2024 RESULTS

UPPER NORTH FARMING SYSTEMS

ANNUAL RESEARCH
& EXTENSION **COMPENDIUM**

Upper North Farming Systems

unfs.com.au

CONTENTS

DISCLAIMER

CHAIRMAN'S REPORT *for* 2024

Michael Zwar

2024 has been a tough season for growers of the Upper North region, with the effect of drought being felt across the entire community.

Our annual Upper Nort Farming Systems (UNFS) Expo was held in August with a great range of speakers. This event also hosted our AGM, which saw me continue as Chairperson and Beth Humphris as Vice Chairperson. We welcomed Tom Kuerschner to the Strategic Board and we look forward to Tom working with the other members of the Committee.

Thanks to our staff Jade Rose, Deb Marner, Rachel Trengove and Miffy Purslow, commenced March 2025, for their outstanding efforts in project management, group governance, finance and administration. They have done a fantastic job, and we are very fortunate to have such great people working for UNFS. Regarding 2025, Miffy joined us in March after completing her internship at the Hart Field – Site Group in 2024, and is proving to be a valuable team member.

I would also like to thank all the Board and Committee members for their time and effort in keeping the group together and making things happen. The continued success of UNFS is only possible through your ongoing efforts.

Finally, thank you to all the UNFS members. Without you attending our events and learning from our projects the group wouldn't be here. Thank you to the Laura and Nelshaby Ag Bureaus for your collaboration again with UNFS. Bringing our members together to learn and get the most out of our events, I think is proving very valuable.

ACCESS UNFS PODCASTS EASILY BY SCANNING THE QR CODE:

SOUNDCLOUD

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PROJECTS & SITES

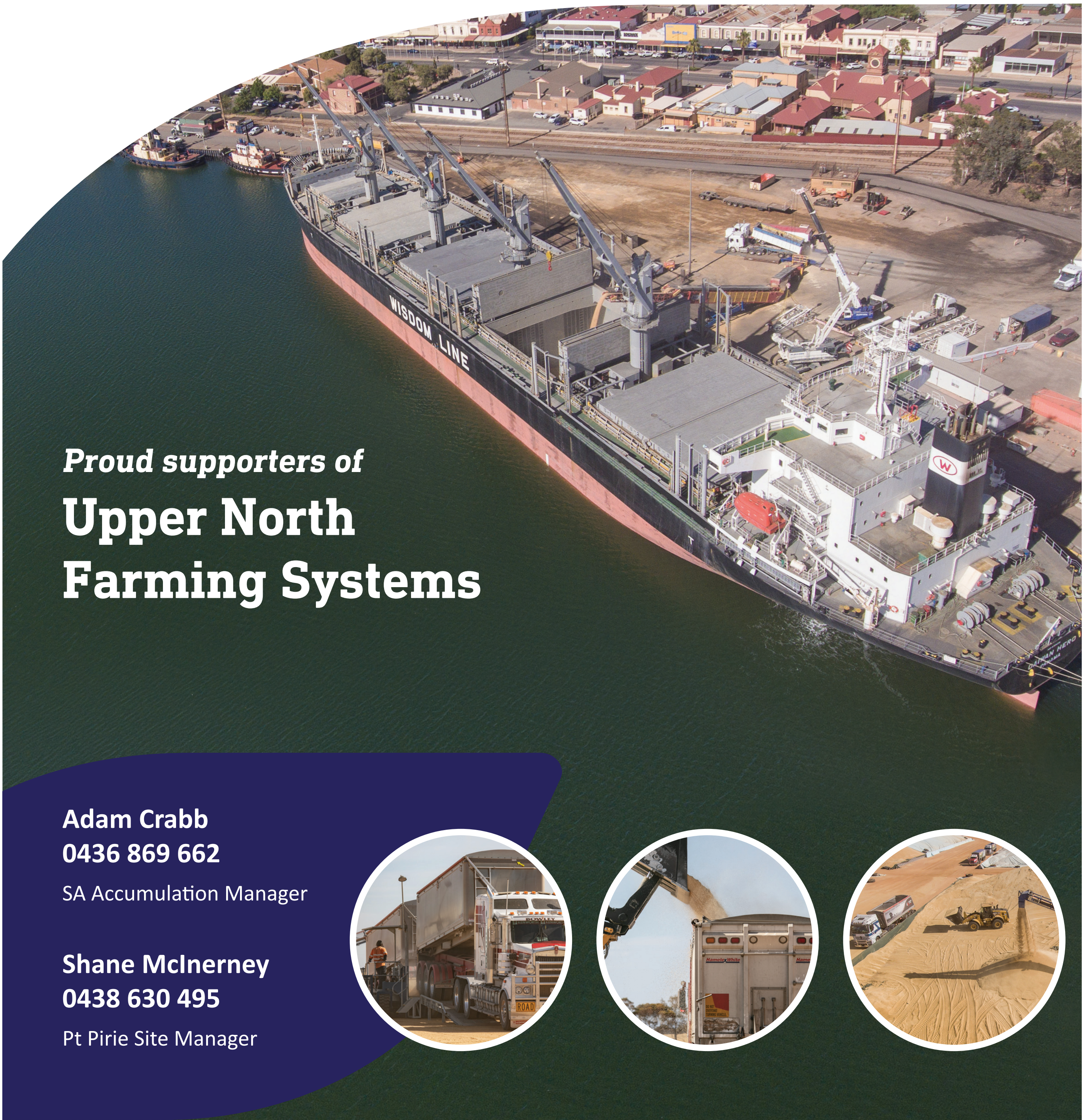
UNFS 2024 PROJECT LIST

UNFS Project #	Other Names/ References	Full Name	Funding Source/Contact
102	Hub Activities	AgTech, LOTL, Jamestown, Booleroo, Nelshaby, Laura/ Glastone, Wilmington, Quorn, New Farmers, Morchard/ Orroroo/Pekina/Black Rock,	GrainGrowers, AGT, Davis Grain Sponsorship
104	Commercial Paddock	Fundraising for delivery of RD&E in UNFS Region	Northern Ag
231	Weather Station Network	Upper North Fire Danger Index Alerting Weather Station Network Project	Safecom/NSS
238	Soil Pathogen	Soilborne cereal pathogens national extension project- Workshops & Trial sites	GRDC via FarmLink/SAGIT via SARDI
240	Septoria Epidemiology	Epidemiology of Septoria Tritici Blotch in the low and medium rainfall zones of the Southern region to inform IDM strategies.	GRDC/ SARDI
245	Pulse Extension	RD & E to close the economic yield gap & maximise farming systems benefits from grain legume production in SA	GRDC via SARDI
246	Pasture Systems	Improved Pasture Management Systems	MLA
247	Lotsa Lambs	Lotsa Lambs - Improving Reproduction Success	MLA
249	Canola Profitability	Canola Profitability in the UN	SAGIT
253	Heat Stress in Sheep	Improving Climate Resilience of the Australian Sheep Industry	Australian Government's Future Drought Fund
254	Farming Systems	Enterprise Choice & Sequencing for profitability & sustainability	GRDC via Uni of Adelaide
255	National Risk Management Initiative	Understand and improve risk-reward outcomes for Australian grain growers through participatory action research	GRDC via Hart FSG
256	Carbon ERF	Applying whole-of-farm carbon project methods for climate resilience and diverse co-benefits in low rainfall farming systems of the Upper North	PIRSA
257	Intercropping	Profitable and resilient pulse break crops in the Upper North - East and West of the Range	SA Drought Hub
259	De-Risking the Seeding Program	Reducing the risk of early/dry sowing through different management tactics in the decision making process	DroughtHub/Australian Government
260	FDF Drought Resilient Soils	Building farming systems resilience and future proofing the impacts of drought through accelerating the adoption of proven cost-effective and yield responsive soil and fertiliser management practices	Future Drought Fund via MSF
261	Wild Dog and livestock productivity project	SA Best Practice Wild Dog Control and Productivity Network	PIRSA
262	Containment Feeding	Sheep Containment Feeding - Boost sheep enterprise resilience and performance (pilot program)	SA Drought Hub
263	FDF Long Term Trials - Medics adapted to droughts	Annual medics with improved drought resilience for low rainfall areas	Future Drought Fund
264	Frost in the Upper North	Strategies for mitigating frost damage in the Upper North Region	SAGIT
265	Pulse Suitability	Building resilience - Break Crop Suitability Across Landscapes	SA Drought Hub
267	Summer Weed control	Demonstrations of residual summer weed control for the Mid and Upper North, South Australia	GRDC

ADM

Port Pirie

Creating value for Upper North grain producers



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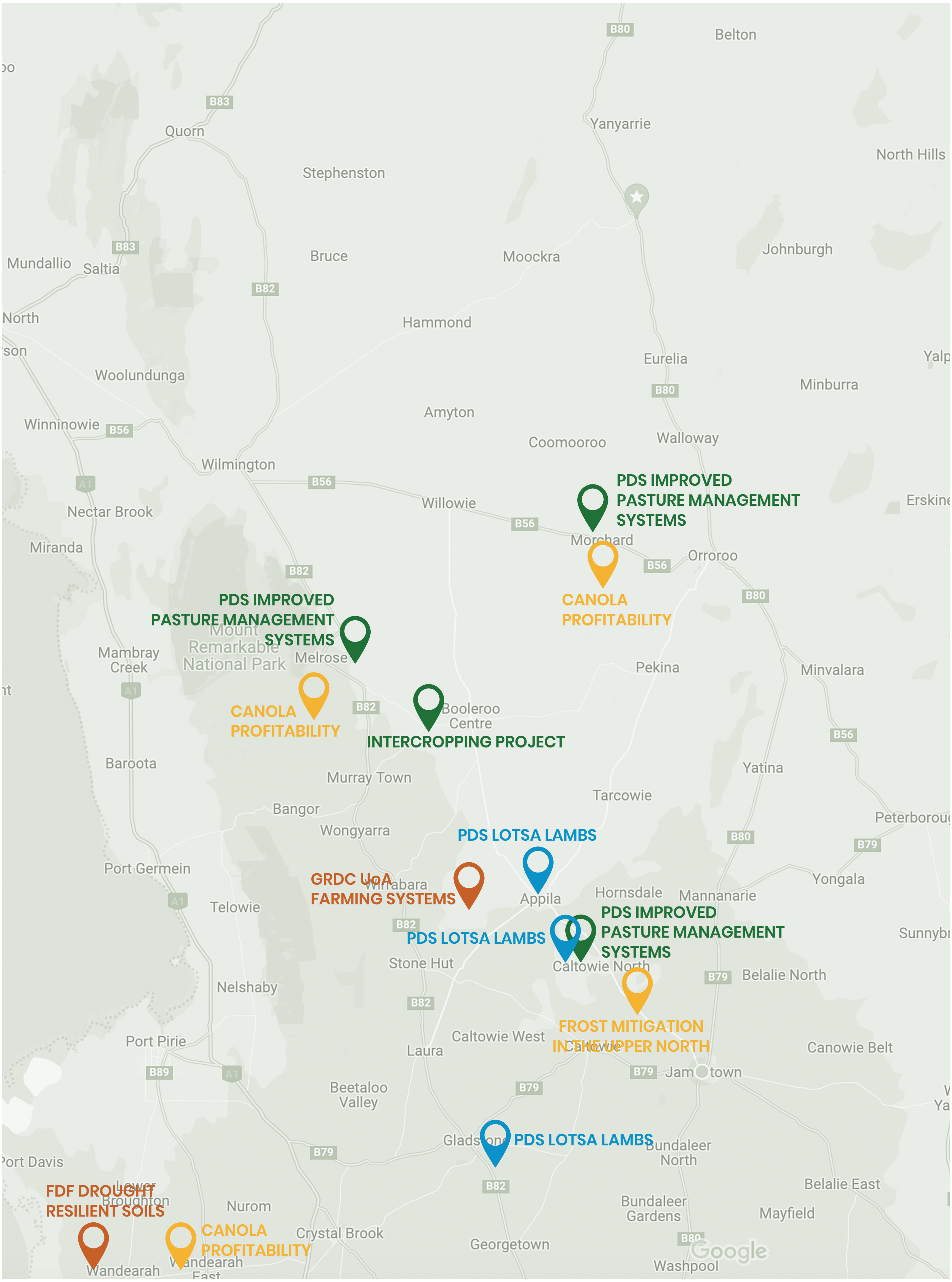
Or if you prefer, we will donate the $100 to one of the charities listed on the Grower Portal™ website

UNFS 2024 RESEARCH SITES



2024 EVENTS

MARCH 17th, LADIES ON THE LAND

UNFS 2024 EVENT SUMMARY

Date	Event	Location	Participants	Details
February				
16	Containment feeding workshop	Booleroo Centre Sporting Complex	12	• Ration creation • Meeting nutritional requirements. • Containment feeding yard design & setup
March				
4	Nelshaby Trials Results Session	Napperby/ Western	20	• Dylan Bruce (SARDI) - Early Time of Sowing in pulses • Navneet Aggarwal (SARDI)\ - GRDC funded Spiny Emex control in lentils • Stefan Schmitt (Ag Consulting & Research) - FDF funded remediation of saline land • SA Power Networks - Farm machinery safety with electrical infrastructure
17	Ladies on the Land	The Park, Jamestown	21	'Females in the Industry networking and panel session' Speakers: • Ruth Sommerville from Rufous and Co • Jess Koch from Breezy Hill Precision Ag Services • Simmone Read from FMC. • Marg Evans, a Senior Research Scientist at SARDI Facilitated by Annabelle Homer
April				
10	Sheep Connect eID Field Day	Melrose Showgrounds	63	• Using eID for profit and productivity – Mark Ferguson (neXtgen Agri) • Selecting the right eID equipment for your enterprise – Michelle Cousins (Cousins Merino Services) • Farmer case studies • Developing a plan for success – Michelle Cousins and Mark Ferguson • Data management – Michelle Cousins • PIRSA update on eID program
11	Saline Soils Mega Site	Chris Crouch Property	30+	Demonstration of amelioration techniques to manage saline soils with automated earth moving equipment
June				
25	Transitioning to non-mulesed sheep workshop	Pekina, McMcallum Woolshed	20	Geoff Lindon, Program Manager, Sheep Genetics & Animal Welfare Advocacy—AWI • Market feedback - latest NWD stats by state—premiums and discounts • Breech and body strike risk factors • Target visual scores and target ASBVs • Resistance to fly control chemicals Andrew Michael, Leahcim Stud • ASBV's important to mulesing transition, not just breech wrinkle • Evolution of Australia's sheep flock moving forward to meet our market demands • Value adding wool and meat products within the sheep flock to increase profitability into the future Farmer panel—Richard & Michelle McCallum, Jim Kuerschner & Dave Clarke

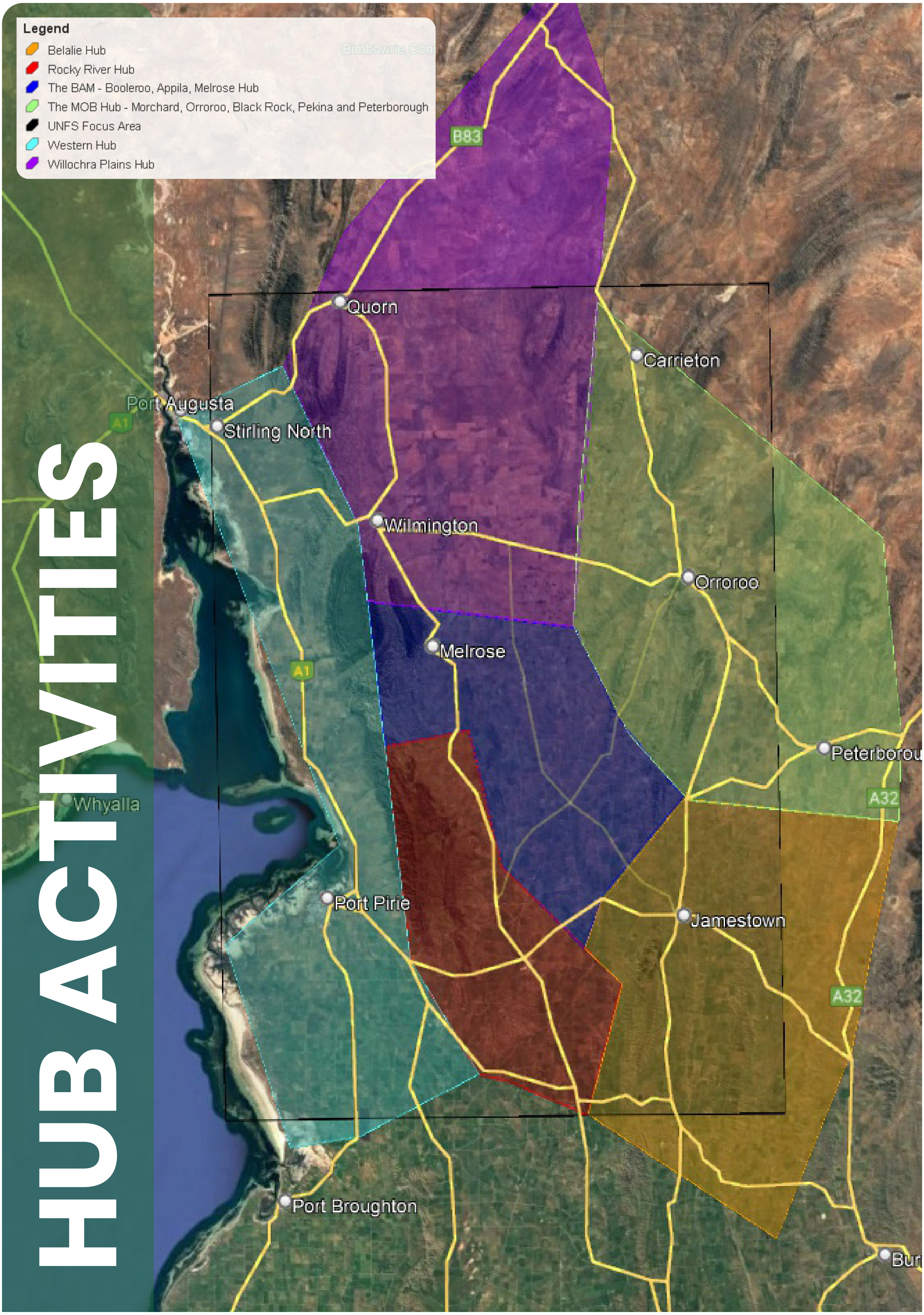
UNFS 2024 EVENT SUMMARY

Date	Event	Location	Participants	Details
August				
1	UNFS Expo	Booleroo Centre	80	Annual UNFS Expo
14	Livestock strategies for the next 100 days	Jamestown David Moore's containment yards	20	Deb Scammell, Talking Livestock • Meeting young animal targets in a tough season • Ewe recovery Felicity Turner, Turner Agribusiness • Looking after yourself and your feedbase • The importance of decision-making tools to forecast and make decisions Ken Solly • Coping better in challenging times Sticky Beak at David Moore's containment feeding set-up with David Moore & Jane Heyneman
23	Jamestown Crop Walk	Pete Kitschke's farm	70	• SAGIT frost trial at Kitschke's farm - Mick Faulkner – frost mitigation strategies • Jordy Kitschke from Flux • Damon Humphris from Taggr • Barry Mudge - GRDC's RiskWi$e initiative – the upside / downside to in-season nitrogen applications
September				
7	GRDC Harvester Set Up	Laura	105+	The workshop, hosted by UNFS, brought together harvester specialists, industry experts and researchers to discuss preventable harvester grain losses and how to measure these, improvements in efficiency and output, methods of harvest weed seed control (HWSC), the prevention of harvester fires and calibrating harvester technology.
22	Eastern Sticky Beak Day	Melrose	20	Dustin Berryman presented on the SAGIT Canola Profitability Trial - talking about different canola varieties and their fit in the UN. Sarah Day presented on the SARDI (DroughtHub) Pulse Trials (intercropping, early TOS), then a small presentation from Flinders Uni staff Peter Anderson and Crystal Sweetman on heat and chilling stress management.

UNFS 2024 EVENT SUMMARY

Date	Event	Location	Participants	Details
September				
2	Eastern Crop Walk	Bus Tour	40	• Rodrigo Coqui da Silva, from Adelaide University.- Farming Systems South" GRDC trial on Heaslip's farm near Appila • FDF project "De-risking the seeding program: adoption of key management practices for the success of dry early sown crops" – Demonstration site at Matt Nottle's farm • Barry Mudge - GRDC's RiskWi$e initiative • 'Mates on a Mission'
27	Western Crop Walk	Bus Tour	50	• Dennis' farm – Baroota – "chasing moisture at depth" – deep sowing • Jonno Mudge's lentils under pivot • GRDC's "Jacks in lentils trial" – Mundoora – Stefan Schmidt • Chris Crouch's soil amelioration for saline soils (sandhill onto saline flats demonstration) • Brendon John's GRDC National Pulse Phenology trials – looking at varietal differences and time of sowing - SARDI • Andrew Sargent – SwarmBot demonstration • Barry Mudge - GRDC's RiskWi$e initiative
October				
15	Jamestown Agronomy Centre Spring Field Day with AgXtra	Jamestown	30	• Lentil viability in the Mid North – Sarah Day – Observations from UNFS demonstration sites – • High yield trial • Spraytec knockdown demonstration presented by Spraytec • Wheat & barley variety trials presented by Colin Edmundson, Longreach Plant Breeders • Craig Davis – agronomist perspective of lentil growing in the Mid North
November				
13	Ladies on the Land	Jamestown	25	WOTL – Tools for Tough Seasons Workshop designed to equip women connected to farming (in both key and support roles) with practical tools and strategies needed to navigate tough seasons. • impact of current seasonal conditions • practical decision-making frameworks • managing stress in business
December				
13	Ladies on the Land	Jamestown	25	• Managing stress effectively • Mediating conflicts • Enhancing communication to strengthen connections within your team

HUB ACTIVITIES



BOOLEROO, APPILA, MELROSE HUB REPORT

Rainfall was low across the Booleroo, Appila and Melrose districts, with a GSR ranging between 92-130 mm.

Exceptional challenges were faced throughout 2024, not only for the Booleroo, Appila and Melrose districts but also for most of South Australia. The main challenge was the near record-low rainfall, particularly throughout the growing season with the district receiving the largest rainfall event in November with 77 mm at the start of an already tough harvest.

With the harsh and unproductive season came a silver lining, a chance to connect with other growers through numerous events held throughout the region. Laura Ag Bureau held the first event at Woolford's shed which many UNFS members attended. This event introduced the Seed Register which directly connects farmers looking to buy and sell seed for 2025 and minimises the amount of good seed being sold into the system.

Other events held within the Booleroo, Appila and Melrose (BAM) hub included a bus tour to the Appila trial site, Matt Nottle's seeding setup trial, and the Booleroo social evening in conjunction with Ski for Life, 'blind and legless', Booleroo seeder setup day which attracted a large crowd, and the Melrose Ag tech day with numerous speakers.

Notable outcomes from the 2024 season would be keep moisture conservation up and take advantage of any opportunities across both cropping and livestock. Hopefully last year's weather was a one-time occurrence, and we don't see another season like it in the future.

by William Heaslip

BELALIE REPORT

Jamestown received 169 mm growing season rainfall (GSR) in 2024.

In the Belalie region, and most of South Australia, 2024 was a year which I see as having little to learn from, but hopefully where the bottom is. Stored moisture from a very dry finish in 2023 was useful to help the crops get to the finish line in some cases.

Hopefully we all look back on 2024 as the once in a lifetime event, though it is difficult to remember anything but challenges. I see resilience as the key take away.

On 14 August we held a very successful containment feeding day at my Bundaleer. The day was well attended by members and non-members alike and was a good discussion on how to manage containment feeding pen design, rations and strategies. We also heard a very important talk on managing mental health in a drought.

In closing at this time, look after yourself and your family and neighbours, remember you are not your farm or your success or otherwise, and all the best for 2025 and beyond.

By David Moore

WILLOCHRA PLAINS

The 2024 season was extremely dry, and harsh on both the cropping and livestock fronts. Wilmington and Quorn received 137.8 mm and 145.0 mm respectively of growing season rainfall (GSR). This was a generous amount in both locations compared to other areas in the Upper North region like Orroroo, Appila and Booleroo Centre which all received less than 100 mm of GSR.

Cropping highlights were minimal, with the best outcome being farmers recovering seed for 2025. However, many didn't achieve this milestone, with most farmers experiencing a complete failure across their cropping program. Those that did recover seed did so at low quantities, around the 200-600 kg/ha mark.

Recovering such low seed quantities resulted in a lack of available sheep feed both on the ground and for feeding out. Thus, lambing percentages were very ordinary with some flocks pushing as low as 10-15%. Other flocks performed better, pushing as high as 70%. For context on the severity of the 2024 lambing percentages, the AWI Sheep Connect SA website states that target survival rates in sheep are 92% for single and 75% for twin-bearing Merinos, and 97% for single and 87% for twin-bearing first-cross ewes.

By Paul Rodgers

MORCHARD, ORROROO, PEKINA, BLACK ROCK & PETERBOROUGH DISTRICTS HUB REPORT

Things that worked well in 2024:

- Off farm work.
- Not sowing a crop.
- Running outdated machinery with no repayments.
- Being significantly under-stocked.
- Selling goats.
- Selling kangaroos.
- Keeping reserves of seed in case there is none to reap.
- Leasing out or selling land.

Lessons learned from 2024:

Never take any notice of any long-term weather forecast. Hopefully others will also realise this and stop giving airtime, so we don't accidentally absorb it.

Interesting observations from 2024:

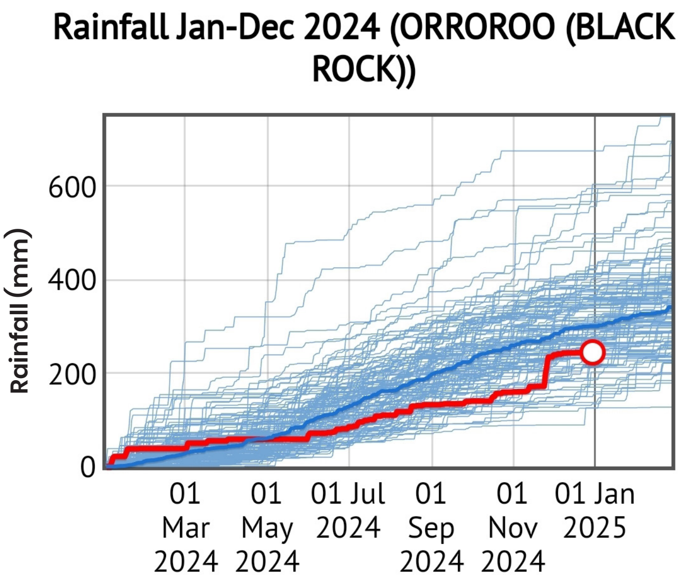
Many parts of the Upper North were affected by the drought of 2023, and nobody really cared. But in 2024 when the Adelaide Plains and South East were also affected by a drought, all of a sudden, the media were all over it!

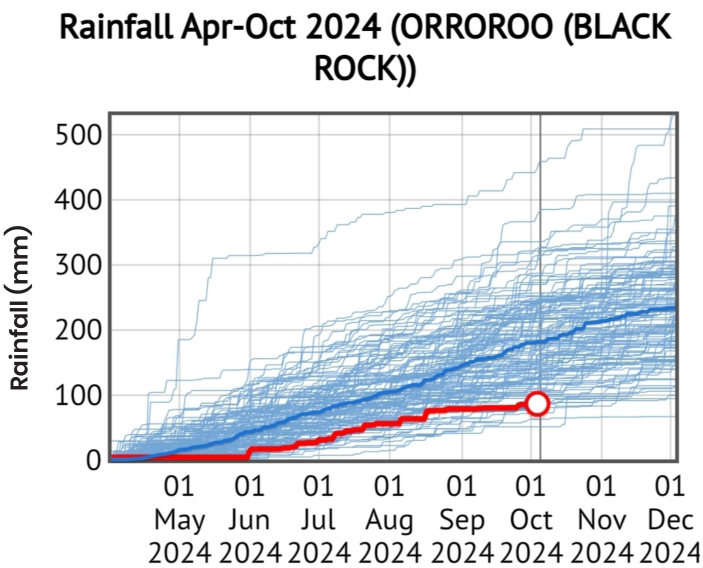
It's also interesting to look at the historical rainfall graphs. The red line is current year, the thick blue line is the average, and all the thin blue lines are all the other years since 1900.

It clearly shows, that the 2024 calendar year was below average, and the 2024 April-October growing season rainfall was way below average. But it also clearly shows that it has been worse than this in the past. Therefore, we need to expect to get seasons like this, or worse, now and into the future. It's just part of it.

Good luck for 2025!

by Tom Kuerschner





ROCKY RIVER (LAURA AG BUREAU) HUB REPORT

In February our hub met in Laura to listen to a presentation from Geoff Power, Dog fence board member and grazier north of Orroroo. We also heard from Laura local and Elders Jamestown agronomist of the year, Darren Pech.

On 20 March we took a large bus for a sticky beak day and visited four farms between Clare and Jamestown which was very informative. First stop was Munduney near Spalding where Tyson Sparks spoke at length about their diverse cropping and sheep programme. Morning tea was held in the historic Munduney shearing shed.

Next stop was the Marola farm of Matt Dare where we heard about their cropping programme and sharing a harvester with a farmer at an earlier district. BBQ lunch was provided and cooked by ADM reps.

Tyler Stephenson who also farms near Spalding was the next stop where we had an opportunity to look at his large seeding unit. Tyler talked about staff, logistics of moving large machinery around some of the narrow roads and bridges and some issues he's had in wet conditions in steep hilly country with the heavy seeder. Tyler also runs sheep.

Lastly, we toured through some reclaimed Bundaleer pine forest paddocks that Peter Kitschke has windrowed, cleared and established crops on. Sheep are also a part of his enterprise due to inarable hills.

We thank sponsors ADM, EPIC, VITERRA, QUALITY WOOL, ELDERS, and CROP SMART for supporting the day and for their reps that travelled with us. They were given an opportunity to talk during lunch.
In April we were lucky to hear from guest speaker Jim Parrett, Jindera, NSW, presenting on the history of hay runs. Jim was travelling through SA on holidays with his wife and stayed in the Laura caravan park. We got off the main planned topic and ended up also hearing from his wife who is principal at a large high school of 800 in a diverse rural NSW regional city. Jim came over in his truck in December 2023 donating hay as part of the hay run locals did then from Gladstone to Orroroo.

In August we had a forum question and answer session with Northern Areas Council staff. CEO Kelly Westall and the Works Manager attended the evening and answered many questions. The main questions centered on road maintenance. We learned that strategies, logistics and rubble supply pits greatly affected costings when building new roads. 34 farmers attended representing land holdings in four councils.

Our Laura Ag Bureau social night on the 3 October was a much-needed time to gather in Kym & Lucas Woolford's farm at Laura and socialise with other farmers in the region.

There were four guest speakers and three industry reps, who gave a great summary of the current and past seasons. Discussions were held around the drought conditions that were being experienced. A seed register was discussed and with 100 attending it was the type of event that was needed. This event was kindly supported by SA Drought Hub, Upper North Farming Systems, Tarcowie Hotel, Laura CFS, Viterra, Agfert, E.P.I.C, Elders & AWB Grain Flow.

The last event for the year was on 18 December. After a disappointing harvest it was pleasing to receive a phone call from AJ from the Laura hotel offering "to provide a meal to you because you're doing it tough!" It was a great opportunity to enjoy a social evening with many staying late. Thanks also to the local farmers that have helped organize events through the year and for the younger ones steeping up with their own input on what they want to see and hear.

By Andrew Kitto

NELSHABY AG BUREAU & UNFS WESTERN HUB REPORT

The Nelshaby Ag Bureau, and UNFS Western Hub had another successful year as a group with good attendance at our regular meetings. We also had a great annual trip which this year took us to Kangaroo Island. The season was less than ideal, with some areas recording their lowest rainfall on record.

We started off the year in July with our AGM, and had Janette Ridgeway, Chair of the SA AG Bureau board as our speaker. In August we travelled to Kangaroo Island on a very windy but successful trip.

We visited multiple farms and locations on the island, and some of the topics included:

- Doing business on the island
- Grain logistics with KIPG
- Recovery from the bushfire
- Clearing blue gum plantation and converting back to farmland
- Oyster farming
- Wool manufacturing

In September we held our Sticky Beak Day and Western Crop Walk.

The day was well attended and included:

- Lentils under pivot irrigation
- Amelioration for saline soils
- Early and deep sowing
- New implement/seed shed
- New machinery including the first Robot weed sprayer (swarm bot) in the area

In December we held our Christmas windup, and in February we held a social catchup with families to get everyone together for a social outing for the ongoing drought. In March, Bron Stedall gave a talk on improving communication and managing stress and conflict. For our April meeting, Barry Mudge gave a talk on Cost of Production for the upcoming cropping season.

By Chris Crouch

Farmers are the backbone of this great country

UNFS 2024 COMMERCIAL PADDOCK REPORT

The Commercial Paddock stands as a testament to the remarkable generosity of the community, which has graciously donated land, time, and resources to support Upper North Farming Systems (UNFS). Situated on the outskirts of Booleroo Centre and owned by Northern Ag, the local NRI business, the paddock's impact on the group has been truly astounding.

From its inception, Northern Ag has been a steadfast supporter of UNFS, and their kindness was evident when they generously offered the use of the paddock as a sponsorship to the group. UNFS members now engage in various agricultural activities within the paddock, including sowing, spraying, spreading, harvesting, carting, and selling the grain produced. This initiative serves to generate income for the group independently of funding bodies or grants.

This financial autonomy equips the group with the flexibility to respond promptly to weather events or economic fluctuations and facilitates the pursuit of research endeavours that may not be prioritised by state or national funding bodies. We extend our heartfelt gratitude to Dustin Berryman and the Northern Ag team for enabling us to raise funds in this manner and for their exceptional generosity in giving back to the local community.

Unfortunately, the 2023/2024 season delivered one of the harshest seasonal outcomes in recent years across the Upper North. Persistent dry conditions, extreme heat, and multiple frost events significantly impacted crop establishment and yield potential across the region. The Commercial Paddock was not spared—resulting in a total crop failure, with no opportunity for either grazing or harvesting. This outcome reflects the broader hardship experienced by growers in the district and highlights the ongoing vulnerability of farming operations to climatic extremes, even under best practice management.

Despite the setback, the Commercial Paddock remains a valuable asset to UNFS. It continues to demonstrate the strength of local partnerships and the importance of flexible, community-driven approaches in sustaining extension and research activities during difficult times.

Thank you to all those involved in the 2023/2024 Commercial Paddock:

Wayne Roocke - Sowing
JP Carey - Summer Spraying
Shaun Borgas - Grass spraying
Nick McCallum - Donated seed (Sunblade)

Thank you to Northern Ag and our amazing group of volunteers that make this partnership an integral part of our delivery of high quality engagement and trial activities to the region.

UNDERSTANDING TRIAL RESULTS AND STATISTICS

Interpreting and understanding replicated trial results is not always easy. We have tried to report trial results in this book in a standard format, to make interpretation easier. Trials are generally replicated (treatments repeated two or more times) so there can be confidence that the results are from the treatments applied, rather than due to some other cause such as underlying soil variation or simply chance.

The average (or mean)

The results of replicated trials are often presented as the average (or mean) for each of the replicated treatments. Using statistics, means are compared to see whether any differences are larger than is likely to be caused by natural variability across the trial area (such as changing soil type).

The LSD test

To judge whether two or more treatments are different or not, a statistical test called the Least Significant Difference (LSD) test is used. If there is no appreciable difference found between treatments then the result shows "ns" (not significant). If the statistical test finds a significant difference, it is written as "P<0.05". This means there is a 5% probability or less that the observed difference between treatment means occurred by chance, or we are at least 95% certain that the observed differences are due to the treatment effects.

The size of the LSD can then be used to compare the means. For example, in a trial with four treatments, only one treatment may be significantly different from the other three – the size of the LSD is used to see which treatments are different.

Results from replicated trial

An example of a replicated trial of three fertiliser treatments and a control (no fertiliser), with a statistical interpretation, is shown in Table 1.

Table 1 Mean grain yields of fertiliser treatments (4 replicates per treatment)

Treatment	Grain Yield (t/ha)
Control	1.32 a
Fertiliser 1	1.51 a,b
Fertiliser 2	1.47 a,b
Fertiliser 3	1.70 b
Significant treatment difference P<0.05 LSD	($P \geq 0.05$) 0.33

Statistical analysis indicates that there is a fertiliser treatment effect on yields. P<0.05 indicates that the probability of such differences in grain yield occurring by chance is 5% (1 in 20) or less. In other words, it is highly likely (more than 95% probability) that the observed differences are due to the fertiliser treatments imposed.

The LSD shows that mean grain yields for individual treatments must differ by 0.33 t/ha or more, for us to accept that the treatments do have a real effect on yields. These pairwise treatment comparisons are often shown using the letter as in the last column of Table 1. Treatment means with the same letter are not significantly different from each other. The treatments that do differ significantly are those followed by different letters.

In our example, the control and fertiliser treatments 1 and 2 are the same (all followed by "a"). Despite fertilisers 1 and 2 giving apparently higher yields than control, we can't dismiss the possibility that these small differences are just due to chance variation between plots. All three fertiliser treatments also have to be accepted as giving the same yields (all followed by "b"). But fertiliser treatment 3 can be accepted as producing a yield response over the control, indicated in the table by the means not sharing the same letter.

On-farm testing – Prove it on your place!

Doing an on-farm trial is more than just planting a test strip in the back paddock, or picking a few treatments and sowing some plots. Problems such as paddock variability, seasonal variability and changes across a district all serve to confound interpretation of anything but a well-designed trial.

Scientists generally prefer replicated small plots for conclusive results. But for farmers such trials can be time-consuming and unsuited to use with farm machinery. Small errors in planning can give results that are difficult to interpret. Research work in the 1930's showed that errors due to soil variability increased as plots got larger, but at the same time, sampling errors increased with smaller plots.

The carefully planned and laid out farmer unreplicated trial or demonstration does have a role in agriculture as it enables a farmer to verify research findings on his particular soil type, rainfall and farming system, and we all know that "if I see it on my place, then I'm more likely to adopt it". On-farm trials and demonstrations often serve as a catalyst for new ideas, which then lead to replicated trials to validate these observations.

The bottom line with unreplicated trial work is to have confidence that any differences (positive or negative) are real and repeatable, and due to the treatment rather than some other factor.

To get the best out of your on-farm trials, note the following points:

- Choose your test site carefully so that it is uniform and representative - yield maps will help, if available.
- Identify the treatments you wish to investigate and their possible effects. Don't attempt too many treatments.
- Make treatment areas to be compared as large as possible, at least wider than your header. • Treat and manage these areas similarly in all respects, except for the treatments being compared.
- If possible, place a control strip on both sides and in the middle of your treatment strips, so that if there is a change in conditions you are likely to spot it by comparing the performance of control strips.
- If you can't find an even area, align your treatment strips so that all treatments are equally exposed

to the changes. For example, if there is a slope, run the strips up the slope. This means that all treatments will be partly on the flat, part on the mid slope and part at the top of the rise. This is much better than running strips across the slope, which may put your control on the sandy soil at the top of the rise and your treatment on the heavy flat, for example. This would make a direct comparison very tricky.

- Record treatment details accurately and monitor the test strips, otherwise the whole exercise will be a waste of time.
- If possible, organise a weigh trailer come harvest time, as header yield monitors have their limitations.
- Don't forget to evaluate the economics of treatments when interpreting the results. • Yield mapping provides a new and very useful tool for comparing large-scale treatment areas in a paddock.

The "Crop Monitoring Guide" published by Rural Solutions SA and available through PIRSA offices has additional information on conducting on-farm trials. Thanks to Jim Egan for the original article.

SOME USEFUL CONVERSIONS

Area
1 ha (hectare) = 10,000 m² (square 100 m by 100m)
1 acre = 0.4047 ha (1 chain (22 yards) by 10 chain)
1 ha = 2.471 acres

Mass
1 t (metric tonne) = 1,000 kg
1 imperial tonne = 1,016 kg
1 kg = 2.205 lb
1 lb = 0.454 kg

A bushel (bu) is traditionally a unit of volumetric measure defined as 8 gallons.
For grains, one bushel represents a dry mass equivalent of 8 gallons.
Wheat = 60 lb, Barley = 48 lb, Oats = 40 lb
1 bu (wheat) = 60 lb = 27.2 kg
1 bag = 3 bu = 81.6 kg (wheat)

Volume
1 L (litre) = 0.22 gallons
1 gallon = 4.55 L
1 L = 1,000 mL (millilitres)

Speed
1 km/hr = 0.62 miles/hr
10 km/hr = 6.2 miles/hr
15 km/hr = 9.3 miles/hr
10 km/hr = 167 metres/minute = 2.78 metres/second

Pressure
10 psi (pounds per sq inch) = 0.69 bar = 69 kPa (kiloPascals)
25 psi = 1.7 bar = 172 kPa

Yield
1 t/ha = 1000 kg/ha

Yield Approximations
Wheat 1 t = 12 bags 1 t/ha = 5 bags/acre 1 bag/acre = 0.2 t/ha
Barley 1 t = 15 bags 1 t/ha = 6.1 bags/acre 1 bag/acre = 0.16 t/ha
Oats 1 t = 18 bags 1 t/ha = 7.3 bags/acre 1 bag/acre = 0.135 t/ha

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30 Eyre Peninsula Farming Systems 2019 Summary

UPPER NORTH SEASON SUMMARY

The Upper North region was extremely dry throughout 2024, with growing season rainfall (GSR – 1 April to 31 October) varying across locations. Booleroo Centre, the primary Upper North Farming Systems (UNFS) location, receiving a marginal GSR of 95.1 mm. Belalie Hills East and Wanderah received higher GSR's of 148.8 mm and 188.6 mm respectively. In contrast, Orroroo (87.6 mm) and Appila (92.2 mm) received lowest GSRs.

The generally very dry conditions across the Upper North led to poor crop performance and low yields. Despite this, dry seasons continue to play an important role in agricultural research, producing education opportunities that support future decision making in a changing climate. The UNFS team trusts that the region-relevant trials detailed in this compendium will be useful as you plan for the 2025 season and seasons beyond.

Darren Pech, a broadacre agronomist with Elders since 2001, provided some insight into the 2024 season, commenting that it was a "very hard year to take much from, with so much variation within the region."

Trends across the region included:

- For some locations, it was their 2nd lowest annual rainfall since records began.

Barley:

- Was very disappointing, as it grew the most biomass early but then ran out of moisture and failed.

Lentils:

- Were most tolerant to the conditions, producing minimal biomass early.
- They produced some grain, but harvesting was a real issue with not enough height or biomass to get into the header front.
- Air-reels on header fronts were an asset at harvest.
- The 'bush-mechanics' set up of corflute signs and rubber belting mounted to the reel to help create enough airflow to push all harvested material into the header front better if air-reels were not fitted.

Wheat:

- Was disappointing on canola stubble, as canola had drained the moisture profile during the 2023 season.

Hay:

- Almost no hay was cut, with little to no biomass grown in many of the dedicated hay paddocks.
- Frost ended up reducing yields significantly.
- A number of canola paddocks were cut for hay, mainly due to the expectation that little cereal hay was going to be cut in the area.

DECISION MAKING

AUTOMATIC WEATHER STATION NETWORK:
BETTER DECISIONS FROM BETTER INFORMATION
WEATHER STATION DATA - Booleroo Centre 2024

BY:
Jade Rose & Miffy Purslow
Upper North Farming Systems

KEY POINTS

Better information provided by the network for making better decisions include:

- Live-time and accurate weather data for farmers in the Upper North Region of South Australia.
- Grassland Fire Danger Index monitoring.
- In the near future it is hoped that inversion monitoring will also be available at all sites.
- As part of the network there are currently four "Hi-Tech" monitoring sites, of which Booleroo Centre is one. These sites also have sensors that record data for soil moisture, NDVI, leaf wetness and canopy temperature as well as having 10m weather sensors that allow inversion monitoring.

OVERVIEW

The Upper North Farming Systems (UNFS) Automatic Weather Station Network was installed in 2019 and funded through the Government of South Australia's Fire and Emergency Commission (SAFECOM).

