mg/kg	0.7	<0.7
Phosphorus	%	0.001	0.46
Lead	mg/kg	2	<2
Sulfur	%	0.0006	0.35
Selenium*	mg/kg	0.05	0.06
Zinc	mg/kg	0.8	25

*Test were performed using ICPMS

Acknowledgements

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The authors wish to thank Farmer Co-operators: The Moll family, the Russell family and the Severin Family.

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VARIABLE RATE NITROGEN IN PRACTICE

DR KIRSTEN BARLOW - PRECISION AGRICULTURE PTY LTD

MR SEBASTIAN IE - PRECISION AGRICULTURE PTY LTD

KEY POINTS

There is no one size fits all approach to Variable Rate Nitrogen

Look for proven strategies that are supported by science and focused on measuring Nitrogen in the soil profile.

Choose an approach that reflects your system, budget and Nitrogen management strategies.

Aim

This paper investigates three different evidence-based approaches for variable rate nitrogen management. Investigating some of the pros and cons of the different methods and presenting a couple of local case studies.

Introduction

Nitrogen (N) is essential for plant growth and crop production. It is critical in cereals for setting yield potential in the early stages of growth, while the availability of soil nitrogen at grain fill, along with soil moisture, is the key determinant of grain protein. Under-application of N is the main reason for the 'yield gap' between potential and actual yields in Australia. On the other hand, current fertiliser prices and the potential environmental impacts make over-application of N equally undesirable.

The importance of the N decision is matched only by its complexity. There are three key factors that explain why determining an optimal nitrogen application rate can be so challenging:

- Variability in N supply: Nitrogen is an extremely mobile nutrient and the amount that is available to plants can change substantially both within and between seasons. Nitrogen moves easily down the soil profile and has multiple loss pathways. Mineralisation – the natural process by which soil organic matter is converted to available N – also accounts for a large proportion of N supply but will vary depending on soil type, temperature, and moisture.

- Variability in N uptake: The amount of N required by plants (and potential yield) is also largely dependent on seasonal conditions. The right amount of N for a poor season is very different to the right amount of N in a great season, and this is impossible to know in advance.

- Spatial Variability: because of the previous factors, and differences in soil types, topography, crop yields and animal movement, N varies significantly within a single paddock. The optimal N rate in one part of the paddock is often very different to that in another.

Variable Rate Applications (VRA), where different N rates are applied to different parts of a paddock can help balance out the variability in N supply.

However, a variable rate N strategy is still based on the strategic decisions around the impacts of seasonal conditions, crop demand, yield estimates and grain quality. The complexity of N decisions means that there isn't one best approach to variable rate N.

This paper introduces three different evidence-based VRA N strategies (figure 1) with associated case studies that illustrate how they can be applied in the real world. These include grid soil sampling to directly measure the variability and the development of robust management zones (using EM38 or yield-protein data) combined with strategic soil sampling.

Grid soil sampling

Grid-based soil sampling involves taking multiple soil samples in a grid pattern across an individual paddock. Unlike conventional soil sampling, where all samples are bulked together to provide an average for the whole paddock, the samples from each grid square are analysed separately. This allows for fertiliser to be varied at the same resolution as the grid itself – normally a 2 ha in medium to high rainfall zones. Whilst grid-sampling for soils is commonly used across Australia, it's application to N management is less common.

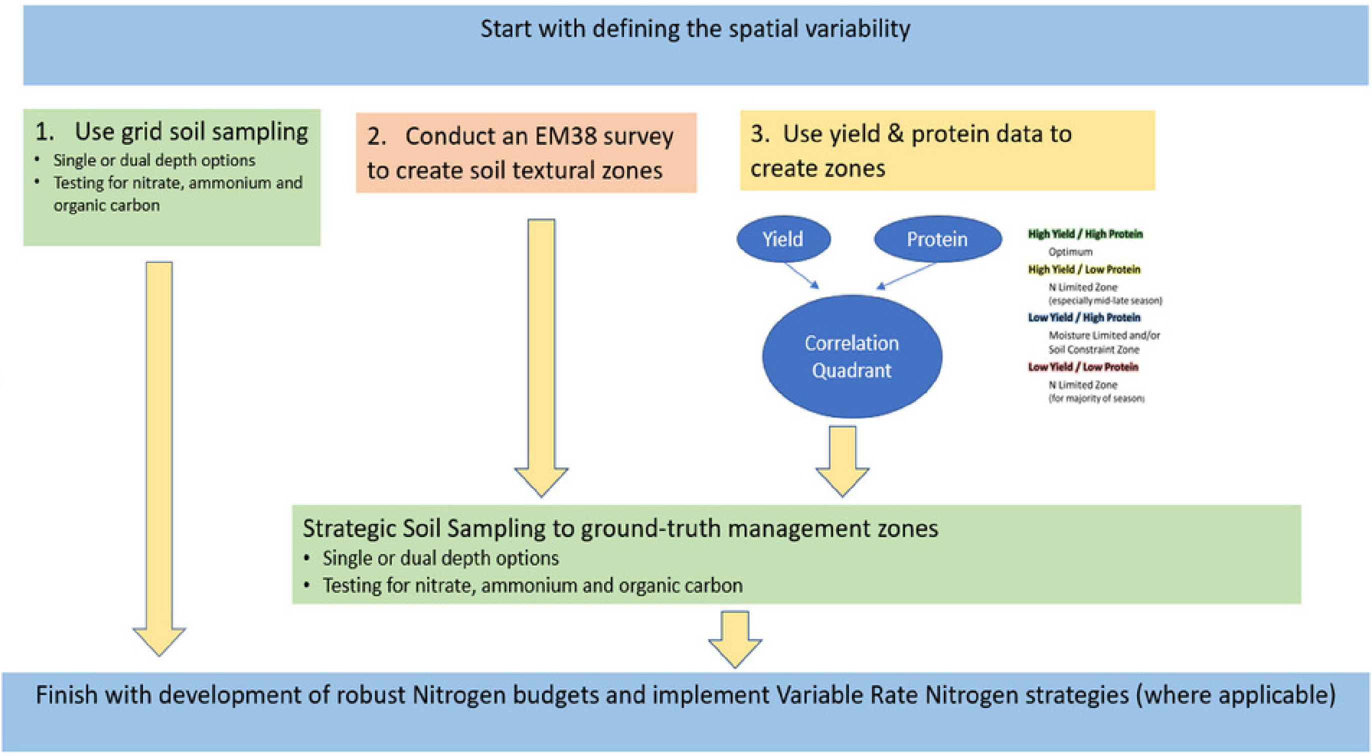
The primary benefit of this approach to VRA N is that a) it involves high frequency direct measurement of N, rather than just measuring a proxy or attempting to predict its distribution, and b) a single round of grid sampling can test for multiple soil characteristics simultaneously. Consequently, this approach is often considered by growers who already use a grid-based approach to manage other inputs (such as lime, gypsum, or phosphorus).