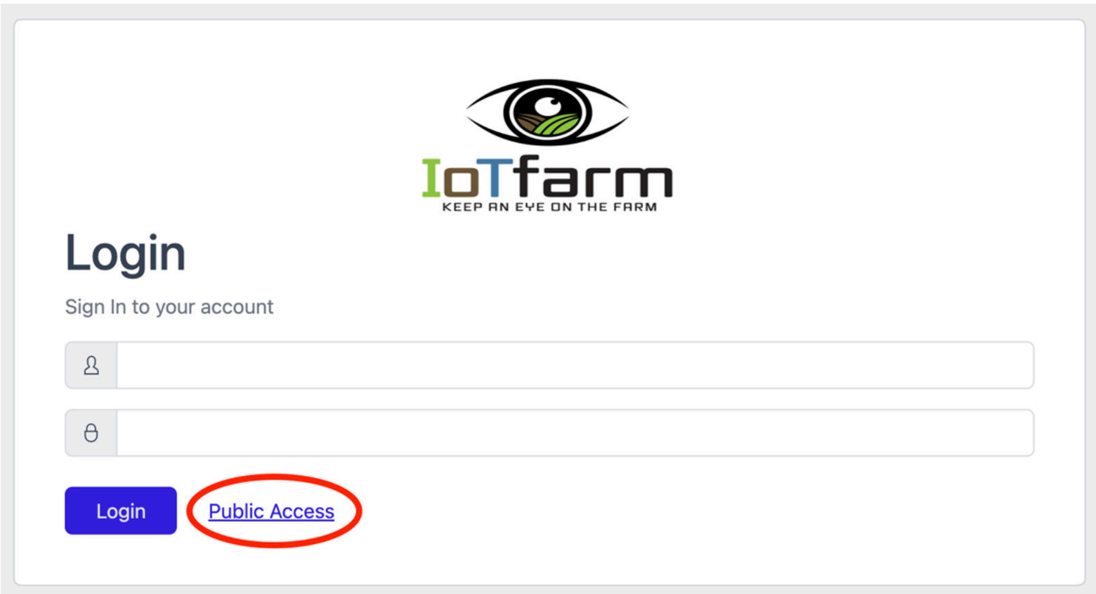
This weather station network aims to provide farmers in the Upper North Region of South Australia with live-time and accurate weather data to enable better decision making on-farm. The weather system will enable farmers to undertake spray and harvest operations safely and effectively, and make better decisions around frost and heat impacts, and nitrogen application.

The initial network comprises 16 weather stations linked to either the 3G or the Telstra CAT M1 Narrowband IoT 700 mHz network. Each site has a rain gauge, wind speed and direction sensors, and air temperature and humidity sensors at 1.2 m. It is hoped that this will be expanded to include 10m weather sensors in the coming year to enable inversion monitoring at other weather stations.

Accessing the data: Head to our website: **www.unfs.com.au** click 'Resources' in the top menu, then click 'Weather Station Network' and the link/button to the Weather Station Network will be at the top, see image below.

ACCESS WEATHER STATIONS AND STATION LOCATIONS

Then, click 'Public Access'



Then, select your weather station network and you will be taken to the weather station dashboard. Use the options on the left panel to switch to 'Map' view.

Interpreting the Data

It is important to understand the topography of each location, as this plays a significant role in the local weather. Ensure that the site you are selecting is representative for your location, not just the closest site.

Disclaimer

The UNFS Automatic Weather Station Network is a data provision service. It is not an advisory service. All decisions made using the information provided through this service are the responsibility of the user. UNFS takes no responsibility for any outcomes of use of this data. All weather sensitive activities should be undertaken with point of activity

2024

UNFS has a weather station located northwest of the Booleroo Centre township. This weather station, UNFS Booleroo 863071, was installed by Agbyte and is funded through income generated from the UNFS Commercial Paddock. The commercial paddock is made available to UNFS by Northern Ag and cropped by volunteers to provide a regular income to the group for projects of this nature that give back to the local community.

The Growing Season Rainfall (GSR, April-October) for the Booleroo Centre weather station was 93.4 mm. The total rainfall recorded for 2024 at this station was 192.2 mm (Figure 1). This weather station is the reference weather station for Upper North Farming System's 2024 trial program.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AVG (°C)	26.1	26.8	24.5	15.1	12.9	9.1	8.6	13.1	13.8	19.5	21.6	25.3
MIN (°C)	7.3	7.7	5.3	2.1	-1.3	-0.5	-1.6	1.0	-1.0	3.9	7.5	7.3
MAX (°C)	51.3	49.7	46.7	33.4	30.7	22.1	20.7	28.0	33.1	38.9	42.8	53.9
SUM (mm)	21.8	0.0	11.0	0.5	9.5	11.3	30.0	15.3	5.5	21.3	66.0	0.0
AVG (% RH)	51.8	39.7	47.4	64.5	61.5	77.9	76.2	63.9	55.8	50.3	56.9	46.5
MIN (% RH)	11.9	10.9	15.4	18.6	23.5	36.2	31.8	23.4	11.5	13.4	10.0	10.8
MAX (% RH)	99.1	96.1	96.8	99.0	99.2	99.3	99.3	98.5	98.0	97.7	99.1	95.1

***Figure 1** – Yearly weather station data (top to bottom: average temperature (C°), minimum temperature (C°), maximum temperature (C°), precipitation (mm), average relative humidity (% RH), minimum relative humidity (% RH) and maximum relative humidity (% RH)) from Booleroo Centre weather station.*

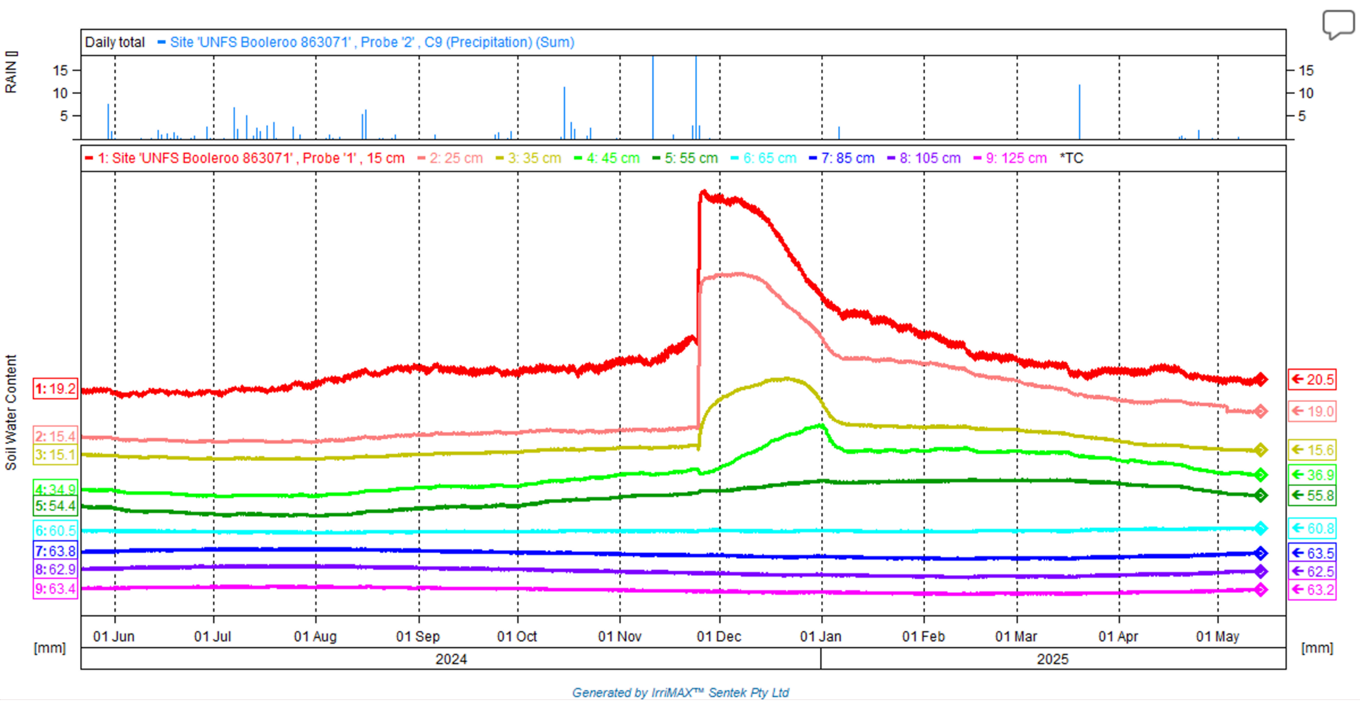


***Figure 2** – Soil Moisture Probe stacked graph from 2024-2025, Booleroo Centre weather station, Agbyte Site 863701*

Along with climatic data, the Booleroo Centre weather station also has soil moisture probes. and the lack of infiltration beyond 65cm (light blue line) is evident, as shown in Figure 2.

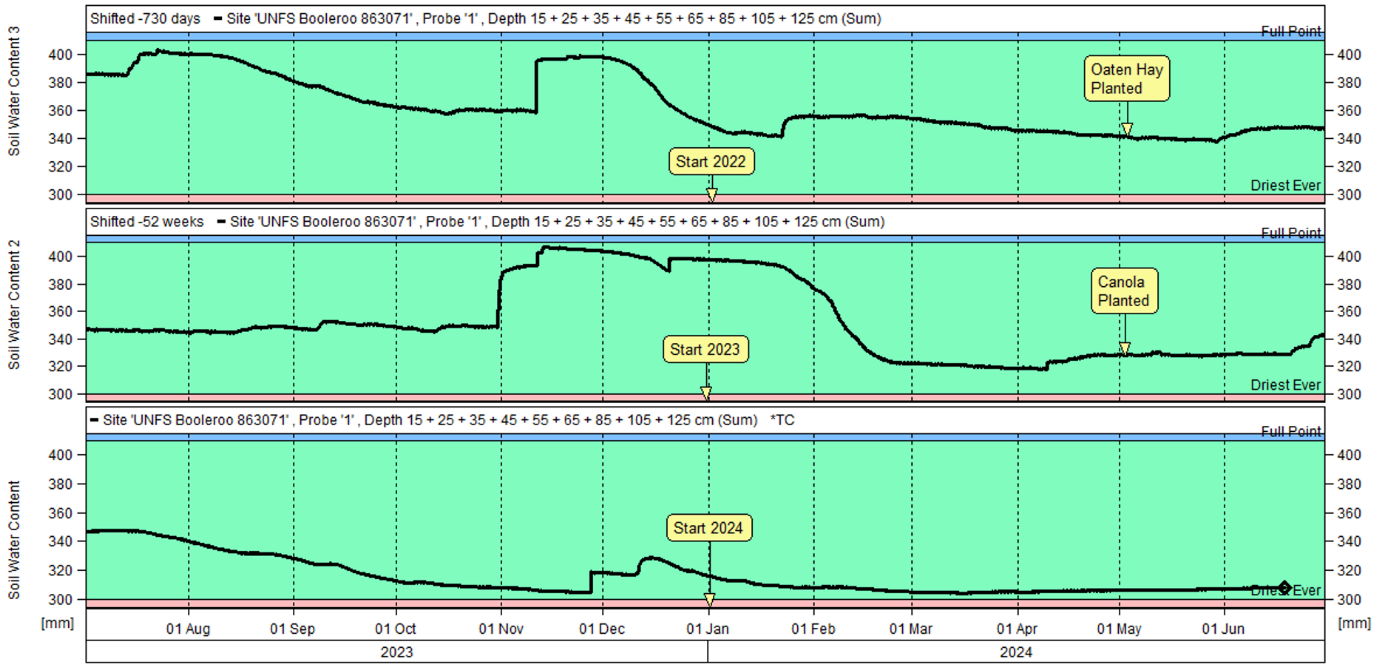


***Figure 3** – Soil moisture probe summed comparison (125 cm) for 2021/2022 (top), 2022/2023 (middle) and 2023/2024 (bottom) at Booleroo Centre*

Figure 3 shows cumulative stored soil moisture from 2022 through to mid-2024, measured at the UNFS Booleroo site. At the start of the 2023 growing season, the soil profile was near the historical minimum ("Driest Ever"), with very little moisture accumulation until late in the year. During the 2023 season, stored moisture briefly plateaued around 340 mm before steadily declining as crops extracted water, dropping further by the end of the season. The 2024 season commenced with one of the driest profiles on record—approximately 300 mm—and remained extremely low through to June, indicating a continued deficit in plant-available water and a challenging outlook for crop establishment and early growth.

Fire Danger Index: The Harvest Code of Conduct and Safe Paddock Practices:

The Grain Harvesting Code of Practice was established by the Country Fire Service (CFS) and Grains Industry Bodies to reduce the risk of fires from unsafe practices at harvest. It is applicable to the harvest of all flammable crops and all in-paddock practices that may pose a risk of fire including but not limited to; operating harvesters or augers and movement or operation of vehicles used for transporting grain.

The Harvest Code of Conduct is built on the Grassland Fire Danger Index (GFDI). The GFDI is calculated on wind speed, temperature and humidity at 2 m. All in-paddock practices must cease when the GFDI is at 35. In paddock harvest activities when the GFDI is above 20 are to be reviewed regularly and appropriate measures to ensure that a fire can be contained if it were to ignite. A fire at a GFDI above 20 has a "very high" risk of being uncontrolled at the point of ignition with an average fire size at an GFDI of 20 being 450 ha.

For more information you can visit:

CFS: https://www.cfs.sa.gov.au/about/publications/cfs-codes-of-practice/

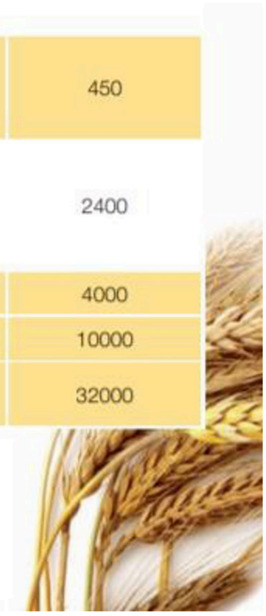
Grain Producers South Australia (GPSA): https://www.grainproducerssa.com.au/policy/grain-harvest-code/

To view the Fire Danger Index via the UNFS weather station network dashboard,
follow the instructions provided earlier in this document.

Grassland Fire Danger Index (GFDI)

Fire Behavior Relationships

FIRE DANGER INDEX	RATE OF SPREAD (km/h)	DIFFICULTY OF SUPPRESSION	MAXIMUM AREA AT VARIOUS TIMES FROM START (hectares)				AVERAGE FINAL SIZE OF FIRE (hectares)
			½ hr	1 hr	2hr	4hr	
2	0.3	**Low** Headfire stopped by road and tracks	3	20	80	320	3
5	0.6	**Moderate** Head attack easy with water.	6	40	160	640	16
10	1.3	**High** Head attack generally successful with water	15	90	360	1440	65
20	2.6	**Very High** Head attack will generally succeed at this Index	35	210	840	3360	450
40	5.2	**Very High** Head attack may fail except in favourable circumstances and close back burning to the head may be necessary	80	480	2000	8000	2400
50	6.4	**Extreme** Direct attack will generally fail. Backburn from a secure good line with adequate personel and equipment. Flanks must be held at all costs.	105	630	2500	10000	4000
70	9.0		170	1000	4000	16000	10000
100	12.8		300	1800	7000	28000	32000



Government of South Australia

CFS

SOUTH AUSTRALIAN FARMERS FEDERATION

RISKWI$E
NATIONAL RISK MANAGEMENT INITIATIVE

BY:
RACHEL TRENGOVE
Upper North Farming Systems

BACKGROUND

RiskWi$e (the National Risk Management Initiative), is a 5-year national initiative of approximately $30 million that will run from 2023 to 2028. It seeks to understand and improve the risk-reward outcomes for Australian grain growers by supporting grower on-farm decision-making. To do this it will:

- Involve grain growers in the identification of on-farm decisions that have unknown components of risk-reward that will be studied to elucidate new insights.
- Develop an improved understanding of the risk-reward relationships for on-farm management decisions.
- Inform growers and their advisers of new insights into optimising rewards and managing risk.
- Challenge grower decision-making so future management decisions are evaluated in terms of the probability of upside returns offset against the associated downside risks.

The target outcome is that 80% of grain growers can articulate their production management decisions in terms of probability of upside returns (reward) offset against the associated downside risks.

DELIVERY OF THE PROJECT

To deliver RiskWi$e, a participatory action research methodology is employed. This is an approach to research that pro-actively involves members of communities affected by that research in the research itself. Participating Upper North (UN) growers and their advisers will quantify the probabilities of uncertainty of outcomes and assess the risk-reward payoffs for specific management decisions in the context of their own farming operations.

RiskWi$e was developed in response to two primary issues. Firstly, growers in various forums including the Grains Research and Development Corporation (GRDC) National Grower Network highlighted that the risk associated with grain production has escalated and needs attention. Secondly, to action Objective 5 'Manage risk to maximise profit and minimise losses' of the GRDC RD&E Plans 2018-23 and 2023-28.

Themes of the Upper North Farming Systems (UNFS) RiskWi$e Project

1. Nitrogen (N) decisions: This theme will take a whole-of-system approach to help growers assess N decision strategies encompassing fertiliser and legume use.
2. Enterprise agronomic decisions: The enterprise agronomic decisions theme will investigate crop sequence decisions from crop choice, fallow choice, soil amelioration and weed/disease management strategies.

Underpinning all the themes are:

- Behavioural science: Focuses on understanding grower behaviour change and supporting adoption.
- Analytics and modelling: Focuses on participatory research tools ('flight simulators') that allow growers to explore their risky decisions and internalise an enhanced understanding of risk into their gut-feel decision-making.

Key Outcomes from the UNFS RiskWi$e project

Overall, the achievements of the UNFS group demonstrate a proactive approach to addressing agricultural risks and fostering collaboration among farmers to enhance decision-making processes.

Aims, Activities and Findings for Theme 1 - nitrogen (N) decisions

Applying N fertiliser is seen as a 'risky' decision due to the uncertainty surrounding the return on investment in the year it is applied, as well as the potential for negative yield responses and N losses from the system. The N trials and extension activities associated with this theme aim to collect local data as well as providing a platform to explore how models and other tools can help guide N fertiliser decision-making processes.

Extension plan: engage with stakeholders, including farmers, researchers, and industry experts, to deliver strategies and resources that assist farmers to identify risks associated with N application and understand the risk-reward outcomes of the on-farm decision.

Extension activities: Peer-to-peer learning and collaboration amongst farmers, through nitrogen-focused workshops led by Barry Mudge (Table 1; Image 3), contributed to a deeper understanding of the risk–reward outcomes associated with N decisions. Participants input data into a modelling spreadsheet and assessed outcomes from a range of N strategies, giving them the opportunity to consider their own enterprises in the process.

Nitrogen trial: The aim was to investigate responses to N, including productivity (yield, protein) and ultimately profitability (gross margin, risk). A replicated trial using Calibre wheat was established with a range of N rates (0, 50, 100, 200, 300kg/ha) and two sowing rates targeting 80 & 200 plants per sq m). This trial was co-located with a frost trial meaning that N management impacts on frost damage will also be explored.

The combination of well below average rainfall, severe frost events, and elevated temperatures led to substantial reductions in crop yields and quality across all trial plots (see Image 1). As a result, there were no significant differences amongst N and sowing rate treatments at the trial site in 2024.

Aims, Activities and Findings for Theme 2 - Enterprise agronomic decisions

The primary issue addressed is managing agronomic risks in relation to frost and improving decision-making for managing frost in the Upper North Farming Systems (UNFS) region. Frost events pose a major yield and profitability risk, particularly in the UN, where seasonal conditions vary. Farmers need to understand how different management strategies can potentially reduce frost damage.

Extension plan: engage with stakeholders, including farmers, researchers, and industry experts, to develop strategies and resources for managing frost risks effectively.

Extension activities: 2024 activities are shown in Table 1 and Images 2 and 4.

Frost trials: were designed to explore how varietal selection and sowing time influence frost susceptibility, helping farmers make proactive management decisions. The specific focus is on the risks associated with decision-making when dealing with frost events, with the aim being to gather valuable data and insights that will help farmers better manage frost risks and make informed decisions to mitigate potential losses.

Treatments were selected and data were collected to better understand:

- Relative frost tolerance and yield stability of different varieties.
- Effectiveness of sowing date manipulation as a risk management strategy.
- Trade-offs between frost avoidance and other seasonal risks (e.g. terminal drought/heat).

Two replicated trials with the same treatments were established in one paddock in the N-E area of the UN. One trial was in a high frost risk (Red Zone) and the other in a low frost risk (Green Zone) area of the paddock. Stevenson screen temperature loggers (Ibuttons) were set up within each trial at soil surface and canopy height.

Wheat, barley and oat varieties with different maturities were sown during early and/or main local sowing windows. Canola was included in the trial (non-statistical) due to its sensitivity to frost during early flowering, to provide a visual and physiological contrast for response to frost events. The following were assessed:

Image 2 shows the level of frost damage to heads in the trials during 2024. Trial findings are in the frost trial report in this compendium. Image

Other examples of agronomic decisions to be addressed through the RiskWi$e project:

- Frosted crops – the decision to cut for hay or take through to grain
- Fungicide application – the decision to apply or not apply fungicides in season and the associated upside and downside of the decision
- Dry seeding - critical success factors for dry seeding

The UNFS RiskWi$e project will continue to deliver programs in the Upper North which aim to equip growers with tools, strategies, and knowledge to enhance risk-return decision-making in cropping systems under uncertain climatic conditions.

Image 1: *Harvesting the RiskWi$e N trial at Kitschke's farm in November*

Image 2:
Vixen wheat frost damage,
19th September 2024

Image 3: *Barry Mudge presenting on behalf of GRDC's RiskWi$e initiative on the upside and downside to in-season nitrogen applications in August 2024*

Image 4: *Mick Faulkner presenting on frost mitigation strategies including zoning of a farm's frost prone paddocks at the UNFS SAGIT frost trial site at Kitschke's farm in August 2024*

***Table 1** – Extension activities undertaken in the UNFS RiskWi$e project during 2024.*

Activity	Date & Location	Activity Description
Royce Pitchford, Pinion Advisory - 'Managing machinery investment'	1st August 2024 Booleroo Centre	▪ Making long-term plans for machinery investment ▪ Machines fit for purpose ▪ Monitoring total investment ▪ Looking for leverage and efficiency opportunities
Ben Smith, Trengove Consulting - Strategies for managing frost in cereals - learnings from the Mid North High Rainfall zone	1st August 2024 Booleroo Centre	▪ Frost Zoning – why do you need to zone? Green, Amber and Red Zones ▪ Phenology – How can we use phenology to mitigate frost risk - Variety selection based on phenology and TOS ▪ Novel methodologies and future work
Jamestown Crop Walk	23rd August 2024 Jamestown – Kitschke's farm	▪ Provided the opportunity to inspect the SAGIT frost trial site at Kitschke's farm and Mick Faulkner discussed management approaches to minimise frost impact ▪ Barry Mudge - GRDC's RiskWi$e initiative – the upside / downside to in-season nitrogen applications/ discuss RiskWi$e approach to N management.
Eastern Crop Walk	2nd September 2024 Bus Tour – Booleroo Centre region	Barry Mudge gave a brief introduction to the GRDC RiskWi$e program and as an example, circulated a decision matrix which incorporated the critical success factors for dry seeding into an index which aims to better inform intuition around dry seeding programs.
Western Crop Walk	27th September 2024 Bus Tour – Wandearah region	▪ Barry Mudge – speaking on GRDC's RiskWi$e initiative and its application in risky decisions discussed on the day ▪ Local Ag Bureau stickybeak day. ▪ Opportunity used to discuss RiskWi$e processes around dry seeding, N management and crop selection.

RiskWi$e

– the National Risk Management Initiative

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MID NORTH HIGH RAINFALL ZONE

MURRAY PLAINS FARMERS

NSS – NORTHERN SUSTAINABLE SOILS GROWER GROUP

UNFS – Upper North Farming Systems

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TRENGOVE CONSULTING

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NATIONAL PROJECT LEAD

CSIRO

CLIMATE
A QUICK REVIEW *of the* 2024 GROWING SEASON.

BY:
Peter Hayman, Dane Thomas and Bronya Cooper

An extremely dry year. Growers are currently focussed on the extremely dry first half of 2025 and we wait to see how the second half pans out. The challenges of 2025 are made greater because of the 2024 cropping season was amongst the driest on record (see Figure 1). Reviewing 2024 is important to place the trial work in context.

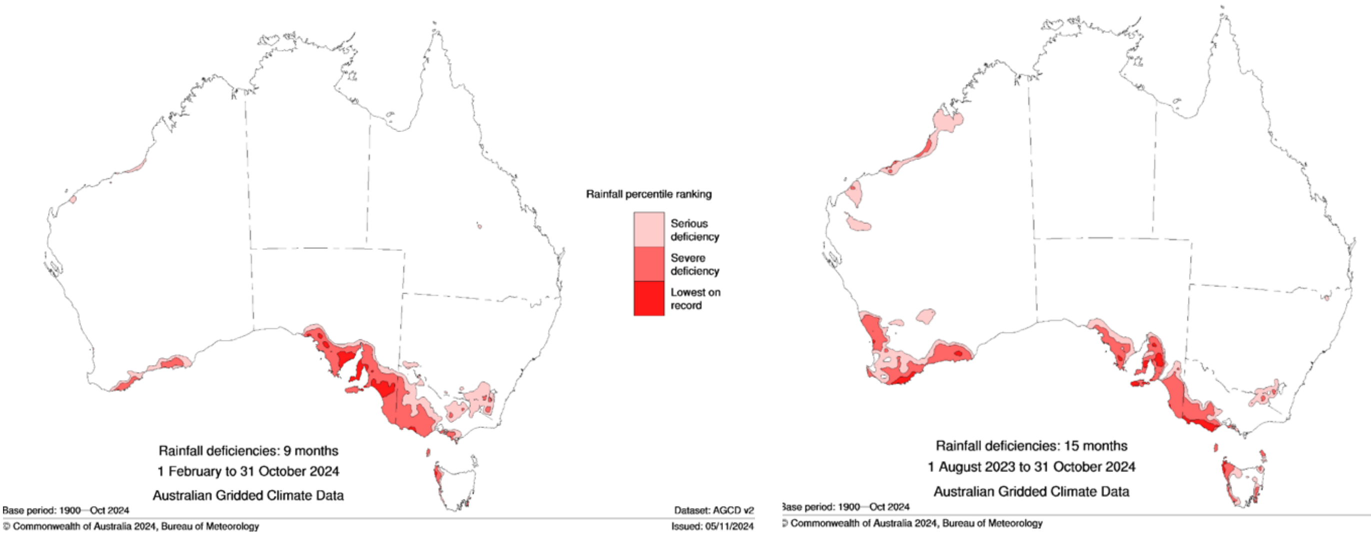


Figure 1. *Maps showing lowest on record, serious (<10th percentile) and severe (<5th percentile) rainfall deficiency. The left hand map shows the 9 months February to October 2024 and the right hand map shows the 15 months August 2023 to October 2024. www.bom.gov.au*

Growers and agronomists have noted stark fence line differences in paddocks mainly explained by moisture carried forward from 2023 and January 2024. Figure 2 contrasts the growing season with the preceding November to January. It is important to recognise that some farms missed out on the late season and summer rainfall and it is easier to retain moisture in some soil types.

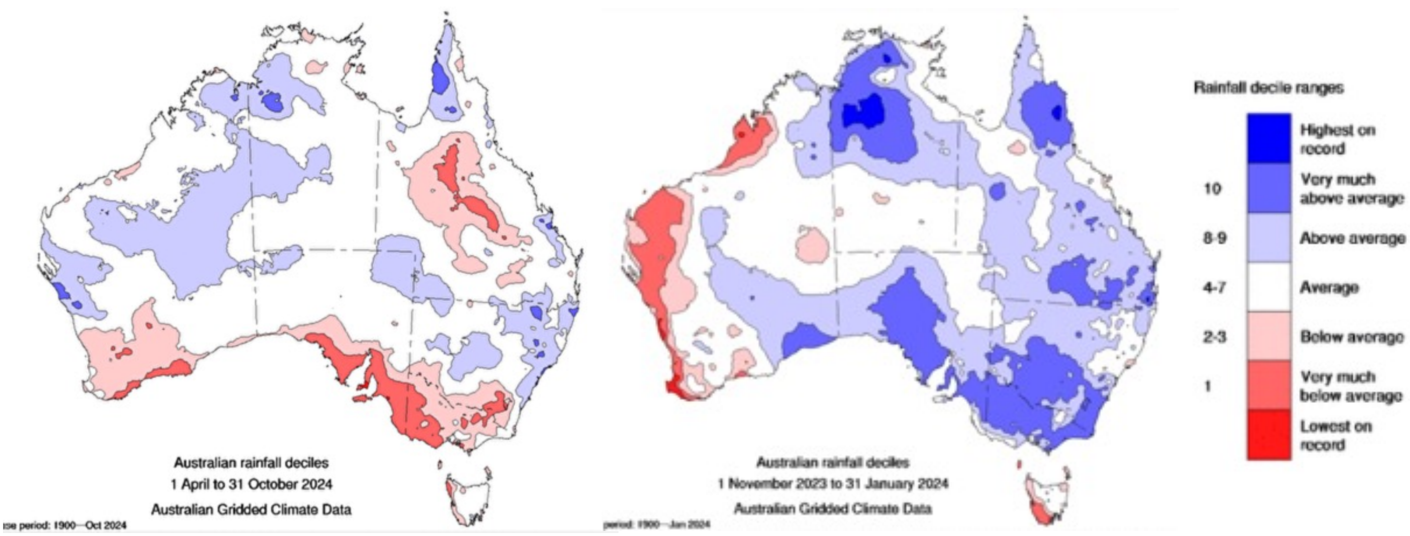


Figure 2. *Maps showing rainfall deciles for April to October 2024 growing season (left) and November 2023 to 31 January 2024 www.bom.gov.au.*

The rain stopped at the end of January 2024. February to May was extremely dry and large areas were dry sown from late April onwards. Rainfall in June and July were mixed but not wet enough to make up for the poor start. The important months of August and September were exceptionally dry (see individual months in Figure 3).

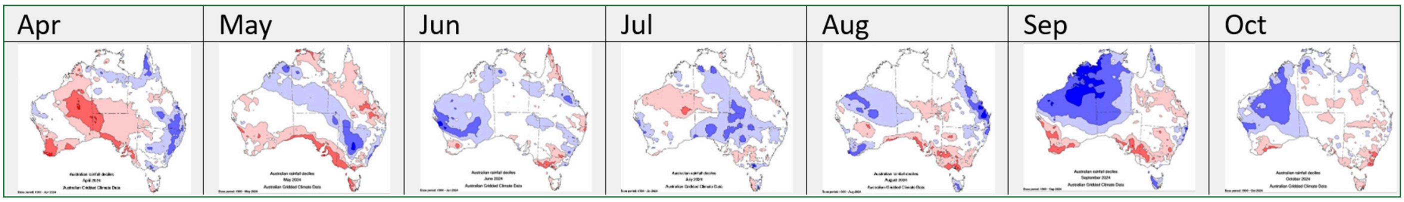


Figure 3. *Maps showing monthly rainfall deciles for April to October 2024 www.bom.gov.au*

A frosty year. Not only was 2024 one of the driest on record, but crops were also hit by a series of damaging frosts. Loggers measuring temperature at head height are often much colder than what is measured in the Stevenson screen at 1.2 m. There are networks of on-farm loggers and meso-nets which provide more localised paddock level data. The Bureau of Meteorology data set can be used to provide broadscale maps of cold nights. Figure 4 shows the spatial Figure 4. Maps of minimum temperature and synoptic map for some of the cold nights in September 2024. Source BoM. high-pressure system from the 12th to the 19th of September.

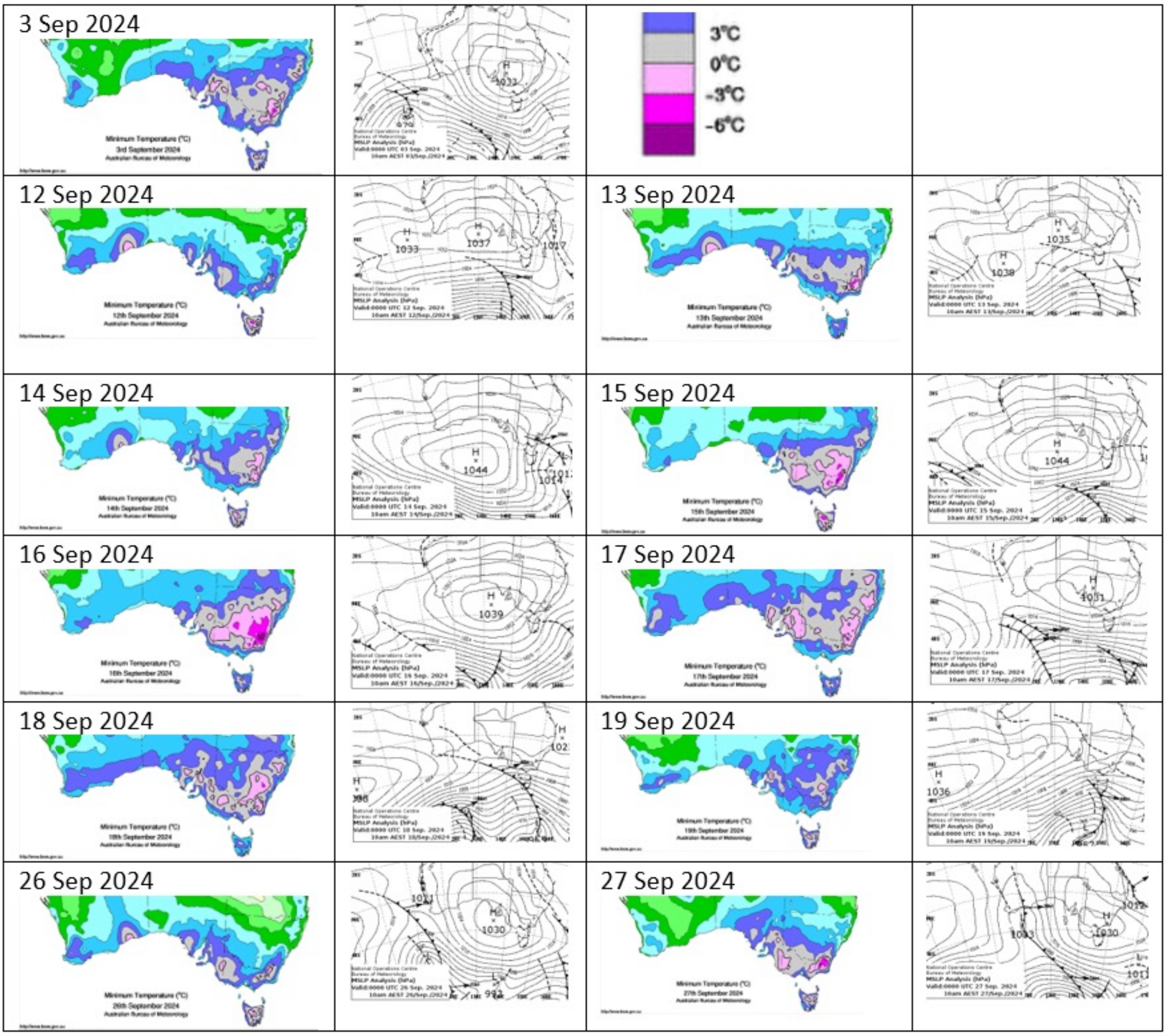
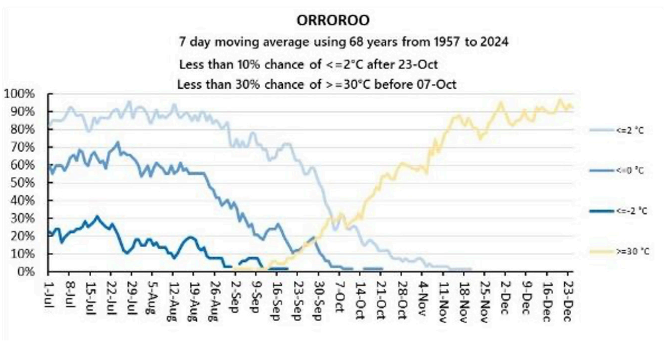
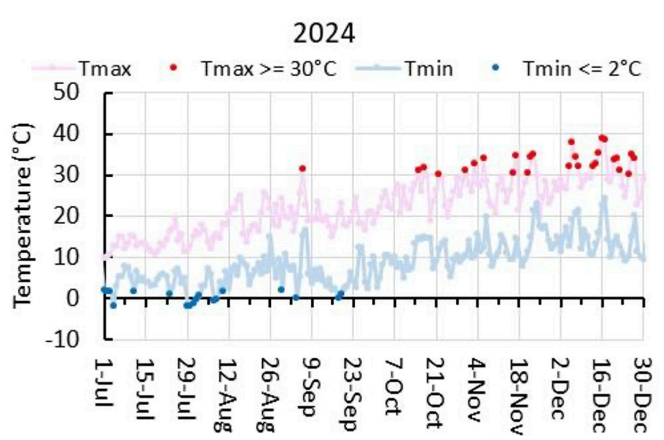


Figure 4. *Maps of minimum temperature and synoptic map for some of the cold nights in September 2024. Source BoM.*

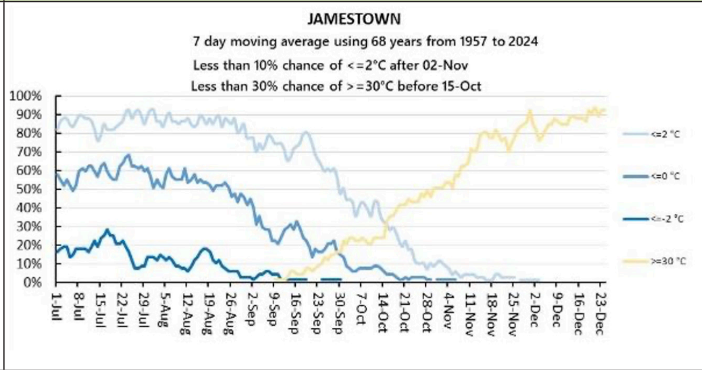
Although we have good access to historical rainfall data across the cropping zones, there are fewer sites where temperature has been recorded and even fewer that have a historical record that enables us to place 2024 in context. Figure 5 shows 6 sites across the southern grains region with the chance of any 7-day period in spring being colder than 2°C, 0°C or -2 °C in the screen and hotter than 30°C. The minimum and maximum temperature for 2024 is also shown for each site.

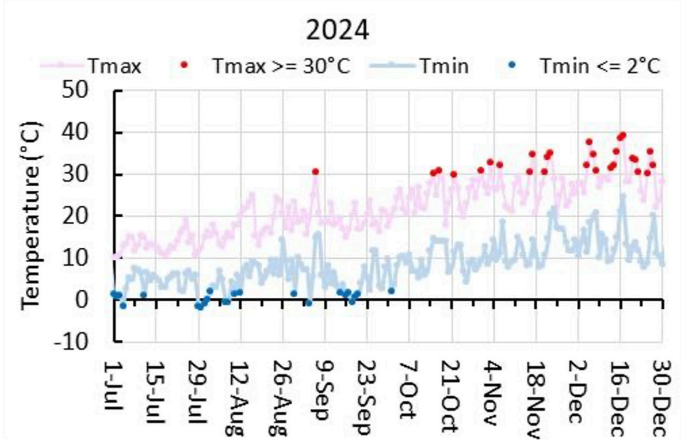
Orroroo, SA



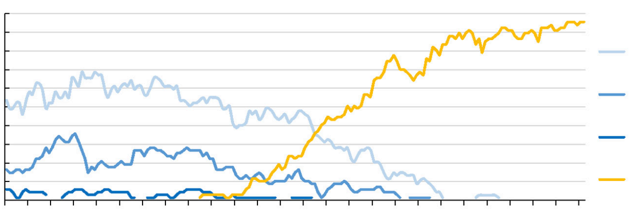


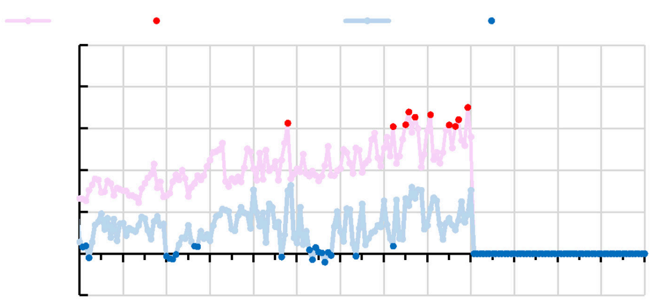
Jamestown, SA



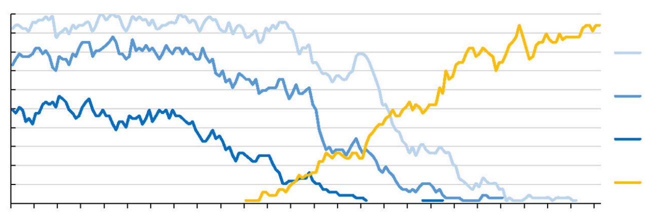


Snowtown, SA





Yongala, SA



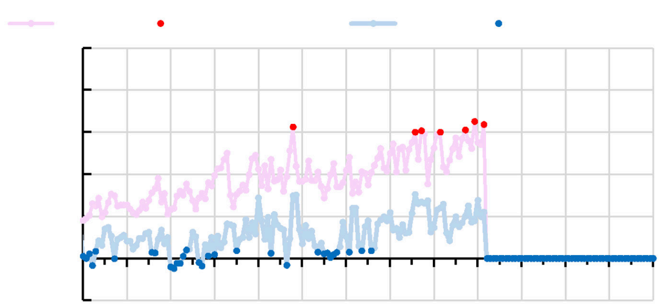


***Figure 5.** The chance of seven-day periods meeting minimum and maximum temperature thresholds at least once in the 67 years from 1957 to 2024 (upper panel) and the maximum and minimum temperature in 2024 with nights <=2°C shown in dark blue and days >=30°C shown in red.*

In most frost prone regions, sub zero nights in mid-September are not unusual. Growers will recall damaging frosts in mid-October and even Melbourne Cup frosts. Nights below -2 °C in the Stevenson screen in mid-September are rare events, but this is not the coldest on record. As mentioned earlier, the run of cold nights was the distinguishing feature of 2024, and there were reports that this led to multiple floret damage.

What about the forecasts and the climate drivers?

The dry start to the 2024 season across most of the southern region was broadly consistent with the forecasts for lower odds of above median, early growing season rainfall from the Bureau of Meteorology. A persistent high-pressure system in the Bight was evident in the observations and captured by the models. During this time, most growers dry sowed and scanned a suite of weather apps. A promising rain system appeared on the apps in late May which seemed to strengthen rather than slip away to the south. This rain was enough for good germination on most lighter soils and patchy germination on some heavy soils.

As can be seen in Figure 6, the 3-month outlook map for June to August that was released on the 30th May switched from brownish to white and green. The Bureau of Meteorology had declared a La Nina watch (shift from 25% to 50% chance of La Nina). As discussed earlier (Figure 3), June and July were patchy, August and September were extremely dry.

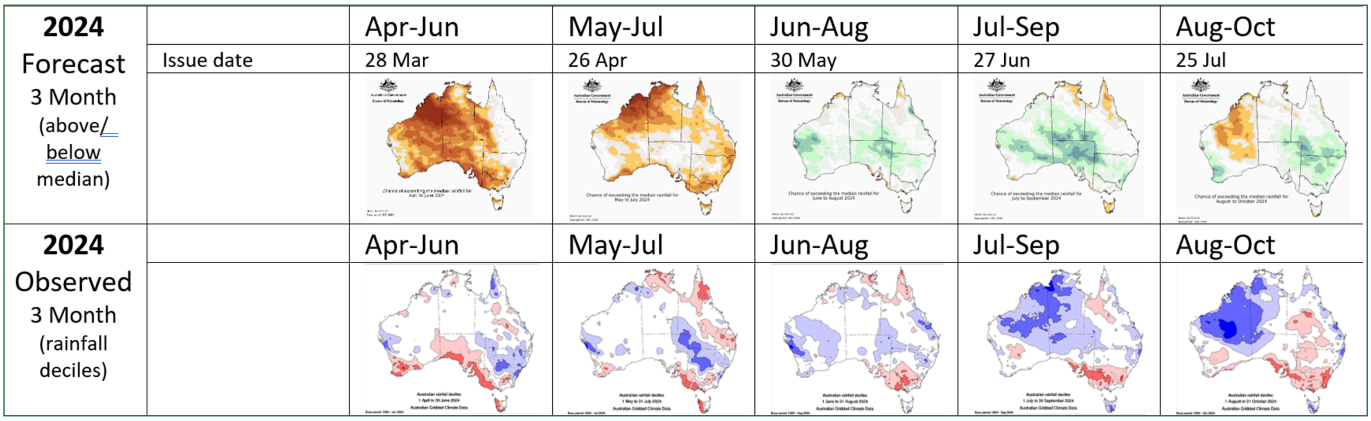


***Figure 6.** Three-month forecasts of chance of exceeding the median rainfall from April to Oct 2024, as issued at the end of the preceding month (top row), and corresponding observed rainfall deciles for each three-month period. Source BoM.*

Media headlines picked up The Bureau La Nina watch along with even higher confidence from international climate experts. Growers following the commentary on climate drivers and looking across a range of international forecasts could see neutral to increased chance of wetter conditions. The Bureau of Meteorology model seemed less confident in a La Nina developing as some international models and had a more neutral outlook for spring rainfall. Very few, if anyone, in the climate science community expected spring to be so dry. Moreover, we are not aware of explanations as to why it was so dry.

A near perfect seasonal forecast system would warn growers of dry seasons like 2024. It is obvious that we have an imperfect seasonal forecast system. When it comes to true warnings of poor seasons and true promises of good seasons, the forecasts are better than pulling numbers out of a hat, but these true warnings will continue to be mixed in with years when there is a failure to warn. After the failure to warn of one of the driest seasons on record, some growers will conclude that seasonal forecasts are best ignored. It is better to ignore the forecast and plan for a full range of outcomes than overinterpret a light green map as a forecast for a wet spring. The SA Drought Hub and RiskWi$e are working on ways to better interpret forecasts and, where appropriate, incorporate them in tactical decisions. RiskWi$e is also working on more strategic approaches such as N Bank which reduces the emphasis on the tactical decision.

Acknowledgements: ***This work was funded by GRDC through the RiskWi$e project and the Commonwealth Government through the SA Drought Hub.***

CROP AGRONOMY

CANOLA PROFITABILITY *in the* UPPER NORTH

Summary and Collated Results 2022-2024

Author: Jade Rose, *Upper North Farming Systems* | **Funded By:** *South Australian Grains Industry Trust (SAGIT)*
Project Title: *Canola profitability in the Upper North* | **Project Duration:** *2022 - 2024* |
Project Delivery Organisations: *Upper North Farming Systems, AgXtra*

Key Points

- This project aims to assess the profitability and reliability of different canola technologies compared to wheat in the Upper North, and determine whether newer varieties can make canola a more viable break crop option in the region
- In 2022, canola performed strongly across all sites (2–3.5 t/ha), achieving high oil content (>42%) and strong profitability ($417–$1754/ha), outperforming wheat at Melrose and Morchard, and in some treatments at Wandearah.
- In 2023, canola yields were modest (0.4–1.7 t/ha) and generally unprofitable across trial sites despite good oil content (39–43%); wheat outperformed canola at most sites, with profitability varying by location and conditions.
- In 2024, only Wandearah was harvested due to crop loss at Morchard (emus) and Melrose (heat stress). Canola yields were low (0.35–1.23 t/ha), but several treatments were profitable, with gross margins from $91 to $381/ha. Wheat yielded 1.37 t/ha but returned only $24/ha.
- **Future use:** Canola remains a valuable rotational option in the Upper North (UN), especially for grass weed and disease management, but its economic viability depends heavily on variety choice, input cost control, and seasonal conditions. Tactical use in favourable years and high-risk paddocks is recommended over routine inclusion.

Background

Extended cereal phases are common in the Upper North region due to the perceived unreliability and limited profitability of break crops. While the adoption of legumes and canola as break crops has increased in recent years, these crops remain secondary to grazing and pasture-based systems in many UN farming enterprises. Compared to similar agroecological zones such as the Upper Eyre Peninsula, oilseed production in the UN remains relatively low. This raises an important question: why is canola not widely regarded as a profitable break crop in the UN?

Canola has the potential to serve as a valuable niche crop in cereal-dominated rotations, especially where extended disease breaks are needed (e.g. to manage crown rot) or where improved grass weed control is required. Roundup Ready® and TruFlex® canola technologies offer significant advantages for managing ryegrass, making them attractive alternatives in systems where chemical options are otherwise limited.

Historically, canola has earned a reputation for being unreliable in the UN, particularly before the introduction of genetically modified (GM) varieties. The limited chemical options for grass weed control—especially reliance on clethodim, which has a narrow application window and phytotoxicity risks—further discouraged its use relative to pulses. The adoption of GM canola has marked a paradigm shift, enabling more robust ryegrass control and expanding the crop's potential role in local farming systems.

Canola is also agronomically well-suited to follow a legume in a double break sequence, capitalising on increased soil nitrogen. It often performs better than legumes in waterlogged or acidic soils. Findings from the GRDC Low Rainfall Crop Sequencing project (2011–2015) highlighted that many of the most profitable crop sequences began with a two-year break phase, reinforcing the value of such strategic rotations.

Multiple studies have shown that wheat grown after canola yields, on average, 20% higher than wheat following wheat. These rotational benefits, along with access to stable markets and improved crop sequencing, suggest that canola can contribute to more profitable and sustainable farming systems in the UN. Bridging the profitability gap between canola and cereals—and addressing agronomic challenges—is key to increasing its adoption and realising its full value in the region.

TT = Triazine-tolerant CL = Clearfield® (variety tolerant to imidazolinone herbicides) TF = TruFlex® (glyphosate-tolerant canola) RR = Roundup Ready® (glyphosate-tolerant).

Table 1. *Information for canola varieties and control (wheat) for Wandearah, Melrose and Morchard, SA.*

Variety and Technology	2022	2023	2024
Triazine tolerant and stacked			
HyTTec Trident	+		
InVigour T 4510	+		
HyTTec Velocity		+	+
ATR Bonito	+	+	+
AGTC0034 (Renegade TT)	+	+	+
Roundup Ready®, TruFlex® and stacked			
Nuseed Emu TF	+	+	+
Pioneer 44Y30RR	+	+	+
Pioneer 44Y27RR		+	+
Clearfield®			
Pioneer 43Y92CL	+	+	+
Pioneer 44Y94CL	+	+	+
Pioneer 44Y95CL		+	+
	Calibre wheat		

This project aimed to:

- Assess the profitability of different canola agronomy packages in local validation trials (GM vs open poll TT) against wheat over a three-year project.
- Inform grower decision making by exploring if new technology in canola could see it become a more reliable and viable break crop option in the UN Agricultural Zone.
- A key factor of this project is improving the profitability and soil health of farming enterprises, particularly those without sheep in the system.

Methodology

Three trial sites (Wandearah, Melrose and Morchard) to represent a vast and diverse area in terms of rainfall, rotations, and soil types.

Eleven canola varieties were selected for the trials (Table 1) after in-depth discussion with UNFS members and canola breeders. Varieties were selected based on their agronomy packages (TT, Truflex, RR, CL) pollination type, GM and maturity characteristics.

Trials had four replicates laid out in a complete randomized block design with a row of wheat separated from the canola by a wheat buffer. Each plot was 12m long x 6 rows.

Results and Discussion

Sowing and agronomic details for trials are presented in Table 2.

Table 2. *Sowing and agronomic details 2022-2024 for Wandearah, Melrose and Morchard sites, SA.*

Site	Sowing date[1]			Fertiliser		
	2022	2023	2024	2022	2023	2024
Wandearah	13 May	27 April	9 May	Granulock Z + Flutriafol @ 100kg; UAN @ 80L late June; early August	Granulock Z + Flutriafol (2L/t) @ 104kg/ha; UAN @ 80 L in late June	MAP + Flutriafol @ 55 kg/ha
Melrose	3 June	27 April	13 May			
Morchard	3 June	28 April	13 May			

[1]Sowing rate = 5 kg/ha

Seasonal Overview

Rainfall varied markedly across the three growing seasons (Table 3). In 2022, total in-crop rainfall (April–October) was above average, driven by a wet spring. In 2023, rainfall was below average during winter, despite a promising start. In 2024, the growing season was the driest of the three, with consistently below-average rainfall recorded across most sites.

Table 3. *Growing season (1 April to 31 October) rainfall data for the Wandearah, Melrose and Morchard sites, SA, for 2022, 2023 and 2024.*

Site	Growing season rainfall (mm) at sites			Long term GSR (mm) BOM
	2022	2023	2024	1991-2020 (April-Oct)
Wandearah	299	221	178	~270
Melrose	462	226	232	~340
Morchard	262	281	201	~260

The 2022 growing season in the UN was characterised by a late break and variable mid-season rainfall, which initially posed challenges for crop establishment and early growth. However, these conditions were offset by above-average rainfall in late spring, supporting strong biomass production and ultimately resulting in excellent canola yields across all trial sites.

In contrast, the 2023 season began with promising early conditions, including timely sowing and adequate soil moisture. Unfortunately, this early potential was curtailed by below-average winter rainfall and multiple frost events during September and October. These conditions, combined with a dry finish, led to moisture stress during grain fill and contributed to significantly lower yields.

In 2024, the season began dry, with below-average rainfall recorded across most sites during the critical April to October growing period. While early-season establishment was achieved, limited in-crop rainfall constrained growth and reduced yield potential. As the season progressed, patchy rainfall events provided only marginal relief, and in many cases were insufficient to fully support flowering and pod fill.

2024 Trial Results

The 2024 season presented significant challenges for canola profitability trials across the UN. Of the three planned trial sites, only Wandearah was successfully harvested. The Morchard site was heavily impacted by emu grazing and was ultimately lost, while Melrose experienced severe heat stress during reproductive stages and did not reach harvest maturity. As a result, yield data is only available from Wandearah.

At Wandearah canola yields were modest, reflecting the dry seasonal conditions and limited growing season rainfall. Some variation in performance amongst varieties was observed (Figure 1), but the yield range was limited, and overall productivity was low.

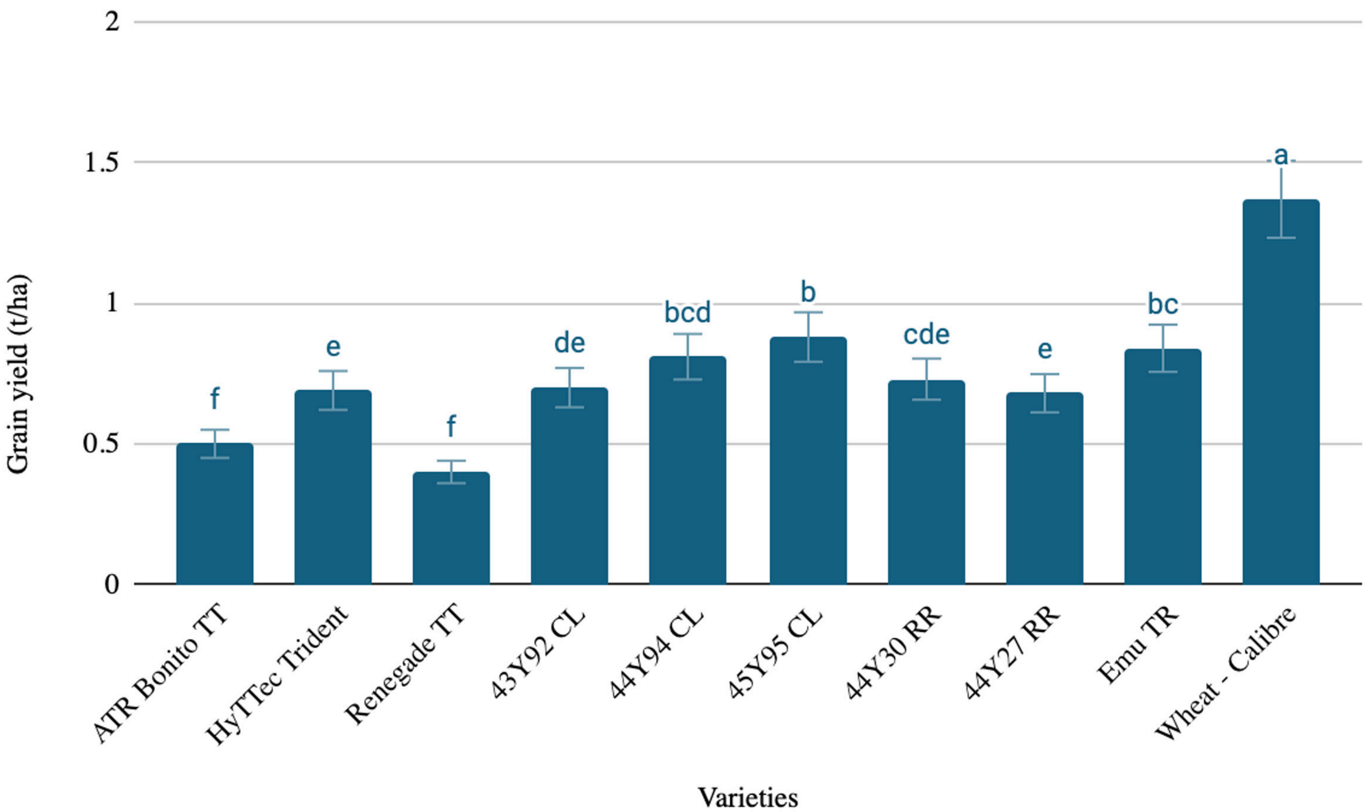


Figure 1. *Yield data for canola varieties against wheat variety Calibre located at Wandearah, SA in 2024. Values are means of yield for each variety; error bar is (±SE). Letters above bars reflect outcomes of ANOVA and post hoc Tukey's tests.*

Gross margin analysis (Table 4) for the 2024 canola trial at Wandearah highlighted the financial challenges posed by a low rainfall season. Using yield data from harvested plots and variable cost estimates drawn from the PIRSA 2024 Gross Margin Guide, profitability varied significantly across canola technologies.

Among the canola treatments, HyTTec Trident (a Triazine Tolerant hybrid) recorded the highest gross margin at $210/ha, despite a moderate yield of 0.69 t/ha. Other TT varieties like Renegade TT and ATR Bonito TT also performed well, with gross margins of $381/ha and $322/ha respectively, highlighting their cost-efficiency under low rainfall conditions. Clearfield varieties delivered more mixed results, with gross margins ranging from $91 to $197/ha, and a top yield of 0.88 t/ha from 45Y95 CL. Roundup Ready (RR) hybrids such as 44Y27 RR and 44Y30 RR returned moderate gross margins between $99 and $127/ha, suggesting their higher input costs were offset to some extent by reasonable yields. The Tri-Tolerant hybrid Emu TR achieved a solid result of $122/ha at 0.84 t/ha.

In comparison, wheat (Calibre) was the least profitable in 2024 despite achieving the highest yield of 1.37 t/ha, returning a gross margin of only $24/ha. This reflects the season's tight margins and dry finish, which limited wheat profitability despite lower input costs.

Overall, the results show that canola performance varied significantly by technology type, with several TT and Clearfield varieties outperforming expectations. Matching canola technologies to seasonal and site-specific conditions remains critical, particularly in low rainfall zones where cost management and variety selection can heavily influence returns.

Table 4 . *Indicative Gross margins for Canola and Wheat treatments in 2024 at Wandearah. Price assumptions based on the PIRSA Gross Margin Guide 2024, prices forecast for LOW rainfall zone and contract rates for machinery Ops. Canola prices adopted by technology type: Conventional = $650/tonne, Clearfield = $650/tonne, RR = $620/tonne, Tri-Tolerant = $650/tonne. Wheat = $340/tonne. *This data should only be used a guide, pricing sourced from 2024 forecasts.*

Variety	Yield (t/ha)	Gross Margin ($/ha)
Renegade TT	0.40	381
ATR Bonito TT	0.50	322
45Y95 CL	0.88	91
44Y27 RR	0.68	127
44Y94 CL	0.81	133
Emu TR	0.84	122
44Y30 RR	0.73	99
43Y92 CL	0.70	197
HyTTec Trident	0.69	210
Wheat, Calibre	1.37	24

Historical opportunity to establish profitable canola crops

The three-year trial period (2022-2024) highlights the variability of seasonal conditions in the UN and their influence on canola profitability. To support grower decision-making, it is useful to consider the historical probability of achieving successful canola crops.

Analysis of long-term rainfall and sowing opportunity data indicates that canola can typically be sown before 15th of May in approximately 30-40% of years at Wandearah and Morchard (CliMate). Timing is critical for maximising yield potential and achieving positive gross margins as, in years where canola is sown early and receives ≥ decile 5 growing season rainfall, the likelihood of positive returns increases substantially. In dry years or with delayed sowing, the risk of loss grows sharply — reinforcing the need to treat canola as a tactical, rather than a routine, break crop.

2022-2024 Results Summary

The 2022 growing season provided highly favourable conditions for canola production in the UN. Although the season began with a late break and some variability in mid-season rainfall, strong spring rainfall helped to drive biomass accumulation and grain fill. These conditions resulted in excellent yields across all three trial sites, with varieties achieving between 2.0 and 3.5 tonnes per hectare. Longer-maturing and newer varieties generally outperformed shorter-season types. Oil content was also a highlight of the season, with most varieties recording levels above 42%, contributing to oilseed premiums. All canola varieties were profitable in 2022, with gross margins ranging from $417 to $1,754 per hectare. At Melrose and Morchard, all canola varieties outperformed wheat, while at Wandearah, several varieties were also more profitable than wheat, despite challenges from weed pressure.

In contrast, the 2023 season presented significant challenges. The year began with good sowing conditions and encouraging subsoil moisture; however, this was followed by below-average rainfall through winter and multiple frost events during September and October. These conditions, coupled with a dry finish, constrained grain fill and significantly reduced yield potential. Canola yields across the trial sites were much lower than the previous year, ranging from just 0.4 to 1.7 t/ha. Oil content remained relatively high, averaging between 39% and 43%, but this was not enough to counteract the poor yields. As a result, profitability was substantially impacted, with gross margins ranging from -$29 to $441 per hectare. Wheat proved to be more profitable than canola at Wandearah and Melrose in 2023. Only at Morchard did a canola variety (Emu TF) outperform wheat.

The 2024 season continued the pattern of challenging seasonal conditions. Rainfall was below average during the critical April to October period, limiting crop growth and impacting yields across trial sites. The average canola yield across all treatments was approximately 0.79 t/ha, with a range from 0.35 to 3 t/ha. Although a small number of plots demonstrated strong performance, the majority of yields remained below 1 t/ha, reflecting bird and storm damage but also the limited rainfall and moisture stress experienced throughout the season. In 2024, insufficient seed was available to conduct oil content analysis due to the low yields and limited harvestable material across trial plots.

These seasonal outcomes have highlighted the variability in canola performance across years and the importance of variety and technology selection in managing profitability. Across the three-year trial period, Clearfield (CL) varieties have emerged as the most consistent performers, offering a favourable balance between input costs and yield stability—particularly under the stressed conditions of 2024, where they delivered the highest gross margin of $102/ha. In contrast, Triazine Tolerant (TT) varieties, while lower-cost, often recorded the poorest profitability outcomes and may be less suited to the UN's variable climate unless part of mixed farming systems that can capture grazing value. TruFlex (TF) and Roundup Ready (RR) varieties showed strong potential in favourable seasons, particularly where ryegrass control was a priority, but their higher input costs made them more vulnerable to seasonal downturns. When benchmarked against wheat, canola was more profitable in 2022, competitive in isolated cases in 2023 and 2024, but wheat remained the more resilient and economically stable option across variable seasons. These findings suggest that while canola—particularly newer CL and TF types—has a role as a profitable and strategic break crop in the UN, its use must be carefully matched to seasonal outlooks, paddock history, and enterprise risk tolerance.

Strategic recommendations and economic comparison summary

Across the 2022–2024 trial period, canola performance in the UN has demonstrated both its potential and its limitations within local farming systems.

Canola as a rotational tool

Canola continues to offer rotational benefits, including effective grass weed control (especially with RR and TruFlex technologies), improved disease management (e.g. crown rot break), and yield benefits for subsequent cereal crops. Evidence from literature suggests wheat after canola may yield up to 20% more than wheat-on-wheat, a benefit not captured in short-term GM analysis but important in multi-year planning.

Economic variability & risk profile

Year	Average Canola Yield (t/ha)	Canola GM Range ($/ha)	Wheat GM ($/ha)
2022	2.0 – 3.5	$417 – $1,754	Lower at most sites
2023	0.4 – 1.7	−$29 – $441	Generally higher
2024	0.35 – 1.23	−$190 – $102	$155.80

Canola shows high upside in favourable years (2022), but significant downside in dry or frost-prone seasons (2023–24), especially when high-input varieties are used. Clearfield (CL) varieties offered the most consistent returns across seasons, balancing input costs with yield potential.

Recommendations by Farming System

Farming System Type	Canola Suitability & Recommendations
Low rainfall, continuous cropping	Prioritise CL or TT varieties in paddocks with weed pressure. Avoid high-input RR/TF varieties unless seasonal outlook is strong. Consider grazing value if mixed enterprise.
Mixed farming (cropping + livestock)	TT and CL types may suit dual-purpose use. Spring rainfall variability may still limit upside; grazing value adds a buffer.
High-input, weed-driven systems	RR and TruFlex technologies are valuable for grass control. Use cautiously in drier years due to cost exposure. Maximise returns with early sowing and strong fertility paddocks.
Disease-prone areas (e.g. crown rot risk)	Canola remains a strategic disease break, particularly when followed by wheat. Profitability may be secondary to long-term system health in these zones.

Key takeaways for growers

- Match variety choice and technology to seasonal outlook, paddock history and weed pressure.
- Clearfield canola provides a stable option for growers reintroducing canola.
- Truflex and RR types, while great for ryegrass management, are best deployed tactically, with careful attention to input costs and spring rainfall forecasts. They carry higher risk in seasons with limited spring moisture or short growing windows.
- Historical sowing opportunities before 15 May occur roughly 1 in 3 years - plan accordingly.

Acknowledgements

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- A special thank you to Andrew Walter, Andrew Catford, Brendon Johns and David Clarke for their invaluable support in providing trial sites, guidance, and assistance throughout the project.
- Thank you to AgXtra for their ongoing management and support of trial sites in the UN.
- We would also like to thank Pioneer®, Nuseed, BASF and AGT for providing seed.

UNFS Upper North Farming Systems   SAGIT   nuseed®   AGT   PIONEER®   BASF We create chemistry

DE-RISKING *the* SEEDING PROGRAM

Eastern Demo (Booleroo)

Author: Jade Rose, *Upper North Farming Systems* | **Funded By:** *Drought Hub* | **Project Title:** *De-Risking the Seeding Program*
Project Duration: *2024 - 2026* | **Project Delivery Organisations:** *Upper North Farming Systems*

Background

This demonstration was established to evaluate the performance and crop safety of a range of pre-emergent herbicide strategies for early-season weed control under dry sowing conditions in the Lower Rainfall Zone (LRZ). The trial was sown in late April 2023 on the Nottle property, east of Booleroo, using two different farmer-scale seeding systems (a hybrid disc and an airdrill).

Three wheat varieties (*Sceptre, Rockstar, and Calibre*) were sown across demo plots, with each herbicide treatment covering all varieties. The layout allowed side-by-side comparisons of seeder type, variety, and herbicide combinations.

Treatments and Objectives

Six pre-emergent herbicide strategies were tested:

1. **Trifluralin, Group 3 @ 1L + Avadex, Group 15 @ 2L**
   A commonly used combination targeting a broad spectrum of annual grasses and some broadleaf weeds. This treatment serves as the industry standard or baseline for comparison, assessing how newer chemistries perform relative to traditional options.
2. **Sakura, Group 15 @ 118g**
   A Group 15 herbicide targeting annual ryegrass and other key grass weeds. It offers residual control and is known for its safety in wheat. This treatment assesses Sakura's standalone effectiveness under dry conditions.
3. **Sakura, Group 15 @ 118g + Avadex, Group 15 @ 1.6L**
   This combination aims to broaden the weed control spectrum and enhance residual activity by pairing Sakura with Avadex. It tests whether this mix improves early-season control and delays resistance.
4. **Luximax, Group 30 @ 500mL**
   A relatively new herbicide with a different mode of action (Group 30), designed to manage resistant ryegrass populations. The trial assesses Luximax's crop safety and consistency in dry sowing scenarios.
5. **Overwatch, Group 13 @ 1.25L**
   With activity on both grass and some broadleaf weeds, Overwatch also imparts a distinct bleaching crop effect when sufficient seed, soil seperation has not occurred. This is particularly true for barley, where crop tolerance is less. Annual ryegrass (ARG) turns purple when dying from an overwatch application.
6. **Mateno Complete, Group 15 @ 1L**
   A new broad-spectrum herbicide offering both pre- and early post-emergent activity, including suppression of key broadleaf weeds. This treatment evaluates its weed spectrum, safety across wheat varieties, and suitability in early dry sowing.

N

White Cliffs Road

Ha

	Total m	Scepter		Rockstar		Calibre			
	66	13	9	13	9	13	9		
0.16								12	Trifluralin @ 1L+ Avadex @ 2L
								12	
0.16								12	Sakura @ 118g
								12	
0.16								12	Sakura @ 118g + Avadex 1.6L
								12	
0.16								12	Luximax @ 500ml
								12	
0.16								12	Overwatch @1.25L
								12	
0.16								12	Matino Complete @ 1L
								12	

Figure 1 . *Treatment list of the demonstration located in Booleroo.*

While the demonstration was not formally monitored throughout the season, a number of important factors were discussed at the grower event held at the site. These included the timing and consistency of weed control onset across different herbicide treatments, and how quickly visual suppression of weeds appeared following application.

Crop safety was also a key topic, with attendees considering potential early crop effects such as bleaching or stunting that may occur under different herbicide regimes and how these may vary between wheat varieties.

The influence of seeding equipment—comparing the hybrid disc and airdrill systems—was another point of interest, particularly in terms of how each system might affect herbicide incorporation and subsequent weed control efficacy.

Environmental conditions, including soil type, crusting, and the lack of rainfall, were acknowledged as having a significant impact on the activation and performance of pre-emergent herbicides in 2023. Unfortunately, due to the dry and difficult season, active measurements and assessments were not conducted across the site.

Despite these limitations, the demonstration provided a valuable opportunity to engage with growers and discuss the practical considerations of herbicide selection, seeder compatibility, and variety choice under dry sowing conditions in the Lower Rainfall Zone.

Acknowledgements

We would like to sincerely thank Matt Nottle and Dave Clarke for generously providing their time, machinery, and the trial site to support this demonstration. Their ongoing commitment and contribution were invaluable in making the project possible. We also acknowledge AgXtra for their support with herbicide application and site assessments. Their technical input and assistance were greatly appreciated and instrumental in the successful delivery of the trial.

THE IMPACT *of* SOWING SPEED, SEEDING POINT TYPE, SOWING DEPTH, *and* PRE-EMERGENT HERBICIDE CHOICE *on* BARLEY ESTABLISHMENT *and* EARLY GROWTH *on* SALINE SOILS

Author: Stefan Schmitt - *Agricultural Consulting and Research* | **Funded By:** *FDF Future Drought Fund (Ag Ex Alliance)*

Project Title: *De-Risking the Seeding Program* | **Project Duration:** *2024 - 2026*

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Future Drought Fund

Key Points

- Sowing speed had a significant effect on barley establishment.
- Fast sowing resulted in significantly lower ground cover at GS30 compared to normal sowing speed.
- Sowing depth, point type, and herbicide type did not have a statistically significant impact under the conditions of this trial.

Why do the trial?

This trial investigates the crop safety of two commonly used pre-emergent herbicides on barley emergence and early growth. It evaluates how these chemistries interact with two different seeding point types, different sowing depths, and both standard and above-recommended sowing speeds. These are all factors which farmers can vary at seeding; the aim was to evaluate if crop establishment can be improved or impeded by not optimising the strategy at seeding.

The trial was conducted on a saline grey loam soil in the Wandearah region. This site was selected because pre-emergent herbicides are known to be more aggressive or “hotter” on crop establishment in these soil types. The two-point types used in the trial are commonly found on local seeding rigs and were included to assess whether point design influences crop safety of different pre-emergent herbicides or if one point is better suited to establishing crops on saline soils.

Sowing was carried out using a plot seeder with tynes spaced at 10 inches. The recommended ‘safe’ sowing speed for this setup is 8 km/h. A faster sowing speed was included in the trial to intentionally test whether crop damage would be exacerbated under less-than-ideal conditions.

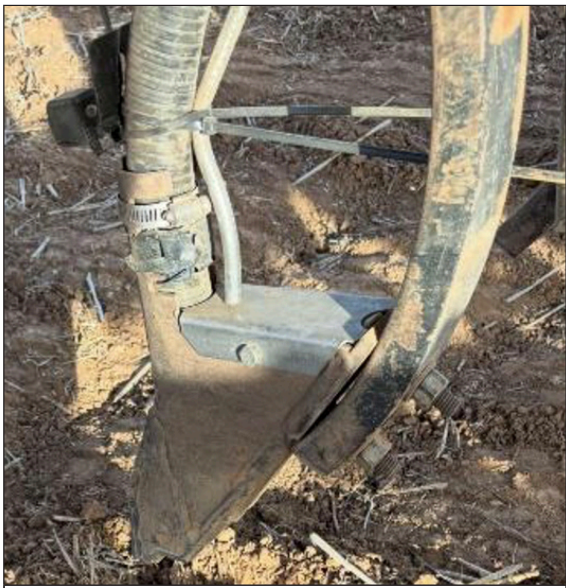
Please note: There was some patchiness across the site, including areas of higher salinity. This may have affected how some treatments performed, so take results as a general guide rather than absolute.

Practical Takeaways for Growers

- Avoid fast sowing speeds when aiming for strong early barley establishment.
- Faster speeds likely reduce seed-soil contact and depth consistency.
- No major differences were observed for different sowing depths, point types, or herbicide strategies in this trial in this season. However, it should be noted that the conditions post seeding were not conducive to herbicide injury due to lack of significant rainfall events.

Table 1. *Treatments at Wandearah site, 2024.*

Factor	Levels Tested
Sowing Speed	Optimum 10km/hr, Fast 12km/hr
Sowing Depth	Shallow (~15 mm), Optimum (~30 mm)
Point Type	Root Boot Paired Row Boot vs Atom Jet Boot
Pre-emergent	Overwatch @ 1.25L/ha vs Sakura @ 85g/ha
Measured Outcome	Ground Cover (%) at GS30



Atom Jet point, this point opens a 20mm slot where seed is dropped on a firm seed bed. There is no under seed tilth or option to split fertiliser away from seed.

Root Boot paired row opener, this opener digs approximately 2 inches under the seed zone and places seed in paired rows on the firm shoulder of the point furrow.

Statistical Analysis Summary (ANOVA)

Factor	p-value	Significant?	Comments
Depth	0.7385	No	No impact on establishment
Speed	0.0001	Yes	Faster sowing speed reduced barely establishment
Point Type	1.0000	No	No impact on establishment
Pre-emergent Herbicide	1.0000	No	No impact on establishment
Depth × Speed	0.4241	No	No impact on establishment
Speed × Pre-emergent	0.2143	No	No impact on establishment
All other interactions	>0.88	No	No impact on establishment

Note Sakura is not registered prior to sowing Barley.*

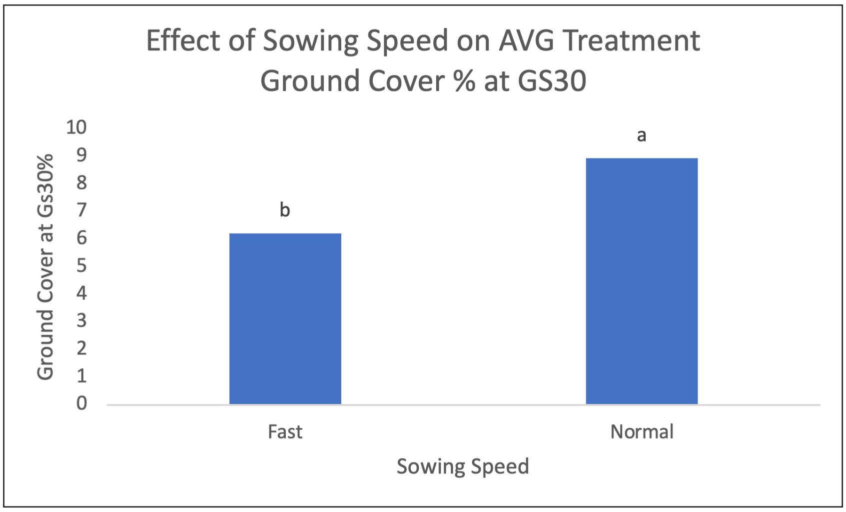


Figure 1. *The effect of sowing speed on ground cover percentage of barley at GS30. Note: means followed by letter in common are not significantly different from one another at the 5% level. Note this trial site has considerable variation in surface salt which has created noisy data, it is best that results are treated with caution.*

Results

Of all the variables tested, the only variable to significantly impact the establishment of barley in this trial was sowing speed. The 'fast' sowing speed recorded significantly lower ground cover levels at 6% at GS30 compared to the normal/optimum sowing speed which recorded 9% ground cover.

Discussion

Unfortunately, due to persistent drought conditions in this area this year this trial was not harvested. However, the ground cover measurements taken at GS30 provide a useful measure of treatment effects. In this season the only variable of those tested that impacted ground cover % was sowing speed. This is not a surprise as it is common knowledge that sowing too fast can decrease crop performance due to decreased safety of pre-emergent herbicides and reduced crop establishment due to seed bounce and reduced depth consistency and seed soil contact.

It would be good to repeat this trial over a range of seasons to see if these results hold true in all situations.

We would like to thank the Crouch Family from Wandearah for hosting this trial site.

This project is supported by Ag Excellence Alliance, through funding from the Australian Government's Future Drought Fund

Australian Government
Department of Agriculture, Fisheries and Forestry
Future Drought Fund

Trial conducted and reported by:

Stefan Schmitt – Independent Agricultural Consultant
Company – Agricultural Consulting & Research

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ON-ROW SOWING *for* IMPROVED ESTABLISHMENT *on* SALINE SOILS

Author: Stefan Schmitt - *Agricultural Consulting and Research* | **Funded By:** *FDF Future Drought Fund (Ag Ex Alliance)*

Why do the trial?

This demonstration explores three variables that can be altered at seeding by farmers and the subsequent impact on crop establishment. The aim of this work is to tease out ways to improve establishment on soil types where establishing crops is a challenge either due to surface crusting or salinity.

The three variables explored in this demonstration are (1) sowing depth – sowing shallow (15mm) or at optimum depth (25mm), ground opener / point type – Atom Jet (no under-seed tilth) vs Root Boot (with under-seed tilth), and (3) row position – on last year's row vs between last year's rows (inter-row).

The trial site was located on a red loamy soil in the Port Pirie region. This soil type has moderate surface salinity levels that impede crop establishment if insufficient rain occurs prior or close to seeding to dilute salt levels. It is also prone to surface crusting due to low organic matter.

Rationale Behind Treatments

Sowing back into the previous year's stubble row is known to improve establishment under marginal soil moisture conditions or on saline soils. The stubble row can increase water harvesting and help flush salts in the seed zone.

The seeding point aspect was included due to ongoing debate about whether digging under the seed and splitting seed rows (e.g. Root Boot) is detrimental to establishment by bringing salty soil into the seed zone or placing seed on furrow shoulders. Atom Jet places seed on a firm seedbed with no under-seed tilth.

Shallow sowing was included as it is thought to be advantageous on soils prone to surface crusting.

Trial Details

Crop: Commodus barley

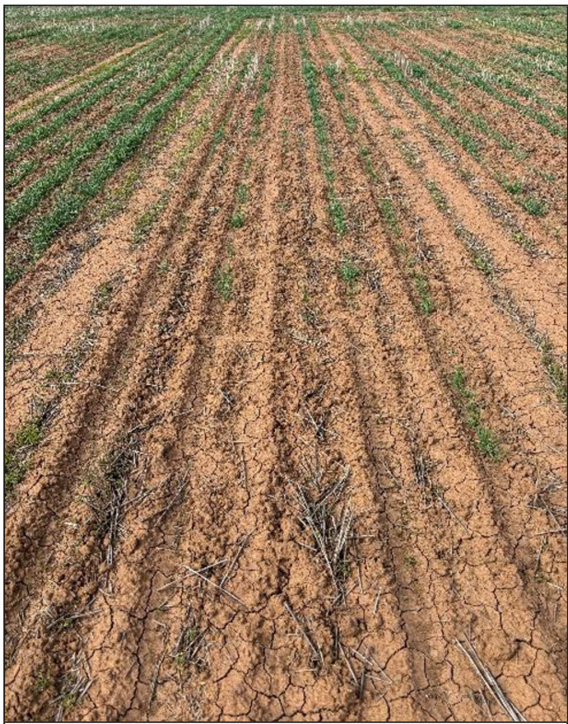
Seeding date: Pre-break of season

Pre-emergent herbicide: Boxer Gold (2 L/ha) + Avadex (1.5 L/ha)

Fertiliser: MAP @ 80 kg/ha

Results

Important Note: This site exhibited considerable variability in surface salinity, which introduced significant noise into the data. As a result, no statistically significant differences were observed between treatments. Anecdotal observations suggested some trends, but these were not statistically supported.


Atom Jet – Inter row sowing @ 25mm


On Row Sowing @ 15mm Depth with Root Boot paired row boots.

Results

Important Note: This site exhibited considerable variability in surface salinity, which introduced significant noise into the data. As a result, no statistically significant differences were observed between treatments. Anecdotal observations suggested some trends, but these were not statistically supported.

Treatment Establishment (plants/m²):

Point Type	Depth (mm)	Row Location	Establishment (plants/m²)
Atom Jet	25	On	16a
Atom Jet	15	On	18a
Atom Jet	25	Inter	5a
Root Boot	25	On	30a
Root Boot	15	On	23a
Root Boot	25	Inter	16a
Root Boot	15	Inter	20a

Treatments followed by the same letter are not significantly different at the 5% level.

Statistical Analysis Summary (ANOVA)

Trial Variability: The overall coefficient of variation (CV%) for the trial was 79.7%, indicating a very high level of variability in plant establishment across plots.

Factor	p-value	Significant?
Row Position	0.421	No
Opener × Row Position	0.885	No
Depth × Row Position	0.844	No
Opener × Depth × Row Position	0.775	No

Note: Opener and Depth main effects returned NaN values due to sparse or unbalanced data combinations.

Observations & Interpretation

Despite no significant differences, some numerical trends suggest potential benefits of on-row sowing, particularly with Root Boot openers. The high variability across the site, especially in salinity levels, likely masked treatment effects. Further trials under more uniform conditions are required to validate these findings.

Next Steps

- Repeat the trial over multiple seasons to assess consistency of any trends.
- Consider controlled salinity blocks or more intensive soil mapping to better manage variability.

Acknowledgements

We would like to thank the Johns family of Port Pirie for hosting this site.

This project is supported by Ag Excellence Alliance, through funding from the Australian Government's Future Drought Fund

Australian Government
Department of Agriculture, Fisheries and Forestry
Future Drought Fund

Trial conducted and reported by:

Stefan Schmitt – Independent Agricultural Consultant
Company – Agricultural Consulting & Research

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FROST MITIGATION STRATEGIES *for the* UPPER NORTH

Author: Jade Rose, *Upper North Farming Systems* | **Funded By:** *South Australian Grains Industry Trust (SAGIT)*
Project Duration: *2024-2027* | **Project Delivery Organisations:** *Upper North Farming Systems, Agricultural Consulting and Research*

Key Findings

- This project aims to identify, and understand key risks associated with hot weather and frost effects on crops, to provide Upper North (UN) growers with more practical strategies to reduce yield losses from frost events.
- Frost risk significantly reduced yield in the Red Zone (high frost risk). Across all varieties, yields in the Red Zone were substantially lower than in the Green Zone (low frost risk), with most varieties yielding 20–40% less. For example, Calibre wheat dropped from 1.04 t/ha (Green) to 0.71 t/ha (Red), highlighting the severe impact of frost exposure on flowering and grain set.
- Early sown, quick-maturing varieties performed best in both zones. Fast-maturing varieties like Vixen and Commodus performed consistently well across both ones when sown early. Vixen achieved 1.03 t/ha in Green and 0.79 t/ha in Red, suggesting that aligning flowering to avoid frost remains one of the most effective strategies for managing risk.
- Varietal response to frost was not always predictable. Some varieties showed unexpected performance under stress. Commodus barley, for example, yielded better in the frost-prone Red Zone (0.69 t/ha) than in the Green (0.60 t/ha), indicating that localised microclimate or soil factors may influence outcomes more than maturity alone.
- Zoning trials provided critical insight into genotype and environment interactions. The dual-zone design clearly demonstrated that variety and management recommendations must be tailored to landscape position. A single sowing strategy across variable zones risks underperformance in one or both environments.

Background

Frost events have been a significant concern in the UN region of South Australia, resulting in substantial crop losses and economic impacts in past years leading up to 2024. The UN is susceptible to frost damage at various stages in the growing season, particularly during their critical reproductive stages, often leading to decreased yields. Consequently, depending solely on planting longer season varieties with later flowering times to evade frost risks is not always a dependable management strategy.

The 2024 season was particularly challenging, marked by severe frost events in September that compounded the effects of a dry winter and early spring. These conditions led to poor crop performance across many regions, with yield potential significantly limited. In response, many growers resorted to cutting severely frosted crops for hay as a salvage strategy. The total crop area harvested for grain was further reduced by the impact of frost, contributing to a revised grain production estimate of 5.2 million tonnes for 2024–25, which is 43% below the five-year average and the lowest total since 2008–09.

Given the UN's medium to low rainfall and heavy clay/clay loam soils, the region faces a high frost risk in August and the onset of summer heat and moisture stress from late September. These factors limit growers' ability to take advantage of early sowing opportunities to increase yields of main season wheat.

This project was developed based on findings from other key frost projects in South Australia (EPAG, Mid North High Rainfall Zone). The aims were to identify and understand key risks associated with hot weather and frost effects on crops, as influenced by both agronomic and risk management strategies. It aims to provide UN growers with more practical strategies to reduce yield losses from frost events.

Aims

1. Evaluate the efficacy of various previously trialled frost management strategies (pre-frost and acute responses) in alleviating yield losses attributed to frost damage on a representative (or multiple), frost-prone sites in the UN.
2. Enhance UN growers' understanding of the origins of frost damage within the region and equip them with effective strategies to reduce associated risks.
3. Consolidate proven research outcomes, and related information, and extend key messages in a practical, flexible and applied manner that is locally relevant to growers, environment and farming systems.

Methodology

A site in Jamestown (Image 1) was identified with a high 'Red Zone' and moderate 'Green Zone' frost risk within the same paddock. Research activities in both zones - the 'Red Zone', where frost events are common, and the 'Green Zone', which is typically frost-free. This dual-zone approach enables a thorough evaluation of treatments—both under frost conditions and in areas unaffected by frost—providing insight into their effectiveness and potential yield benefits across varying environments.