Whilst high frequency soil sampling provides the most accurate measurement of N it is also relatively expensive and is rarely used beyond a 30cm soil depth. These constraints can mean that a multi-year VRA N strategy based on grid soil sampling is challenging. Nevertheless, grid-based N sampling is probably the most accurate method of determining a soil N baseline.

Case Study 1 – Grid based N management

In Case Study 1 grid soil mapping was undertaken across the paddock on a 2-ha grid, using a 0-10cm soil depth, with the samples analysed for nitrate, ammonium, and carbon. While this was shallow compared to the 30 to 60cm depth more commonly used for nitrogen management, the agronomist was focused on the variability in surface nitrogen and potential mineralisation,

Figure 1: Three tested pathways into a variable rate nitrogen strategy



with many years of deep N analysis to support his understanding of the soil profile. As seen in Figure 2, there was significant variability across the paddock with total mineral nitrogen (ammonium plus nitrate) ranging from 10 – 29 mg/kg while organic carbon ranged from 0.25– 0.74 %. In combination with the agronomist's knowledge of the soil profile this was used to develop a VRA N strategy for the paddock with N rates ranging from 0 to 175 kg/ha of Urea. These were applied as a late season application following earlier blanket Urea spreading. The farmer and agronomist were happy with the results and will use a similar strategy this year, however final yield response to the strategy could not be accurately assessed as the paddock was heavily frosted.

(b)

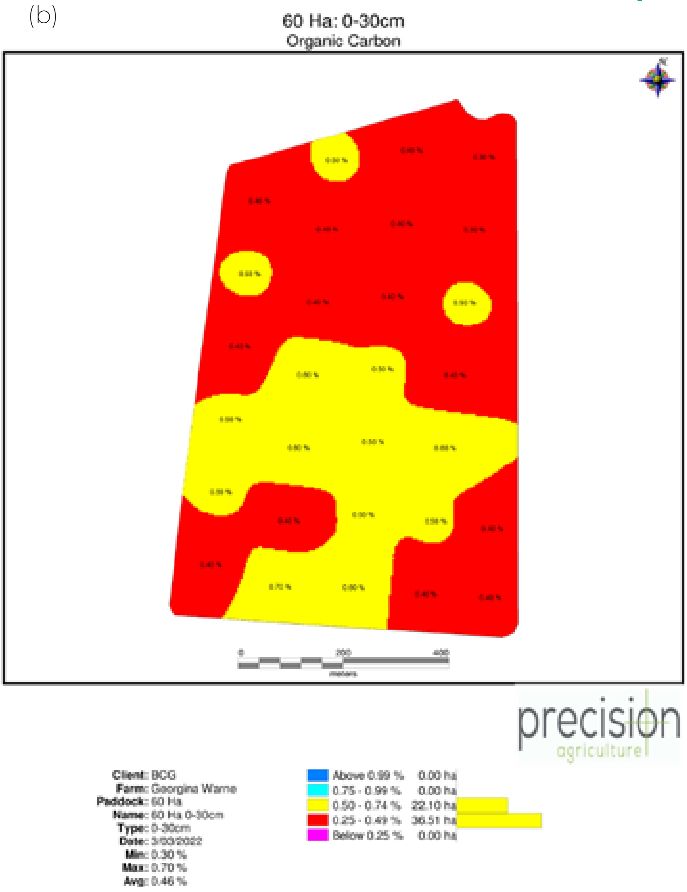
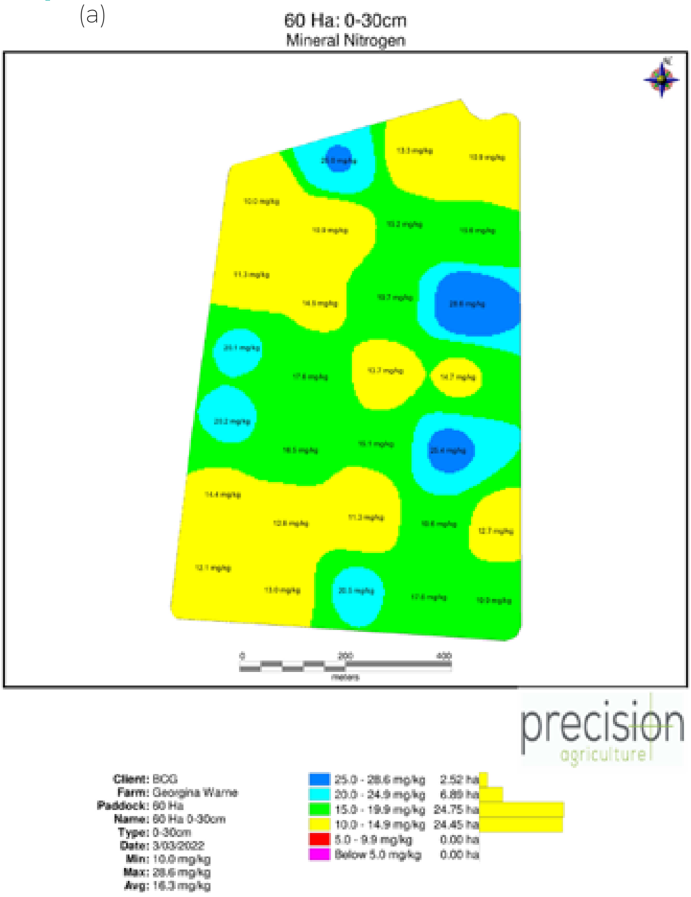


Figure 2: Grid soil mapping (0-10cm soil depth on a 2ha grid) with results for (a) total mineral nitrogen (mg/kg), (b) organic carbon (%), and (c) the VRA N fertiliser strategy developed for in-season urea following previous blanker applications.

(a)



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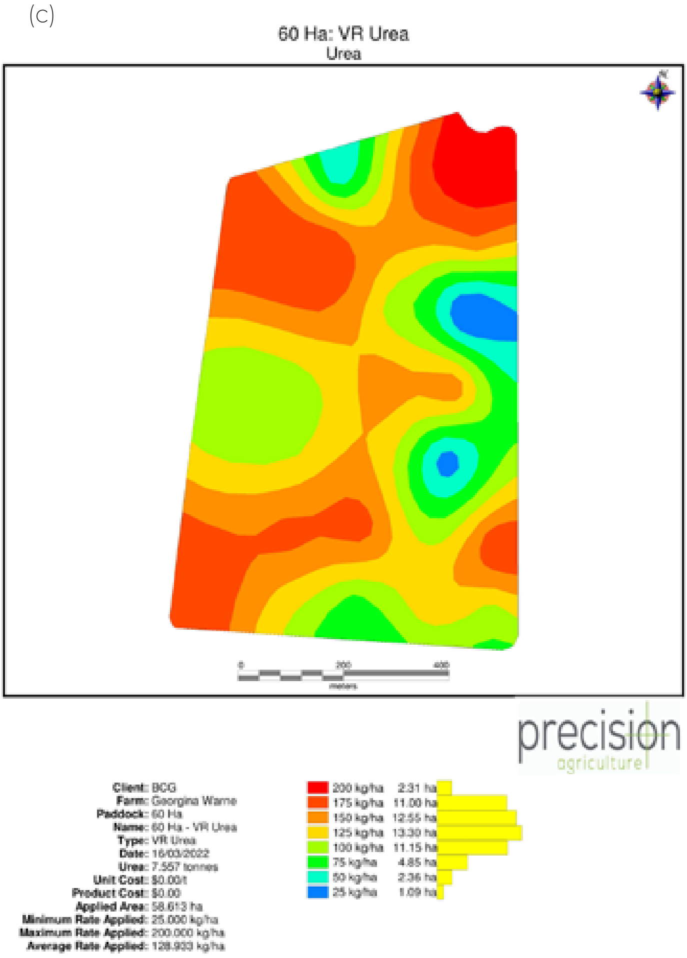


EM38 Soil Management Zones

The use of soil type zones for VRA N has been one of the most enduring and reliable methods to date. This is driven by the strong relationship between soil texture and drivers of N availability and crop uptake. For example, heavier soils will generally provide greater N mineralisation and have lower losses of N to leaching. Soil texture also affects plant available water, which in water-limited environments will strongly affect crop N requirements.