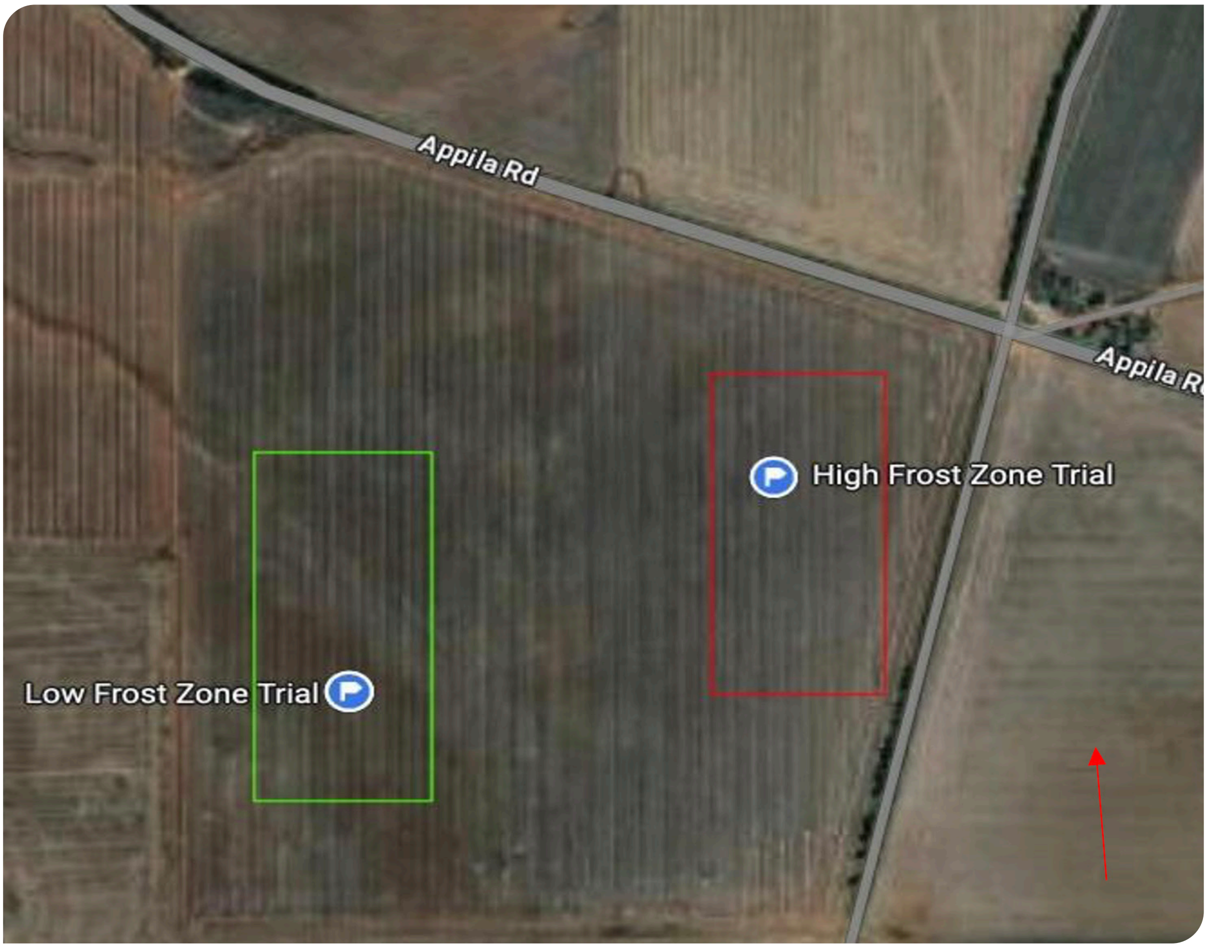

Image 1. *High (Red) and Low (Green) frost risk Zone locations, within the paddock at Jamestown.*

Stevenson screen temperature loggers (Thermochron Ibuttons) were set up within each trial (Red Zone and Green Zone) at soil surface and canopy height.

Treatments were selected to assess the:

- Relative frost tolerance and yield stability of different varieties.
- Effectiveness of sowing date manipulation as a risk management strategy.
- Trade-offs between frost avoidance and other seasonal risks (e.g. terminal drought or heat).

To evaluate the interaction between genotype and environment in relation to frost risk, 9 wheat, 1 barley and 4 oat varieties with differing maturities were sown at two times of sowing (see below) in a split plot design, with three replicates. Plots were 12m long and 6 rows. Canola was included in the trial (non-statistical) due to its sensitivity to frost during early flowering, to provide a visual and physiological contrast for response to frost events.

Varieties sown early and in the main local sowing window:

- Oats – Kingbale, Archer, Bannister, Koala.
- Wheat – Bale, Mohawk, Denison, Bennett, Calibre, Rockstar, Dual, Vixen, LPB19-6850.
- Wheat mixture – Rockstar+Calibre+Vixen
- Wheat – Calibre: Frosted vs Late Fill
- Barley – Commodus.

Varieties sown early only:

- Barley – Commodus Frosted vs Late Fill; Commodus Frosted vs Mid Fill
- Canola – Hyola 970, Hyola Regiment, 45Y95CL

Plots were 12 m long, with 25 cm row spacing. **Sowing dates:** 1 May 2024 - early; 14 June 2024 - main local sowing window (post break of season). **Fertiliser at sowing:** Granuloc Z @ 100kg/ha cereals and 56kg/ha canola. **Fertilizer in-crop:** UAN (32% N) was applied in-crop on 10th July 2024: 135L/ha on cereals; 160L/ha on canola. **Pre-emergent herbicides:** cereals - 2.5L/ha Boxer Gold, 200ml Calisto, Roundup + Hammer knockdown; Canola - 1.2L/ha Overwatch. **Harvest** was on 4th December 2024.

Results

Frost events

Importantly, the heading/flowering phase at Zadoks GS 60–69 (particularly GS 65 – flowering, or anthesis), is particularly sensitive to frost damage in wheat, barley and oats. Vegetative phases (pre-GS 60) are much less sensitive to frosts.

Multiple frost events were recorded across the trial period, where minimum temperatures consistently fell below zero and distinct temperature patterns occurred amongst zones and treatments. Red Zone treatments (north and south) experienced the most severe frosts (Figure 1). These conditions likely impacted early vigour and crop development, although the relationship with final yield was less direct than expected and varied by variety and sowing time.

Early-season frost (28 July 2024): Minimum temperatures reached -6°C in the Red Canopy, with average temperatures below freezing across all Red Zone treatments. The Green Zone was milder, with an average of 0.23°C and a minimum of -3°C. At this stage, plants were in the less sensitive vegetative stages, and while this frost likely reduced vigour and early biomass, especially in the Red Zone, it did not coincide with sensitive reproductive phases and thus had limited direct yield impact.

Early–mid season frost (6 August 2024): The Red Zone again experienced significantly lower temperatures (minimums of -4.5°C) than the Green Zone (minimum -1.5°C). This event, observed across all TOS treatments, likely reinforced early-season stress (especially for earlier maturing lines such as barley and oats) but again occurred prior to flowering, limiting its direct effect on yield.

Late season frost (3 September 2024): A further frost event occurred with minimums down to -4.5°C in Red Zone South. Notably, the Red Zone (canopy height) remained colder (average 0.91°C) compared to the Green Zone (canopy height) (1.55°C), despite no sub-zero temperatures in the latter. By this date, early-sown varieties such as Vixen, Calibre, Bannister, and Kingbale were at or near flowering (GS65) in both zones, making them highly susceptible to frost damage. This event coincided with critical reproductive stages for many wheats and oats in the Red Zone and may have contributed to lower grain set and yield.

Very late season frost (19 September 2024): A sharp frost event occurred late in the season, again showing the lowest minimums in the Red Zone (-6°C). The Green Zone and Red Zone recorded similar minimums (-3°C and -3.5°C, respectively), while the average temperature in Red Zone remained below zero (-1.045°C). Around this time, later-developing varieties such as Rockstar, Dual, and Kingbale (Late) were approaching or just entering flowering, placing them at heightened risk of frost damage during this sensitive stage. The impact of this frost likely varied with variety maturity and sowing time.

Overall, the Red Zone canopy treatments consistently experienced the coldest conditions, particularly on the southern side, indicating strong topographic or canopy-induced cold air pooling effects. These temperature differences highlight the importance of landscape position and canopy structure in influencing frost severity and potential yield impact.

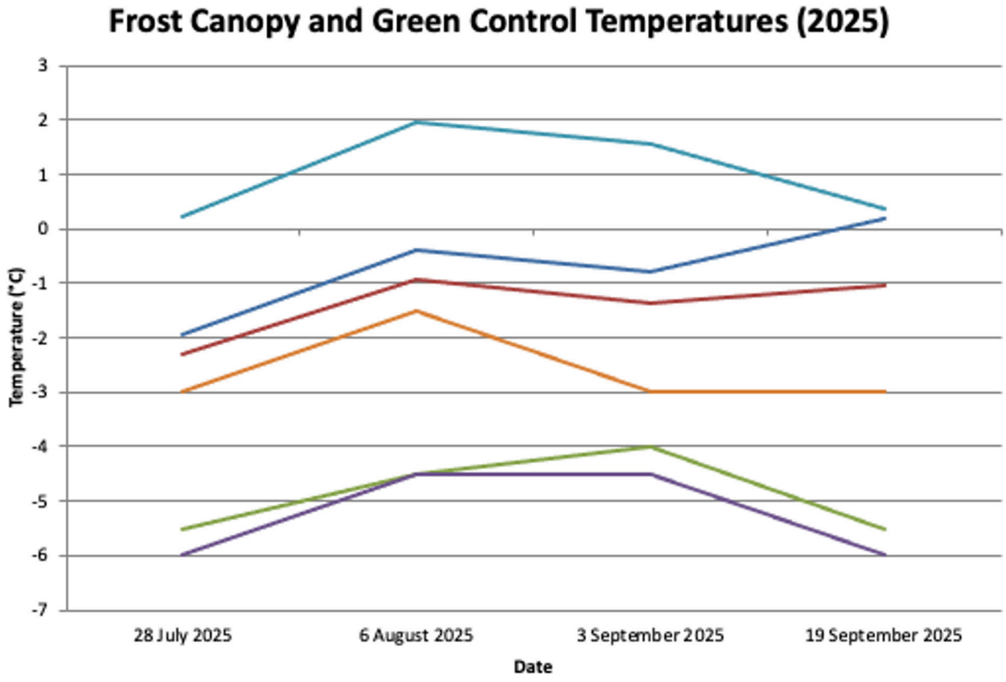

Figure 1. *Canopy temperatures (average and min) during frost events in 2024 at Jamestown in the Red Zone in comparison to the Green Zone control.*

Yield

The Green Zone, characterised by more favourable soil conditions and reduced frost exposure, produced consistently higher yields across most varieties (Figures 4 & 6). Commodus barley yielded 0.47 t/ha, performing modestly despite its early maturity. High-yielding wheat varieties such as Calibre (1.14 t/ha) and Dual (0.91 t/ha) likely benefitted from flowering during frost-free periods and favourable spring moisture, although no significant effect of time of sowing was detected. Bannister oats yielded 0.83 t/ha, reflecting strong adaptability under lower frost pressure. While later sowing generally showed a trend toward lower yields, varieties like Calibre (Late) still achieved 0.91 t/ha, demonstrating consistent performance across sowing times.

The Red Zone (Figure 5) experienced lower overnight temperatures and a shorter effective growing season. Varieties such as Vixen and Calibre reached flowering (GS 65) in mid-September (18–19 Sept), coinciding closely with the late frost on 19 September, while later-flowering varieties including Rockstar, Kingbale, Dennison, and Dual entered flowering during early to mid-October, which was also a period marked by lingering cold conditions. Yields were notably reduced, particularly for crops that flowered during frost events. Although Calibre achieved the highest yield at 0.78 t/ha, followed by Dual (0.61 t/ha) and Rockstar (0.59 t/ha), the differences between these varieties were not statistically significant. Interestingly, Commodus barley outperformed its Green Zone result, yielding 0.52 t/ha, suggesting a degree of frost or environmental tolerance. Kingbale oats maintained a yield of 0.59 t/ha, performing reasonably despite slower development under colder conditions. Later-sown varieties generally yielded below 0.60 t/ha, underscoring the risks associated with delayed maturity in frost-prone environments; however, the differences in yield among these varieties and sowing times were not statistically significant.

The most frost-tolerant crop in the 2024 trial — based on average yield in the frost-prone Red Zone — was wheat, with an average yield of 0.70 t/ha across all wheat varieties. This was higher than oats at an average of 0.54 t/ha and barley at 0.52 t/ha. This suggests that, under the specific frost conditions at Jamestown, wheat exhibited greater resilience and yield stability than barley or oats. The most frost-tolerant cereal crop in Time of Sowing 1 (Early) was Vixen wheat, which recorded the highest grain yield in the frost-prone Red Zone, achieving 0.95 t/ha. It also performed strongly in the Green Zone, with 1.14 t/ha, indicating both frost resilience and high yield potential under unfavourable (drought) conditions.

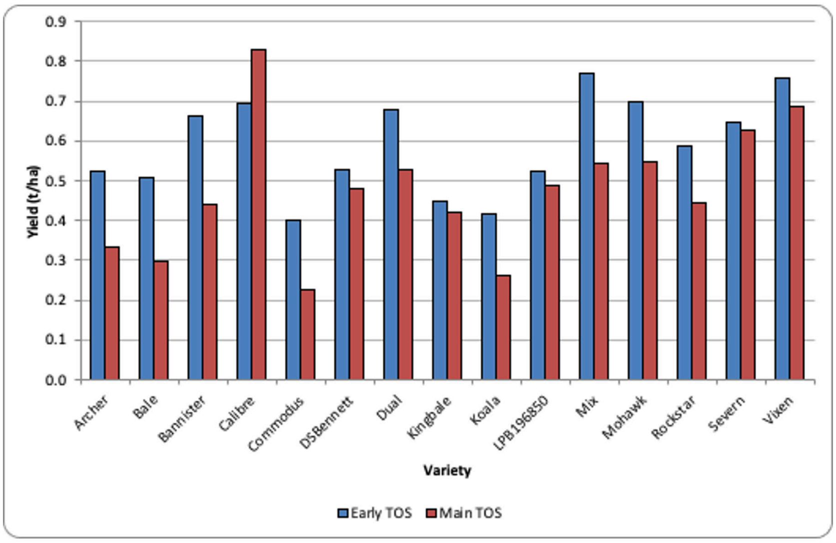

Figure 4. *Figure 4. Yield (t/ha) at the frost trial in Jamestown for the Green Zone (low frost risk) showing Early time of sowing (blue) and Main time of sowing (red) for all varieties. Statistical comparison cannot be made as spatial modelling could not be completed for two different trial sites.*

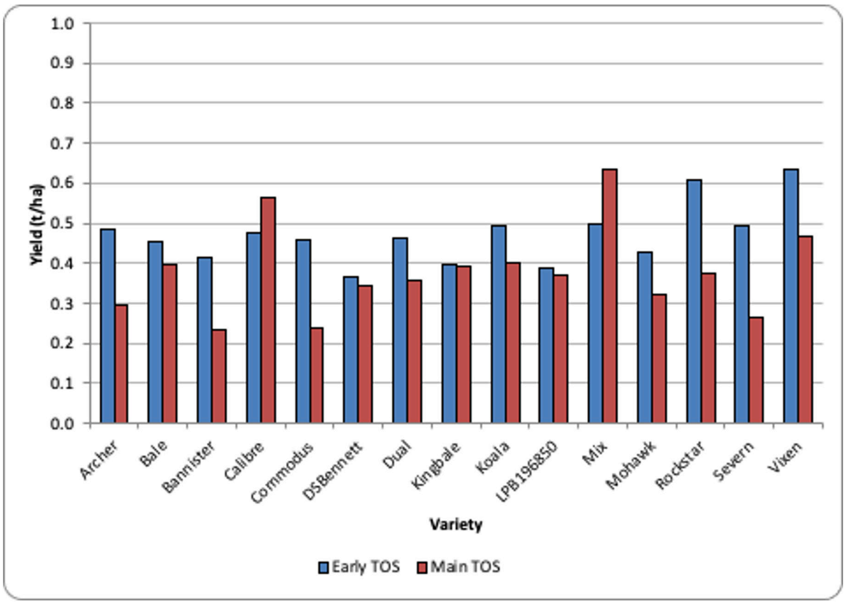

Figure 5. *Yield (t/ha) at the frost trial in Jamestown for the Red Zone (high frost risk) showing Early time of sowing (blue) and Main time of sowing (red) for all varieties. Statistical comparison cannot be made as spatial modelling could not be completed for two different trial sites.*

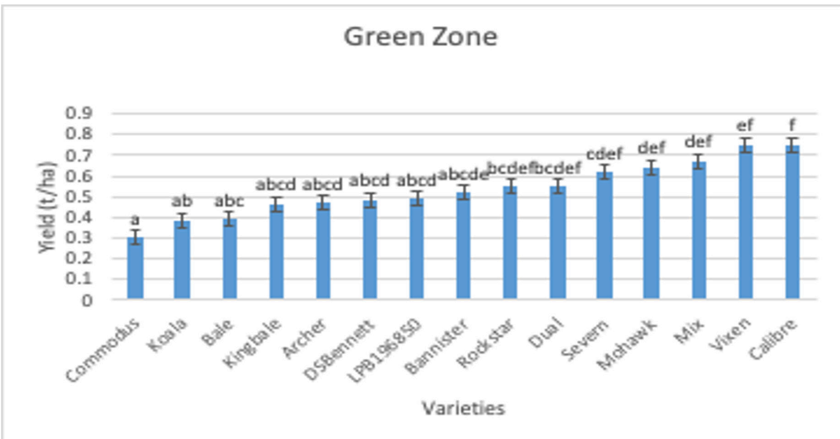

Figure 6. *Yield (t/ha) of trial varieties in the Green Zone of the frost trial located at Jamestown, SA in 2024, with corresponding statistical letters above bars. Groups that share at least one letter are not significantly different from each other ($p < 0.05$). Groups with different letters are significantly different.*

Takeaways for growers

The 2024 frost trial at Jamestown was the first year of a three-year project aimed at understanding and managing frost risk in the UN. Despite being an exceptionally challenging season—characterised by dry conditions and multiple frost events—the results have already provided valuable early insights. While these findings represent just one year of data, several clear strategies have emerged that may help growers begin to refine their approach to managing frost-prone paddocks. Ongoing trial work in 2025 and 2026 will continue to build on these observations and validate recommendations across seasons.

Know your frost zones - Variability in yield and canopy temperatures across the paddock confirmed that landscape position strongly influences frost risk. Identify high-risk (Red Zone) areas using historical yield maps, topography, or local observations, and manage them differently to low-risk (Green Zone) areas.

Select fast-maturing, frost-resilient varieties for early sowing - Varieties like Vixen and Calibre performed well when sown early, achieving higher yields and avoiding peak frost windows. Early sowing of quick-maturing types remains one of the most effective tools for reducing frost damage in high-risk areas.

Don't assume all crops will respond the same - Variety performance under frost was not always predictable. Commodus barley, for example, yielded better in the Red Zone than in the Green. Trial results emphasise the need to validate varietal performance under local frost conditions.

Match flowering time to frost risk - Growth stage data showed that early-sown crops in the Green Zone reached flowering (GS65) well before severe frost events, while later-sown crops in the Red Zone flowered into riskier periods. Use sowing dates and maturity type to shift flowering away from known frost windows.

Consider whole-farm crop sequencing - Including canola in the trial highlighted the different frost sensitivities between crops. Strategically spreading flowering windows across crop types (e.g. early oats, mid wheat, late canola) can reduce the risk of whole-farm damage in frost years.

Use dual-purpose varieties in high-risk areas - Dual-purpose cereals that offer both high biomass and grain potential (e.g. certain oats, barley, or wheats) can provide a safety net in frost-prone zones. If frost severely impacts grain production, these crops can be cut for hay, offering a viable plan B without total crop loss. This strategy is particularly useful in early-sown paddocks with higher frost exposure.

Use in-season tactics where needed - In severe frost years like 2024, having a plan to switch damaged crops to hay or reduce input costs can help salvage returns and reduce losses.

These efforts underscore the importance of developing integrated frost management strategies that combine long-term approaches, such as soil amelioration and crop selection, with in-season tactics like hay cutting. By focusing on high-risk areas and implementing appropriate strategies, growers can optimise profitability while minimising losses due to frost.

Acknowledgements

- Upper North Farming Systems gratefully acknowledge the South Australian Grain Industry Trust (SAGIT) for funding this project and supporting continued investment in the UN.
- This trial was managed and delivered by Stefan Schmitt at Agricultural Research & Consulting, whose efforts in site setup, data collection, and trial operations were critical to its success.
- Thankyou to Mick Faulkner for his technical input and advisory support throughout the season.
- Special thanks to Peter Kitsche for generously providing the paddock and offering ongoing in-kind assistance and local knowledge.

Their collective contributions have been invaluable in enabling this work and supporting future frost management strategies for the region.

PEST & DISEASE MANAGEMENT

MANAGING CROWN ROT *in* LOW RAINFALL FARMING SYSTEMS

Author: Margaret Evans and Andrew Ware | **Funded By:** *South Australian Grains Industry Trust (SAGIT)*
Project Title: *Managing crown rot on upper Eyre Peninsula – a joint learning experience.* | **Project Duration:** *1 July 2022 – 30 June 2024*
Project Delivery Organisations: *Agricultural Innovation and Research Eyre Peninsula (AIR EP), EPAG Research, Evans Consulting.*

Key Points

- VICTRATO® (registration pending, January 2025) is a Syngenta fungicide product used as a seed dressing for managing crown rot. In replicated field trials on upper Eyre Peninsula (UEP) in 2022 and 2023, this product demonstrated efficacy against crown rot. Effects were large enough to give profitable yield improvements as well as some reduction in crown rot inoculum carryover.
- VICTRATO® will be a useful addition to the strategies currently available for crown rot management. However, VICTRATO® is not "a silver bullet" and should be pyramided with other management options, not used stand-alone.
- When considering using VICTRATO®: determine if there is a risk of yield loss due to crown rot; base your profitability calculations on the t/ha yield potential in the paddock; remember higher sowing rates have higher VICTRATO® application costs.
- With a management option that reduces crown rot expression and inoculum carryover, it is important to check for crown rot risk – either by using PREDICTA B or by checking for incidence of stem base browning in cereals before or soon after harvest.
- Sowing deep reduced plant densities and yields (even for long coleoptile varieties) but did not change yield responses to VICTRATO®. Soil moisture was not limiting at sowing in this project, so in seasons with limiting soil moisture at sowing, findings might differ. If sowing deep, consider increasing sowing rates.

Background

Crown rot is a fungal disease of cereals caused by *Fusarium pseudograminearum* and/or *F. culmorum*. Symptoms include basal stem browning (diagnostic), scattered white heads (not diagnostic) and pink fungal growth inside/on stem bases (diagnostic). Crown rot fungi cause significant yield losses in cereals and have a wide host range amongst cereals and grasses.

High cereal cropping intensity, wide-spread adoption of stubble retention and reduced tillage have all contributed to increased crown rot issues in current farming systems. No fungicides are currently available for managing crown rot in-crop and cultivar resistance is limited. Rotation is helpful, but a two to four year break from cereal is needed to reduce high crown rot levels to low levels.

Consultation (by Agricultural Innovation and Research Eyre Peninsula -AIR EP) with growers across Eyre Peninsula found management of crown rot is a high-ranking issue in the low rainfall areas of Cowell and Kimba on upper Eyre Peninsula (UEP). Prior crown rot research at Mitchellville indicated that low crown rot expression produced more yield loss than seen in higher rainfall areas. Findings from this research imply that crown rot management options used in higher rainfall zones should be validated in low rainfall zones.

VICTRATO® (with Tymirium® chemistry) is a Syngenta seed applied fungicide in the process of being registered for assisting in managing crown rot. VICTRATO® seed dressing (VSD) has improved cereal yields in medium and high rainfall areas in the presence of crown rot, but no information is available for low rainfall environments such as those found in the Upper North (UN) and on UEP.

Methodology

VField trials (Table 1) were established in the UN at Booleroo Centre in 2022 and on UEP at Buckleboo and Mitchellville in 2022 and 2023. Trial sites with a medium to high risk of yield loss due to crown rot were selected. Only naturally occurring crown rot inoculum was used in trials, to ensure treatments were applied under conditions present in commercial paddocks.

Table 1. *Replicated trials undertaken in the Upper North and on upper Eyre Peninsula.*

Trial type	2022			2023	
	Booleroo	Buckleboo	Mitchellville	Buckleboo	Mitchellville
Variety*VSD[1]	✔	✔	✔	✔	✔
Depth*VSD		✔			✔
Depth*Variety		✔			
Depth*Calibre					✔
Inoculum carryover				✔	✔

[1] VICTRATO® seed dressing (VSD).

In variety*VSD trials, six bread wheat varieties were sown in 2022 and seven in 2023, with one barley variety each year. Varieties were sown in paired plots with and without VSD. Bread wheat entries had a range of crown rot resistance ratings and maturities, as maturity can influence crown rot responses. Depth of sowing trials compared the standard (normal) sowing depth of 2.5 cm with one of 5 cm.

The same seed sources were used for all trials. VICTRATO® was supplied by Syngenta Australia and applied to seed at a total solution rate of 600mL/100kg seed together with Vibrance® at 180mL/100 kg seed to manage smuts and bunts. Fungicides were applied by Lyndon May, Elders. Trial designs and data analyses were by Sharon Nielsen, SN Stats.

Plant samples (8x10 cm samples per plot) were taken at early grain filling to provide data on plant densities, head numbers, white head numbers and crown rot expression (visual incidence, browning score) on main stem bases. At the start of 2024, soil samples were taken from the inoculum carryover trials and sent for PREDICTA B analysis. Grain yield and quality (screenings, protein, test weight) were also recorded.

Results and Discussion

The high incidence of crown rot on main stems (Table 2) was consistent with all sites having medium to very high risk of yield losses due to crown rot (as indicated by soil DNA in Table 2). Mild seasonal conditions meant high crown rot incidence did not result in the high levels of stem browning and white head expression expected at these sites. Despite this, average browning scores (Table 2) had potential to reduce yield.

Table 2. *Agronomic information for trial sites and severity of crown rot expression (average for all varieties) for untreated plots in variety*VICTRATO® trials.*

	2022			2023	
	Booleroo	Buckleboo	Mitchellville	Buckleboo	Mitchellville
Site soil DNA (pg/g)[1]	4,898	6,542	23,017	2,135	172
Crown rot incidence %	70	94	97	77	82
Sowing date	June 21[2]	May 9	May 9	May 2	May 4
Site (Av.) GSR mm	244 (276)	350 (195)	215 (190)	160 (195)	160 (190)
Scepter yield t/ha	2.28	3.42	2.89	1.67	2.33
Crown rot expression:					
Browning score (0-5)[3]	1.14	2.1	2.19	1.56	1.7
White heads %	0.1	5	7	4	4

[1] 1 PREDICTA B risk categories for yield loss in wheat: Medium = 32-<316; High = >316.

[2] Very late sown due to lack of early season rainfall.

[3] Yield loss risk: Nil=0; Low=>0-1.5: Some=>1.5-2.5; Medium=>2.5-3.5; High=>3.5->5.

Crown rot responses

VICTRATO® reduced crown rot incidence and basal stem browning scores - as demonstrated by the results (Table 3) from two trials in 2023. This effect was not influenced by variety (data not presented). The wide range in results (Table 3) across the eight replicates in these trials is typical of the spatial variability seen in crown rot expression.

Table 3. *Effects of VICTRATO® seed dressing (VSD) on crown rot expression in Calibre (paired plots, eight replicates) at Buckleboo and Mitchellville in 2023.*

	Visual incidence (%)		**Browning score (0-5)**	
	No VICTRATO®	VICTRATO®	No VICTRATO®	VICTRATO®
Average:				
Buckleboo[1]	85	67	2.05	1.28
Mitchellville[2]	74	58	1.66	0.91
Range:				
Buckleboo	79-89	54-81	1.73-2.75	0.87-1.89
Mitchellville	61-86	48-68	1.15-2.07	0.70-1.08

[1] VSD P-values at Buckleboo: Incidence P-value = 0.001; Browning score P-value = 0.001.
[2] VSD P-values at Mitchellville: Incidence P-value = 0.001; Browning score P-value = 0.001

Yield responses

Responses to VICTRATO® were spatially variable (Table 4), presumably due to spatial variations in crown rot inoculum levels and soil type. On average, however, there were positive yield responses to VICTRATO® (Tables 4 and 5). The effect of VICTRATO® was not influenced by variety (data not presented).

Table 4. *Yield responses of Calibre to VICTRATO® seed dressing (VSD) in two paired plot (treated and untreated) trials, 2023.*

Replicate	**Buckleboo**		**Mitchellville**	
	%	**t/ha**	**%**	**t/ha**
1	-1	-0.02	19	0.40
2	31	0.41	17	0.36
3	31	0.34	0	0.01
4	12	0.15	12	0.25
5	29	0.42	5	0.12
6	29	0.38	1	0.03
7	2	0.04	4	0.10
8	4	0.07	5	0.11
Average	17	0.22	8	0.17
VSD P-value		***P = 0.001***		***P = 0.013***
Untreated Calibre yield		1.44		2.25

An unexpected yield loss of 22% in Commodus barley at Mitchellville (Table 5) appears to be due to the combination of season, soil and site conditions at that site in 2023. Good early growth with production of many tillers promoted by VICTRATO® in the presence of crown rot, was followed by an extended period of moisture stress. Yield losses are unlikely to occur often in barley (one occurrence in seven trials, 2020-2023) and are unlikely to occur in bread wheat varieties, which have different tillering habits than barley.

Table 5. *Average yield changes (%) in selected varieties where seed was treated with VICTRATO® seed dressing. Trial design - paired plots (treated and untreated) in 4 replicates.*

Ratings[1]	Maturity[2]	Varieties	2022			2023	
			Booleroo	Buckleboo	Mitchellville	Buckleboo	Mitchellville
MSS	VQ-Q	**Emu Rock**	6	0	6	4	-1
S	Q	**Vixen**	-1	8	10	8	2
MSS	Q-M	**Anvil**	6	5	7	4	7
S	Q-M	**Razor**	1	1	10	3	8
U	Q-M	**Calibre**	9	11	6	3	8
S	M	**Scepter**	4	4	2	10	8
MS	M-L	**Trojan**	na	na	na	10	3
-	Q-M	**Commodus**	0	12	7	7	-22
Untreated Scepter yield t/ha			2.28	3.91	2.82	1.56	1.60

[1] U=Unknown; S=Susceptible; MS=Moderately susceptible; MSS=MS to S
[2] Q=Quick; M=Mid; L=Late; VQ=Very quick

Profitability

When VICTRATO® was applied to seed in cereal crops in paddocks with medium to high risk of yield losses due to crown rot, yield improvements were large enough to return a small margin of profit (Table 6). Combined with some reduction in carryover of crown rot inoculum, this makes VICTRATO® an attractive proposition for crown rot management in low rainfall zones.

When considering VICTRATO® application, use t/ha improvements to calculate profit margins, rather than percentage yield improvements. For example at Mitchellville, an 8% yield improvement in a 2.25 t/ha crop led to a similar t/ha advantage to that seen for a 17% yield improvement in the 1.44 t/ha crop at Buckleboo (Table 6).

Table 6. *VICTRATO® effects on yield (% and t/ha) and profitability, assuming: 70 kg/ha sowing rate (rate influences costs); $22.40/ha for VICTRATO® ($160/L estimated cost ex GST @ 200 mL/100 kg grain); $380/tonne (AH1 delivered to Lucky Bay T Ports).*

	Buckleboo			Mitchellville		
	%	**t/ha**	**$/ha**	**%**	**t/ha**	**$/ha**
Average	17	0.22	62	8	0.17	42
Range	0-31	0.00-0.42	-30-136	0-19	0.01-0.40	-19-128
	Calibre yield untreated: 1.44t/ha			Calibre yield untreated: 2.25t/ha		

Inoculum carryover

VICTRATO® application to seed in 2023 reduced crown rot expression in-crop (Table 3), leading to inoculum reductions at the start of 2024 (Table 7). Reductions in inoculum levels of 31% (Buckleboo) and 77% (Mitchellville) did not reduce the PREDICTA B risk category for a 2024 cereal crop, due to the very high starting inoculum levels at the sites. Combining VICTRATO® in-crop with a break from cereal is likely to have good efficacy for reducing high crown rot inoculum levels, to low levels in the medium to long term.

Table 7. *Effects of VICTRATO® seed dressing (VSD) applied in 2023 on crown rot inoculum concentrations (pg fungal DNA/g of sample as measured by PREDICTA B analysis) at the start of 2024 (Calibre, paired plots, eight replicates).*

	Buckleboo		Mitchellville	
	Control	**+VSD**	**Control**	**+VSD**
Average	5,057	3,473	6,210	1401
P-value for VSD	***VSD P-value = 0.001***		***VSD P-value = 0.003***	
Change due to VSD	31% decrease		77% decrease	
Range	2,152-10,302	838-10,128	1,725-15,303	19-2,420

Sowing deep to "chase moisture"

Sowing deep to "chase moisture" for germination is common low rainfall zones. Growers asked that this treatment be included in trials as deep sowing effects on responses to VICTRATO® are unknown.

Deep sowing decreased plant densities, increased heads/plant (responding to decreased plant densities) and decreased yields, except at Buckleboo in 2022, where there was no effect on yield (Table 8). Long coleoptile varieties (Mace LC, Valiant CL, Yitpi LC) also exhibited lower yields when deep sown (data not presented). Average yield decreases ranged from 5% to 32%.

Deep sowing did not affect crown rot incidence or browning score, except at Mitchellville in 2023 where these parameters decreased with deep sowing (note that seed was sown very deep due to row in-filling).

For both sowing depths at Mitchellville in 2023, VSD increased yields, but there was no response to VSD at either sowing depth at Buckleboo in 2022. There was no interaction between sowing depth and efficacy of VICTRATO®.

At Mitchellville in 2023, the Calibre sowing depth trial (no VICTRATO® treatment) was on very light soil. In this trial, sand in-filled the row after sowing. In the deep sown treatments, this meant seed was up to 11 cm below the soil surface – much deeper than expected.

Table 8. *Sowing depth and VICTRATO® seed dressing (VSD) effects on crown rot expression and yield, Buckleboo 2022.*

Treatment	Plants per m row	Heads per plant	Incidence (%)	Score (0-5)	White heads (%)	Yield (t/ha)
Normal	31	2.7	85	1.48	0.3	4.74
Deep	24	3.3	78	1.27	1.7	4.55
Normal + VSD	32	2.5	73	1.16	0.5	4.76
Deep + VSD	24	3.0	77	1.16	0.5	4.76
Depth P-value	0.003	0.016	ns	ns	ns	ns
VSD P-value	ns	0.003	ns	0.024	ns	ns
Normal sowing depth = 2.5 cm; Deep sown = 5 cm.						

What does this mean?

The effects of VICTRATO® begin with reductions in crown rot incidence and severity, leading to yield and profitability improvements in-crop and some reduction in inoculum carryover to the next season. The immediate yield and profitability outcomes combined with the longer-term effect on crown rot inoculum makes VICTRATO® a useful addition to current crown rot management strategies.

VICTRATO® is not a 'silver bullet' and should not be used as a stand-alone option. Rather, it should be combined with other crown rot management strategies.

When planning to use VICTRATO®, ensure there is a risk (medium to high) of yield loss due to crown rot. Consider sowing rate (higher rates increases VICTRATO® cost) and base profitability calculations on t/ha yield potential for individual paddocks (a 10% yield improvement in a 2 t/ha crop is 0.2 t/ha but in a 4 t/ha crop is 0.4 t/ha).

Positive average yield responses to VICTRATO® were seen in bread wheat (1%-11%) and barley (7%-12%) in 2022 and 2023, despite limited crown rot expression. This level of response is consistent with lower-end responses seen at medium and high rainfall sites in South Australia. Although small and spatially variable, yield responses in the low rainfall environments of the UN and UEP were sufficient to provide a profitable outcome.

An unexpected 22% reduction in average barley yield occurred at Mitchellville in 2023 - the only negative average yield response seen in barley in seven trials 2020-2023 in South Australia. It appears barley may show a negative yield response to VICTRATO® if conditions promote good early growth and tillering that cannot be supported during grain filling.

Yield response to VICTRATO® was not affected by bread wheat variety (maturity or crown rot resistance rating), so variety selection can be made based on general performance. VICTRATO® will not return yields to those seen in the absence of crown rot. Where crown rot inoculum is at a medium to high risk level and conditions are conducive, white head expression can still occur in crops where seed was treated with VICTRATO®.

Sowing deep (simulating "chasing moisture") in seasons when moisture was not limiting did not affect responses to VICTRATO®, but reduced yields due to decreased plant establishment. Long coleoptile varieties did not perform better than varieties with normal coleoptile lengths. Consider increasing sowing rate to increase plant density if sowing deep.

On very light soils, there can be in-filling of rows that results in seed being deeper than expected, which can be particularly problematic if sowing deep. Slight increases in sowing depth and increasing sowing rate, may assist in reducing yield losses.

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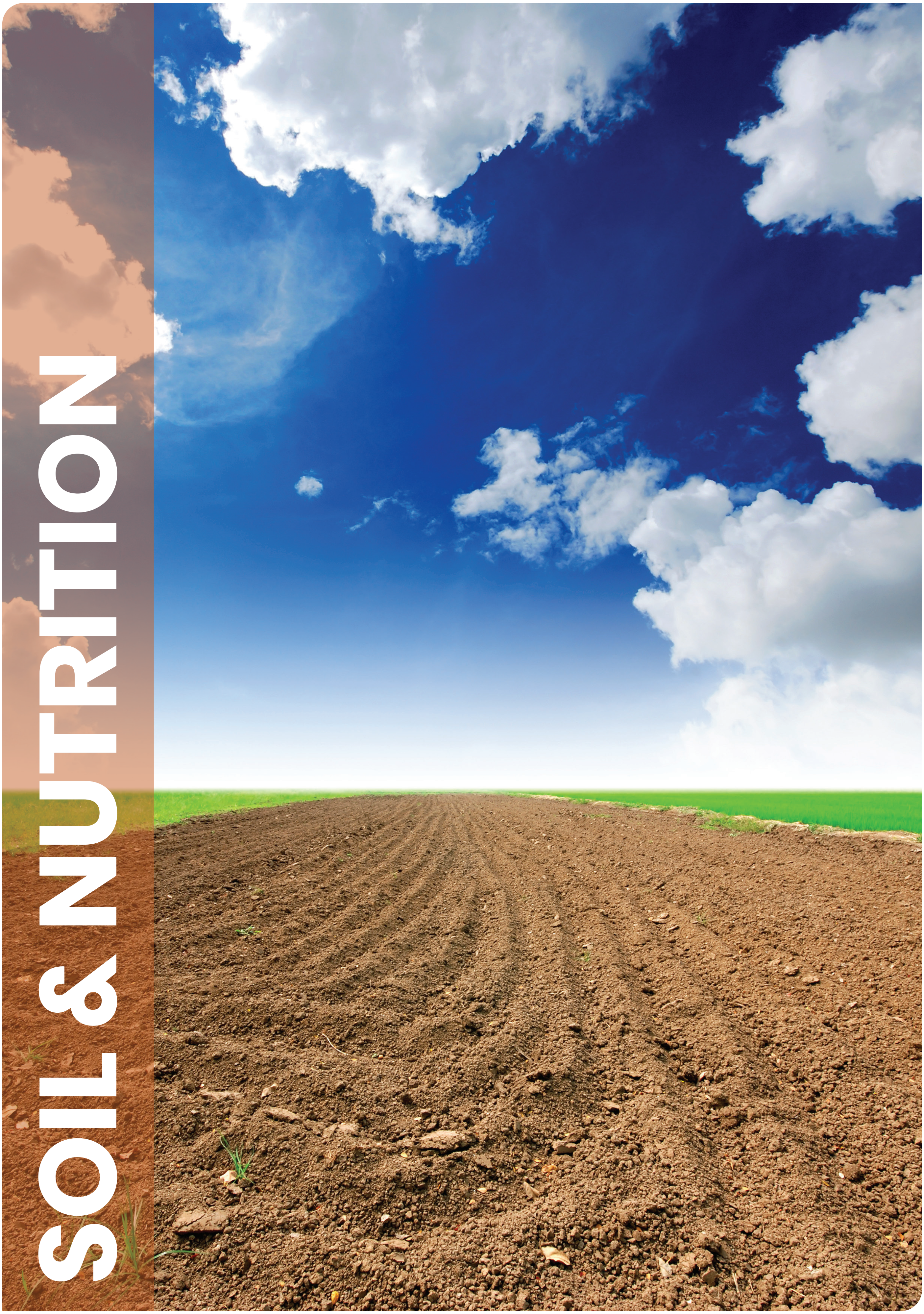
Funding and Delivery Partner Logos


SOIL & NUTRITION

INTEGRATING SPATIAL DATA *and* LONG-TERM STRATEGIES *for* IMPROVED PHOSPHORUS FERTILISER MANAGEMENT

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Take home messages

- A methodology called the P sufficiency index (pHnNDVI) has been developed for combining soil pH and NDVI data layers and generating P fertiliser prescription maps for use in variable rate seeders and spreaders.
- Across 57 P fertiliser response trials conducted from 2019 – 2024 the optimal P rate to maximise partial gross margin ranged from 0 up to 50 kg P/ha.
- Among different long-term P management strategies trialled, increases in DGT-P levels pre-seeding in 2024 generally only occurred where high rates of P fertiliser (50 or 90 kg P/ha) had been applied repeatedly or the year prior to soil sampling.
- Residual P available in the year following fertiliser application continued to increase grain yields in four out of six trial years, but generally only at rates greater than 50 kg P/ha. This is highlighted in highly P responsive soils, where current district practice application rates of 10 - 20 kg P/ha are unlikely to provide any useful residual P from the season prior.

Why do the trials?

Fertiliser inputs are the single largest variable cost for grain growers producing a crop. The variability in rainfall experienced by growers coupled with high fertiliser prices has resulted in conservative fertiliser management. As a consequence, P deficiency still causes yield losses in many environments and soil types across SA. In contrast there are many areas where P response is minimal and optimum gross margin can be achieved with little or no application of P fertiliser.

The use of pH mapping has become common practice to identify areas within a paddock of low pH to improve lime application efficiency. While generating pH maps and comparing them with satellite NDVI imagery, it has been observed that high pH areas on the map correlate with low crop vigour and P deficiency in many instances (Trengove et al. 2019; Mason et al. 2022) (Figure 1). This finding resulted in the development of the P sufficiency index.

The P sufficiency index has been given the acronym pHnNDVI as it is the soil pH value divided by NDVI normalised to the paddock average using the formula below.

pHnNDVI = soil pH / (NDVI/paddock NDVI average).

Areas of a paddock with high soil pH (>7.5) and low relative normalised NDVI (<0.9) result in a high pHnNDVI value and are likely to be highly responsive to applied P (for example, site 23 and 25 in Figure 1). Areas with lower pH (<6.5) and high relative NDVI (>1.1) result in a low pHnNDVI value and are likely to be unresponsive to applied P (for example site 22 in Figure 1). This data layer can then be used to generate P application maps for variable rate seeding operations.

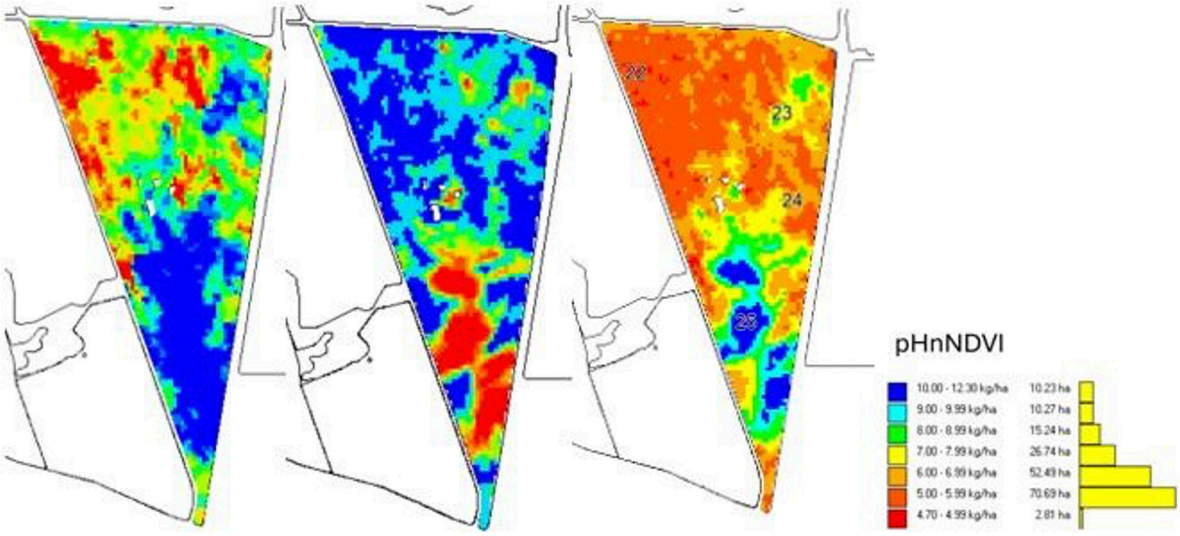


Figure 1. *Soil pH (left), satellite NDVI (middle) and pHnNDVI (right) for a paddock at Crystal Brook*

How was it done?

From 2019 to 2024 57 P fertiliser rate response trials have been established across 14 paddocks in the Mid North, Yorke Peninsula, Eyre Peninsula and Mallee. With in each paddock the pHnNDVI maps were used to locate four small plot trials with seven P rates ranging from 0 – 90 kg P/ha. The P fertiliser was applied as MAP and urea was used to match the nitrogen to the highest P rate at each trial. All fertiliser was applied below the seed using a knife point and press wheel system. The plots were monitored for NDVI, leaf tissue P concentration, grain yield and quality. NDVI and grain yield will be discussed in this paper.

Three of the 57 trial sites (Hart, Spalding and Crystal Brook) had long term trial sites established in 2021 where the range of P rates were applied. The P fertiliser management strategies evaluated single applications of high P rates (0-90 kg P/ha) followed by 15 kg P/ha in subsequent seasons or repeated applications of 0-90 kg P/ha applied each season. Alternative P management strategies were also included such as broadcasting MAP prior to seeding and the use of chicken litter. Full trial details and soil characterisations can be found in previous reports (Trengove et al. 2023). Soil samples were collected from these plots prior to sowing in the fourth season (2024) to assess changes in soil P levels, Colwell P, and DGT - P.

Results and discussion

Field evaluation of the P sufficiency index

In paddocks with significant spatial variation the P sufficiency index has shown it can accurately predict areas of low, medium and high P response in the Mid North and Yorke Peninsula. More recently, this method has also been tested in areas of the Mallee and the Eyre Peninsula. This trial series has provided a robust database to assess the capabilities of the pHnNDVI methodology (Figure 2).

Across six years of investigation there was a strong in-season biomass response (measured by Greenseeker NDVI) to higher rates of P with increasing pHnNDVI (Figure 2). This strong relationship for crop biomass can be used by growers for hay crops and biomass production for grazing.

The P rate to achieve maximum biomass and pHnNDVI relationships have been stronger than the yield response. This can be attributed to the fact that biomass (NDVI) is assessed earlier in the season and is less likely to be influenced by as many factors as grain yield such as seasonal conditions, crop disease, herbicide residues, frost and weed competition.

For paddocks that contain soil types such as calcarosols, dermosols, chromosols and sodosols the model has been most accurate. For paddocks that contain vertosols (deep black cracking clays) the model has been less accurate. It is unclear why the vertosols do not produce similar grain yield responses when predicted to be highly P responsive. Both soil test values (DGT-P range 14-97 µg/L) and the pHnNDVI suggest they should be P responsive, and while they produce a biomass response this has not translated into grain yield. This lack of grain yield response on vertosols has been observed in other trials in the Southern region. For this reason, the vertosol sites have been removed from the dataset presented in (Figure 2).

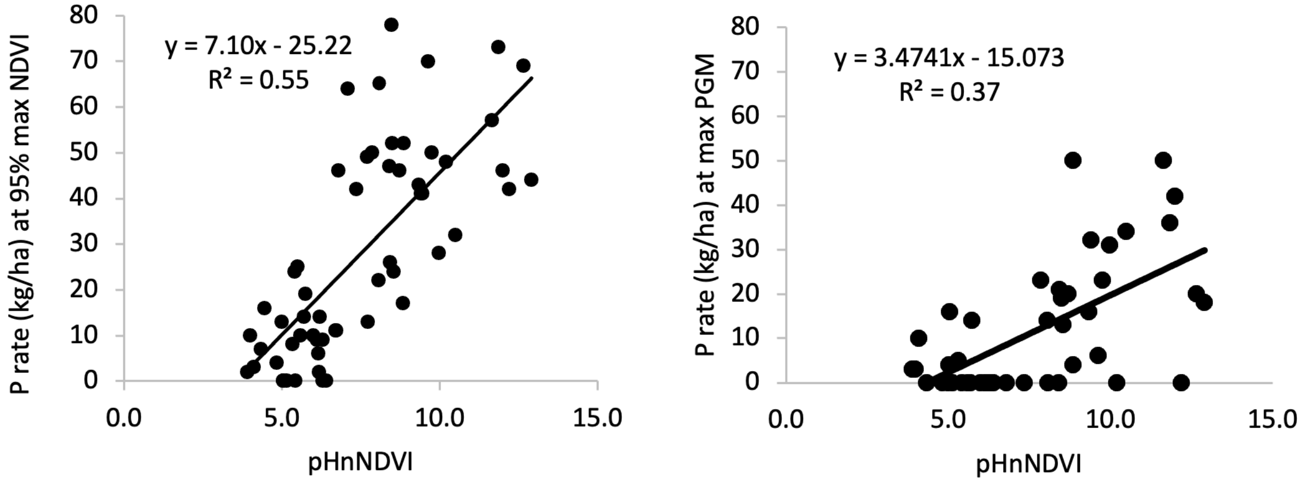


Figure 2. *Relationship between pHnNDVI and P fertiliser rate (kg/ha) at 95% maximum NDVI for 57 sites (left) and 95% maximum grain yield for 45 sites across the Mid North, Yorke Peninsula and Eyre Peninsula (right).*

The pHnNDVI has been able to predict where there will be a low P requirement to maximise PGM. However, there has been some variability around the higher end of the pHnNDVI scale. Where grain yields were low the grain yield response to P has been reduced resulting in a lower P rate to maximise PGM than predicted by pHnNDVI alone. Where a grain yield potential (maximum yield) for the site is included in the prediction model, the accuracy is improved (Table 1).

The information presented in Table 1 can be used by growers and advisers to determine the optimum P rate for given paddock zones. The response modelling shows at low pHnNDVI (<5) there is a low predicted P rate requirement (0-5 kg P/ha). As pHnNDVI increases the P fertiliser rate required to maximise PGM also increases and it increases at a faster rate at higher yields. For example, at pHnNDVI 11 a crop with 3.0 t/ha yield potential is predicted to require 18 kg P/ha. However, as the yield potential for the same pHnNDVI increases to 6.0 t/ha, the P fertiliser required is now 40 kg P/ha.

Grain yield data from a reliable historical yield map could be included in the model with pHnNDVI to produce a P rate prescription, or a yield target could be chosen for a given paddock to calculate the optimum P rate to produce the prescription.

Table 1. *Predicted P rate at maximum partial gross margin for pHnNDVI and site max yield.*
*P rate at max PGM = -4.72 – 3.66*site max yield + 1.01*(site max yield * pHnNDVI), R^2 = 0.56*
Assumptions for gross margins – MAP = $1100/t, Lentil = $800/t, Wheat = $330/t, Barley = $275/t.

Site max yield	1	2	3	4	5	6	7
pHnNDVI	Predicted P rate at Max PGM						
4	0	0	0	0	0	0	0
5	0	0	0	1	2	4	5
6	0	0	2	5	7	10	12
7	0	2	5	9	12	16	19
8	0	4	8	13	17	22	26
9	1	6	12	17	22	28	33
10	2	8	15	21	27	34	40
11	3	10	18	25	32	40	47
12	4	12	21	29	37	46	54
13	5	14	24	33	43	52	61

Long term P management trials

Residual soil available P from repeated and once of applications of P fertiliser rates

The P use efficiency (PUE) of fertilisers is generally low in the year of application, ranging from 2 – 26% in this trial series, however, it continues to provide P to crops for several years. Pre-seeding 2024 the three long term trials were soil sampled (following three trial seasons) to understand if the various P management strategies have built up or mined soil available P compared to year one.

At Hart all DGT-P values remained below the critical limit (60 μg/L). There was a greater range and higher number of treatments above the critical DGT-P at both Crystal Brook and Spalding (Figure 3 and 4). Among the three trial sites, Hart has the highest PBI (111) compared to Spalding (77) and Crystal Brook (88) which indicates a stronger ability to bind added fertiliser P. This has likely contributed to the lower P availability and lower variation in DGT-P values at this site.

Among all the strategies trialled, the only P rates to have an impact on starting DGT-P were generally where high rates of P fertiliser had been applied repeatedly each year (Figure 3) or in year three only, prior to testing in year 4 (Figure 4). This shows a portion of the fertiliser P applied in these high rates last season or cumulatively has carried over in the plant available form and will be available to the subsequent crop. However, it also highlights P fertiliser rates of <50 kg P/ha applied repeatedly or in a single season, are not sufficient to increase DGT-P to an impactful level the following season on P fixing soils.

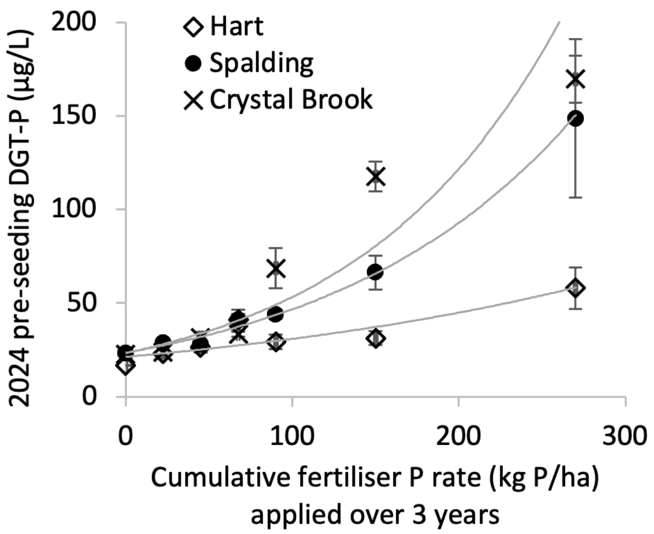


Figure 3. *Pre-seeding 2024 DGT-P following three seasons (2021 – 2023) of repeated applications of P fertiliser rates ranging from 0 – 90 kg P/ha for Hart (R^2=0.79), Spalding (R^2=0.997) and Crystal Brook (R^2=0.87).*

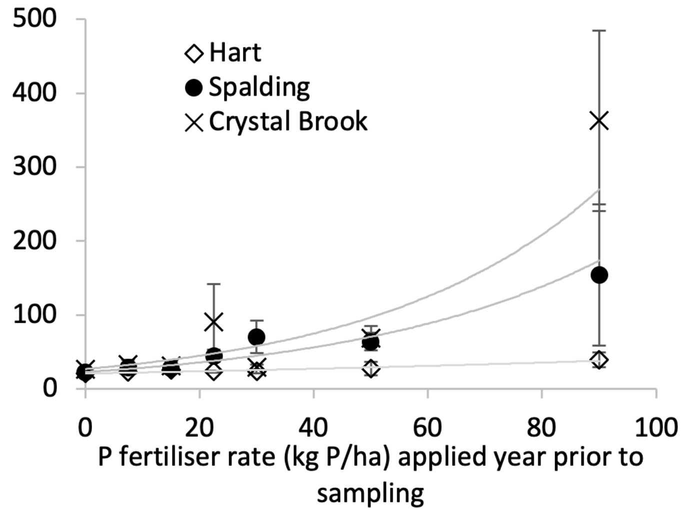


Figure 4. *Pre-seeding DGT-P following once off applications of P fertiliser rates ranging from 0 – 90 kg P/ha the year prior (2023) to sampling at Hart (R^2=0.92), Spalding (R^2=0.94) and Crystal Brook (R^2=0.94).*

Soil P balance

Using the soil test results above we can determine the soil P balance to understand which P management strategies are mining or building soil available P. Here were review two scenarios 1) the effect of a single year 10 kg P/ha application and 2) three years of repeatedly applying 10 kg P/ha (resulting in a cumulative P application of 30 kg P/ha). For the Hart site a single application of 10 kg P/ha is expected to increase in DGT-P by 1.5 μg/L (Table 2). This only increases to 2.8 μg/L for the three-year cumulative balance. While this shows an application rate of 10 kg P/ha is maintaining - slightly building DGT-P overall, it is having little impact on increasing the level above the critical limit (60 μg/L for wheat). The increases in DGT-P were predicted to be higher for Spalding and Crystal Brook (lower PBI = lower fertiliser P tie-up) however, they still only ranged from 6.6 – 9.2 μg/L in these scenarios.

Table 2. An example of P fertiliser applications and their expected effect on soil DGT-P levels.

			Single year	Three year
Cumulative P balance (kg P/ha)			10	30
Trial site	**PBI**	**Starting DGT P (µg/L)**	**Increase in DGT P (µg/L)**	
Hart	110	17	1.5	2.8
Spalding	77	18	7.6	7.5
Crystal Brook	88	23	6.6	9.2

Crop responses to residual P

In addition to soil testing, yield responses assessing the value of residual P were also measured (Figure 5). In general, yield responses were measured in year 2 in response to P application the year prior in 4 out of 6 site years, as demonstrated at Hart (Figure 5). Responses were also observed in year 3 in 2 out of 3 site years, though the level of response declines from year 2 to 3 (Figure 5). However, while there are meaningful responses to residual applied P, the Hart results also demonstrate that higher yields are attainable in subsequent years, by repeatedly applying higher rates, rather than relying on the residual benefit of the year prior.

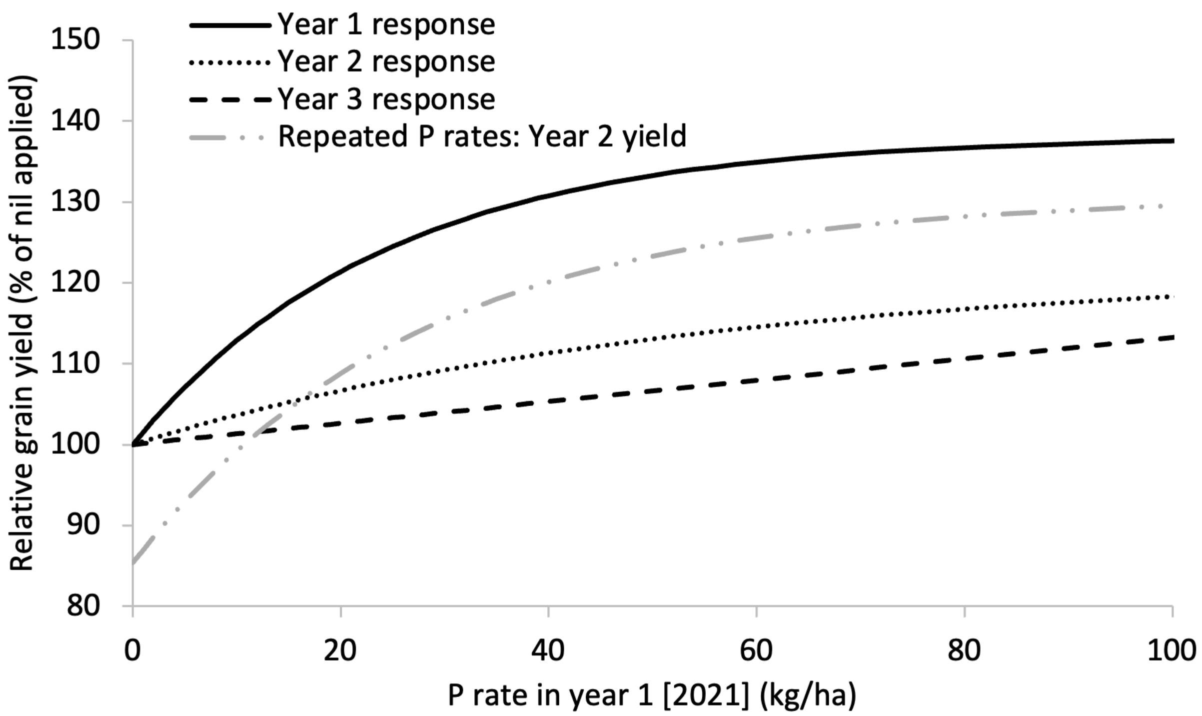


***Figure 5.** Grain yield response at Hart to P rate range applied in year 1 (2021) and residual response to year 1 application in year 2 (2022) and year 3 (2023) when 15 kg P/ha was applied in those years. This is compared with the response in year 2, when the P rate range are repeated in both years.*

Crop response to P fertiliser strategies in a dry 2024

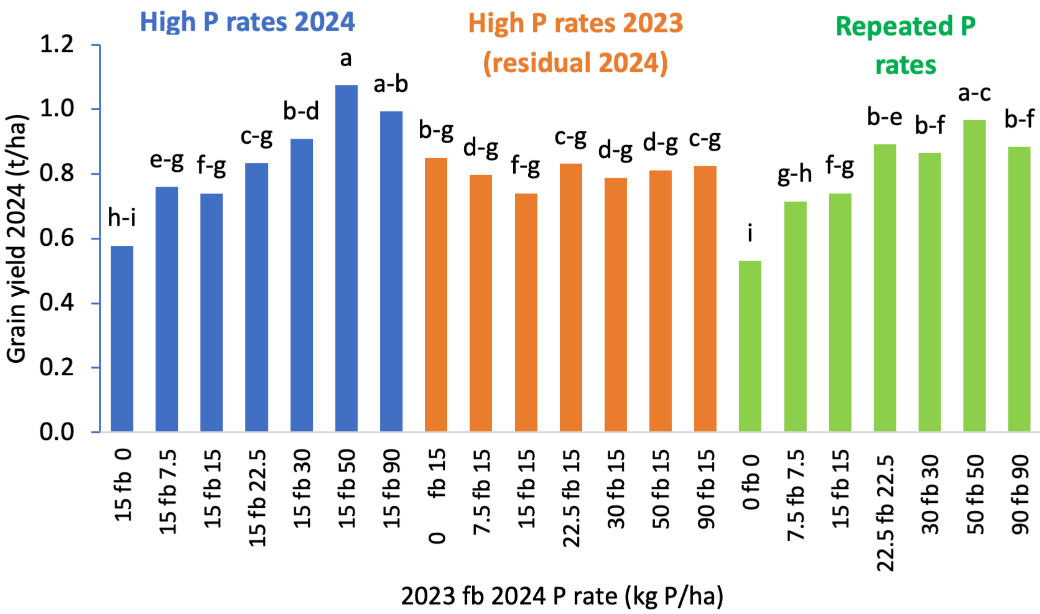
Wheat (Hart)

Grain yields at the Hart site in 2024 were low, averaging 0.83 t/ha (Figure 6). High rates of P fertiliser (50 kg P/ha and 90 kg P/ha) applied in 2024 led to increased grain yields. On average these two application rates increased grain yield by 40% (0.3 t/ha) compared to the district practice treatment (15 kg/ha/year). The slightly lower P rate of 30 kg P/ha also increased grain yield this season. This demonstrates that even in a low yielding year such as 2024, grain yield increases are still likely on these responsive soil types, although the rate that optimises gross margin will be lower, as per Table 1.

The alternative P management strategies had mixed outcomes on wheat grain yield this season. Broadcasting MAP did not improve grain yields compared to the district practice treatment. However, the application of chicken litter (2021 and 2024) increased grain yield by 23%. As previously reported the chicken litter treatment has generally performed as well as higher P rates and provided one of the highest PGM at both Hart and Crystal Brook (Trengove et al. 2023).

Repeated applications of different P fertiliser rates (0 – 90 kg P/ha) did not result in a consistent increase in grain yield (Figure 6). Two out of the five P fertiliser rates resulted in improved grain yield (22.5 kg P/ha and 50 kg P/ha) while the remaining were no different to the district practice. It is likely crop water use in previous seasons (e.g. high yielding treatments = less carried over soil water) may have influenced the results in these treatments this season. This lack of response in the year following high applications of P fertiliser demonstrates that on these soil types relying on the previous year's fertiliser is likely to result in reduced grain yields.

As a result of the dry season and low grain yields it is not surprising that grain protein across the trial was high, averaging 13.6% (data not shown). In general, there was little variation among the P management strategies. The most consistent outcome was higher grain protein where 90 kg P/ha had been applied in 2024 (one off or repeated application strategies).



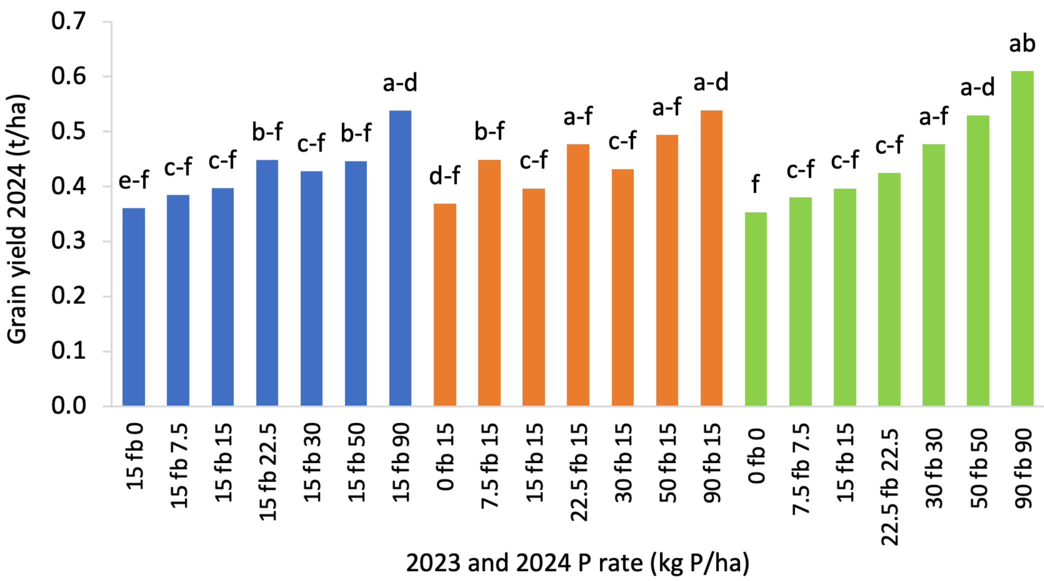


Figure 6. *Grain yield (t/ha) for the Hart (top) and Crystal Brook (bottom) long-term P management site 2024.*

Lentils (Crystal Brook and Spalding)

Grain yields across both sites were low averaging 0.46 t/ha at Crystal Brook (Figure 6) and 0.86 t/ha at Spalding. At Crystal Brook there were minor differences in lentil grain yield among the P management strategies. Generally, the highest grain yield came from the application of 90 kg P/ha applied this season as either MAP spread prior to sowing or the repeated application.

At Spalding, there were even fewer differences in grain yield compared to the Crystal Brook site. All P management strategies had grain yield similar to the district practice. The only exception was the repeated 0 kg P/ha which reduced grain yield.

Implications for P fertiliser management in 2025

It is common for growers in the southern region to use a P replacement strategy based on the amount of P removed in the grain (i.e. 3 kg P/t cereal grain) to determine fertiliser P application rates. Using this strategy, 'district practice' P fertiliser rates are generally in the range of 10 – 20 kg P/ha annum. Given the below average grain yields last season, it would be fair to assume <5 kg P/ha has been exported in the grain in many areas. The P replacement strategy would therefore assume a reduction in P fertiliser rates going into this season. Using the field trials above we explore the question - can we cut back to 5 kg P/ha as replacement this season?

This research has shown at district practice P fertiliser application rates (<20 kg P/ha) a grower cannot rely on residual P from the season prior if the zone/paddock is P responsive with moderate PBI (range 77-110 at these sites). Repeated applications of >20 kg P/ha or more were required to shift pre-seeding DGT-P soil levels enough to have any implications on crop growth and grain yield.

The yield responses from Hart (Figure 5) have shown the response to residual P, when returning to district practice in year 2 and year 3. However, this graph also shows how much economic benefit is lost by not applying the optimum P rate or continuing with repeated fertiliser rates. It is in fact, a demonstration of what not to do on P responsive soils, unless the expectation is for low cereal yield potential of less than 2t/ha. Reducing P fertiliser rates coming into 2025 will limit the yield potential of this season's crop (year 1 response), and the yield potential of the subsequent crop may be limited too (year 2 response), even when 'district practice' rates are reapplied in future years.

Conversely, P fertiliser management for non-responsive zones/paddocks requires a different approach. For these areas there is significant value in residual fertiliser P from previous applications. In some cases, they are not responsive to P at all, and it is rare that they respond to greater than replacement levels. The pHnNDVI methodology can help to identify where these areas are, and it can be used to make considerable savings on P fertiliser application on these soil types.

Acknowledgements

This research is made possible by the contributions of the Wundke, Stephenson and Sargent families through trial cooperation for long term trials. Other growers involved in the projects include Bill Trengove, Leigh Fuller, James Venning, Joe & Jess Koch, Scott Weckert, Kenton Angel, Tristan Baldock, Andrew Thomas and David Cooper. This program is co-funded by SAGIT and GRDC (project code TCO 06024) and the authors would like to thank them for their investment in this research. We would also like to acknowledge the previous SAGIT investments (TC221 and TC219) to establish and monitor the single year and long-term field trials.

SAGIT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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MANAGEMENT OPTIONS *for* DRY SALINE SOILS *on* UPPER YORKE PENINSULA: *Results from season three*

By: Sam Trengove, Stuart Sherriff, Jordan Bruce, Declan Anderson and Sarah Noack - *Trengove Consulting*

Key messages

- In season one lentil grain yields were generally low (0.16 t/ha – 0.62 t/ha) across the trial. The high sand application rate (1300 t/ha) was the only treatment to improve lentil grain yield compared to the control.
- In seasons two and three larger increases in crop emergence, NDVI and grain yield are emerging among the sand and straw rates. Specifically, sand rates above 650 t/ha and straw rates above 6.6 t/ha resulted in the highest wheat and barley grain yields.
- Two years after the trial was implemented, all sand and straw application rates have reduced the salinity level (ECe and TDS) in both the 0-10 cm and 10-20 cm depths.
- In general, the results show three years after application, the straw and sand rates are having a positive impact on both cumulative grain yield and partial gross margin (despite the high initial amelioration costs).

Why do the trial?

Dry saline soils are a type of land salinity that occurs in soils with high levels of naturally occurring salt (but is not associated with a shallow water table). In mild situations, dry saline land can also be referred to as transient salinity, where salts are trapped within the soil profile (e.g., due to low permeability clay subsoil) and salts move up and down depending on seasonal conditions. Situations which lead to higher evaporation of moisture e.g., long hot summers, periods of drought and the loss of surface plant/stubble cover increase the presence and severity of saline soil patches.

This research aims to trial and demonstrate different management practices which could be used by growers to ameliorate saline soil patches. The application of amendments (e.g. straw and sand) to the soil surface were trialled to improve crop emergence by reducing evaporation leading to reduced accumulation of salt in the top soil, more soil moisture, or by reducing the moisture required to germinate a seed by increasing the sand content of the soil surface. Gypsum was also included to increase the amount of calcium relative to the level of sodium (salt) and address sodicity in the longer-term.

How was it done?

Site selection and rainfall

An amelioration trial for the management of saline soils was established at Tickera, SA (-33.8466, 137.6844) in 2022. The saline area was selected based on historical crop performance and soil test results (Table 1). The trial was a randomised complete block design with four replicates and eight treatments that are described below (Table 3).

Soil properties – please refer to previous trial reports for full characterisation

The Tickera site is a moderately to strongly alkaline (pH >8.0) clay loam with salinity issues. Salinity was measured using chloride and an electrical conductivity estimated (ECe) which uses a texture conversion factor (9.5 for sandy loam) from the EC1:5. Chloride levels in the surface and subsurface ranged from 520 – 4800 mg/kg. The critical level for chloride in clay soils is 300 mg/kg (Hughes 2020). Above this critical value salinity damage is likely to occur depending on crop tolerance. The ECe across the site was 5.9 – 37. In general, it is expected at ECe 4-8 yields of many crops will be affected and 8-16 only crops with tolerance will yield well (Hughes 2020). Beyond 32 is generally considered too salty for most broadacre crops to grow.

Boron levels across the site and soil depths ranged from 8 – 38 mg/kg. Boron toxicity for sensitive crops generally occurs at levels > 5 mg/kg and at levels > 15 mg/kg it is considered toxic for dryland cereals (Hughes 2020).

Trial details

Sand and gypsum treatments were spread on the soil surface 3rd May 2022. Straw treatments (from baled wheat) were applied post seeding on 27th May 2022. Treatments included; control, gypsum 10 t/ha, straw 3.3 t/ha, straw 6.6 t/ha, straw 10 t/ha, sand 130 t/ha, sand 650 t/ha and sand 1300 t/ha. Sand rates were calculated on applying a sand layer of 1 cm (130 t/ha) 5 cm (650 t/ha) and 10 cm (1300 t/ha) covering the surface. The sand was sourced from a sand pit 15 km northeast of the trial site at Alford and applied using a front-end loader and shovel. The gypsum used in the trial had a purity of 69% making it a grade 3 product.

Table 1 *. Summary of rainfall and seeding details from 2022 – 2024.*

Year	Growing season rain-fall*	Seeding date	Crop and seeding rate	Fertiliser at seeding
2022	250 mm	26th May	Hurricane XT lentils @ 50 kg/ha	MAP 1%Zn 60 kg/ha
2023	219 mm	11th May	Chief CL Plus wheat @ 80 kg/ha	MAP 65 kg/ha + Urea 42 kg/ha
2024	146 mm	10th May	Commodus CL barley @ 80 kg/ha	MAP 1%Zn 60 kg/ha + Urea 100 kg/ha

** Long-term average growing season rainfall for Tickera is 252 mm*

Soil and crop assessments 2024

Pre-seeding all plots were soil cored 0-10 cm, 10-20 cm and 20-40 cm from the original soil surface. Soil samples were analysed for total dissolved solids (TDS) and ECe (as per method above). The high application rates of sand (650 t/ha and 1300 t/ha) created a new soil layer and an additional soil sampling increment was added 'sand' which represents the layer above the original soil surface. The control and gypsum treatment soil samples were also analysed for exchangeable sodium percentage (ESP).

Plant establishment was scored on May 31 and July 9, Greenseeker NDVI on July 12 and September 11. All plots were harvested for grain yield and quality on November 8.

Statistical analysis

Analysis of this experiment was conducted using linear mixed models with restricted maximum likelihood using ASReml-R (Butler, 2022) and the R Core Team (2022) package biometryassist (Nielsen et al. 2022). Where there is significant evidence from the model that the explanatory variable means differ, Tukey's multiple comparison test was used to determine which of the means are different at a significance level of 5%.

What happened in the first two seasons?

In season one lentil grain yields were generally low (0.16 t/ha – 0.62 t/ha) across the trial. The high sand application rate (1300 t/ha) was the only treatment to improve lentil grain yield compared to the control (Table 5). In the second season larger differences among the sand and straw rates were emerging. Sand rates above 650 t/ha and straw rates above 6.6 t/ha resulted in wheat grain yields of 1.95 t/ha – 2.42 t/ha compared to the control 0.67 t/ha.

What happened in 2024?

Changes in soil properties

Soil salinity can be measured using both ECe and TDS. The average ECe across the site 0-10 cm was 16.5 prior to trial establishment. Without any amelioration, the current control ECe was 18.1 (Table 2) and it is expected only salt tolerant crop types will yield well in these areas. The salinity level (ECe) in all the sand and straw application rates has been reduced, on average by 58% and 33% in the 0-10 cm and 10-20 cm depths, respectively. Overall, it has lowered ECe to an average of 7.6 in both of these layers. This reduction in salinity has also lowered the effect on plant growth to the category 'yield of many crops effected' from 'Only tolerant crops yield well' prior to treatment (Hughes 2020).

Total dissolved solids (TDS) is a measure of the total salt content in a given soil or water sample. Similar to the ECe results, any application rate of sand or straw has reduced TDS compared to the control in both the 0-10 cm and 10-20 cm layer (Table 2).

The ESP identifies the degree to which the soil exchange complex is saturated with sodium and is used to characterise sodicity. ESP was measured in the control and gypsum treatment. It showed a reduction in sodicity in 0-10 cm layer from 17.3 (control) to 12.5 (gypsum) where gypsum was applied (data not shown). This reduction in ESP reduced the soil from >15% 'strongly sodic' down to a 'sodic' classification (Huges 2020). No changes in the ESP for the 10-20 cm and 20-40 cm layer were observed. However, the results also show the application of gypsum has had no effect on salinity (Table 2). This treatment was imposed to address sodicity at this site in the longer term.

Crop establishment and biomass

Despite dry conditions pre and post seeding, there were differences observed in crop establishment at the end of May (3 weeks after seeding). Both the higher rates of sand (650 t/ha and 1300 t/ha) and the high rate of straw (10 t/ha) had more plants emerged compared to the control (Table 3). The higher plant establishment can be attributed to the retention of more soil moisture under the sand and straw treatments due to reduced evaporation and lower matric potential (pressure by which water is held in the soil pores) in the sand, meaning the sandier soils can germinate seeds with less moisture. However, early establishment in sand at 1300 t/ha is less than for sand at 650 t/ha. This is due to deeper sowing in the high sand rate (despite best efforts to adjust seeder setup) reducing early emergence. The remaining treatments were no different to the control at this timing.

Following 40 mm of rain during June, crop establishment was improved by all sand and straw rates when assessed in early July (Table 3). In general, the establishment was similar across the three rates of straw trialled, averaging 88%. However, for the sand, application rates >650 t/ha resulted in the highest crop establishment (>91% of the plot emerged).

In general, NDVI assessments in late winter – early spring show that crop biomass was improved by the two higher application rates of both sand and straw. Similar to crop establishment the lower rates of both products also increased NDVI compared to the control. These results show three years after application, the straw and sand rates are having a positive impact on crop establishment and biomass on a saline soil.

Table 2 . *Pre-seeding ECe and TDS for treatments in the salinity management trial Tickera, SA 2024.*

Treatment	ECe			TDS (mg/L)		
	0-10 cm	10 – 20 cm	20-40 cm	0-10 cm	10 - 20 cm	20-40 cm
Control	18.1 a	11.4 a	15.2 a	1235 a	807 a	993 a
Sand @ 130 t/ha	8.6 b	8.6 b	12.4 a	598 b	592 b	820 a
Sand @ 650 t/ha	6.7 b	8.6 b	14.3 a	450 b	581 b	948 a
Sand @ 1300 t/ha	5.7 b	7.6 b	13.3 a	355 b	511 b	898 a
Straw @ 3.3 t/ha	8.6 b	6.7 b	10.5 a	575 b	474 b	720 a
Straw @ 6.6 t/ha	9.5 b	7.6 b	10.5 a	615 b	498 b	695 a
Straw @ 10 t/ha	6.7 b	6.7 b	10.5 a	450 b	473 b	708 a
Gypsum @ 10 t/ha	15.2 a	12.4 a	15.2 a	1035 a	836 a	1005 a
Pr (>F)	<0.001	<0.001	0.001	<0.001	<0.001	0.003

Table 3 . *Crop establishment and GreenSeeker NDVI for the salinity management trial Tickera, SA 2024.*

Treatment	Establishment %		NDVI	
	May 31	July 9	July 12	Sept 11
Control	0.3 d	50 e	0.191 d	0.244 d
Sand @ 130 t/ha	2.8 cd	70 cd	0.222 cd	0.502 bc
Sand @ 650 t/ha	55.0 a	91 ab	0.383 a	0.653 a
Sand @ 1300 t/ha	16.3 bc	98 a	0.276 bc	0.702 a
Straw @ 3.3 t/ha	3.1 cd	81 bc	0.230 cd	0.434 c
Straw @ 6.6 t/ha	6.3 cd	86 ab	0.268 c	0.603 ab
Straw @ 10 t/ha	21.9 b	96 ab	0.327 ab	0.622 a
Gypsum @ 10 t/ha	0.1 d	63 de	0.197 d	0.279 d
Pr(>F)	<0.001	<0.001	<0.001	<0.001
LSD	14.6	16	0.058	0.115

** Long-term average growing season rainfall for Tickera is 252 mm*

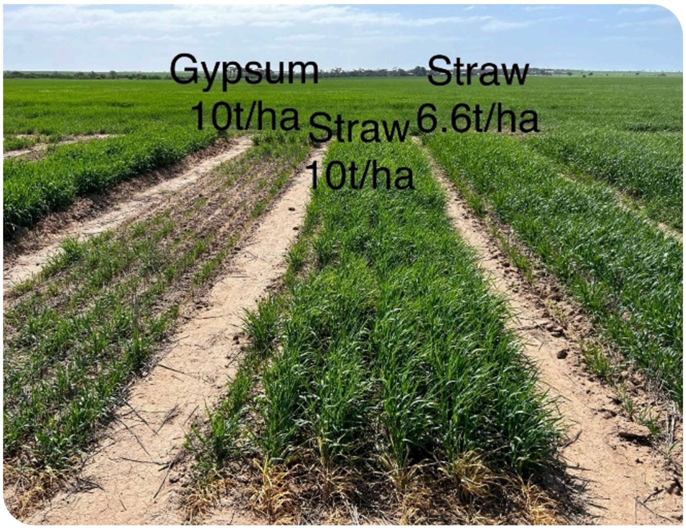

Figure 1 *. Commodus CL barley in the control and various sand and straw rates (labelled above) in the salinity management trial Tickera, SA 30th August 2024.*

Grain yield and quality

Consistent with 2023, the two higher rates of sand (650 t/ha and 1300 t/ha) and straw (6.6 t/ha and 10 t/ha) improved barley grain yields compared to the control (Table 5). On average there was a 2.6 t/ha yield increase for these rates. The lower sand (130 t/ha) and straw (3.3 t/ha) rates also increased grain yield compared to the control, averaging a 1.1 t/ha yield improvement. These results show the sand and straw are providing significant benefits. Most likely through a mulching effect, reducing evaporation from the soil surface, retaining more moisture and reducing surface salinity. The higher rates of sand are also providing a layer of soil with lighter texture for crops to establish.

Similar to this season's grain yield results, cumulative yields are also showing all rates of sand and straw have improved grain yield (Figure 2). For the sand rates, grain yield stabilises after approximately 650 t/ha. That is, application of sand rates beyond this point did not result in larger yield gains. For the straw rates there is a linear response in cumulative grain yield (Figure 2). This suggests the straw rates trialled have not maximised grain yield and further gains may be achieved from rates above 10 t/ha.

Gypsum applied at 10 t/ha has not improved grain yield or quality compared to the control in any season to date. The soil test results this season showed the gypsum has moved into the 0-10 cm layer and reduced sodicity. However, the primary constraint of salinity has not been improved, as such, crop performance continues to be limited by salinity despite a reduction in sodicity. Long-term monitoring of this site will be required to understand the full soil, crop and economic returns from these treatments.

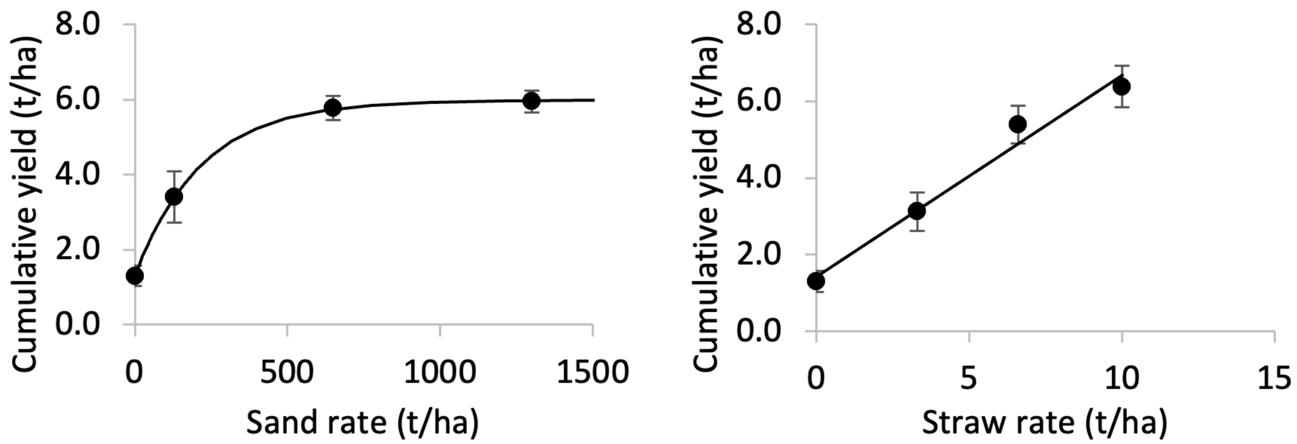

Figure 2 *. Cumulative (2022 lentil + 2023 wheat + 2024 barley) grain yield response in relation to sand (left, $R^2 = 0.867$) and straw (right, $R^2 = 0.978$) rates applied in salinity management trial Tickera, SA.*

Grain quality from all the sand and straw treatments was higher (BAR1) compared to the control (BAR2) (Table 4). While Commodus CL has been approved for malt accreditation, all treatments within the trial had protein levels >12% (maximum level allowed). This reflects the below average growing season rainfall reducing grain fill in the trial which had lower yield potential (lower yield = higher protein).

Table 4 . *barley grain quality, receival standard and gross income for salinity management trial 2024 Tickera, SA.*

Treatment	Protein %		Test weight kg/hL		Retention %		Screenings %		Receival standard
Control	14.1	ab	61.5	e	71.3	b	8.9	a	BAR2
Straw at 3.3 t/ha	13.5	abc	64.5	cde	82.2	a	4.9	b	BAR1
Straw at 6.6 t/ha	12.5	c	67.1	abcd	86.1	a	2.6	b	BAR1
Straw at 10 t/ha	13.1	bc	68.5	ab	84.6	a	3.0	b	BAR1
Sand at 130 t/ha	14.2	a	64.9	bcde	80.4	a	5.0	b	BAR1
Sand at 650 t/ha	14.1	ab	68.4	abc	87.9	a	2.6	b	BAR1
Sand at 1300 t/ha	14.5	a	68.9	a	85.9	a	3.1	b	BAR1
Gypsum at 10 t/ha	13.9	ab	62.5	de	69.0	b	10.2	a	BAR2
Pr(>F)	0.023		0.011		0.001		0.001		

Partial gross margin analysis

Partial gross margin (PGM) analysis conducted on the three seasons of trial data shows positive returns for most treatments (Table 5). The highest PGM come from straw applications where the straw is sourced and spread cheaply. In this scenario cost recovery was achieved after two seasons for straw applied at 6.6t/ha and was generating profit in the third season (Figure 3). However, sourcing straw at commercial value ($90/t) and paying full contract rates for spreading reduced PGM below the control (<$500/ha) after three seasons (Table 5). While spreading straw cheaply can be achieved on smaller areas of paddocks, it may not be practical over a larger area.

Despite the high costs of spreading sand as an amelioration strategy, it has produced positive PGM outcomes for the lower rates in the short-term. The 130 t/ha and 650 t/ha have resulted in cumulative PGM of $838/ha and $668/ha, respectively (Table 5). Sand applied at 650 t/ha did not achieve cost recovery until

Table 5 . *Treatment costs, grain yields (t/ha) and partial gross margin for 2022 – 2024 in the sand, straw and gypsum treatments at Tickera, SA.*

Treatment	Treatment cost* ($/ha)	2022 Lentil	2023 Wheat	2024 Barley	Cumuilative	Cumulative partial gross margin**
		Grain yield (t/ha)				($/ha)
Control	$0	0.23 b	0.67 c	0.58 c	1.30 c	**$526**
Sand at 130 t/ha	$240	0.25 ab	1.26 bc	1.76 b	3.41 b	**$838**
Sand at 650 t/ha	$1,185	0.40 ab	1.97 ab	3.32 a	5.77 a	**$668**
Sand at 1300 t/ha	$2,370	0.62 a	2.26 a	3.16 a	5.95 a	**-$315**
Straw at 3.3 t/ha	$270 - $625	0.40 ab	1.19 c	1.63 b	3.12 b	**$854 - $499**
Straw at 6.6 t/ha	$545 - $1,310	0.46 ab	1.95 ab	2.89 a	5.39 a	**$1,222 - $457**
Straw at 10 t/ha	$825 - $1,920	0.46 ab	2.42 a	3.50 a	6.38 a	**$1,265 - $170**
Gypsum at 10 t/ha	$465	0.16 b	1.26 c	0.65 c	1.53 c	**s**
Pr(>F)		0.001	<0.001	<0.001	<0.001	

**Treatment costs have been estimated based on contract rates for sand spreading in the area (where sand can be sourced is within 1 km of the paddock applied) and a combination of contract rates and estimates of 'do it yourself' straw spreading options. Gypsum prices are based on Everard gypsum delivered and spread at Tickera.*
***Cumulative partial gross margin assumes grain prices of $700 for lentil, $300 - $320 for wheat and $260 - $284 for barley depending on receival grade achieved.*

the third season, whereas 130t/ha had recovered costs in year 2 and was more profitable in year 3 (Figure 3). However, the trends of these lines would indicate that the higher cost 650t/ha treatment will surpass the lower cost treatment in the near term. Currently the results show the 1300 t/ha sand application rate is too costly to apply and has a negative PGM. However, the longevity of all treatments will continue to be assessed and may impact the final economics on which product and rates will be optimal for the longer-term management of saline soils in the area.