One of the most accurate and established methods for mapping soil types is through an EM38 survey. The EM38 measures soil apparent electrical conductivity (ECa), which is influenced by soil texture (clay type and content), soil moisture, and salinity. Once the EM38 survey is completed strategic sampling is used to determine current N reserves and determine fertiliser requirements for the zone.

The primary weaknesses of the EM38 approach is that although soil type is a key driver of soil N other factors that influence crop variability (e.g. disease, weeds, prior management) are not always taken into account. This can lead to a degree of N variability which isn't measured or managed within the otherwise uniform zones.

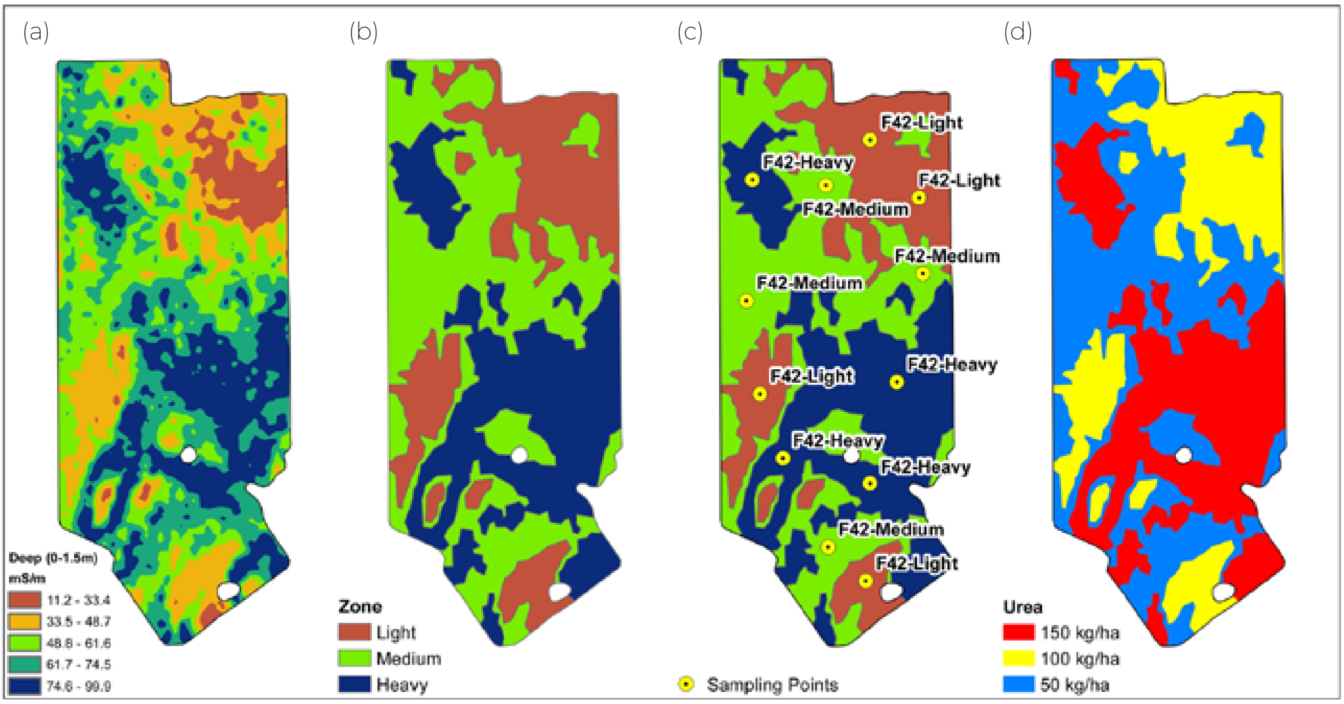
Case Study 2 – EM38 Soil Management Zones

The case study paddock was mapped using an EM38-MK2 sensor on a 24m swath width (each pass of the paddock is 24m apart). The ECa data is collected as point data which is then converted into an EM38 map of the paddock (Figure 3a) and divided into 3 soil management zones (Figure 3b), defining areas of light, medium and heavy soils. Strategic soil sampling was conducted in June 2021 with 4 0-50cm soil samples collected within each management zones and composited to create a single analysis per zone (Figure 3c). The soil for nitrate and ammonium were summed together to give a soil mineral N within the profile. The mineral N concentrations ranged from 9.6 to 19 mg/kg between zones. Based on soil results and expected crop production a VRA N strategy was developed for in-season Urea applications (Figure 3d) following previous blanket applications.

Yield/Protein Management Zones

Finally, on-farm data including yield and protein data can provide a basis for defining nitrogen management zones. Caution should be used in the development of zones using yield data alone, as even when yield appears stable over multiple years (which isn't always the case), yield reflects

Figure 3: Case Study 2 paddock showing (a) the EM38 map for the paddock which was used to build (b) 3 soil management zones and (c) a strategic soil sampling plan. The results from the strategic soil sampling was used to inform (d) the VRA N strategy for in season urea application.



everything that affected the crop through the season: nutrition status and soil type, but also frost, weeds, disease, landscape, establishment and more. Therefore, differences in productivity may not equate to fertiliser responsiveness depending on whether N is the key soil constraint. Consequently, VRA N based only on yield maps will likely still lead to excessive applications in some areas and deficiencies in others.

However, combining yield with cereal grain protein maps from on-the-go harvester-mounted protein monitors is showing some real potential in the development of management zones for nitrogen. These layers can be used to develop 4 zones based on a distinction of high/low yield and high/low protein (Figure 1) with different constraints in different zones. For example, high yield:low protein is likely to be indicative of a N constraint, while low yield: high protein suggests a moisture or soil constraint other than N. These management zones can then be used as a basis for strategic soil sampling to measure the mineral N within the soil profile and formulate VRA N strategies. This approach was recently explored in a research project conducted by FarmLink and Precision Agriculture in southern NSW (Moffitt 2020), which highlighted the value of cereal protein data in this context.

Observations and comments

Mineral nitrogen can be highly variable between seasons but also within a paddock. Choosing a nitrogen management strategy that fits your farming system is the key to success.

The use of grid or zoning strategies for measuring soil N, does not have to lead to a VRA of Nitrogen. From experience a lot of the properties where they have used grid or soil management zones don't use a VR application or they save this for a late season application if required. However, they do start the season with an accurate knowledge of what is in their soils and can use this knowledge to ramp up or down their N strategy to manage production and risk throughout the season.

A good N strategy should be based on measured N within the soil profile. All three of the strategies presented here represent an evidence-based approach to defining and measuring the variability as the first step to optimising N management across the paddock.

References

E Moffitt (2020) Utilising new technology to better managed within paddock nitrogen variability and sustainably close the yield gap in southern NSW. Farmlink Research Report.

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INCREASING PLANT SPECIES DIVERSITY IN CROPPING SYSTEMS

JANE MCINNES - RIVERINE PLAINS INC.

KEY POINTS

Cover crops produced < 1 t biomass in the 2020/21 summer. Cover crop water use did not significantly affect 2021 wheat yields, likely due to the relatively wet season.

Growing vetch as a temporary intercrop with wheat did not significantly ($P < 0.05$) lower grain yield, however, evidence suggests that a greater understanding on impacts to yield be completed. The effect of temporary intercropping on the 2022 canola yields will be assessed this season.

Few changes in soil functional properties were observed due to cover cropping, likely due to the small amounts of biomass produced each season.

The current summer cover crop (2021/2022) appears larger than previous seasons due to the wet conditions, so any impacts on soil biology may be more detectable this season.

Background

Cropping systems in Australia can have limited plant species diversity, with cropping sequences dominated by cereals and declining use of legumes. Increasing plant diversity can enhance species richness of soil biota by providing more diverse litter, root exudates and rooting patterns. To help address a lack of species diversity in the region, Riverine Plains has established a long-term (five-year) trial site at Burramine as part of a national Cooperative Research Centre for High Performance Soils (Soil CRC) project, led by Southern Cross University. The trial is examining the viability of integrating diverse species into the farming system, as either winter rotation crops (or green/brown manures), winter temporary intercrops (where multiple crops are sown but only one is taken to harvest) or as summer cover crops, within the constraints of soil water and weed pressures. The effect of each of these treatments on soil function and, ultimately, grain yields and farm profitability, will be examined.

Aim

Cereal-canola or cereal-canola-legume rotations have advantages in terms of yield stability and profitability in southern Australia, and there is little incentive for grain growers to include other cash crops (a crop that returns a monetary value rather than for use by the grower) in their rotations. This project aims to identify other options for increasing plant diversity in cropping systems without upsetting the use of crops with the highest earning potential. This will be achieved by testing the impact of summer cover cropping, intercropping, or temporary intercropping (sowing multiple species and spraying out all but the cash crop species during the season) on soil water balance and mineral N at sowing, crop performance, and soil function over time.

Method

A field trial spanning three growing seasons (2019, 2020 and 2021) was established at Burramine, Victoria, during autumn 2019. A total of 9 different rotational treatments were established based around the core wheat–canola rotation growers in the area typically employ (Table 1). The 2019 winter treatments also included a temporary intercropping treatment with wheat under-sown with sub-clover, field peas for grain, a pulse brown manure treatment (field peas) and a brown manure mix (field peas + radish). Mixed species cover crops were grown over the summer period in cover crop treatments in early 2020 following the harvest of the 2019 wheat crop. Details of species sown in 2019, 2020 and 2021 are given in Table 1.

For the 2021 season, all plots were sown on 12 May 2021 using a randomised block design, with plots measuring 8m × 18m. Wheat (cv. Rockstar) was sown at 75 kg/ha using direct drilling by the plot planter. In the temporary intercrop treatment, wheat (cv. Trojan) was sown at 75 kg/ha with an additional 40 kg purple vetch (cv. Popany, Vicia americana) in the same seeding row. Vetch was inoculated with Group F peat-based inoculant (WSM-1455 Rhizobium leguminosarum bv. Viciae). All plots received 80kg/ha MAP and 50kg Urea fertiliser at sowing. Two applications of 100kg Urea were applied on 6th August and 2nd September. Vetch was terminated using XX on 9th September 2021. The timing of key events, as well as rainfall and temperature data, are shown in Figure 1.

A range of measurements including soil moisture and soil mineral N prior to sowing, as well as crop emergence counts, biomass at anthesis and grain yield were taken during the 2021 season. Summer cover crop biomass from the 2020/21 summer was also measured. In January 2022, summer cover crops were sown in the cover crop treatments. While no measurements have been taken on these cover crops yet, photos are shown in Figure 4 to give an indication of their growth this season.

Table 1: Treatments and crop rotation from 2019-2022

Treatments	2019 Winter Crop	2020 Summer Cover Crop	2020 Winter Crop	2021 Summer Cover Crop	2021 Winter Crop	2022 Summer Cover Crop	2022 Winter Crop
Control (wheat-canola)	Wheat (cv Trojan)		Canola (cv. Bonito)		Wheat (cv Trojan)		Canola (cv. Bonito)
Pulse–canola–wheat	Field peas (cv Morgan)		Canola (cv. Bonito)		Wheat (cv Trojan)		Canola (cv. Bonito)
Brown manure (pulse)	Field peas (cv Morgan)		Canola (cv. Bonito)		Wheat (cv Trojan)		Canola (cv. Bonito)
Brown manure (mix)	Field peas (cv Morgan + Oilseed Radish (cv Tillage Radish)		Canola (cv. Bonito)		Wheat (cv Trojan)		Canola (cv. Bonito)
Intercrop	Wheat (cv Trojan)		Canola (cv. Bonito) + pea (cv. Morgan)		Wheat (cv Trojan)		Canola (cv. Bonito)
Temporary intercrop	Wheat (cv Trojan) + sub-clover (cv Riverina)		Canola (cv. Bonito)		Wheat (cv Trojan) + Common vetch		Canola (cv. Bonito)
Cover crop mix 1	Wheat (cv Trojan)	Medic and buckwheat	Canola (cv. Bonito)	Medic and buckwheat	Wheat (cv Trojan)	Buckwheat and cowpea (cv Red caloona)	Canola (cv. Bonito)
Cover crop mix 2	Wheat (cv Trojan)	Sorghum (cv Crown), millet (cv Shirohie), forage rape (cv Greenland) and oilseed radish (cv Tillage Radish	Canola (cv. Bonito)	Sorghum (cv Crown), millet (cv Shirohie), forage rape (cv Greenland) and oilseed radish (cv Tillage Radish	Wheat (cv Trojan)	Sorghum (cv Crown), millet (cv Shirohie), forage rape (cv Greenland) and oilseed radish (cv Tillage Radish	Canola (cv. Bonito)
Maximum diversity	Wheat (cv Trojan)	Sorghum (cv Crown), millet (cv Shirohie), forage rape (cv Greenland) and oilseed radish (cv Tillage Radish	Canola (cv. Bonito)	Sorghum (cv Crown), millet (cv Shirohie), forage rape (cv Greenland) and oilseed radish (cv Tillage Radish	Wheat (cv Trojan) + Common vetch	Sorghum (cv Crown), millet (cv Shirohie), forage rape (cv Greenland) and oilseed radish (cv Tillage Radish	Canola (cv. Bonito)

Additional soil measurements were taken to investigate whether summer cover crops or temporary intercrops improve soil function. Soil samples were analysed for several indicators that have been proposed as candidates for assessing soil health. These include soil enzyme activities (6 different enzymes involved in organic C, N, P and S-cycling), hot-water extractable carbon (C) (representing biologically-active C), microbial biomass C (the size of the soil microbial community) and autoclavable-citrate-extractable protein (ACE-protein, which is contributes to soil aggregation and mineralisable-N).