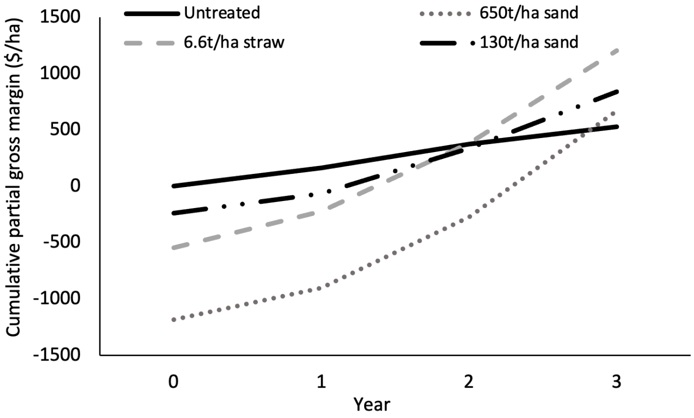

Figure 3 . *Cumulative partial gross margin ($/ha) over time from initial treatment application for selected treatments. Lower cost ($545/ha) estimate of 'do it yourself' scenario used for straw applied at 6.6t/ha.*

What does this mean?

All straw and sand rates are having a positive impact on grain yield three years after application to ameliorate this saline soil. However, the highest grain yields were achieved when at least 650 t/ha of sand or 6.6 t/ha of straw were applied. The application of sand at that rate is logistically difficult unless a source is located nearby. Where sand is not locally available, application of straw at a minimum of 6.6 t/ha would be more achievable.

Partial gross margin analysis has shown most treatments have produced a positive return compared to the control. It is expected that grain yields will continue to be maintained or improved in the short term now that consistent crop cover has been achieved and salinity levels have declined in response to treatment. It is likely this will continue to increase the PGM for all sand and straw treatments going forward. The longevity of response is important for these amelioration treatments due to the high implementation cost and this trial will be monitored for another three seasons (six total).

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We acknowledge the support of local growers; Michael Barker trial host, Andrew Bruce supplied sand, Josh Flowers freight and Bruce Bros baled straw.

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Future Drought Fund

SA DISCOVERY FARMS

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We acknowledge the support of local growers; Michael Barker trial host, Andrew Bruce supplied sand, Josh Flowers freight and Bruce Bros baled straw.

USING GRAIN PROTEIN MAPS *to* OPTIMISE NITROGEN FERTILISER *to* PADDOCK SCALE NITROGEN VARIABILITY: *Season two*

By: Sam Trengove, Stuart Sherriff, Jordan Bruce, Declan Anderson and Sarah Noack *- Trengove Consulting*

Key Messages

- Wheat grain protein continued to show a moderate correlation with soil available N pre-seeding in the following season at Bute and Redhill.
- Historic protein was able to predict the N fertiliser response in four barley trials at Bute this season.
- All of the N fertiliser trials at Redhill were severely moisture stressed resulting in a negative relationship between grain yield and N fertiliser rate.

Why do the trial?

In paddocks with significant spatial variation there is an opportunity to utilise data layers that can provide information at the site-specific level and aid nitrogen (N) decision making. The use of on-harvester protein analysers is becoming more common among grain growers. At harvest this technology allows growers to blend and segregate different grades of grain based on protein. However, the resulting grain protein maps also have the potential to assist N decision making by showing the spatial variation in protein (and therefore N) across a paddock. This variation can be used to assign zones and produce variable rate fertiliser maps.

The aims of this project are to increase the profitability derived from N fertiliser applications by:

- Examining the relationship between soil mineral N pre-seeding with grain yield and protein maps from the previous season,
- Examining the relationship between historical grain yield and protein maps, and the spatial variability of nitrogen response across paddocks in the Mid North and Yorke Peninsula,
- Provide information towards the potential for protein maps to create variable rate nitrogen application maps.

How was it done?

Paddock and trial site information

Two growers using standard yield monitors and retrofitted CropScan 3000H grain analysers were identified at Bute and Redhill. Wheat grain yield and protein maps from 2023 were analysed and one paddock per grower was selected for small scale field trials (Figure 1 and Figure 2).

Four sites per paddock were identified based on the 2023 data layers for small plot trials (Table 1). Each of the sites was predicted to have a different level of N fertiliser response based on historical crop performance. The 2023 grain yield and protein data from each of the selected trial sites are shown in Table 1. The topsoil at Redhill was characterised as a silty loam compared to a loamy sand at Bute. Soil available N for the Redhill site ranged from 89 – 127 kg N/ha and at Bute ranged from 44 - 89 kg N/ha. Organic carbon levels in both paddocks were generally moderate-high at Redhill sites and low-moderate at Bute sites. There were no other constraints identified in the soil properties tested (data not shown).

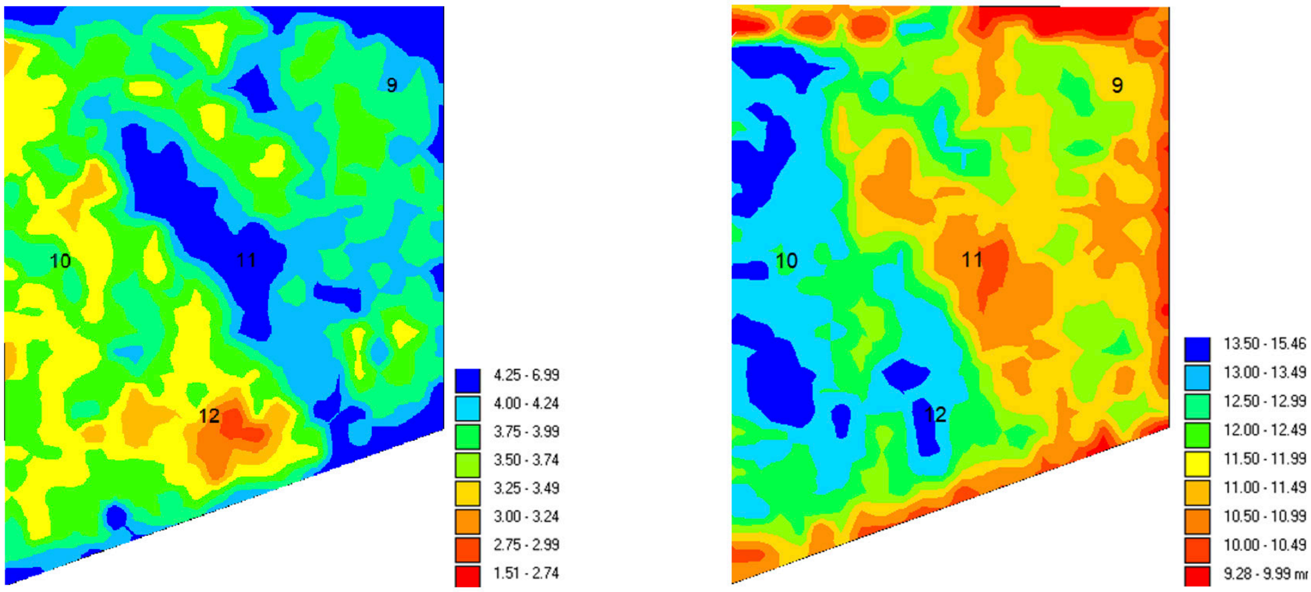


Figure 1. *The 2023 Redhill paddock wheat yield map (left) and protein map (right)*

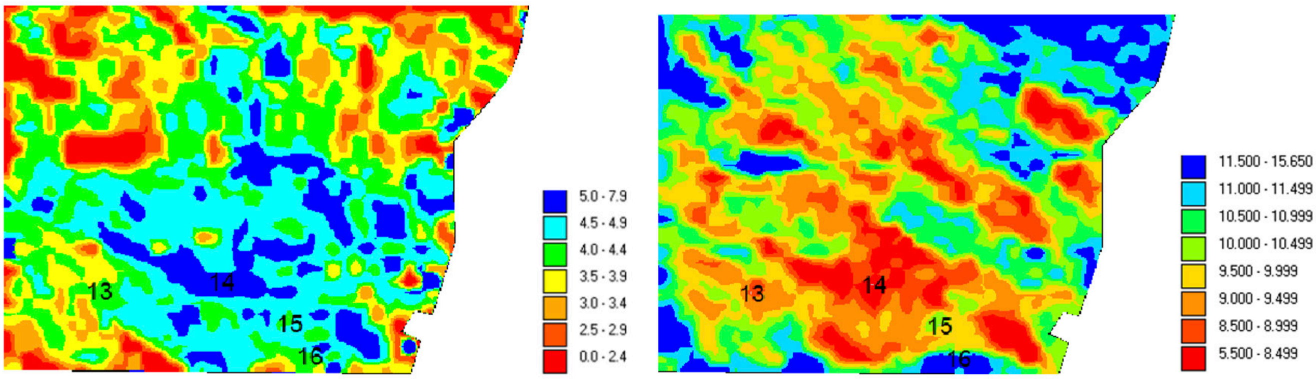


Figure 2. *The 2023 Bute paddock wheat yield data (left) and protein map (right)*

Table 1. *Wheat grain yield (2023), grain protein (2023), soil available N (sampled pre-seeding 2024) and organic carbon for the small-scale plot trial locations.*

N trial site	Location	Description*	2023 Wheat grain yield (t/ha)	2023 Protein (%)	Soil available N (0-100 cm)	Organic carbon (%)
9	Redhill	HYLP	4.3	10.7	89	1.5
10		HYMP	4.1	12.2	123	1.9
11		LYHP	2.9	14.0	127	2.6
12		LYMP	3.3	12.4	89	1.7
13	Bute	MYLP	4.0	8.9	59	0.7
14		HYLP	5.3	8.3	50	1.1
15		HYMP	4.9	10.1	44	1.0
16		MYHP	3.9	12.8	89	1.0

**Example MYLP = Medium yield, low protein*

Nitrogen fertiliser rate plot trials

The trials were randomised complete block designs with three replicates. Plot dimensions were 1.5 m x 10 m. The N fertiliser response at each trial site was assessed with fertiliser rates of 0, 25, 50, 75, 100, 150 and 200 kg N/ha applied as urea early post emergent.

Trial management details for the individual sites are shown in Table 2. Plots were sown with a knife point press wheel system on 250 mm spacing. All plots were harvested for grain yield and grain quality was assessed. Nitrogen removal (kg N/ha) was calculated as the product of grain protein (%) and yield (t/ha) multiplied by a protein conversion factor of 1.75. Grain yield and quality statistical analysis was performed using ANOVA and ASREML in R.

Nitrogen response curves were fit to the yield data for each site with either a polynomial or linear function. Predicted grain yield was then used to conduct partial gross margin (PGM) analysis to find the N rate at maximum PGM. Prices used in the PGM were $700/t for urea and $300/t for BAR1 barley.

Table 2. *Agronomic information for trial sites at Redhill and Bute in 2024.*

Site	Redhill	Bute
Seeding date	13th May	5th June
Variety (Seeding rate)	Beast barley @ 70 kg/ha	Commodus CL barley @ 80 kg/ha
Starting fertiliser	MAP + Zn @ 90 kg/ha	MAP + Zn @ 90 kg/ha
Harvest date	15th November	18th November

Seasonal conditions

There was minimal rainfall in the region for March, April and May. The Redhill site was dry sown in mid-May and the Bute site shortly after marginal germinating rains in early June (Figure 3). When rainfall was received in early June, they were small events (<10 mm) and the sites never had the opportunity to properly 'wet up'. Rainfall in August and September was generally half of the long-term average followed by average rainfall in October. Total growing season rainfall was decile one (lowest 10% of rainfall records) at both sites totalling 189 mm for Bute and 179 mm for Redhill.

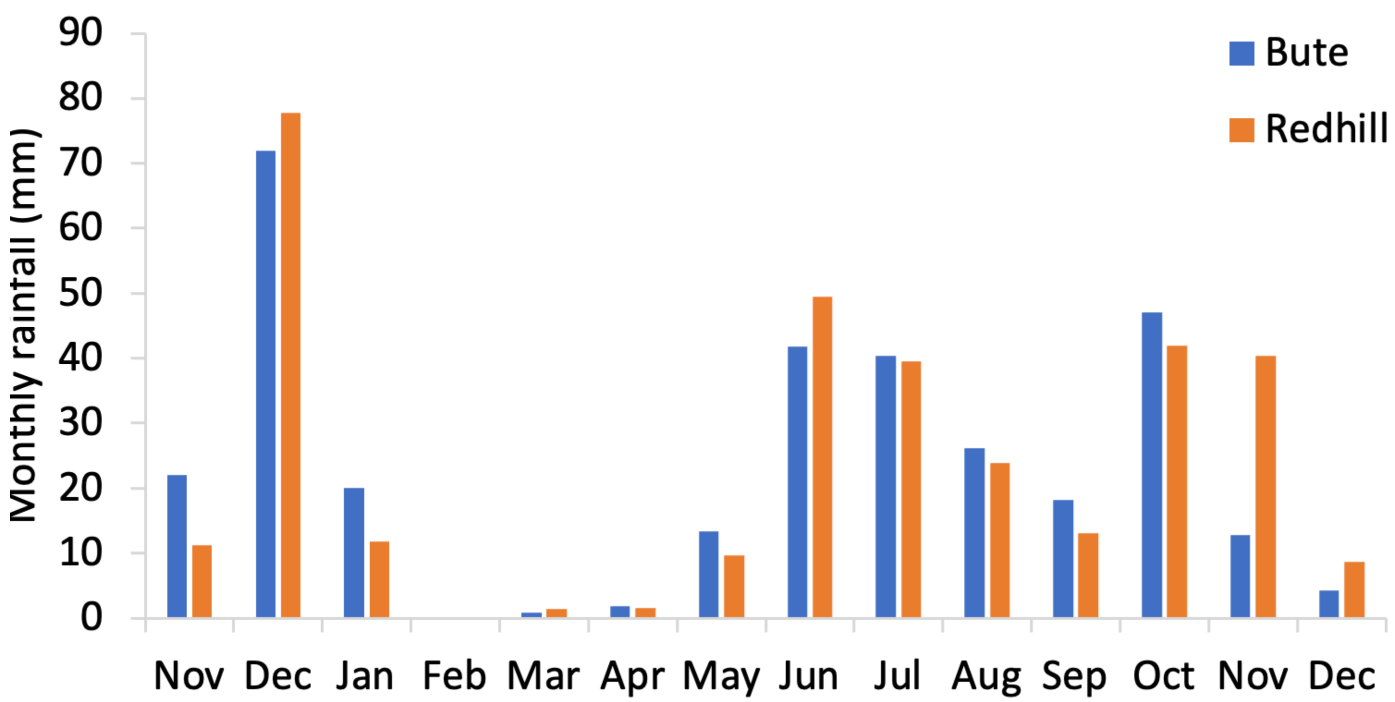


Figure 3. *Monthly rainfall for Redhill (Koolunga nearest BOM station) and Bute (BOM station) from November 2023 to December 2024.*

Results and discussion

Exploring the relationship between historical data layers and pre-seeding soil available N

Grain protein from the previous season had a moderate correlation to pre-seeding soil available N this season (Figure 4). At both the Redhill and Bute sites, as grain protein increased, soil available N measured in March the following season also increased. This is also consistent with results collected in 2023, with different paddocks utilised in each season (Figure 4). The rate of increase was similar for all four paddocks across the two seasons at an average of 8.5 kg N/ha for every 1% increase in grain protein.

In comparison, there was a weaker relationship between previous seasons grain yield or N removal (combination of grain yield and protein) and soil available N pre-seeding (Figure 4). For example, previous grain yield had a moderate correlation with soil available N pre-seeding for the two Bute paddocks. However, there was a very weak correlation between these two parameters at Redhill ($R^2 \leq 0.1$). The relationship between N removal and soil available N varied considerably and there were no consistent outcomes between sites or seasons. This data suggests grain protein can better describe the variation in soil available N compared to grain yield or N removal.

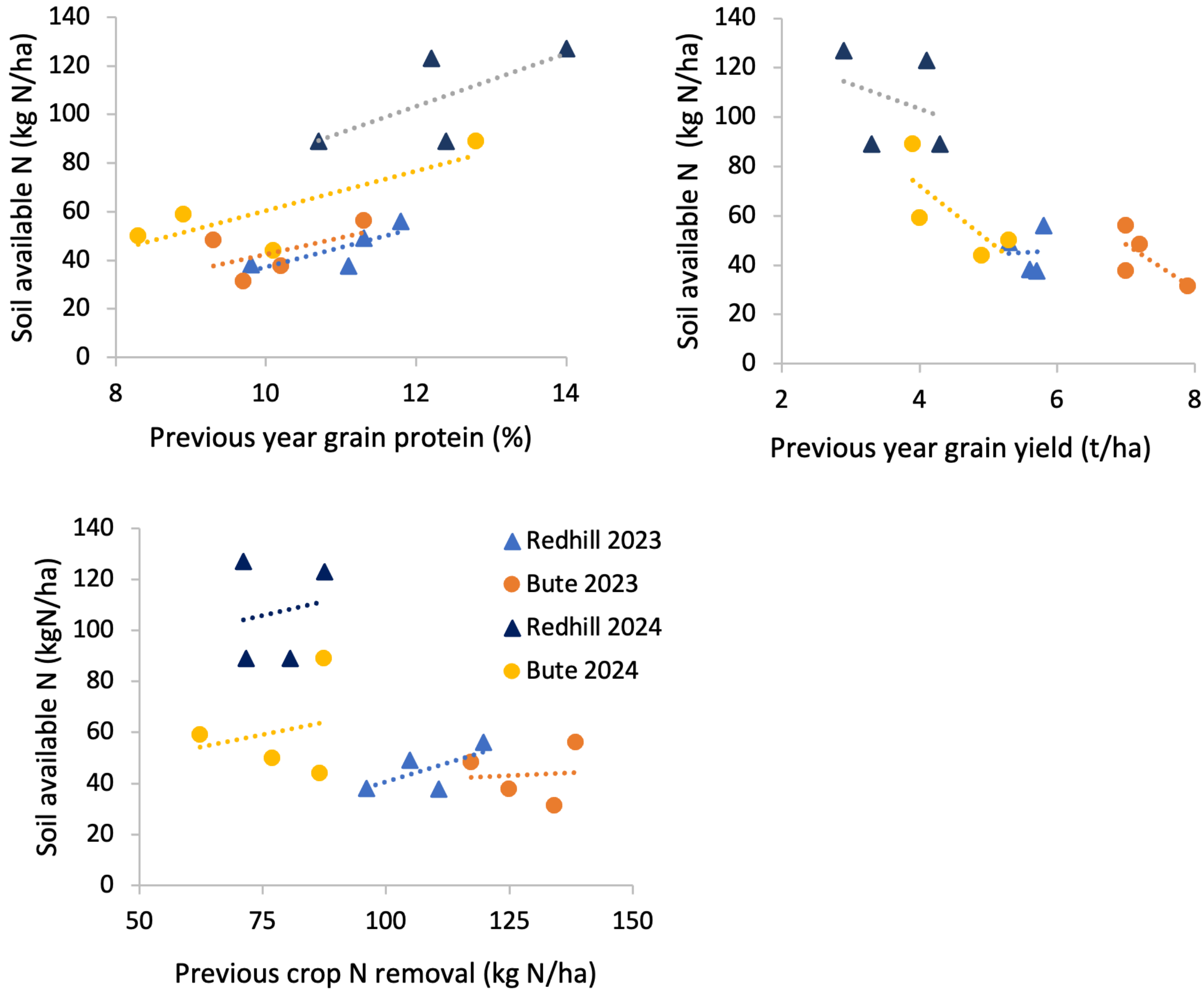


Figure 4. *The relationship between previous season grain protein (top left), grain yield (top right) and N removal (bottom) and soil available N sampled pre-seeding the following year for sites at Bute and Redhill.*

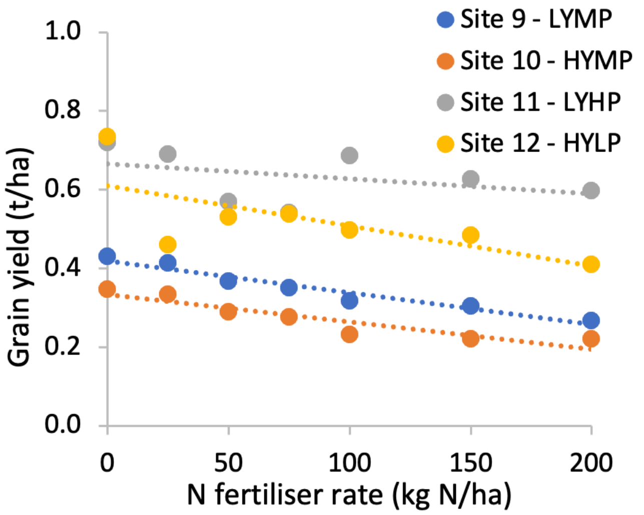
General crop performance across the paddocks

Grain yields at Redhill were impacted by severe moisture stress, ranging from 0.22 – 0.73 t/ha. There was a negative yield response to applied N this season (Figure 5). Within all four trials at Redhill grain yields were highest where 0 kg N/ha had been applied. Given the low grain yields, it is not surprising protein levels were high averaging 19.4% across all trials (range 17.1-21.0%).

Despite both locations receiving similar amounts of rainfall (Figure 3), grain yields at Bute were higher ranging from 3.1 to 4.7 t/ha. The difference in grain yields between Redhill and Bute this season can be attributed to soil type. The sandier texture soil at Bute, has a low crop lower limit (amount of water left in the soil after a crop has used all the available water) meaning there was more soil available water for the crop to access compared to Redhill.

A range of N responses were predicted and observed among the Bute trials this season (Figure 5). Three of the four sites had low or medium grain protein levels last season, suggesting they were N limited in 2023. As expected, all three of those sites (site 13,14 and 15) showed N fertiliser responses. The maximum PGM for site 13, 14 and 15 was achieved at 65 kg N/ha, 67 kg N/ha and 72 kg N/ha, respectively.

The fourth site at Bute (site 16) had historically higher protein (12.8%) and moderate grain yield compared to the other sites. This indicated the current seasons barley crop was likely to be least responsive to N in these areas of the paddock. The results show there was a negative response between grain yield and applied N rate (Figure 5). Grain yield was highest at 3.7 t/ha where 0 kg N/ha had been applied. Overall, protein data from the previous season was useful to predict the N fertiliser response in barley at the Bute sites this season.



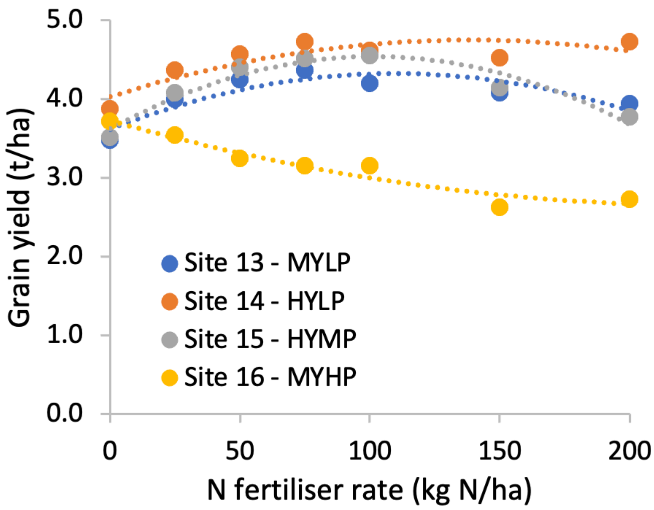


Figure 5. *Barley grain yield response to N fertiliser rates for the various sites/zone at Redhill (left) and Bute (right), 2024.*

Historical protein to predict crop N response

This season's results continued to provide evidence that historical protein can be used to indicate the variability in N demand for the current crop in a given paddock (Figure 6). At Bute in 2024, as the previous seasons protein increased the N rate required to maximise PGM reduced by a rate of 15 kg N/ha for each 1% protein increase. That is, less applied N was required where historic protein levels were high. Interestingly, the slope of this site was also similar to Redhill 2023 (16 kg N/ha). The slope was steeper for Bute 2023 however, this was largely driven by a single site response (site 7 = 11.3% protein, 9 kg N/ha at maximum PGM). In the absence of this site, the slope is similar to the remaining sites, at 24 kg N/ha.

The absolute N requirement for a given historical protein varied between the sites. For example, at a protein level of 10% in the previous season (Figure 6 black line) the N fertiliser rate requirement to maximise PGM in 2023 was 129 kg N/ha at Redhill and 68 kg N/ha and 51 kg N/ha for Bute in 2023 and 2024, respectively (Figure 6). The specific reason for the difference in optimum N rates between the two sites remains unclear given both sites generally have similar yield potentials (within 0.5 t/ha). The Redhill site also had higher starting soil available N and organic carbon (Table 1) indicating this site should have a lower N fertiliser requirement. Further investigation and another season of data from Redhill is required to see if the higher N demand is consistent across multiple seasons.

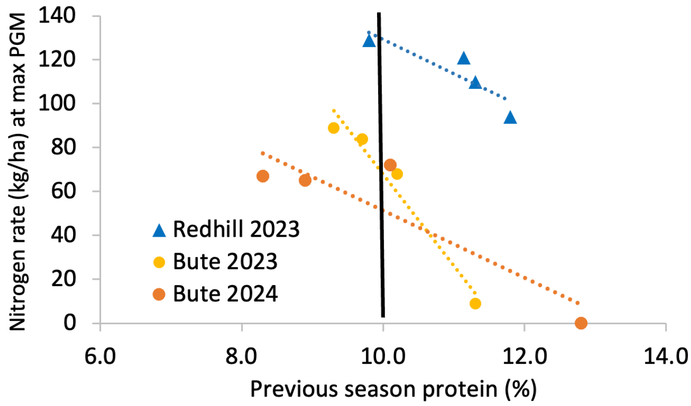


Figure 6. *Previous season grain protein (%) and N rate required to maximise PGM in 2023 and 2024 trials. Bute 2023 y = −41.6x + 483, R^2 = 0.96, Bute 2024 y = −15.3x + 204, R^2 = 0.80 and Redhill 2023 y = −15.6x + 286, R^2 = 0.78.*

Conclusions

Grain yield and protein maps collected in the previous season can provide useful insight for understanding the variability in N response in the current season. Protein data was more consistent than grain yield at predicting soil available N and was useful in describing the variability in fertiliser N response in the following crop. The yield responses at the Redhill site in 2024, were impacted by severe moisture stress and do not meaningfully contribute to the project objectives.

Acknowledgements

The authors gratefully acknowledge the financial support from SAGIT (TCO 02423) and Co-Funding through the SA Drought Hub 'Using grain protein maps to optimise nitrogen fertiliser to paddock scale nitrogen variability' to conduct this research. We also acknowledge Linden & Rob Price and Bill Trengove for hosting the field trials this season.

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LIVESTOCK & MIXED FARMING SYSTEMS

IMPROVING *the* PRODUCTIVITY *and* CLIMATE RESILIENCE *of the* AUSTRALIAN SHEEP INDUSTRY

Author: *Megan Tscharke* | **Funded by:** *Davies Research Centre University of Adelaide, SARDI, SA Sheep Industry Fund, and the South Australian Drought Resilience Adoption and Innovation Hub* | **Project Title:** *Improving the climate resilience of the Australian Sheep Industry* | **Project Duration:** *2 years* | **Project Delivery Organisations:** *University of Adelaide*

THE UNIVERSITY *of* ADELAIDE

Key Points

- In the mid North region, the use of both Regulin and ADE supplementation improved ewes bearing multiple fetuses across two consecutive joining periods.
- The use of Regulin and ADE increased overall fetal number per ewe by 18% in summer 2023/24 for both supplements.
- Across all sites in South Australia, Regulin, showed the greatest improvement in ewe fertility.

Trial participant Tom Trengove and Adelaide University researcher Megan Tscharke

Background

Health, reproduction, and welfare of sheep are compromised when heat events occur during mating and pregnancy. Each day in excess of 32°C during the week of mating reduces the number of lambs born per 100 ewes mated by 3.5%. Incidences of heat can impair oestrus expression, increase embryo loss, retard fetal growth, and decrease pregnancy and lambing rates. To combat the negative effects of heat stress, alleviation strategies need to be explored, with both melatonin and vitamins ADE as potential candidates. Both supplements are strong antioxidants that reduce free radicals within the body that cause cell damage and are produced during times of heat stress. Determining the ability of melatonin and ADE on reducing the negative effects of heat stress in sheep will provide producers with information to make informed choices about adoption of these amelioration strategies. Therefore, the aim of this trial was to determine the impact of supplementation with either melatonin implants (Regulin®) or a vitamin ADE drench on the fertility and fecundity of sheep across South Australia.

Methodology

This trial work commenced in November 2023 and is still currently running, involving 29 producer sites, across South Australia. The producer sites were obtained through collaborations with multiple farming systems groups including; South Australian Research and Development Institute (SARDI), MacKillop Farm Management Group (MFMG), Barossa Improved Grazing Group (BIGG), Upper North Farming Systems (UNFS), Northern and Yorke Landscape Board (NYLB), Mallee Sustainable Farming Systems (MSF), Murray Plains Farming Systems Group (MPF), and Agricultural Innovation and Research Eyre Peninsula (AIR EP). The treatments consisted of control (no supplementation), melatonin (Regulin®), or ADE; with each site acting as a replicate. Treatment was given just prior to joining, with ewes randomly allocated to a treatment; ewes were separated by age where applicable. Melatonin was administered through an 18 mg melatonin capsule (Regulin®) via a subcutaneous injection behind the ear, and the ADE was administered through a 10 ml oral drench of Maxivit Vitamin A, D & E Oral (Compass Feeds). At sites where applicable, an additional treatment group was added with ewes receiving a combination of both melatonin and ADE, and/or rams received a melatonin implant. Post treatment the ewes are returned to be managed as one mob according to standard husbandry procedures for that site. At each site pregnancy status and fetal number was determined by a commercial operator using ultrasound to determine the percentage of ewes pregnant, and the percentage of ewes carrying 1, 2 or 3 fetuses, which in turn was used to calculate potential lambing rate (expressed as fetuses as a percentage of ewes joined).

Results

In the joining season across summer 2023/24 the use of both melatonin (Regulin®) and vitamin ADE improved the fertility of the ewes at four properties in the Upper North Farming systems. Regulin® increased the number of ewes bearing multiple fetuses by 14.56% and the number of fetuses per ewes joined by 18.17%. The vitamin ADE drench increased the number of ewes bearing multiple fetuses by 15.79% and the number of fetuses per ewes joined by 18.31%. In the joining season of 2024/25 the use of Regulin® and ADE had a similar effect with an increase in multiple fetuses by 3.75% and 9.94%, respectively, and greater fetal number per ewe by 2.68% and 3.63%, respectively.

***Table 1.** Effects of a single Regulin® implant or a 10 ml oral Vitamin ADE drench administered just prior to joining on pregnancy outcomes across four properties in the Upper North Farming Systems across two consecutive summers 2023/24 and 2024/5.*

Ewes from four trial sites from the Upper North Farming Systems						
		Total Ewes (n)	**% Pregnant**	**% Single**	**% Multiple**	**Fetuses, % joined**
Summer 2023/24	Control	742	89.08	55.80	33.29	122.37
	Regulin	629	92.69	44.83	47.85	140.54
	ADE	381	91.60	42.52	49.08	140.68
Summer 2024/25	Control	402	86.07	56.72	29.35	115.42
	Regulin	420	85.00	51.90	33.10	118.10
	ADE	84	79.76	40.48	39.29	119.05

***Table 2.** Effects of a single Regulin® implant or a 10 ml oral Vitamin ADE drench administered just prior to joining on pregnancy outcomes from all properties enrolled within the trial in South Australia across two consecutive summers 2023/24 and 2024/5.*

Ewes from all producer sites across South Australia						
		Total Ewes (n)	**% Pregnant**	**% Single**	**% Multiple**	**Fetuses, % joined**
Summer 2023/24	Control	3266	89.71	45.81	43.91	134.97
	Regulin	2984	91.86	34.92	56.94	151.04
	ADE	2662	91.36	44.63	46.73	139.18
	Reg+ADE	161	95.65	22.36	73.29	178.26
Summer 2024/25	Control	1566	88.25	43.93	44.32	133.59
	Regulin	1415	89.54	40.85	48.69	139.43
	ADE	756	85.32	39.81	45.50	131.22

Trial site in Quorn

Acknowledgements

- The 29 producers across South Australia for hosting this trial.
- Compass Feeds for the Maxifit ADE Drench, and to CEVA Animal Health for the Regulin®.
- The funding bodies for providing funding to the University of Adelaide for this trial including the Davies Research Centre University of Adelaide, SARDI, SA Sheep Industry Fund, and the South Australian Drought Resilience Adoption and Innovation Hub.

SA BEST PRACTICE WILD DOG CONTROL *and* PRODUCTIVITY NETWORK

Author: *Rachel Trengove, Project Manager, UNFS*
Funded By: *PIRSA, MLA & Livestock SA.* | **Project Title:** *SA Best Practice Wild Dog Control and Productivity Network*
Project Duration: *January 2024 - December 2026*
Project Delivery Organisations: *UNFS, PIRSA, Andrew Michael, Leahcim Stud, Anne Collins, AC Consulting*

Aim:

'SA Best Practice Wild Dog Control Network' initiative aims to support primary producers to lift their productivity, including controlling wild dogs. This four-year initiative lets producers decide what they want to learn through a peer-led, landscape-scale, locally-driven approach.

Delivery of the project

At least one workshop per year and one simple trial per group over 4 years.

The program is designed to develop producer-driven capacity and knowledge to improve productivity in:

- wild dog behaviour and control
- livestock productivity
- other programs identified by the groups
- leadership and business skills

Potential focus areas:

- Productivity - pregnancy scanning, condition scoring, nutrition assessments, and diagnosing and managing livestock diseases.
- Wild dog behaviour - trapping and new technologies
- Trials - predator alerts, eDNA, livestock nutrition, and bait efficacy.

UNFS participants chose to focus on transitioning to non-mulesed sheep flocks 2024 Workshop

Title: Transitioning to Non-Mulesed Sheep | **Date:** Tuesday 25th June 2024

Attendance: 20 | **Location:** Richard & Michelle McCallum's Woolshed

Topics & Speakers:

Geoff Lindon, Program Manager, Sheep Genetics & Animal Welfare Advocacy—Australian Wool Innovation (AWI)

- Market feedback - latest National Wool Declaration (NWD) stats by state—premiums and discounts
- Breech and body strike risk factors
- Target visual scores and target Australian Sheep Breeding Values (ASBVs)
- Resistance to fly control chemicals

Andrew Michael, Leahcim Stud

- ASBV's important to mulesing transition, not just breech wrinkle
- Evolution of Australia's sheep flock moving forward to meet our market demands
- Value adding wool and meat products within sheep flocks to increase profitability into the future

Farmer panel - Richard & Michelle McCallum, Jim Kuerschner & Dave Clarke

- Share their considerations, experiences and management strategies in transitioning to non-mulesed sheep

Image 1: *Richard & Michelle McCallum (workshop hosts), Dave Clarke, Jim Kuerschner, Rachel Trengove and Geoff Lindon, AWI*

Image 2: Transitioning to Non-Mulesed Sheep Workshop on 25th June 2024

Simple Trial – Merino Flock Profiling with Upper North Farmers

Background

In 2021, a group of nine members of UNFS completed Merino Flock Profiles (MFP) together. The profile results (see example in Image 3) include yearling fibre diameter, clean wool weight, eye muscle depth and worm egg count as well as post weaning weight and early breech wrinkle (score) – along with seven other flock production parameters. Results are compared with Industry averages and ranges.

Once all results were received, a workshop was held, delivered by Andrew Michael of Leahcim Poll Merino and Anne Collins of AC Ag Consulting. At this workshop, all the individual flock results were shared and each one discussed as a group. Also discussed was how to define a breeding objective, and there was a demonstration of the on-line RamSelect app. Each producer was able to go away with the genesis of a breeding objective for their own flock, and a plan for making better ram buying decisions having identified the traits they want to improve. As a result of the discussions, many were planning to place more focus on the carcase traits of fat & eye muscle diameter.

Following this workshop, some producers were happy to have it confirmed that they were on the right track with their existing breeding strategy; some felt they had greater confidence in talking to their ram source and outlining what they are looking for as a client; some were planning to have conversations with their ram source about their potential to start supplying ASBVs with sale rams; and others were even considering changing ram sources, so that they could make more informed ram buying decisions.

Simple Trial Description

For UNFS's 'simple trial' funded by this project, the same group of producers completed MFPs in 2024, three years after the initial testing. This is the suggested interval between tests, to enable producers to track any changes to their flock over time and to gauge whether the traits a flock is interested in are trending in the right direction. Another workshop was held where all the new MFP results were shared. Producers willingly released both sets of results from 2021 and 2024 to UNFS, and a report was written to discuss the changes that were observed with each flock. This report aims to support learning through knowledge-sharing across Upper North sheep producers.

Key Outcomes

The format adopted in this simple trial has proved to be an excellent approach for wool grower learning and adoption of the use of ASBVs in formulating breeding objectives and in Merino ram buying decisions. Importantly, participants in this trial have acquired knowledge and skills that are resulting in them implementing practice change that will move them toward using ASBV's, regular MFP's and also toward adopting non-mulesed sheep flocks.

Producers were able to improve their understanding of ASBVs and industry indexes; benchmark their flock against the Australian Merino flock; identify individual traits that present opportunities for flock improvement; formulate an individual breeding objective; make ram buying decisions based on these objectives; and observe the impact of these decisions on their flock's genetic potential over a three-year period.

Nearly all of the producers in this group are mixed farmers, and one of the participants provided the following analogy, "In our cropping enterprises we wouldn't make fertilizer decisions without doing a soil test every few years. The MFP is the equivalent of a soil test for your Merino flock. And we wouldn't change varieties without looking at the National Variety Trial results first, which is the equivalent of using ASBVs to make genetic decisions in the flock."

This project is potentially a useful model for other producer groups who want to become familiar with Australian Sheep Breeding Values and how they can be a useful tool for making genetic progress in their flocks.

The full report on this simple trial on merino flock profiling can be found here: https://unfs.com.au/resources/

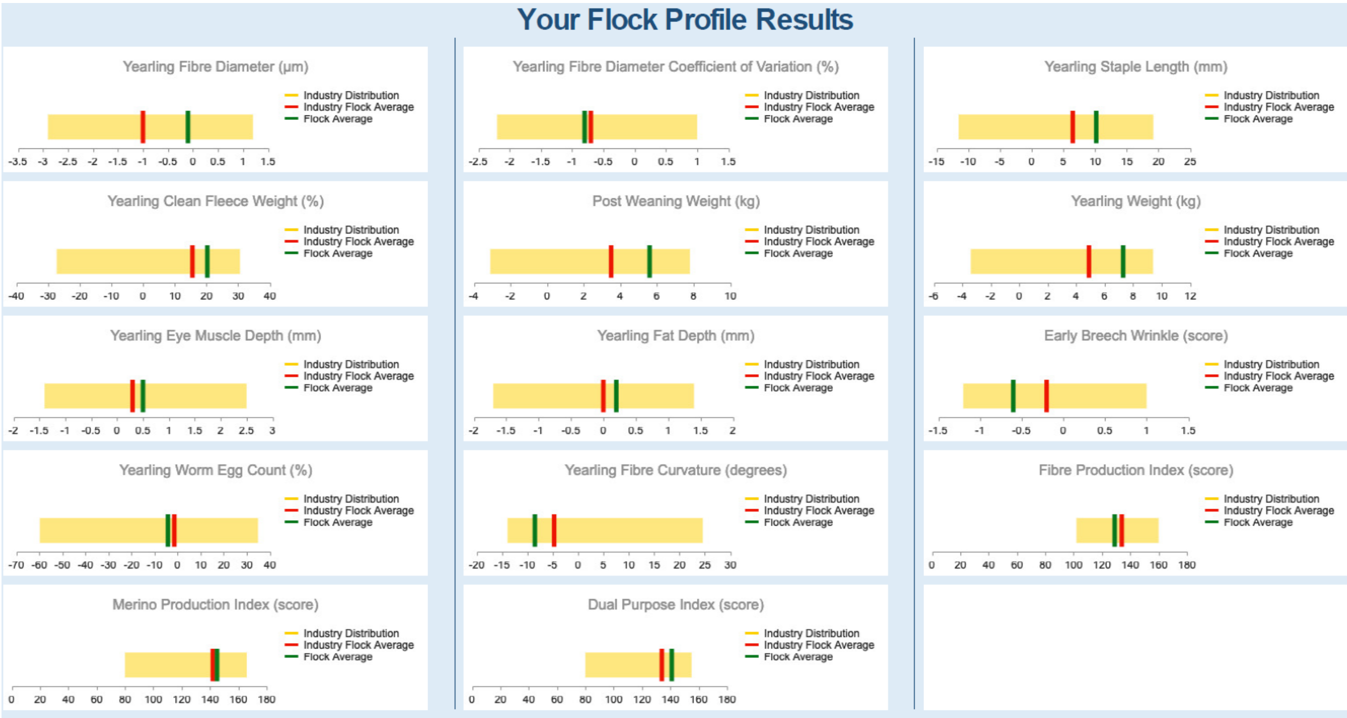

Image 3: *An example of flock profiling results as part of the UNFS simple trial conducted through this project*

Image 3: *A producer scoring his flock for breech wrinkle*

Acknowledgments

We sincerely thank all Upper North farmers who generously contributed their results to this project. We also gratefully acknowledge Andrew Michael of Leahcim Stud and Anne Collins of AC Consulting for their valuable input and support, which were instrumental in the successful delivery of the trial.

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mla MEAT & LIVESTOCK AUSTRALIA
Government of South Australia Department of Primary Industries and Regions

CONTAINMENT FEEDING

Author: *Rachel Trengove, Project Manager, UNFS*
Funded By: *SA Drought Hub* | **Project Title:** *Containment Feeding to Boost Business Performance and Resilience*
Project Duration: *January - December 2024 (completed)*
Project Delivery Organisations: *UNFS, Jane Heyneman, Deb Scammell, Talking Livestock*

Aim

This project aimed to boost the adoption of containment systems on farms by training and assembling a network of containment adoption advisors, connected to farming systems groups working directly with livestock producers.

The project trained advisors, developed learning resources, conducted small group producer workshops, and provided 1 on 1 advice so farmers were supported in the planning, implementation and operation of containment systems that are appropriate to their farming operation.

The project was tailored to regions, as well as individual farm businesses, to cater for those at different stages of adoption. For example, to support those just starting their containment feeding journey to those who wish to optimise and enhance their containment feeding systems.

Delivery of the project

UNFS nominated Jane Heyneman to be their connected advisor for the pilot program. Jane participated in a train-the -trainer event and was provided with resources and delivery materials. Jane was supported with coaching by Deb Scammell, Talking Livestock.

Producers were recruited for the containment feeding pilot program, with support from the UNFS project coordinator.

A 1-day workshop was delivered to a group of 12 producers based on the learning content provided through the advisor training. A producer resource guide was provided to participants.

Following the 1-day small group workshop, Jane then worked 1-on-1 with 6 producers in the group to create and support the planning, design and implementation of a containment feeding setup best suited to the farmer, sheep enterprise and farming environment.