Data on water and nitrogen pre-sowing and wheat yields were analysed using a one-way ANOVA. Statistical analysis of soil function measurements involved individual ANOVAs for each sampling time, with treatment and block as main factors. Where significant differences (P<0.1) were detected, treatment means were compared using least-significant difference. All statistical analysis and plotting were conducted in the R statistical framework using the packages 'agricolae', 'lsmeans', 'ggplot2'.

Results

Soil water balances and grain yields

Summer cover crop biomass was marginally higher in the autumn of 2020, but in both seasons the aboveground biomass was well below 1 t/ha (Table 2). The sorghum/millet/forage rape/radish cover crop that produced 731 kg/ha biomass in 2020 resulted in around 35 mm less water in the soil profile prior to sowing compared to the chemical fallow control (Table 3). The reduction in total soil water at sowing in the sorghum/millet/forage rape/radish cover crop treatment was due to water use in the subsoil (30-60 cm and 60-90 cm depths; Figure 2a). The canola yield following the sorghum/millet/forage rape/radish cover crop of 1.48 t/ha was lower than the 1.76 t/ha in the chemical fallow treatment, but the yield loss was not statistically significant at P < 0.1.

In the 2021 season, the sorghum/millet/forage rape/radish cover crop resulted in around 25 mm of water less in the soil profile in autumn compared to the chemical fallow treatment (Table

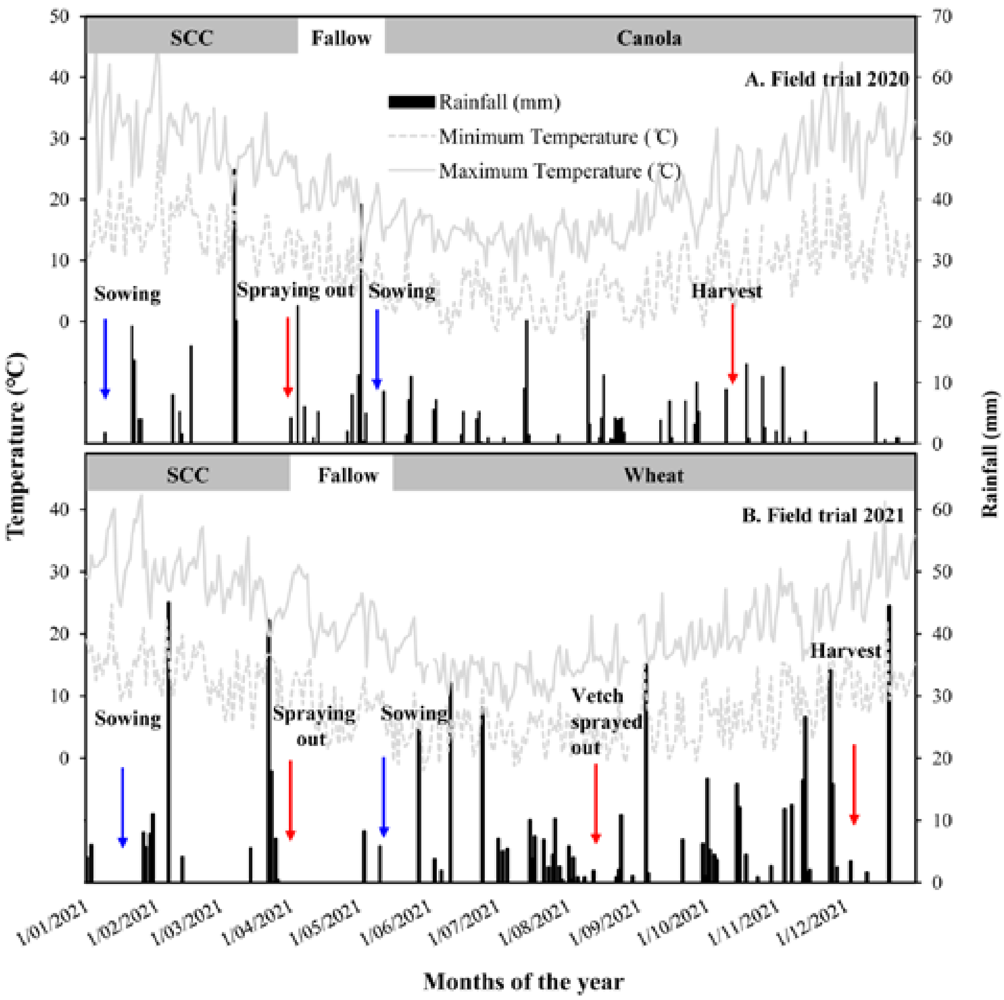

Figure 1:

Seasonal rainfall (black bars), maximum (solid lines) and minimum (dotted lines) temperature at the Burramine site during 2020 (A) and 2021 (B). Arrows indicate sowing and termination of summer cover crops (SCC) as well as sowing and harvest of winter crops (canola in 2020 and wheat in 2021). Vetch was sprayed out on 09 September 2021.

3). Once again, the reduction in total soil water at sowing in this cover crop treatment was due to depletion of subsoil water in the 30-60 cm and 60-90 cm layers (Figure 2b). The reason that topsoil moisture contents at sowing were similar between all treatments in both years was because of rain events between termination of the cover crops and soil water measurements prior to sowing (Figure 1), which recharged the 0-10 cm and 10-30 cm layers in all treatments. The soil water use by the summer sorghum/millet/forage rape/radish cover crop had no effect on wheat grain yields (around 4.3 t/ha in both the chemical fallow control and the sorghum/millet/forage rape/radish cover crop treatments), likely due to the wet seasonal conditions (Figure 1).

In contrast to the summer cover crop treatments, the temporary intercropping treatment (wheat/vetch sown together with vetch sprayed out in winter) resulted in a reduction in wheat grain yield (3.6 t/ha vs 4.3 t/ha in the control treatment; Table 3), although the difference was not statistically significant at $P < 0.1$. This difference may be linked to lower wheat emergence counts in the intercropping treatment (65 plants/m2 compared to 81 plants/m2 in the control treatment; Table 3).

Effect of cover crops on soil function

There was no significant effect of summer cover crops on soil health indicators after the first summer of the experimental trial (2019/20). However, after termination of the summer cover

Table 1: Treatments and crop rotation from 2019-2022

Season	Cover crop biomass (kg/ha)	
	medic/buckwheat	Sorghum/millet/forage rape/radish
2020	561 ± 54	731 ± 119
2021	434 ± 70	463 ± 70

crops in 2020/21, a significant increase in the levels of ACE-protein were detected in the sorghum/millet/forage rape/radish cover crop (SCC-2) treatment (Figure 3). Significantly higher ($P < 0.05$) concentrations of labile C (water soluble C plus hot-water extractable C) were also detected in this treatment in March 2021, compared with the control and medic/buckwheat cover crop (SCC-1) treatment. Although levels of both ACE-protein and labile-C were also higher the sorghum/millet/forage rape/radish cover crop (SCC-2) plots in April 2022, a month after cover crop termination, the effect was no longer significant at $P < 0.05$. ACE-protein is a measure of non-specific soil proteins and potentially other organic matter fractions (previously known as 'glomalin') thought to be predominantly formed by soil fungi and are well-correlated to soil aggregation and soil mineralisable N. Although ACE-protein concentrations returned to similar levels as the control plots by sowing in May 2021, it is not known if any associated benefits to soil

Figure 2: Effect summer cover cropping or temporary intercropping on distribution of soil water to a depth of 90 cm at sowing of winter cash crops in a) 2020 and b) 2021. Error bars depict the standard error of the mean of three replicate plots. Treatment bars not followed by a common letter are significantly different at P < 0.1.

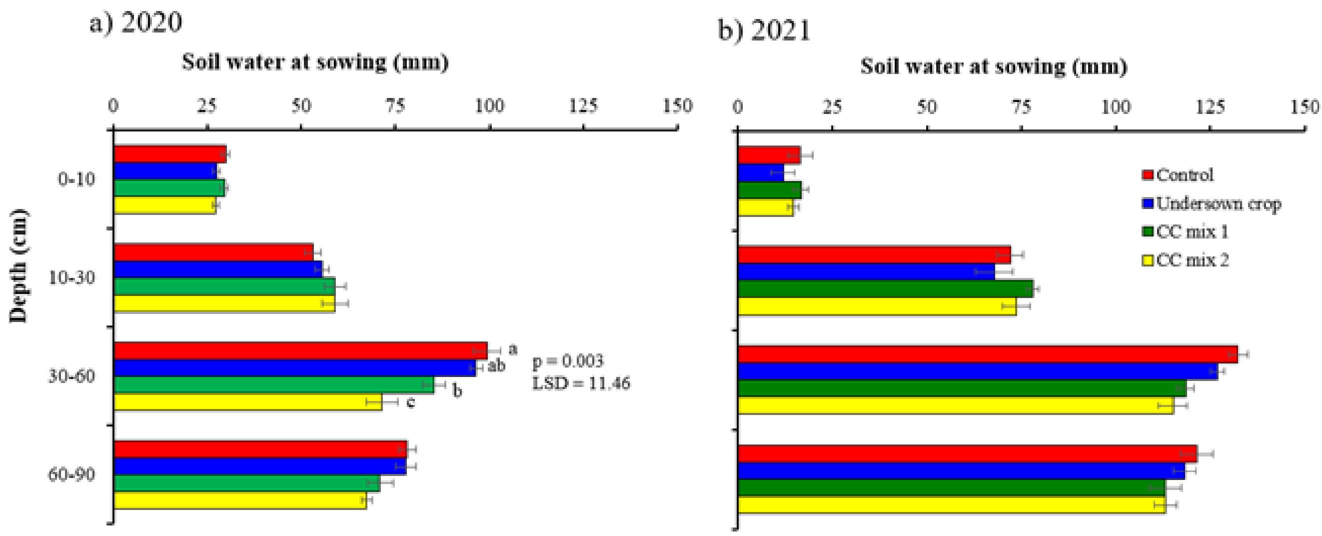

Figure 2: Effect of cover crop treatments SCC-1 (medic + buckwheat) and SCC-2 (sorghum, millet, forage rape and tillage radish) on ACE-protein levels in soil over summer 20/21, compared with no summer cover crop control. Different letters above bars indicate a significant difference between treatments ($P < 0.05$), ns = not significant ($P > 0.05$). Error bars are standard error of the mean.

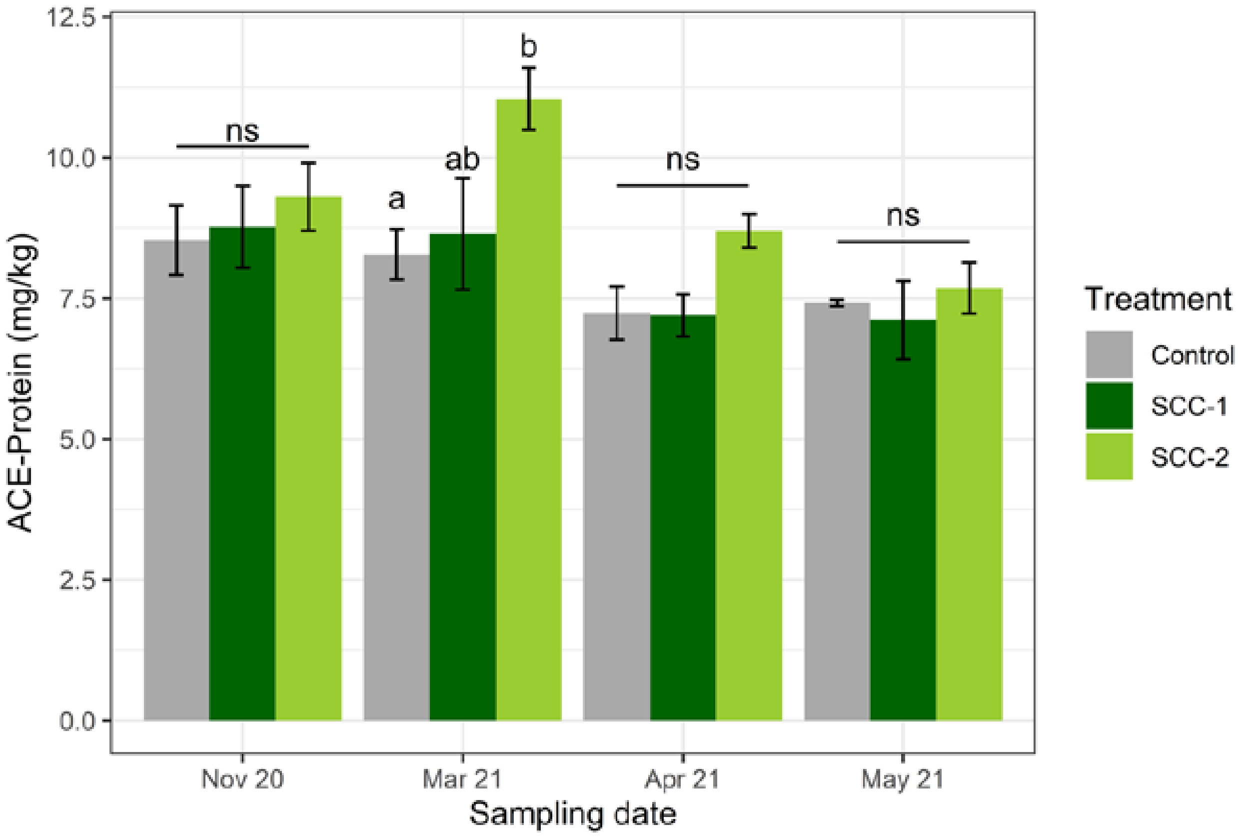

Figure 2: Cover crop treatments a) Cover crop Mix 1 (buckwheat with medic; b) Cover crop mix 2 (sorghum, millet, forage rape and oilseed radish (Tillage Radish) at Burramine, Victoria in March 2022.