Key Outcomes

- Attained a newly trained and networked containment adoption advisor who can provide service to UNFS and Upper North farmers after the project is completed.
- Support provided 1-on-1 to six producers, including: containment yard site selection advice, customised containment design and development of ration formulations to meet nutritional needs.

Image 1: *Containment feeding workshop & sticky beak day at David Moore's property near Jamestown in August 2024.*

Image 2: *An Upper North containment feeding site for 1-on-1 consultation for ration planning in 2024.*

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This program received funding from the Australian Government's Future Drought Fund

LONG TERM EVALUATION *of* ANNUAL MEDIC *and* CLOVER ACCESSIONS *for* DROUGHT ADAPTION

Author: *David Peck[1,2], Jeff Hill[1], Lee Bartlett[1], Rafael Prezzotto[1]*
Project Delivery Organisations: *[1] SARDI, Waite. [2] University of Adelaide Affiliate*

Key Points

- This long-term trial is evaluating annual medic and clover accessions collected from areas in the world with a climate like the predicted climate of low rainfall areas of South Australia 2030-2050.
- We are hopeful that we can identify accessions with increased production and persistence over the long term.
- We discuss pasture restoration options to implement in average and wet years to assist pastures during and after a drought.

Why do the trial?

Annual medics provide feed to livestock, fix nitrogen for the benefit of following grain crops, and reduce input costs and risk in low rainfall areas (e.g. increase yield of following grain crops by 0.7-2.9 t/ha EPFSS 2020. P. 205, EPFSS 2020, p. 213). Annual medics are typically used as ley pastures, they have relatively high levels of hardseededness that allow them to persist through 2-3 years of grain crops.

Lifting the production level of annual medic pastures from OK to good, increase overall farm profitability by 20% with much of the increase in profit accruing in the cropping phase due to higher nitrogen and lower disease levels.

Due to farmers wanting to sow annual medic pastures once, then not sow them again for at least 20 years, they are required to persist and be productive over the long term and need to perform before, during and after dry, average, and wet years. Selecting pasture legume genotypes for their performance over several years can deliver new cultivars that are more persistent and productive than prior cultivars.

The low rainfall, mixed farming zone of South Australia is expected to be impacted by a changing climate, experience warmer temperatures and more droughts. The changing climate will put annual medics under pressure which in turn will impact their ability to feed livestock and to fix nitrogen for subsequent grain crops. Ensuring viable medic pastures for the long term reduce carbon emissions from the manufacture and transport of nitrogen fertiliser. SARDI climate applications reviewed climate change models to determine future climate (2030-2050) of low rainfall mixed farming areas of South Australia. SARDI pastures used this climate data to shortlist productive medic accessions collected from places in the world with similar climates. 321 accessions were sown at two low rainfall sites (Orroroo and Palmer) in 2022 (EPFS 2022 p 152-155). Long term trials are required for accessions to show that they are well adapted to the environmental and agronomical/management conditions. Unlike grain crops, pasture legumes are not sown annually but rather are sown once and then expected to be persistent and productive over 2-3 decades. By evaluating pasture legumes in long term trials, Queensland Department of Agriculture developed five new stylosanthes cultivars with 40-70% increase in persistence over existing cultivars. Attributes that allow individual annual medic and clover genotypes to achieve long term production and persistence are expected to include hardseed characteristics (level and timing of softening), ability to tolerate water deficit, ability to grow rapidly and set seeds after rainfall events. The hypothesis is that we will find accessions with higher performance during and after droughts than current cultivars.

How was it done?

EPFS 2022 p 152-155 provides details of how 321 annual medic accessions were chosen and planted at Orroroo and Palmer in 2022. In brief, the accessions were selected: 1) collected from areas in the world with a climate like the predicted climate of low rainfall areas of SA 2030-2050; 2) have high dry matter when seed increased at Waite (de-facto high rainfall year); 3) low levels of spines to minimise wool fault. Species were grouped into six cohorts: 1) barrel medic; 2) strand and disc medic; 3) spineless burr medic; 4) minor species; 5) large-seeded species; 6) clovers. Current cultivars were sown in each cohort as controls. Plants established well in June 2022, experienced a very dry July, and a wet spring allowed all accession to set high amounts of seeds. In 2023, plants were allowed to regenerate but were sprayed out in early spring to mimic the first year being a cropping year. In 2024, plant regeneration and plant growth were scored until early spring and then sprayed out to mimic a second non-pasture year.

What happened?

The 2024 growing season had a late break at Palmer (early June) and a very late break at Orroroo (July). A box whisker plot of biomass score at Palmer 26/6/2024 is shown in figure 1. Accessions typically have lower minimums, first quartile and medians than the cultivars (controls). However, the top performing accessions performed similar or better than the best controls plots.

Plant establishment (plants/m2) is a large driver of early biomass and reflects the level of seed softening. Some accessions had very low plant regeneration due to very high levels of hardseed rather than exhaustion of soil seed reserves. We know this, as the same accessions had very low regeneration in 2023, and pods produced in 2022 are readily observed and when opened have healthy looking seed. These accessions are not suitable for 1:1 pasture grain cropping rotations but may be suitable to 2:1 rotation. We also scored average number of leaves 26/6/2024 and most had 1-2 leaves, some had 2-3 leaves and the occasional accession had 3 or 4 leaves. The accessions with higher number of leaves may have faster growth rates. Later biomass scores showed similar variation in biomass as shown in Fig 1, but some individual accessions had higher rankings which reflects faster biomass production during the dry 2024 growing season.

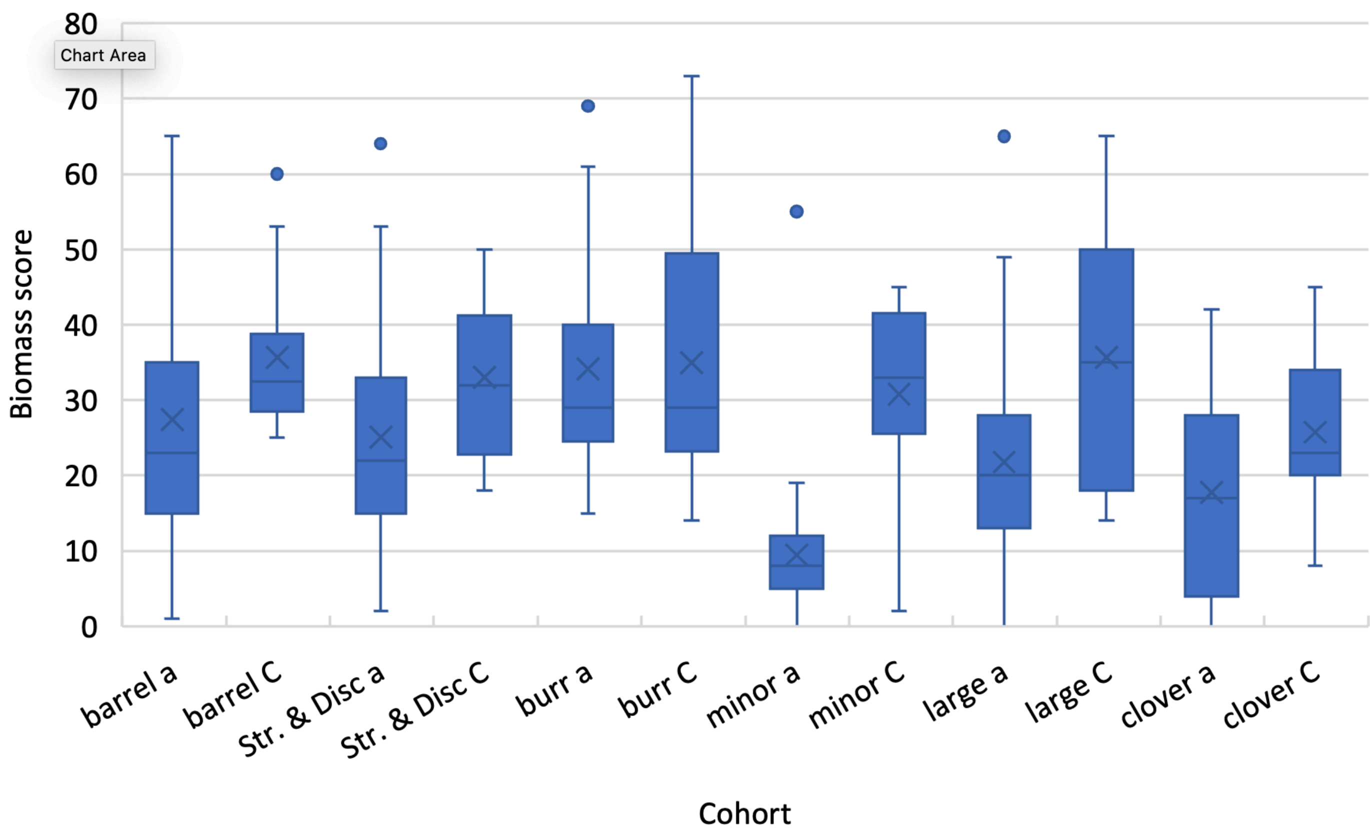

Figure 1. *Box whiskers plot of biomass score of accessions (a) and cultivars (C) of the six cohorts [barrel, strands (Str.) and disc, spineless burr (burr), minor species, large seeded species, and clover] at Palmer 26/6/2024. From bottom to top, box whiskers show minimum, first quartile, median, mean (X), third quartile, maximum and any outliers (circle).*

What does it mean?

This trial is searching for genotypes with increased persistence and production over the long term. This year represented pasture production in a 1:1 rotation and we have identified accessions with high and low performance. The number of plants established is a function of seed softening and is a big driver of early dry matter production. It is possible that plants with low level of softening this year may have more seed soften next year, and that accessions with high plant numbers this year may have less seeds soften next year due to seed reserve decline. Greater weighting will be provided to biomass production next year as 2:1 rotations are more common than 1:1 rotations. At the end of 2025, we will develop a short list of preferred accessions based on production from 2022 to 2025. The short-listed accession will be followed in greater details in subsequent years.

2024 had a late break and therefore we were unable to determine if accessions varied in the time of peak softening. If a relatively early break occurs in subsequent years, we can determine which accessions soften early and which soften late. If an early break is followed by a dry spell, we can also determine which accessions have increased seedling drought tolerance.

This project is focused on which genotypes deal well with droughts. However, with the focus on droughts it is apparent that pasture agronomy/management practices impact the ability of medics to perform before, during and after droughts. Key pasture managements practices are ones that increase medic production and maintain high levels of seed reserves. The simplest way of increasing annual medic pastures is to use grass and broadleaf herbicides to maximise the medic component. Plant establishment number is an indicator of seed reserves and a good predictor of pasture performance. Monitoring plant establishment allows decisions to be made on treating medic pasture paddocks as usual or allocating them to restoration work. Restoration work focuses on increasing seed set, which can be done by weed control, reducing grazing pressure from early flowering onwards, and delaying spray topping. Paddocks with low soil seed reserves will also benefit from increased frequency of pasture in a rotation (e.g. 1:1 rotation until seed reserves recover and then change back to 2:1). Excess feed is usually present in spring in average and wet years, and in these years medium and poor paddocks can be managed for high seed set. In a drought year, pasture paddocks will have less seed set than usual and therefore may require a shorter rotation than usual, particularly if plant establishment observations had determined that the paddock needs restoration work.

Medic pastures are required to be productive and persistent for many years. Low rainfall areas of South Australia have good seasons and poor seasons and what makes a good pasture genotype is complex and multifaceted. Monitoring annual medic genotypes in a long-term trials is expected to identify genotypes with increased persistence and production. Monitoring your medic pastures in average and wet years will allow you to identify when restoration practices are required, which will assist their ability to persist through droughts and to continue to contribute to overall farm profitability.

Acknowledgements

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Australian Government Department of Agriculture, Fisheries and Forestry | Future Drought Fund | SA DISCOVERY FARMS

This project received funding from the Australian Government's Future Drought Fund through the Long-term Trials of Drought Resilient Farming Practices Grants

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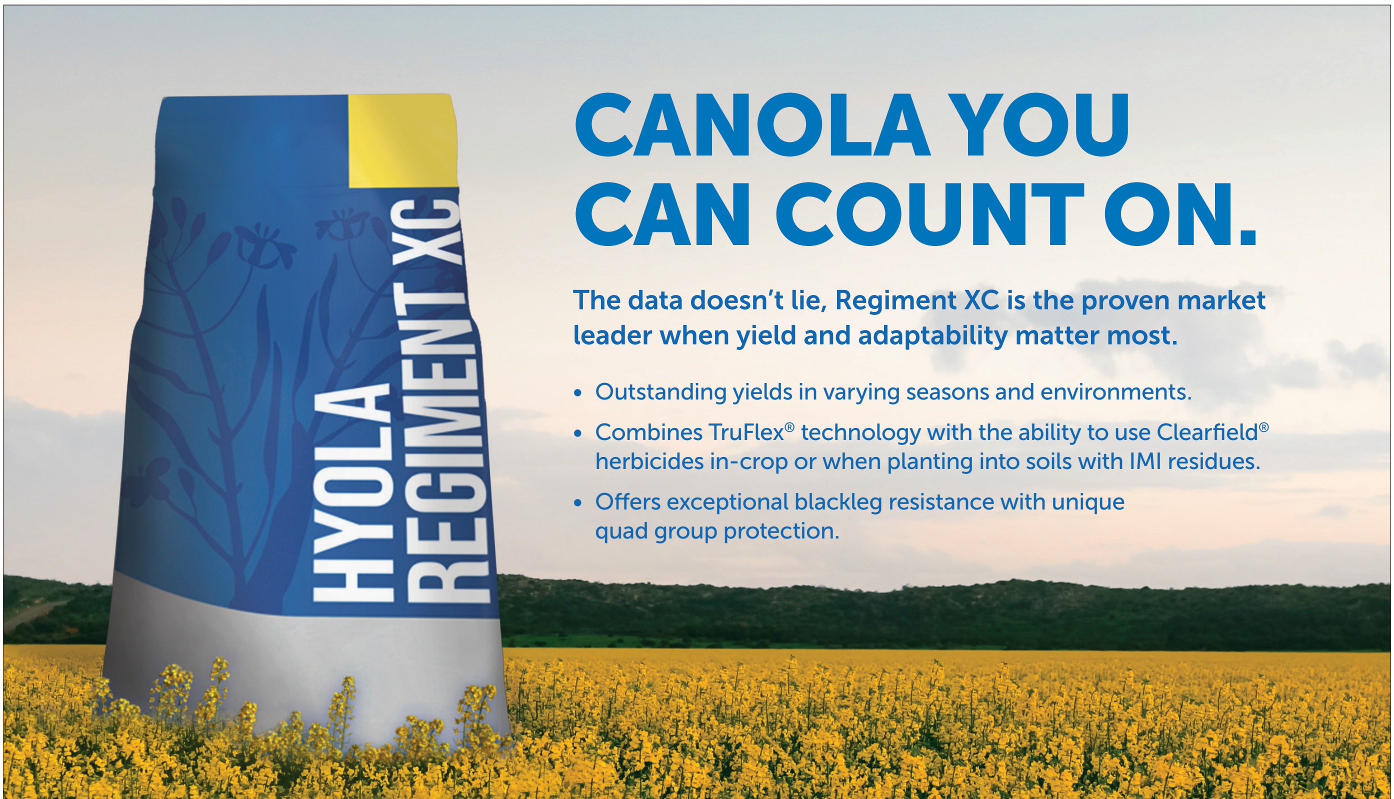

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PDS: LOTSA LAMBS – IMPROVING REPRODUCTION SUCCESS
Project Summary and Case Studies

The Lotsa Lambs – Improving Reproduction Success producer demonstration site project was funded by Meat & Livestock Australia from 2022 to 2025. The project aimed to demonstrate that the adoption of best practice management strategies, including pregnancy scanning for multiples and early/late, selective management of pregnant ewes in containment, smaller mob size at lambing for twin bearers and genetic selection, can improve reproductive performance of sheep flocks in the Upper North of South Australia.

The project is now complete with the final report undergoing review for publishing, the following is an summary of the project outcomes and four producer case studies.

Abstract

The profitability of sheep enterprises in Australia is declining (Ashton et al, 2024). Improving productivity from the existing ewe base through maximising reproductive efficiency and minimising mortality will improve production outcomes and long-term profitability.

Four sites in the Upper North Agricultural District of South Australia demonstrated the use of pregnancy scanning ewes in containment for foetus number, condition scoring and targeted feeding based on foetus number to increase lamb survival rates over one lambing cycle. An 8% increase in lamb marking was achieved compared with historic lambing results before twin and single bearing ewes were managed selectively in containment.

In addition, two sites demonstrated lambing multiples in smaller mobs over three lambing cycles. Twin-bearing ewes in mobs of 100 or fewer during lambing reduces the risks of mismothering, ewe-lamb separations, and lamb mortality. The average increase in lambing marking over the 3 year PDS project from the adoption of reduced mob size at lambing for multiple bearing ewes was 8% compared with historical lambing results.

This Upper North Farming Systems project, through workshops and extension material, also increased producer understanding of the impact of genetic selection on reproduction, including the use of selection tools such as Australian Sheep Breeding Values (ASBVs), the RamSelect app and Merino Flock Profiling.

Executive summary

Background

To ensure the long-term profitability and productivity of the Australian sheep industry, it is crucial to maximize flock production efficiency by improving reproductive efficiency and minimizing mortality. Seasonal conditions in the Mid-Upper North Agricultural Districts of South Australia have led many producers to aim for autumn lambing to maximize feed availability for lambs. However, this period poses a high risk due to low feed availability and quality, necessitating careful management of pregnant ewes through paddock or confinement feeding.

Research indicates that managing ewes pregnant with twins can result in progeny performance similar to single-born lambs when managed under similar targets. Reducing mob size without altering stocking rates has been shown to improve twin-born lamb survival. Despite awareness of these strategies, many producers struggle to implement them, especially in mixed farming systems with larger paddock sizes. Demonstrations and on-ground solutions are needed to help producers adopt these practices effectively.

Additionally, the project aims to enhance producers' knowledge and use of genetic and maternal health management tools to improve lamb survival. With increasing attention on reproductive wastage due to animal welfare and economic concerns, breeders seek viable options, including genetic improvements, despite slow progress predictions. The demonstration results will provide local knowledge and best practice strategies for improving reproductive performance in sheep flocks in the Upper North Agricultural District of South Australia.

Objectives

This project aimed to demonstrate that the adoption of best practice management strategies including pregnancy scanning for multiples and early and late bearing ewes, selective management of pregnant ewes in containment, smaller mob size at lambing for twin bearers and genetic selection, can improve reproductive performance of sheep flocks in the Upper North of South Australia.

The project objectives were achieved successfully with participants increasing their overall knowledge, skills and overall confidence and final surveys showing an increase in participant's adoption of practices aimed at improving reproductive performance. There was an overall increase in lambing marking compared with historical lambing across all sites.

Methodology

Two sites were provided by Upper North producers to demonstrate the implementation of pregnancy scanning and lambing multiples in smaller mobs over three lambing cycles.

Four sites demonstrated the use of pregnancy scanning ewes in containment for foetus number, as well as the use of condition scoring, and targeted feeding based on foetus number to increase lamb survival rates over one lambing cycle.

All producers worked alongside a livestock consultant to guide implementation of PDS demonstration practices

The extension and communication activities were held to enable producers to learn from the PDS project. Sessions were designed to suit producer needs providing opportunities to engage with livestock technical experts and researchers, practice skills such as condition scoring and feed budgeting, as well as engaging in peer-to-peer learning.

Results/key findings

- Lamb survival percentage increased by an average of 8% compared to historical averages. This was associated with better overall management of ewes over the three years.
- Knowledge, skills and practice change increased over the project in both core and observer producers in recommended management practices.
- Local producer groups and peer-to-peer discussions with access to researchers and technical experts lead to improved learning and adoption.
- Measuring and monitoring condition scoring is important for achieving improved lamb survival as well as general animal health.
- Pregnancy scanning is essential for splitting ewes into better management groups and for future management decisions.
- The economic analysis showed an average $3.95 net benefit per ewe joined for selective management of multiple bearing ewes in containment and average $1.80 net benefit per ewe joined for running multiple bearing ewes in smaller mobs.
- Four core producers and 18 observer producers were involved in the project
- A total of nine extension activities were delivered with a total attendance of 310
- 26 communication outputs were delivered to UNFS members and the wider farming community.

Benefits to industry

Over the three-year project, there has been an increase in knowledge and adoption of best practice management strategies including pregnancy scanning for multiples and early/lates, selective management of pregnant ewes in containment, smaller mob sizes at lambing for twin bearing ewes and the use of genetic selection tools.

The reproductive performance and profitability of sheep flocks in the Upper North of South Australia can be improved with more effective overall management of ewes during pregnancy and at lambing.

Future research and recommendations

Supported peer to peer learning on farm leads to increased confidence and skills and adoption of management practices.

Control flocks would give a direct comparison rather than relying on historical data for analysing the results of the demonstration sites.

Alternative grazing strategies, fodder crops and feed sources could be investigated to bridge the feed gap during summer/autumn for pregnant ewes in the Upper North.

Investigate the concept of high condition score ewes at lambing having better lamb survival, and those lambs having a higher lifetime fleece value.

PRODUCER CASE STUDY

Targeted nutrition a smart choice

Upper north SA sheep producer Lachie Smart.

Upper North Farming Systems Project Officer Rachel Trengove and Talking Livestock consultant Deb Scammell assess feed on offer in Lachie's hill paddocks.

Upper North Farming Systems Project Officer Rachel Trengove and upper north SA sheep producer Lachie Smart.

MORE INFORMATION

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KEY RESOURCES

- **MLA Producer Demonstration Sites:** mla.com.au/pds
- **Containment feeding resources:** mla.com.au/containment-feeding
- **Lifetime Ewe Management:** wool.com.au/ltem

ON-FARM SNAPSHOT

Name/s	Lachie and Diane Smart
Location	Wirrabara, SA
Area in hectares	1,600ha
Enterprise	Mixed farming, with 1,200 self-replacing Merinos, plus 400–500 ewe hoggets and 700–800 Merino ewes mated to White Suffolk rams.
Pastures	Cropping (wheat, canola, beans, lupins), lucerne vetch for hay and pasture, perennial hills pasture
Soils	Red clay loam soils
Rainfall	460mm

LESSONS LEARNED

- It's hard to catch-up when it comes to poor condition – condition scoring ewes in the lead up to January joining gives the best chance of achieving ideal ewe condition at joining time
- Understanding feed quality and condition scoring is important to improve the accuracy and precision of feeding ewes correctly.
- Containment feeding not only improves lambing rates but also allows us to protect our hill grazing country.

Targeted nutrition a smart choice

Prolonged dry conditions across South Australia prompted sheep producer Lachie Smart to implement on-farm containment feeding, a strategic management approach where animals are fed in a designated area to protect pasture, manage nutrition, and reduce erosion during adverse conditions, helping to maintain the productivity of his ewes.

As a result of running ewes in smaller mobs based on pregnancy status, he's been able to maximise reproductive efficiency and minimise mortality in his flock – and he puts good lambing results down to having the right nutrition.

Lachie was part of an MLA-funded Producer Demonstration Site (PDS) run by the Upper North Farming Systems (UNFS), to build producers' knowledge about how to successfully run smaller groups of ewes for higher lamb survival.

The PDS looked at on-ground solutions for producers with autumn lambing systems, who needed to maximise feed available to lambs and extend feed on offer in the face of shorter springs and extended summer conditions.

Ewe management

Lachie's 1,600ha Wirrabara mixed farming enterprise, Avonmore, is characterised by 1,000ha of nonarable hills grazing country.

He has been lambing ewes in containment for seven years to allow these hills pastures to get established and recover from spring and summer grazing, without having to compromise on stocking rates.

Lachie drew on information from Lifetime Ewe Management (LTEM) and Grazing for Profit courses, to adjust how he manages ewes to lift productivity and profitability.

"We always have a feed deficit each year in this region, so we have two choices: either feed out or reduce numbers. By containment feeding, we've been able to increase our stocking rate – but the best part is we've been able to let the hills get away."

Lachie has seen four main benefits to his land and livestock from containment feeding:

1. **Utilising feed on offer:** higher stocking rates better utilises the flush of feed from July–September.
2. **Protecting hills grazing:** containing ewes gives the perennial pastures on his fragile hills time to get away – Lachie has observed improved ground cover, increased grass species and better feed on offer, year after year.
3. **Better monitoring:** containing ewes enables better monitoring, to ensure their condition score targets are met and fertility is maintained.
4. **Improved productivity:** since Lachie began supplementary feeding lambing rates have lifted and ewe wool cuts have improved.

Pregnancy scanning

Lachie completed an UNFS workshop to set breeding objectives and track progress using the Merino Flock Profile tool developed by Sheep Genetics. He uses electronic identification (eID) tags, with a Tepari handler and TruTest weigh scale indicator, to track pregnancy status and condition score.

Pregnancy status is an essential part of Lachie's flock management.

He has an eight-week joining, beginning in mid-December. He preg-scans in April and drafts ewes three ways: dry, single and multiple-bearing.

Lachie lambs in mid-May when feed can be scarce, especially with a failed seasonal break (as seen in the upper north region during autumn 2024).

Prior to splitting up single and multiple-bearing ewes, Lachie found he would end up with low condition scores in multiple-bearing ewes which were then hard to get back into condition.

"These were most likely twin-bearing ewes who weren't fed enough – and I suspect the lambs born and raised by those ewes were likely to be small and potentially less productive," he said.

"This is where containment feeding has helped maintain ewe condition. If the ewe is in good nick, the lambs are generally in good nick."

Containment infrastructure

Lachie's containment feeding set-up uses existing small paddocks which had been used as small weaning paddocks and to manage sheep during shearing and crutching.

There are eight pens, ranging from 4–12ha, fenced to land class with post and dropper, cyclone and barbed wire fencing. Each has a water point – either a dam or a permanent trough.

After preg-scanning in early April, Lachie condition scores, the ewes as they enter the containment area.

Ewes stay in these small paddocks for lambing, and receive good quality high protein hay, such as wheaten hay cut right before flowering. Alternatively, Lachie supplements with barley and lupins when prices make that viable.

Ewes return to the main grazing paddocks when ground cover is established – which can be as late as July. At this point, ewes continue to receive a transition ration, which gives their rumen time to adjust as they move from supplementary feeding back to pasture.

Targeted nutrition

The containment feeding period for the PDS ran from mid-March to the end of June 2023.

SA-based consultant Deb Scammell of Talking Livestock conducted feed tests on Lachie's barley, lupins and hay to measure dry matter, protein, energy and neutral detergent fibre (NDF%).

Based on this data, twin-bearing ewes were given the following preferential rations:

Twin-bearing ewes:

- lower quality hay ad-lib through pregnancy
- higher quality sorghum hay at day 140 of pregnancy
- 75% barley/25% lupins rations gradually increased from 500g/head/day at day 100 of pregnancy to 1.8kg/head/day by lambing
- high quality sorghum hay ad-lib at lambing, to reduce reliance on grain.

Single-bearing ewes:

- lower quality hay ad-lib through pregnancy
- higher quality sorghum hay introduced at lambing
- barley/lupin ration gradually increased from 500g/head/day at day 100 of pregnancy to 1.2kg/head/day by lambing.

All ewes:

- a high-quality pre-lambing mineral loose lick supplement
- if it was still dry coming into lambing, all ewes received the ration through the whole lambing period.

Hay was fed on the ground using a Hustler bale feeder, and the grain ration was fed using handmade trail feeders.

Lachie used the LTEM app to track condition scores (CS), aiming for CS 3.5 for singles coming into lambing and CS 3.5–4 for twin-bearing ewes.

Table 1. *2023 Smart Feedtest results*

Feed Type	DM	Protein	Energy	NDF%
Barley	91.4	11.4	13.4	19%
Lupins	93.9	31.9	14.8	25%
Canola Vetch Ryegrass Hay	92.4	7.6	6.4	71%
Sorghum Brassica Medic Hay	92.2	9.9	10.9	46%

While he wants to improve survival in larger lambs, lambs which are too large can result in dystocia, so Lachie has set a target birthweight of 5–6kg.

Containment results

Lachie was pleased with the results of lambing in containment paddocks in 2023, which were:

- twins: 161% at lamb marking
- singles: 95% at lamb marking

"Since completing the LTEM course, our overall lambing percentage has improved through the use of containment – as has the nutrition and management of our pregnant ewes," he said.

"This PDS reiterated the importance of keeping your eye on the ball and reinforced the importance of understanding the quality of feed and condition scoring to deliver precision feeding."

Challenges and opportunities

While Lachie has seen multiple benefits to his business from containment feeding, he acknowledges there are some challenges to consider.

"We already had containment paddocks established, so the cost of a containment set-up was not significant and, if you go down the route of fencing smaller paddocks, they do come in handy for other purposes such as shearing," he said.

"There's also more labour involved in containment feeding compared to paddock feeding – it added about 2.5 hours a day to our workload, and meant we were tied to feeding and monitoring ewes throughout the containment period."

The cost of grain and hay is also significant, however in Lachie's case he was able to produce this on-farm.

Looking ahead, Lachie plans to focus on condition scoring in December/January to prepare ewes for joining. He would also like to build additional pens, so he can separate twin-bearing ewes with lower condition scores to further target management and improve twin survival.

Another focus will be the nutrition of his hills pastures, to improve the performance of lambs.

PRODUCER CASE STUDY

Detail in data drives decisions

Upper-north SA sheep producer Alison Henderson conducts preg-scanning as a ewe management strategy. Image: Rachel Trengove, UNFS

Alison Henderson keeps an eye on pregnant ewes during the PDS. Image: Alison Henderson

The Henderson's operate commercial and stud Merino flocks on their Caltowie and Booborowie farms. Image: Alison Henderson

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KEY RESOURCES

- **MLA Producer Demonstration Sites:** mla.com.au/pds
- **Lifetime Ewe Management:** wool.com.au/Item

ON-FARM SNAPSHOT

Name/s	Alison Henderson
Location	Caltowie and Booborowie, SA
Area in hectares	1,600ha owned/share-farmed
Enterprise	800 SRS Merinos – 300 stud ewes
Pastures	400ha pasture/grazing 1,200ha cropped (cereals, beans, vetch and hay)
Soils	Red clay loam
Rainfall	425mm

LESSONS LEARNED

- Setting specific breeding objectives guides genetic selection in our flock.
- Preg-scanning technology enables targeted management of pregnant ewes.
- Running smaller mobs of multiple-bearing ewes during pregnancy and lambing helps lift lambing rates.

Detail in data drives decisions

Fifth generation South Australian sheep producer Alison Henderson believes attention to detail is the key to running a profitable enterprise.

Participating in an MLA-funded 'Lotsa Lambs' Producer Demonstration Site (PDS) equipped her with detail and data to make informed decisions and maintain lambing results despite seasonal variability.

The Hendersons operate a mixed farm in the state's Mid North. Their SRS Merino enterprise includes both commercial and stud flocks, so data is an important tool to maintain breeding objectives. Their flock is founded on Baderloo bloodlines, with the Hendersons acquiring the Baderloo Stud in 2024 in addition to Hendowie Stud.

Hendowie Stud have used Australian Sheep Breeding Values (ASBVs) to make flock decisions since 2008, in conjunction with visual assessments. Selection traits include long staple and fleece weight, fat and muscle, and early growth. Specific targets are 1.3 lambs/ewe/year, 6kg wool, and lambs to grow out to 50kg within 7-8 months.

"Our breeding objective is to breed a truly dual purpose, productive, balanced Merino sheep that thrives in a wide range of environments," Alison said.

"If I'm going to push for reproduction there will be sacrifices in areas such as growth but having a clear breeding objective ensures a balance."

They introduced electronic identification (eID) technology in 2018 and use AgriWebb to manage stock and BreedElite to record data such as wether lambs being born in twin or single mobs, ewe pregnancy status, visual traits and fleece weights.

Other genetic tools used include RamSelect, DNA testing in the stud flock, and the Flock Profile test for commercial sheep.

Livestock management

The Hendersons' livestock management calendar includes shearing twice a year (mid-April and mid-October). They ceased mulesing wether lambs in 2018, and all lambs the following year.

They join for five weeks in February/March, which is timed to optimise conception rates as day length shortens, so ewes lamb go onto green feed in July/August.

The Hendersons have pregnancy scanned since 2018 and automatically cull dry ewes when they are not in a flock-building phase.

"The preg-scanning technology enables us to better manage pregnant ewes, with more nutrition provided to smaller mobs of multiple-bearing ewes during pregnancy and lambing," Alison said.

They lamb into separate twin and single paddocks so multiples can receive preferential nutrition.

Paddocks are split with electric fencing to allow for smaller twin bearing mobs of around 100 ewes, while singles are run in mobs of 150-250. Identifying and splitting singles and twins has lifted lambing by 20%, up to around 120%.

The Hendersons' nutrition strategies are based on principles adopted from the Lifetime Ewe Management (LTEM) program, such as condition scoring and feed budgeting.

"The LTEM course included training in body condition scoring, and I have used that ever since as a crucial tool to improve lamb survival and reduce ewe mortality," Alison said.

"We have also found our feed rations are hitting the mark – condition scores give instant feedback on what's working."

They match land type to enterprise where possible. Regular pasture paddocks have a medic base, and sown pastures include a rotation of vetch.

Containment feeding helps bridge the autumn feed gap. They currently feed grain out in Poly Belt troughs (at a cost of $13-14/m).

If there is an early break, ewes go into the paddock sooner to make the most of the feed on offer, topped up with supplementary feed. However, in the dry years of this PDS (2022 and 2024), they were supplementary fed from March until just before lambing in early June.

PDS results

The site Alison allocated to the PDS was a grazing block without a cropping rotation. During lambing, exposure is an issue and Alison intends to plant shelter belts in the future. However, in the meantime she makes use of a north-facing slope and electric fencing to keep ewes in the most sheltered area.

"Paddock characteristics contribute significantly to lambing percentage and we've seen lamb survival rates increase by up to 10% in paddocks with shelter and reduced exposure to weather fronts, compared to poorer lambing paddocks lacking shelter, or which are close to trainlines or busy roads," Alison said.

After scanning and separating ewes based on pregnancy status, ewes were put into containment with supplementary feeding. For this PDS, Alison aimed for 100 or less twin bearing ewes in a mob for lambing.

Ewes are usually released from containment ten days before lambing, to help preserve feed. However, in seasons with late breaks like 2022 and 2024, supplementary feeding continues in the paddock to meet the ewes' nutrition requirements.

The prolonged dry conditions of 2024 resulted in a very late seasonal break in June, which meant there was little or no feed available for lambing ewes and they had to rely on a full ration of supplementary feed to meet their energy requirements during the lambing period.

Survival focus

The Hendersons already had low ewe mortality (2% or less) which Alison attributes to the role of genetics, with their focus on fat and muscle, as well as the right nutrition.

So they identified twin survival through finetuning nutrition and lambing conditions as the big opportunity to make productivity gains.

As part of the PDS, Alison weighed any dead lambs to build up a picture of what was causing mortality – revealing birth weight of under 3kg was a contributing factor.

"Our goal was to get twin lamb birth weights up for greater survival," she said.

This was a challenge with ewe lambs in particular, where we tried to balance feeding for growth without too much weight gain (which can lead to dystocia).

Alison achieved ideal condition scores of an average 3.5 at preg-scanning for all three seasons of the demonstration.

Seasonal challenges

The three-year trial presented a range of seasonal challenges.

The late break in **2022** meant there was no green feed to lamb onto, which contributed to the lambing results. Mismothering at feeders was an issue but with no feed on offer in paddocks, feeding was the only option.

There was an earlier break in **2023** with a useful 30mm in April and follow-up rains in May which delivered nutritional green feed and pasture growth to lamb onto. This removed the need to supplementary feed during lambing and reduced mismothering. However, cold/wet snaps contributed to some mortalities from exposure.

Mob size was more than 100 head in **2024** due to low feed on offer from drought conditions. With supplementary feeding, Alison managed to maintain condition scores around 3.5 from joining.

Although seasonal conditions were very different across the three years, Alison's consistent lambing results showed how implementing a combination of best practices can help achieve production targets, despite seasonal challenges and feed gaps.

During 2024, the Hendersons also had the chance to see the impact of mob size when they purchased additional stud ewes. While these ewes were not included in the PDS, they provided a direct comparison as both were twinning mobs with one feeder and access to scrub areas for shelter.

The smaller mob (120 ewes on 4ha) produced 168 lambs, or 140%, whereas the larger mob (170 ewes on 7ha) produced 212 lambs, or 125%.

While the stand-out observation from the PDS was the benefits of smaller mobs, Alison also observed how other factors such as lack of shelter, cold/wet snaps and genetics impacted lamb survival.

The PDS reaffirmed Alison's focus on breeding and selecting for lamb survival characteristics, such as fat and eye muscle area, which correlate with resilience.

Infrastructure and labour

Reducing mob size for lambing required investment in temporary fencing to split up paddocks.

Alison purchased two 500m electric fence kits with energisers and posts for $1,000, which enabled her to divide a 20ha paddock in half to run twinning ewes in smaller mobs. It took two hours to erect/deconstruct the fence.

Looking ahead, she plans on permanently splitting some of the paddocks to enable smaller mobs at lambing. Existing water points will enable these permanent areas to be reduced into smaller areas (10-15ha) with temporary electric fencing to be rotationally grazed over the growing season.

	Number of lambs	Number of ewes	% Lambing	CS at Preg scanning	Ewe mortality	Lambing % prior to preg scanning and smaller mobs
Henderson						100%
Singles 2022	68	62	110%			
Multiples 2022	150	128	117%	3.36	2.4%	
Overall %	218	190	115%			
Henderson						
Singles 2023	71	65	109%			
Multiples 2023	104	76	137%	3.25	4.9%	
Overall %	175	141	124%			
Henderson						
Singles 2024	91	88	103%			
Multiples 2024	149	116	128%	3.3	2.8%	
Overall %	240	204	118%			

Figure 1. *PDS results for Hendersons' trial site*

PRODUCER CASE STUDY

Smaller mobs deliver 'lotsa' lambs

SA livestock consultant Deb Scammell, pictured with Gladstone sheep producers Andrew Kitto (left) and Nathan May. *Image: Rachel Trengove, UNFS*

Andrew Kitto and Deb Scammell condition score ewes as part of the PDS. *Image: Rachel Trengove, UNFS*

Andrew Kitto condition scores ewes as a strategy to lift reproductive performance. *Image: Rachel Trengove, UNFS*

MORE INFORMATION

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KEY RESOURCES

- **MLA Producer Demonstration Sites:** mla.com.au/pds
- **Lifetime Ewe Management:** wool.com.au/ltem

ON-FARM SNAPSHOT

Name/s	Andrew and Maria Kitto, Nathan and Rachel May
Location	Gladstone, SA
Area in hectares	830ha owned and 200ha of agistment (plus additional opportunistic agistment)
Enterprise	Sheep and cropping
Pastures	20% grazing (hills country with perennial pastures plus sown pastures on some arable country) 80% cropping (cereals, lentils, vetch)
Soils	Red clay/loamy soil
Rainfall	435mm

LESSONS LEARNED

- Supplementary feeding, feed budgeting and condition scoring are important strategies to maintain lambing rates.
- Condition scoring ewes at joining and at key times throughout pregnancy helps identify if nutrition needs to be adjusted before it's too late to correct.
- Providing extra feeding stations helps prevent lamb mortality from mismothering at crowded feeders.

Smaller mobs deliver 'lotsa' lambs

A quest to implement best practice in their sheep enterprise led Andrew Kitto and his family to join an MLA-supported Producer Demonstration Site (PDS), where they saw the on-farm benefits of lambing twin-bearing ewes in smaller mobs.

he 'Lotsa Lambs' PDS was run by Upper North Farming Systems, with a goal to improve reproductive success in mixed farming businesses.

Andrew and his wife Maria run a mixed enterprise with their daughter and son-in-law, Rachel and Nathan May, at Gladstone in the Mid North of South Australia.

Their sheep enterprise focuses on breeding prime lambs with high growth rates and high lambing percentages. They purchase Merino ewes to join with White Suffolk rams, and also operate a small White Suffolk stud to breed rams for on-farm use and to sell.

Ewe management

When Nathan completed a Lifetime Ewe Management (LTEM) course in 2020, he was inspired to implement many of the best practice principles presented in the program.

The family introduced pregnancy scanning the following year. They use electronic identification (eID) tags to collect pregnancy status data and to identify the 'doers' to retain when culling ewes. They also collect data on lamb weights at marking and weaning.

Rams are provided with a protein flush – usually lupins – prior to joining in January. The family aims for the rams to have a condition score of 3.75 at joining.

They preg-scan at 90 days and use this as an opportunity to condition score ewes again.

Ewes are drafted into single and multiple bearing ewes and run in specific paddocks based on their pregnancy status.

Around 20% of the family's farm is hills country for grazing and 80% is cropping, which also provides stubbles for grazing over summer.

While the hill country offers good protection for lambing with tussocky grasses, this is offset by poorer nutrition, combined with practical challenges of supplementary feeding in these paddocks. It's also difficult to run smaller mobs in the hills, so preferential paddocks are allocated to multiple-bearing ewes based on feed-on-offer, but this often comes at the cost of less shelter.

Ewes receive barley and hay through pregnancy and lambing, depending on the quality and availability of feed, as well as licks providing mineral supplementation.

Challenges

The Kittos had identified some challenges in their flock, so participating in the PDS was an opportunity to dig deeper into these issues.

In particular, they wanted to:

- investigate why pregnancy toxicity was occurring
- adjust supplementary feeding to prevent ewe condition score slipping as it was difficult to regain condition
- fine-tune grain rations to prevent birthing problems as a result of larger lambs.

"We were experiencing ewe mortality up around 8-13% in a bad year, and we were keen to decrease this," Andrew said.

"We thought this could be achievable by monitoring condition score, aided by having a younger flock with a new line of hoggets introduced in 2021, but we also wanted to introduce other practices to reduce ewe mortality."

Infrastructure for smaller mobs

Previously, the Kittos would run ewes with multiples in mobs of around 300 head, but for the PDS they reduced this to 120 multiple-bearing ewes per mob.

This required some investment in temporary water troughs (with water pipe running on top of the ground) and electric fencing to split paddocks up for these smaller twinning mobs.

Andrew plans to further reduce twin-bearing mob size after hearing livestock consultant Nathan Scott of Achieve Ag Solutions present as part of the Lotsa Lambs project. Their ideal would be 60 head/mob but this isn't commercially viable for the business, so the family will target 100 head for multiples moving forward.

Maintaining conditions

A core focus of the Kittos' demonstration site was on maintaining optimal condition scores during gestation to target a lambing rate of 130% across the flock.

SA-based consultant Deb Scammell of Talking Livestock provided guidance to achieve this through:

- supplementary feeding
- feed budgeting
- condition scoring.

Upper North SA sheep producers Andrew Kitto and his son-in-law Nathan May implemented lambing twin bearing ewes in smaller mobs as part of an MLA PDS in 2022–24. *Image: Rachel Trengove, UNFS*

Over the three-year PDS, the family lifted condition scoring at lambing from 3.2 in 2022 to 3.5 in 2023 and 2024. While the average was good, they faced a challenge of how to reduce the range in mob condition scores.

In the first year of the PDS (2022), they achieved 89% lambing for singles and 88% for multiple-bearing ewes.

This was the lowest result across the three years and was attributed to:

- a lower-than-ideal condition score
- a high proportion of older ewes
- challenging seasonal conditions with cold, wet weather during lambing.

With condition scores ranging from 2.6 to 4, Deb advised Nathan and Andrew to use the LTEM condition score graph to track this range to understand the impact it has on lambing percentage, especially on multiple-bearing ewes.

"Deb suggested we aim to keep variation in the mob within around 0.5 of a condition score, especially during late pregnancy," Andrew said.

"If we're getting a large range, it's best practice to draft ewes in mid-pregnancy based on their condition score and feed the tail slightly more. Often ewe mortality and decreases in lamb marking percentage is due to the ewes that are below the average of the mob, so drafting these off can make a significant difference to your overall result."

Another strategy was to allocate two feeders per 100 ewes, to reduce mismothering and prevent ewes rushing the feeder.

Reducing mob size

The more favourable conditions in 2023 delivered a good early season break which provided green feed for ewes at the end of pregnancy and into lambing (compared to the dry start in 2022).