(a)

(b)

Table 3: Effect of integrating plant diverity within the wheat-canola rotation using summer cover crops or temporary intercrops with wheat (vetch) on soil water and mineral N at sowing, and crop emergence, biomass production and grain yields in 2020 and 2021. Means not followed by a common letter are signfiicnatly different at P < 0.1.

Integrated plant species treatments within the wheat/canola rotation				
Treatment	**1**	**6**	**7**	**8**
Rotation	Control (2019: wheat, 2020: canola 2021: wheat)	Intercrop-undersown wheat (2019: wheat undersown with sub-clover 2020: canola, 2021: wheat undersown with vetch)	Cover crop mix 1 (2019: wheat, 2020: CC mix 1, 2020: canola, 2021: CC mix 1, 2021: wheat, 2022: CC mix 1	Cover crop mix 2 (2019: wheat, 2020: CC mix 2, 2020: canola, 2021: CC mix 2, 2021: wheat, 2022: CC mix 2)
2020 season (canola)				
Water at sowing (mm) (P = 0.05)	**261 b**	**257 b**	**245 ab**	**225 a**
Mineral N at sowing (kg N/ha) (P = 0.21)	119 a	137 a	124 a	105 a
Emergence (plants/m2) (P= 0.22)	24 a	27 a	26 a	21 a
Canola biomass at flowering (t/ha) (P= 0.28)	4.5 a	4.5 a	5.7 a	3.1 a
Canola yield (t/ha) 2020 season (P = 0.12)	1.76 a	1.74 a	1.85 a	1.48 a
2021 season (wheat)				
Emergence (plants/m2) (P = 0.06)	81a	65 (wheat) b 56 (vetch)	83 a	86 a
Water at sowing (mm) (P = 0.41)	342 a	325 a	326 a	316 a
Mineral N at sowing (kg N/ha) (P = 0.22)	72 a	65 a	55 a	49 a
Wheat biomass at anthesis (t/ha) (P =0.76)	6.22 a	6.69 a	6.86 a	6.56 a
Wheat yield (t/ha) 2021 season (P = 0.28)	4.28 a	3.57 a	4.20 a	4.33 a

Background

Biomass production in the summer cover crop treatments has been < 1t/ha dry matter each season owing to low rainfall over summer and the short (2 month) growing season. Cover crops have been terminated after 2 months to allow time for some soil water to be replenished by rainfall between a late March termination and a May sowing of crops. This has been largely successful with soil water deficit of around 35 mm (2020) and 25 mm (2021) between the sorghum, millet, forage rape and tillage radish cover crops treatment and chemical fallow treatment. In the drier 2020 this water deficit at sowing led to a yield reduction of around 10% in canola that was not significant at P < 0.1, but there was no wheat yield loss in the wetter 2021 season. The temporary intercrop treatment did lead to a wheat yield reduction of around 10% (again, this was not statistically significant at P < 0.1), which was likely associated with lower plant establishment counts compared to control treatments. In subsequent years, we will focus on ensuring adequate plant numbers to give this treatment the best chance of success.

Few changes in soil functional properties were due to cover cropping, likely due to the small amounts of biomass produced each season.

However, some transient increases in water-extractable C and ACE-protein were observed in the 2021 season. This season we will focus on examining whether these soil functional changes after cover crops are linked to any measurable benefits in soil aggregation and water infiltration.

Acknowledgements

This trial is part of the Plant-based solutions to improve soil performance through rhizosphere modification project, led by Southern Cross University. The project is supported by the Cooperative Research Centre for High Performance Soils whose activities are funded by the Australian Government's Cooperative Research Centre Program. The project is also supported by the Goulburn Broken Catchment Management Authority's 'From the Ground Up' program through funding from the Australian Government's National Landcare Program.

NEW SOUTH WALES DROUGHT RESILIENCE ADOPTION AND INNOVATION HUB: SOUTHERN NSW

DR SARA HELY - RIVERINE PLAINS INC.

KEY POINTS

The Southern NSW Drought Resilience Adoption and Innovation Hub (Southern NSW Drought Hub) will enable regional stakeholders to have a voice in drought resilience activities, collaborate with experts, gain access to resources, and participate in adoption programs such as workshops, seminars and field days.

Riverine Plains Inc. have conducted an engagement process for the Southern NSW Drought Hub and will be funded to employ a part-time knowledge broker for developing projects of benefit to the Riverine Plains region.

The work to date has revealed that while they have learnt lessons from past droughts, there are still many knowledge gaps that could be filled by helping farmers not only in drought, but between droughts.

Background

The Southern NSW Drought Resilience Adoption and Innovation Hub (Southern NSW Drought Hub) is a consortium of nine regional partners including primary producers, Indigenous, industry and community groups, researchers, entrepreneurs, education institutions, resource management practitioners and government agencies.

It is one of eight hubs being established across Australia to combat drought and create user-driven innovation, research and adoption and facilitate transformational change through the co-design of research, development, extension, adoption and commercialisation (RDEA&C) activities.

The partners in the Southern NSW Drought Hub are the Australian National University, Farming Systems Groups Alliance which includes Riverine Plains Inc, First Nations Governance Circle, Local Land Services, NSW Department of Primary Industries, Rural Aid, University of Canberra and University of Wollongong. It encompasses most of the Macquarie River catchment and lower reaches of the Darling River, the Illawarra and South Coast, Riverina, Australian Alps, Western NSW and includes Canberra, Dubbo, Orange and Bathurst and their surrounding regions.

Riverine Plains, as a partner to the Southern NSW Drought Hub has been funded to appointment a part-time knowledge broker which will assist in gathering and sharing knowledge to southern NSW members and their communities.

Through this partnership, Riverine Plains has conducted an initial engagement process which has provided important insight into what factors build drought resilience. It was found in interviewing 12 farmers that drought resilience is considered a farmer's ability to survive an economic downturn and be flexible in generating income and managing the business in a way that means they are viable post drought. It was highlighted throughout our engagement process that drought resilience has a lot to do with how they farmed in good years and that planning for an impending drought was important by putting aside reserves of fodder, cash and water when possible. The youngest interviewee believed drought resilience meant keeping a sound mindset and making rational decisions despite stress points making it difficult.

The experience of drought itself seems to be the greatest example of learning on the job as many participants have now implemented several changes to their business to increase their drought preparedness.

Progress to date

The engagement process for the Southern NSW Drought Hub was completed in November 2021. The people interviewed during the Riverine Plains Inc Community Engagement Survey were all family farmers or agribusiness professionals based in Southern New South Wales. Diversity of business was deliberate to ensure we covered the community and received well rounded information to present to the Southern NSW Drought Hub. Most operations had 2 generations of family active in the business and included a mix of dairy, summer and winter cropping, sheep, cattle and potato farmers. The age of interviewees ranged from 28 to 60 and included an even split of male and female owner operators. All participants had small children or adult children who had returned to work within the business.

Themes

The interview process conducted by Riverine Plains Inc for the region identified major challenges facing these farmers. These include:

- Mitigating risks of external factors – global commodity markets, availability of inputs (such as chemical, fertiliser, fuel) and the impact water policy has on a farmer's ability to plan for crop and fodder production as well as predicting profitability year on year.

- Sourcing and maintaining labour given the seasonality of peak periods on-farm and the time commitment required of farming staff. This has been exacerbated with our community being on the border with cross jurisdictional differences.

- Time management is a major stressor due to the demands of commercial farming operations and business management. Phone and internet accessibility plays a huge role in a farm businesses ability to operate.

The consensus amongst participants is they deal with these challenges in-house and rely upon each other's experience or education to problem solve. However, external advice and support are often sourced from agronomists, accountants and bank managers as they have an established understanding of the farming businesses. Farmers that utilised these networks often had long standing relationships with these professionals that provide key support.

Summary

The engagement process for the Southern NSW Drought Hub revealed that in order for the Southern NSW Drought Hub to be a success, it must provide support that is accessible, and farmers must be aware of what knowledge and support the Southern NSW Drought Hub offers. Suggestion for how this could be achieved are:

- Communicate clearly and use existing networks in place such as farming systems groups including Riverine Plains Inc, local councils, schools, banks, agronomists and accountants to create awareness of the Southern NSW Drought Hub.

- Whatever assistance is available, it must be easily accessible to people who are already stressed, time poor and need help yesterday.

- A centralised platform could be created where farmers can register themselves as a primary producer and upload all relevant financial information during good years so when a drought does occur, farmers can simply apply for whatever support is relevant to them without starting from scratch with multiple applications.

- Farmers are time poor when it comes to regulation and industry information, therefore the Southern NSW Drought Hub Drought Hub must streamline everything that is available (be it commercial or government) and become the renowned, reputable source of assistance for farmers.

- By nature, farmers do not ask for help therefore Southern NSW Drought HubHub staff must be able to communicate easily with farmers and ensure there's a level of respect and trust in place so that the customer experience is positive. This also allows the word of mouth will work in the Southern NSW Drought Hub and the farmers favour.

- Localised support can make a huge difference to how people view a service. Whether that's the coordination of a local farmer led support group, or a location people can attend, farmers tend to baulk at the idea of a centralised point of contact for assistance.

Acknowledgements

The NSW Drought Resilience Adoption and Innovation Hub is funded by the Department of Agriculture, Water and Environment over four years through the Future Drought Fund.


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VICTORIAN DROUGHT RESILIENCE, ADOPTION AND INNOVATION HUBS: NORTH EAST NODE

DR SARA HELY - RIVERINE PLAINS INC.

KEY POINTS

The Victorian Drought Resilience, Adoption and Innovation Hub will give farmers and rural communities tools to address the 4 stages of drought.

The Hub has regional nodes across Victoria, which aim to provide new ways to collaborate and drive on the ground outcomes for farmers and communities.

A consultation process with farmers in the North East Node has highlighted the role that social and business events play in supporting farmers and agribusiness during drought, when mental and financial stress is high, as well as the value of education, training and upskilling while times are relatively good.

Background

The Victorian Drought Resilience Adoption, and Innovation Hub is funded by the Commonwealth Government and will contribute $8 million over four years through the Future Drought Fund.

The Hub is led by the University of Melbourne's Dookie Campus and is conducted in association with Deakin, La Trobe, and Federation University and Agriculture Victoria. Within the Hub there are five regional nodes across Victoria. These regional nodes are all led by highly respected farming/industry groups – Birchip Cropping Group (NW Node); Riverine Plains Inc (NE Node); Food & Fibre Gippsland (Gippsland Node); Southern Farming Systems (SW Node), and Mallee Regional Innovation Centre (NW Irrigated Horticulture Node).

Each Node is required to consult the agricultural industry through farmers, councils, businesses, health organisations, and community groups in their region about building drought resilience at the local level. Other activities being led by the drought hub are the development of pilot projects to address specific knowledge or technical skill gaps identified through the hubs, capacity building and the brokering of knowledge between nodes.

Riverine Plains has identified a strong need for further investment in the use of stock containment as a drought resilience strategy, and has wide reaching implications for Victoria and Australia. To this end, contribution, we are leading the development of an Investment Prospectus to guide a national initiative into the use of stock containment practices to increase future drought and climate resilience.

Progress to date

The development of an investment prospectus for the use of stock containment practices commenced in November 2021 with the employment of Kate Parker, as a livestock officer for Riverine Plains Inc. Kate will prepare a review of the state of play of work on stock confinement to date, and through a series of farmer focus groups in consultation with other farming systems groups in Victoria and possibly other states, investigate where greater investment nationally could lead to wider spread adoption of the practise.

Alongside the stock containment t project, Riverine Plains Inc has also conducted an extensive interview process with farmers, community groups and agribusiness representatives.

The themes emerging from the engagement process will be used to drive project development.

Some of the themes emerging are:

- the importance of diversifying farm incomes, through having a member of the farming family with another income stream, and/or leasing machinery to farmers in other regions with an earlier or later season.
- That reactive and responsive support for farmers and agribusiness during the worst of the drought phase is essential for managing mental health issues. This could be in the form of overt mental health events (Comedy festivals, events or workshops connecting farmers and agribusiness with financial advisors, mental health professionals, and cultural awareness events), or covert mental health events (such as farm safety workshops, field days or agribusiness days where socialising is part of the event)
- Interviewees consistently said they used the good times, or recovery phase to upskill in terms of business acumen and latest research on different management systems/options to suit their environment.

Most interviewees indicated that what helped prepare for future drought was good business acumen skills, having cash saved away, or having on farm storage for grains and hay s to allow income to be generated during the drought and recovery phase.

Summary

To date, work developed the Victorian Drought Hub has already uncovered key priorities for action. These will be used to identify seed funding, new R&D priorities, extension and capacity building, community development, and health and mental health support projects. It is hoped that in addition to the $8 million provided to the drought hubs across Australia, further investment will be attracted to support Riverine Plains region farmers and used to deliver outcomes for building drought resilience through this North East regional Node.

Acknowledgements

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L-R: Fiona Hart, Riverine Plains; Prof. Richard Speed, La Trobe University; Prof. John Fazakerley, University of Melbourne; The Hon. Damian Drum, Federal Member for Nicholls; Prof. Tim Reeves, University of Melbourne; Scott Chirnside, Southern Farming Systems; Assoc. Prof. David Ulgade, University of Melbourne; Angela Avery, Agriculture Victoria.
Photo credit: Kate Norman/University of Melbourne

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