Pregnant ewes were on vetch stubble and grain supplements until 20 May, when they were split into four 10ha paddocks with vetch and barley for lambing in June.

Scanning results were inaccurate this year as lots of multiples were in the single mobs – resulting in lambing rates of 141% for singles and 155% for multiples. Some of the mortalities may have been because twin-bearing ewes were underfed in the single mobs, and vice versa for the single-bearing ewes being overfed in twin mobs.

However, the 2023 lambing results were excellent overall, which was attributed to the earlier seasonal break, feed-on-offer at lambing and smaller mob size. Undulation in the hills provided shelter, and ewe mortality dropped to just 2% during lambing.

In 2024, the Kittos split an undulating paddock into three (using electric fencing) for multiples and ran mob sizes of just under 100 ewes.

This was labour intensive, with two people setting up approximately 10km of electric fencing over three days. It also took about one hour each day to rotate mobs through the paddocks and provide supplementary feeding to the smaller mobs.

"Mild weather at lambing in 2024 gave an advantage to lamb survival compared to the 2022 season, when there was a cold snap at lambing time," Andrew said. "We also had an ideal condition score of 3.25 during pregnancy and, importantly, had less variability in the condition score range."

Managing the dry

The final year of the Kittos' demonstration site (2024) was the driest season on record for the region.

"Conditions were very challenging for both cropping and grazing," Andrew said. "We had a very late season break after lambing, with just 28mm on 26 May, followed by 50mm in early June and then ongoing very dry conditions throughout late winter/spring."

Lack of feed on offer meant splitting mobs into the 10ha electric fenced paddocks was not an option, so multiple bearing ewes – still in mobs of less than 100 head – remained in larger paddocks sown to barley and vetch (which had limited germination).

The very dry conditions required additional supplementary feeding, which increased the risk of mismothering due to the ewes walking back to the same area to feed.

Considering the season, lamb percentages were good (95% for singles and 140% for multiples). Ewe mortality was also relatively low (2.3%), aided by small lamb size.

In years like this, to ensure high marking percentages in twin mobs Deb's advice was to further reduce mob size and provide supplementary feed at a few different feed stations.

"When there isn't adequate feed on offer, the more feeding stations you can have per mob the better," Deb said. "For a mob this size, two self-feeders and two different hay feeding sites is preferable."

Outcomes

By implementing these practices, the Kittos lifted lambing percentages from their historical average of 110% to about 130%, which improved their business' profitability and efficiency. Improving lamb and ewe survival was also important outcome at an industry level for markets and consumers.

One of the biggest learnings was the importance of condition scoring.

"Ideally, doing a score around joining and during early, mid and late pregnancy gives us something to look back on, and allows us to realise if they are slipping or getting too fat before it's too late to correct," Andrew said.

The Kittos will also take on board Deb's advice to split lambing groups by pregnancy status instead of into age groups, as a strategy to reduce the range of condition scores within a mob and support tailored feeding.

The benefits of dividing up paddocks to run smaller mobs were also clear:

- lamb survival lifted by an estimated 30%
- feed utilisation improved
- more ground cover was maintained compared to grazing one large area.

"After the guidance from this project, we've now got the confidence to continue lambing multiple-bearing ewes in smaller mobs," Andrew said.

The family is conscious that higher lambing percentages could lead to overstocking, so will be vigilant in culling the bottom 30% of performers each year.

Specific challenges arose from the mixed farming enterprise, including trying to juggle the timing of grazing and cropping activities, as well as not having permanent lambing paddocks with appropriate infrastructure such as fencing, water points and shelter belts.

Lamb mortality was higher in paddocks with little or no shelter, and although planting shelter belts would be ideal, this is not practical in paddocks which are rotationally cropped and not permanently allocated to lambing.

Reducing mob size also required investment in additional feeders. Looking ahead, the Kittos will explore other feed options such as:

- **managing excess quantities of spring feed** - splitting some of the grazing areas into smaller paddocks with electric fencing and increased stocking rates. This could also provide an extra paddock to crop and cut for hay or grain, providing an extra fodder reserve for summer/autumn feeding
- **considering silage to reduce grain feeding** – although the cost of silage is double that of hay, it's also double the nutritional value of hay, so it's a good option when barley prices are high
- **grazing cereals destined for harvest for six weeks before nodes to avoid yield penalties** - cereals at this stage are a good source of feed, with 20% protein.

Future plans

Andrew and Nathan are now equipped with strategies to adopt, and benchmarking figures to work towards with lamb survival.

"We will continue preg-scanning and running mobs separately, with multiple-bearing ewes in smaller mobs," Andrew said.

"The more precision we have in our flock management, the easier it is to make decisions with confidence. For example, when we sold lambs early in 2024 because of the dry, we found that knowing what condition ewes and lambs were in and what we were aiming for lead to improved decision making."

	Number of lambs	Number of ewes	% Lambing	*CS at Preg scanning*	*Ewe mortality*	Lambing % prior to preg scanning and smaller mobs
Kitto						
Singles 2022	124	139	89%			
Multiples 2022	198	225	88%	3.2	4.0%	
Overall %	322	364	88%			
Kitto						
Singles 2023	327	232	141%			
Multiples 2023	453	292	155%	3.5	2.0%	110%
Overall %	780	524	149%			
Kitto						
Singles 2024	158	166	95%			
Multiples 2024	245	175	140%	3.5	2.4%	
Overall %	403	341	118%			

Figure 1. *PDS results for Kittos' trial site*

PRODUCER CASE STUDY

Focus on multiples delivers Moore lambs

Upper north SA sheep producer David Moore.

Upper north SA sheep producer David Moore (right) with livestock manager Jamie Clapp.

Talking Livestock consultant Deb Scammell condition scores sheep with Jamestown sheep producer David Moore (left) and his livestock manager Jamie Clapp.

MORE INFORMATION

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KEY RESOURCES

- **MLA Producer Demonstration Sites:** mla.com.au/pds
- **Containment feeding resources:** mla.com.au/containment-feeding
- **Lifetime Ewe Management:** wool.com.au/ltem

ON-FARM SNAPSHOT

Name/s	David Moore
Location	Jamestown, SA
Area in hectares	1,150ha arable, 750ha nonarable
Enterprise	Mixed farming, 1,600 ewes joined
Pastures	Winter cropping program, vetch for pasture, permanent enhanced native grassland hills grazing
Soils	Red clay loam soils
Rainfall	450mm (180mm in 2024)

LESSONS LEARNED

- Source sufficient feed as early as possible, in case supplies dry up in tough years.
- Scan for multiples/singles and separate ewes so they can be managed accordingly.
- Small mob sizes are especially critical for twin-bearing ewes.
- Monitoring condition score throughout pregnancy is a valuable management tool

Focus on multiples delivers Moore lambs

When the Moore family of Jamestown, SA, expanded their mixed farming enterprise to include a neighbouring parcel of forestry, it not only increased their grazing area but also provided the perfect location for containment infrastructure.

Initially established to carry livestock through the feed gap between March and the seasonal break expected in late April, the investment proved to be an integral part of their drought management program and allowed them to better maintain ewes through 2024's unprecedented and prolonged dry.

David Moore, who farms in partnership with his parents Lynn and Lynnette, and wife Bec, participated in an MLA-funded Producer Demonstration Site (PDS), run by Upper North Farming Systems (UNFS), which focused on the benefits of containment feeding twin-bearing ewes and singles separately.

"Containment feeding has become an essential practice in our business, as we have to balance cropping and pasture," David said.

"We rely on containment between the end of stubble grazing and the seasonal break to maintain sheep condition score, conserve energy and allow ground cover time to establish in our hills before grazing."

Flock management

The Moores run a self-replacing dual-purpose Merino flock, on Kiandra bloodlines. Surplus ewes are joined to White Suffolk rams for prime lamb production.

They aim to breed fast-growing lambs, while at the same time increasing wool production, for overall increased productivity and profitability.

David conducted flock profiling in 2022 as part of another UNFS project supported by MLA.

"The flock profiling provided us with a benchmark of how our flock is currently performing, so we could identify areas for improvement," he said.

"Our maternal flock was productive for meat and wool, but there is still space for improvement."

David and his livestock manager, Jamie Clapp, collect data from electronic identification (eID) tags. Their focus for 2025 is to track the performance of lambs, using eID to monitor and manage their growth rates. In the future, they would like to use eID to profile the flock and identify poor performing animals to cull.

David recently introduced the AgriWebb farm management software into his business, which was been a useful tool for flock and paddock management and allocating tasks. This is especially useful in a mixed farming enterprise, helping balance the often-competing priorities of cropping and livestock.

Containment infrastructure

The Moores have been containment feeding since 2016 but their original containment area, while having a slope for effluent run-off, had no shelter and only a 600-head capacity.

The new site is nestled between established gum trees on a gentle slope –ticking the boxes for both drainage and shelter. The new set-up includes four 0.5ha containment pens with post and ringlock fencing, and a permanent water point in each pen.

Alongside the containment pens are three 3–5ha paddocks for lambing into. In 2024, David added three pens for finishing lambs as part of the complex.

Ewe management for lambing 2024

In 2024, the business fed 1,620 sheep in containment during a year which delivered only 40% of their anticipated rainfall.

Ewes were joined to the White Suffolk rams in mid-November 2023, and the self-replacing flock were joined to Merino rams in January 2024.

Each joining ran for six weeks, and the mobs were preg-scanned ~90 days after the commencement of joining. The timing is aimed at optimising the ability to scan for twins, so ewes can be separated for preferential management.

All ewes were inducted into the containment pens in late March.

Dave also purchased an additional 300 Merino ewes in January 2024, which were scanned in lamb to Suffolk rams (but not scanned for litter size).

For the PDS, there were three cohorts of ewes in containment:

1. **Purchased Merino ewes – joined to Suffolks:**
    - 300 scanned in lamb

These ewes lambed into containment in early April.

2. **Merino ewes – joined to Suffolks:**
    - 300 twin bearing ewes
    - 285 single-bearing ewes

The multiple-bearing ewes were lambed in larger containment pens (3–5ha) and the single-bearing ewes lambed in the paddock, in mid-April/May.

3. **Merino ewes – joined to Merinos**
    - 386 single scanned ewes
    - 350 multiple scanned ewes

These ewes were moved out of containment in late May, into hill paddocks for lambing in June. As they lambed onto dry feed (500kg/DM/ha) they had access to barley in self-feeders.

Containment nutrition

Talking Livestock consultant Deb Scammell provided guidance on condition scoring (CS) for the PDS, which was conducted regularly throughout containment period. The target was CS 3 for single-bearing ewes and CS 3.5 for twin-bearing ewes.

Ewes received lime/salt/magnesium supplementation throughout pregnancy, which was replaced with Magforce for the final few weeks before lambing.

The main difference between multiple and single-bearing ewes was that the ewes scanned with multiple lambs had access to more grain for the last few weeks of gestation, as well as better quality hay for the duration of their containment to meet their higher energy requirements.

Results

The very dry conditions and no green feed in the lead up to, and during, lambing had a downward impact on lambing rates, with only 74% lambing for singles and 108% for multiples achieved with the Moores' ewes in 2024.

This compares with a five-year average of 98% for singles and 140% for multiples.

"Sourcing hay was difficult in a tight market with the incredibly dry season in 2024 across SA and that was compounded by a longer-than-planned supplementary feeding program," David said. "This meant condition scores in late pregnancy were lower than optimal, due to the extenuating seasonal circumstances."

Despite the lower than desired lambing rates, the PDS demonstrated the productivity benefits of preferentially managing ewes based on preg-scan results.

For example, in one of the mobs of purchased ewes (which were not separated based on litter size), the marking rate was 92%. However, in two other mobs which were segregated, the multiple-bearing ewes had 144% lamb marking.

"We realised we could increase lambing rates by identifying multiple-bearing ewes and managing them accordingly," David said. "That included implementing small mob sizes and increased grain rations, compared to the single-bearing ewes and the purchased ewes which weren't segregated."

Challenges

Although running sheep in containment allowed regular monitoring to identify any health concerns, David and Jamie observed a higher rate of prolapse in ewes in 2024 than previously seen.

Deb advised this could possibly indicate a calcium deficiency. However, in the future, autopsies and further investigation would be worthwhile to determine if there were any other contributing factors.

Maintaining a balanced diet was a challenge in 2024, due to the variable quality and constrained availability of hay supplies. The Moore's produced all their own barley for feeding, and hay is either produced on-farm or purchased.

The ongoing poor seasonal conditions resulted in no hay being produced in 2024, so David sourced hay and straw in preparation for containment feeding in 2025.

Opportunities

As they continue to embrace the opportunities from eID, David and Jamie plan on recording ewe and lamb mortality data.

"This will allow us to troubleshoot what is likely to have gone wrong and also identify the best lambing paddocks for lamb survival," David said.

He said a well-designed containment yard has delivered many benefits to their business.

"A single, central set-up near feed stores has reduced labour, and the addition of laneways, permanent water supplies and good fencing has streamlined livestock management during containment.

"Although the unprecedented conditions did impact lambing rates for 2024, overall, we saw ewe condition coming into lambing and lambing percentages significantly improve since introducing containment feeding, with excellent results in previous years.

"Key learnings from the tough season in 2024 is to source feed early, maintain ewe condition score as early as possible (because it's hard to catch-up when condition drops), and to lamb twin-bearing ewes separately in small mobs."

The Moores containment fed 1,620 sheep in 2024.

CARBON IN FARMING LANDSCAPES

CARBON FARMING IN THE UPPER NORTH – *a Pilot Project*

Author: *Ruth Sommerville, Rufous and Co* | **Funded by:** *South Australian Government under the Growing Carbon Farming Demonstration Pilot*
Project Title: *Applying whole-of-farm carbon project methods for climate resilience and diverse co-benefits in low rainfall farming systems of the Upper North Project* | **Project Duration:** *2023-2025* | **Project Delivery Organisations:** *Upper North Farming Systems, RegenCo, Rufous and Co, FarmLab, Anne Brown Consulting, PIRSA, Northern and Yorke Landscape Board, Ag Excellence Alliance*

Key Points

- Developed in 2023 this project aimed to provide guidance to farmers in the Upper North as to where the local farming systems and landscape condition positioned them in the evolving Carbon and Natural Capital markets and transparency requirements.
- 3 farms along Goyder's Line were selected near Burra, Hallett and Orroroo. They are primarily livestock enterprises with small areas of opportunistic cropping production. With support from the Northern and Yorke(NY) Landscape Board, each property had an updated Property Management Plan (PMP) which tackled production and profitability challenges, planned improvements and environmental actions.
- Current Carbon Accounts of each property were developed, and Natural Capital analyses were undertaken. In addition, Carbon and Natural Capital Accounts were modelled for proposed actions outlined in the PMP were implemented. Based on this, access to carbon markets and the proposed nature repair market on these three farms was analysed.
- Results varied significantly across the three properties. The current carbon account (current level of emissions vs sequestration) of each property was highly varied, and a surprise to the landholder in many cases. Whether landholders would access carbon market funds remained uncertain, but promising, for future management changes. The Nature Repair market has significant potential on the three properties if it proceeds as predicted.
- Findings highlighted how different each enterprise is and the importance of avoiding a "one size fits all" approach to carbon farming.
- In general, findings have demonstrated that management actions focussing on improving Natural Capital and carbon sequestration can improve both production and climate resilience of agricultural systems in the Upper North Agricultural District.
- A summary of each site is listed below, and full reports of each property follow.

A brief video on the Luckraft property, and other Growing Carbon Farming Demonstrations can be found here: https://pir.sa.gov.au/primary_industry/climate_change/pilot_projects?fbclid=IwY2xjawK8gYdleHRuA2FlbQIxMABicmlkETFETExTSnp4REVlUFhmYTRNAR48c7H-p8nvp2ou2RmoFJw9Fzh34kwzUUt1OQHUlfOQNOnF8qU6L7DciMv-Fw_aem_NH-LPwgIZBB4IMuV9TJdPw

Background

The Growing Carbon Farming Demonstration Pilot is a State Government initiative providing grants of up to $100,000 to 6 carbon farming projects. The Pilots aimed to show carbon abatement activities alongside measurable environmental and socio-economic benefits best suited to South Australia, promoting:

1. Methods that have application for our primary industry sector.
2. Carbon farming activities that contribute to revenue and jobs.
3. Co-benefits of carbon farming.

The Upper North Farming Systems (UNFS) project aimed to review the methods available and their suitability to the low-medium rainfall zone to account for a farms on farm emissions, analyse the carbon stored on farm and the potential to sequester more, the natural capital existing on farm, potential for improvements in this natural capital account and how implementing already planned productivity and profitability focussed on farm actions can alter the above mentioned results. It then costed these actions and reviewed potential sources of income from the carbon market and potential natural capital markets, and other sustainability co-benefits, to assess long term implications of actions.

Methodology

This project was led by UNFS, who brought together Daniel Hanisch at RegenCo Pty Ltd, Oli Madgett at FarmLab, the NY Landscape Board, Ruth Sommerville at Rufous and Co, and Anne Brown (Anne Brown Consulting) to work with three landholders – Tim and Christy Luckraft (Orroroo), Ryan and Ellie Oates (Burra), and Brad and Tess Tiver (Hallett).

Each property had a Property Management Plan (PMP) developed independently of the project that identified management changes and on ground works to improve landscape function, productivity, and the profitability of the enterprise. Each property has implemented significant changes in the past 5 years to work towards these goals.

The project undertook a current and potential analysis across each property of the following:

- Carbon Footprint Assessment – current on farm carbon emissions using the MLA Carbon Calculator
- Woody Biomass Carbon Current and Sequestration Analysis using FullCAM
- Soil Carbon Assessment as per the Emission Reduction Fund Soil Method
- Vegetation Condition Assessment using the Significant Environmental Benefit (SEB) Method.
- Woodland Bird Assessment using the Accounting for Nature Woodland Bird Method (F-02).

Demonstration Property Overviews

Ridgeview: Owned by Tim and Christy Luckraft, Ridgeview is a 1800ha meat sheep and cropping property located about 5 km south-east of Orroroo. The PMP outlined three main strategies to be employed at Ridgeview including:

- Establish a rotational grazing system between and within blocks to improve feed on offer
- Rehabilitate soil and pasture to restore function and resilience
- Establish tree shelter belts to improve shelter

Toolangi: Owned by Brad and Tess Tiver, Toolangi is a 2900 ha sheep grazing property on the western side of the Northern Mount Lofty Ranges a few km south-east of the town of Hallett and approximately 25 km north of Burra, South Australia. Some parts in the west of the property are cropped for sheep feed, but mostly it is managed native pasture for grazing. The PMP outlined three main strategies to be employed at Toolangi:

- Improve groundcover management, including increasing capacity of confinement feeding,
- Establish additional waterpoints to improve paddock utilisation
- Improve pasture production in semi-arable areas, through improved fencing, including a significant 12 km kangaroo exclusion fence to restrict the incursion by kangaroos from the hills grazing area to the arable areas and rotational grazing.

Poonunda: Owned by Ryan and Ellie Oates, Poonunda is a 16,650 ha sheep grazing operation on the eastern side of the Northern Mount Lofty Ranges, approximately 20 km north-east of Burra, South Australia, in a locality known as Mongolata. The PMP outlined 3 main strategies to be employed at Poonunda:

- Improved grazing management matched to food on offer to maintain ground cover and livestock condition, including building a four-pen confined livestock facility to fatten weaners and cull ewes
- Repair of compacted and bare ground through contour and scald ripping to regenerate vegetation and hold water to allow infiltration
- Ripping of gully erosion heads to avoid further gully development and landscape dehydration

Results and Discussion

The three case studies have resulted in significant learnings in how carbon farming can be implemented within the Low Rainfall Agricultural Zone near Goyder's Line. It has also highlighted how different each enterprise is and the importance of avoiding a "one size fits all" approach to carbon farming.

Table 1. *Carbon Footprint 2024:*

	Current Carbon Emissions tCO2e/yr (Scope 3 emissions upstream incl.)	**Net Carbon Emissions tCO2e/yr** (after subtracting the carbon sequestered)	**Emissions Intensity kgCO2e/kg liveweight** Industry Benchmark: 6.8, range 6-10	**Emissions Intensity kg-CO2e/kg Greasy Wool** Industry Benchmark – 24.4, range 20-35
Ridgeview	229	36.8	6.3	-
Toolangi	1464	1462	5.25	19.5
Poonunda	1442	1386	5.59	20.8
Comments	Ridgeview is so low due to its low stocking density, therefore low enteric fermentation.	Ridgeview is so low due to significant regeneration of Acacia Victoriae native shrubland. Toolangi and Poonunda sequestration is lower than expected due to lack of young age class eucalypts in woodlands.	All enterprises are low compared to industry standard and may be able to use this to access green loans, secure market access or gain a premium.	All enterprises are low compared to industry standard and may be able to use this to access green loans, secure market access or gain a premium.

Full business cases costed restoration activities, and co-benefits to implementing these Carbon Farming and Biodiversity Improving activities, designed to improve the profitability and productivity of the farming enterprise are in the following case studies.

In general, the 'Growing Carbon' Pilot Project has demonstrated that management actions that focus on improving Natural Capital and Carbon Sequestration can improve both the production and the climate resilience of agricultural systems in the Upper North Agricultural District.

Emerging markets in carbon and nature repair, as well as shifting consumer preferences, can improve the business case for making these changes.

The full reports on each property follow this summary. Follow up workshops on Carbon Accounting, Carbon Sequestration, Natural Capital and the Biodiversity Repair and Carbon Markets will be running through UNFS over the next 12 months. Come along to learn more.

Acknowledgements

This project has been funded by the South Australian Government under the Growing Carbon Farming Demonstration Pilot and delivered in partnership with Upper North Farming Systems, RegenCo, FarmLab and the Northern and Yorke Landscape Board on Ngadjuri Land.

Acknowledgement and thanks to Daniel Hanisch from RegenCo for his ongoing work to get the most out of these case studies for the region and the landholders. To Oli Madgett from Farm Lab for his unwavering enthusiasm for soil carbon and improving agricultures long term viability. To independent vegetation and sustainable agriculture consultant, Anne Brown,

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Table 2. *Carbon and Natural Capital 2024 Baseline*

	Woody Biomass	Soil Organic Carbon				Biodiversity Assessments					
	tCO2e	0-30cm %	District Mean % (0-10cm)	Potential increase		Vegetation Condition and Biodiversity Score			Woodland Bird ECond		
				t SOC	tCO2e	Highest	Lowest	Mean	Highest	Lowest	Combined
Ridgeview	20405	0.48	0.59	19000	70000	80.37	39.6	60.5	41	18	33
Toolangi	129150	0.49	1.5	20600	75000	78.61	44.68	59.57	51	15	28
Poonunda	431805	0.44	0.68	17350	63676	65.4	26.32	45.86	37.5	26	31
Comments	Total biomass varies significantly across the properties. Age-class and plant species has a significant impact on ability to include the vegetation in a net emission calculation.	Such low % SOC has a significant impact on water holding capacity & infiltration. Increasing this will improve water use efficiency & improve biomass production.	District mean presented here is deceiving as it is a 0-10cm mean, the topsoil has on average higher SOC than at depth.	This is by increasing the %SOC to reach the 25th percentile of district average for the predominant soil type.		RV: Acacia Vic. Regeneration paddock. TL: Euc leucoxylon with high vegetation condition and diversity. PN: Heritage Agreement Site.	RV: paddock is undergoing revegetation and is spelled from grazing. TL. Lower species diversity at this Euc leucoxylon dominant site. PN: Ripping paddock to restore function to clay pan scalds.	Like many averages, this means very little in issolation, but it gives an overall health of the property that you can track over time.	A number that indicates the function of an ecosystem, not just its plant composition. Higher number of species with a larger percentage of small birds results in a higher score. Smaller birds require a more complex environment than larger bodied birds in Australia.		

for conducting the vegetation condition assessments. Thanks to Emma McInnerny at Ag Ex Alliance for helping to line up the ducks in the beginning and to the Northern and Yorke Landscape Board team for being eternally supportive.

This project was not possible without the willingness, transparency and blind faith of the property owners. Through the extended process the positive engagement of the Ridgeview landholders, Tim and Christy Luckraft, Toolangi landholders Brad and Tess Tiver and the Poonunda landowners Ryan and Ellie Oates has made it all possible. Our thanks to them for their participation and we hope there has been many benefits for you along the way.

The extended version of this publication is available on the Upper North Farming Systems website.

You can access it by scanning the QR code below.

Alternatively, **visit www.unfs.com.au**, click on '**Resources**' in the top menu, then select '**UNFS Publications**'. The report can be found under the '**Growing Carbon Final Reports**' section.

If you experience any issues accessing the publication, feel free to contact us at **admin@unfs.com.au**

Toolangi

Carbon & Natural Capital for Resilient Farming Systems
Status & Opportunities

Executive Summary

This executive summary provides an overview of the entire report prepared by RegenCo. For further information and context, please refer to the main report.

Disclaimer
Any information relating to potential costs and revenue of a carbon project is general in nature, and for indicative purposes only. Nothing in this report is intended to constitute financial advice.

The carbon project proposal described is intended to provide stakeholders with a prospective project plan and general business case for taking a project at Toolangi towards registration as an ACCU-generating project. By providing this documentation, RegenCo is not providing an offer or invitation to proceed with a project.

Landscape & Climate Context

Toolangi is a 2900 ha sheep grazing property with a unique position ecologically. From west to east, the property starts at an altitude of just under 600 m AHD in the Broughton IBRA (Interim Bioregionalisation of Australia) subregion of the Flinders Lofty Block IBRA region. The landscape then passes into the Olary Spur subregion, rising steeply towards the locally prominent Mt Bryan range. The eastern border of the property, about 3-4 km from the western border, has an altitude of just under 900 m AHD. The line separating Broughton and Olary Spur subregions is also regarded as the Australian Rangelands boundary, with country to the north and east primarily being low intensity grazing operations and those to the south and west being mixed farming, cropping and horticultural enterprises. As such, Toolangi can be said to exist in transitional country, both ecologically and agriculturally.

Toolangi's climate is semi-arid Mediterranean, receiving an average of about 400 mm of annual rainfall on the western flats, rising to about 500 mm on the uplands to the east. Summers are hot and dry, while winters are cold and historically wetter. Strong winds blow mostly from the south-west from late winter to early summer. Modelled climate projections have substantial implications for Toolangi's future management decisions, predicting:

- Declining autumn and spring rainfall.
- Increasing evapotranspiration.
- Increased heat stress for sheep (e.g. 5 more heat risk days by the 2030s).
- Little change in high risk cold days for lambs/sheep.

Overall, historical trends and forecast climate modelling suggest an increased water deficit, and increased heat stress on livestock worsening cumulatively to 2030, 2050, and 2070.

Natural Capital Assessment

Broadly, natural capital at Toolangi has been analysed against five parameters: woody biomass carbon, soil carbon, property-level carbon footprint, vegetation condition, and a woodland bird assessment. Measurement and modelling has been performed using Australian Government datasets, methodologies, and models, as well as using Meat and Livestock Australia and Accounting for Nature tools and methodologies where appropriate.

Woody biomass

By far the largest pool of woody biomass at Toolangi is found in the large area of South Australian Blue Gum (*Eucalyptus leucoxylon*) woodland. Remnant Blue Gum woodland across the property, covering approximately 1050 ha, is estimated to store 129,150 tonnes of carbon dioxide equivalents (tCO_2e^-) (147t CO_2e^- / ha). This carbon pool is not able to be counted for carbon credits or property level carbon accounts, as the woodlands are not new and regenerating according to rules derived from the Kyoto Protocol.

Soil carbon

Soil organic carbon (SOC) was tested at 30 and 100cm depths at 52 sample points across four 'Carbon Estimation Areas' (CEAs) in accordance with the Australian Carbon Credit Unit (ACCU) Scheme's soil method protocols. The tests returned an average concentration of 0.49% soil organic carbon at 0-30cm depth and 0.35% across the whole 100 cm depth profile. This equates to 102,885 tCO_2e^- in the top 30cm across Toolangi. The SOC% varied across the property consistent with rainfall levels and/or intensity of agricultural production.

Comparison of Toolangi numbers with SA Govt datasets of SOC in the Mid North District places Toolangi below the bottom 25% of results, leaving significant opportunity for SOC improvements via increasing plant biomass and soil cover through restoring natural hydrology and managing grazing pressure. If average SOC was increased across the analysed CEA to equal the 25th percentile District benchmark, this would result in the storage of about 75,000 tCO_2e^- in the soil. These gains could potentially be claimed as carbon credits or accounted for in a property level carbon footprint.

Carbon footprint

Total gross farm emissions were found to be 1464t of CO_2e^-/year. After subtracting a small area of tree plantings, net emissions were 1462 tCO_2e^-/year. Emissions intensity of sheep meat production was 1.55 $kgCO_2e^-$ better per kg liveweight than the industry benchmark, and 4.9 $kgCO_2e^-$ better per kg for wool production. Enteric fermentation/ animal waste was the dominant emissions source (92%).

Vegetation condition

Using the SEB (Significant Environmental Benefit) survey method, three sites were assessed reflecting some of the topographical diversity across the property. The site in the northern paddock recorded the highest score, with noteworthy high scores for diversity and native to exotic understorey. The site near the homestead and eastern boundary, on the other hand, had relatively poor diversity, potentially indicating overgrazing of the understorey. Despite SA Government mapping indicating their presence, no areas of Peppermint Box woodland were able to be located.

Bird assessment

An 'Accounting for Nature' environmental account for woodland birds has been registered and certified, with the survey returning a condition score of 28/100. In total, 21 native bird species were identified. The survey site in the vicinity of the highest scoring vegetation survey site (with the most intact understorey) also scored highest for woodland birds, with a high diversity of small-bodied birds, indicative of good condition.

Key opportunities

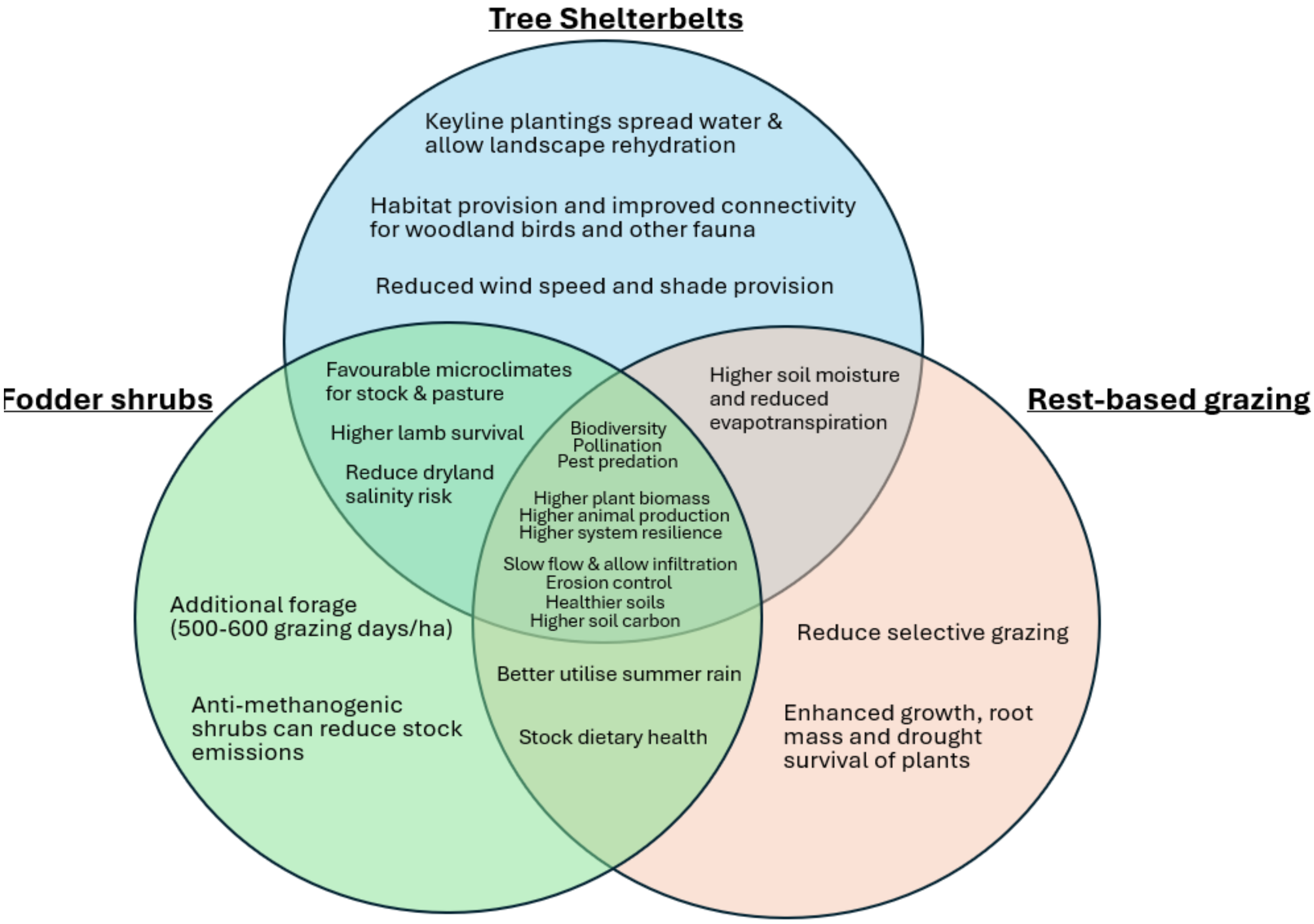
Production, Climate Resilience & Natural Capital Benefits

Natural capital opportunities were identified for Toolangi. These align with, and expand on the current Property Management Plan (PMP) developed in 2024 through Pinion Advisory. Broadly, the opportunities identified will help Toolangi to be a drought resilient and efficient property, as envisaged in the PMP.

The three key opportunities - tree plantings (shelterbelts and blocks), fodder shrubs, and rest-based grazing - are summarised briefly in the diagram below, noting the benefits they offer to the farm production system. All these benefits are explained in more detail in the full report along with linked reference materials. In particular, it should be noted that all three will increase on-farm carbon sequestration and offer opportunities for the generation of carbon credits or to offset farm emissions in property level carbon accounts.

All three will also help to restore degraded water and soil processes, which have been heavily targeted for action in the PMP, as well as biodiversity which can offer ecosystem services to the system such as pollination and pest control.

Finally, all three will help improve the economic resilience of the production system by improving the natural resource base on which it relies, boosting production, improving climate resilience and reducing expenditure on things such as autumn feeding.



POTENTIAL ENVIRONMENTAL PLANTING PROJECT

Building off the existing PMP and management goals, the proposed environmental planting project would be delivered according to applicable methodologies of the ACCU scheme and is designed to maximise benefits for production and landscape integrity. The key features include:

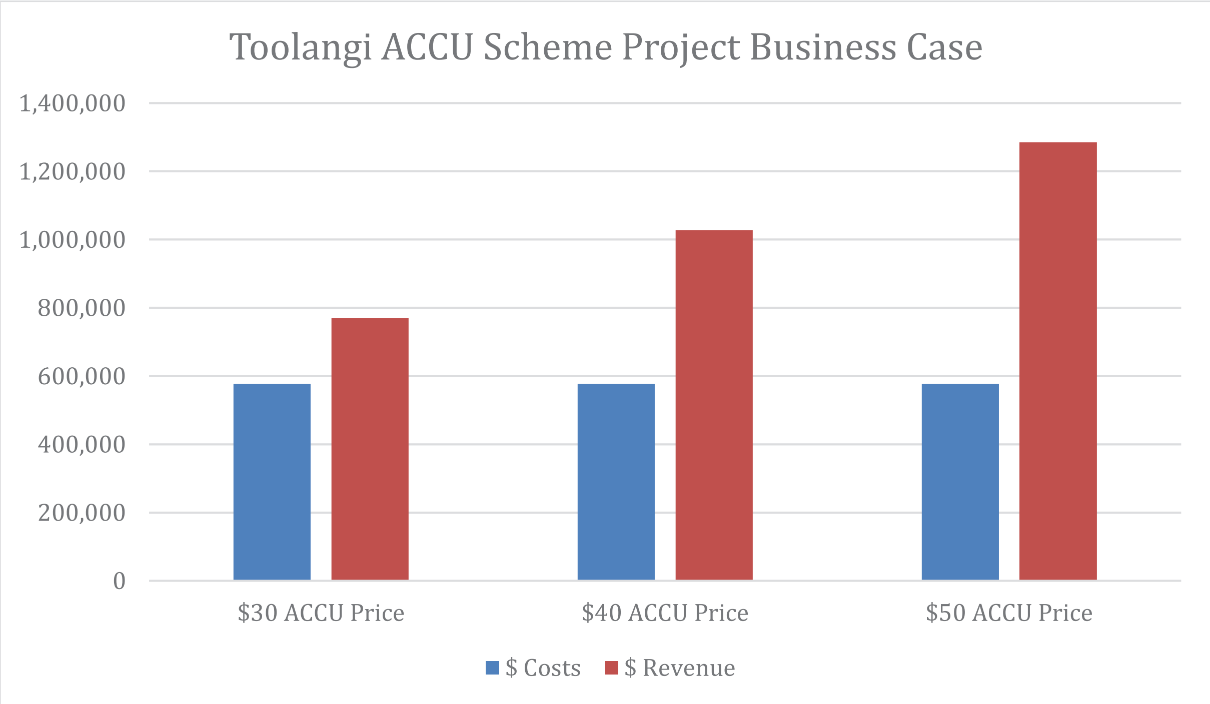
- **Keyline shelterbelts** totalling 54ha of planted area in 30-40m wide plantings. Designed along keyline contours to maximise ecological value and benefits, providing stock shelter and connecting habitats across the property while ploughed keylines hold water higher upslope and redirect flow to ridges to enable rehydration of the downslope landscape. Fodder shrub rows could potentially be planted between paired tree belts, also following keyline design principles.
- **Fenceline shelterbelts** totalling 32 ha of 30-40 m wide plantings along Cattle Station Rd fence line and the perimeter of Ringbark Paddock. These would primarily be designed to provide protection from prevailing winds. Fenceline plantings along the north-west boundary might also be considered.

- **Riparian belts** covering 45 ha of 40 m wide planting on the arable outwash plains along currently deforested creeklines. These will slow flow, filter water moving into dams, control erosion, provide shelter and connect habitats for biodiversity.
- **Riparian blocks** across 88 ha of the valleys of two creeks running off of Mt Bryan Range. These could be designed to reintroduce Peppermint Box grassy woodlands to the area, as well as slow flow, control erosion and facilitate rehydration of the landscape.

Using the Australian Government's Full Carbon Accounting Model (FullCAM), the overall 219 ha planting area is estimated to sequester carbon at an average of 4.9 tCO_2e^-/ha/year, totalling 27,047 tCO_2e^- for the 25-year crediting period. This calculation assumed less than 1500 stems planted per hectare.

Business case

Initial indicative and generalised estimates of potential costs and revenue suggest the proposed project may be financially viable (without taking into account production system benefits). Project revenue will differ greatly depending on the ACCU price. The current ACCU spot price at time of writing is $35.65, and subject to change.



Project cost breakdowns are available in section 4 of the report and can be discussed in more detail with RegenCo.

Outside of the immediate financial return of a carbon credit-generating project, a business decision on the viability of a planting project should also factor in the benefits and outcomes listed above, and the following:

- Improved farm system production, productivity, and resilience.
- Potential to finance infrastructure improvements proposed under the PMP.
- Potential for participation in nature repair and biodiversity markets.
- Improvement or maintenance of market access via environmental credentials.

Conclusion

In general, the Toolangi 'Growing Carbon' Pilot Project has demonstrated that management actions that focus on improving Natural Capital can improve both the production and, in particular, the climate resilience of agricultural systems in the Mid North Agricultural District. Emerging markets in carbon and nature repair, as well as shifting consumer preferences, can improve the business case for making these changes.

Poonunda Station

Carbon & Natural Capital for Resilient Farming Systems
Status & Opportunities

Executive Summary

This executive summary provides an overview of the entire report prepared by RegenCo. For further information and context, please refer to the main report.

Disclaimer

Any information relating to the price of Australian Carbon Credit Units is general in nature, and for indicative purposes only. Nothing in this report is intended to constitute financial advice.

The carbon project proposal is intended to provide stakeholders with a prospective project plan and possible steps that can be taken to bring a project at Poonunda towards registration as an ACCU-generating project. By providing this documentation, RegenCo is not providing an offer or invitation to proceed with a project.

Landscape & Climate Context

Poonunda is a 16,650 ha sheep grazing property that sits across two distinct bioregions. It starts in the foothills and rises of the Flinders Lofty Block bioregion in the west, and extends into a wide plain of the Murray Darling Depression bioregion to the east. The property is regarded as being located inside the Australian Rangelands - just 2km east of the boundary. West of the boundary, mixed farming, cropping and horticulture are prominent. As such, Poonunda can be said to exist in transitional country, both ecologically and agriculturally.

Poonunda's climate is semi-arid Mediterranean, receiving about 350 mm of rain in the west and only about 230 in the east. Modelled climate projections have substantial implications for Poonunda's future management decisions, predicting:

- Declining spring rainfall.
- Increasing evapotranspiration.
- Increased heat stress for sheep.
- Little change in high risk cold days for lambs/sheep.

Overall, historical trends and forecast climate modelling suggest an increased water deficit, and increased heat stress on livestock worsening cumulatively to 2030, 2050, and 2070.

Natural Capital Assessment

Broadly, natural capital at Poonunda has been analysed against five parameters: woody biomass carbon, soil carbon, property-level carbon footprint, vegetation condition, and a woodland bird assessment. Measurement and modelling has been performed using Australian Government datasets, methodologies, and models, as well as using Meat and Livestock Australia and Accounting for Nature tools and methodologies where appropriate.

- <u>Woody biomass</u>

There are two dominant sources of embedded carbon at Poonunda. Remnant mallee woodland across the property, covering approximately 2350ha, is estimated to store 345,450t of carbon dioxide equivalents (CO_2e^-) (147t CO_2e^- / ha), and the dominant blackbush and chenopod shrubland, representing approximately 14,310ha, is estimated to store 85,860t CO_2e^- (6t CO_2e^- / ha). These carbon pools are not able to be counted for carbon credits or property level carbon accounts, as they are not new and regenerating (i.e. they were not bare areas in the period since 1990).

- <u>Soil carbon</u>

Soil organic carbon (SOC) was tested at 30 and 100cm depths at 127 sample points across four 'Carbon Estimation Areas' (CEAs) according to the Australian Carbon Credit Unit (ACCU) Scheme's soil method. The tests returned an average concentration of 0.44% soil organic carbon at 0-30cm depth. This score varied across the property consistent with rainfall levels and/or degradation of natural hydrological processes.

Comparison of Poonunda numbers with SA Govt datasets of SOC in the Mid North District places Poonunda below the bottom 25% of results, leaving significant opportunity for SOC improvements via increasing plant biomass and soil cover through restoring natural hydrology and managing grazing pressure. If average SOC was increased across the analysed CEAs to equal the 25th percentile District benchmark, this would result in the storage of about 64,000 tCO_2e^- in the soil. These gains could potentially be claimed as carbon credits or accounted for in a property level carbon footprint.

- <u>Carbon footprint</u>

Total gross farm emissions were found to be 1422t of CO_2e^- per year. After subtracting a small area of regenerating shrubland, net emissions were 1386 tCO_2e^-/year. Emissions intensity of sheep meat production was 1.21kg CO_2e^- better per kg liveweight than the industry benchmark, and 3.6kg better per kg for wool production. Enteric fermentation/ animal waste was the dominant emissions source (91%).

- <u>Vegetation condition</u>

Using the SEB (Significant Environmental Benefit) survey method, five sites were assessed, reflecting diversity of vegetation communities across the property. The four western assessment sites scored reasonably highly - between 55 and 65 The highest score was recorded in the private conservation Heritage Agreement area of mallee woodland. The survey site in the Newikie Creek flood-out area to the east of the property scored 26, reflecting severe degradation.

- <u>Bird assessment</u>

An environmental account for woodland birds has been registered and certified by Accounting for Nature, returning a condition score of 31/100. In total, 40 native bird species were identified. The survey site within the conservation area scored highest by a significant margin, with a high diversity of small-bodied birds, indicative of good condition. The EPBC Threatened Ecological Community of mallee birds was also found to be present at this site.

Key opportunities

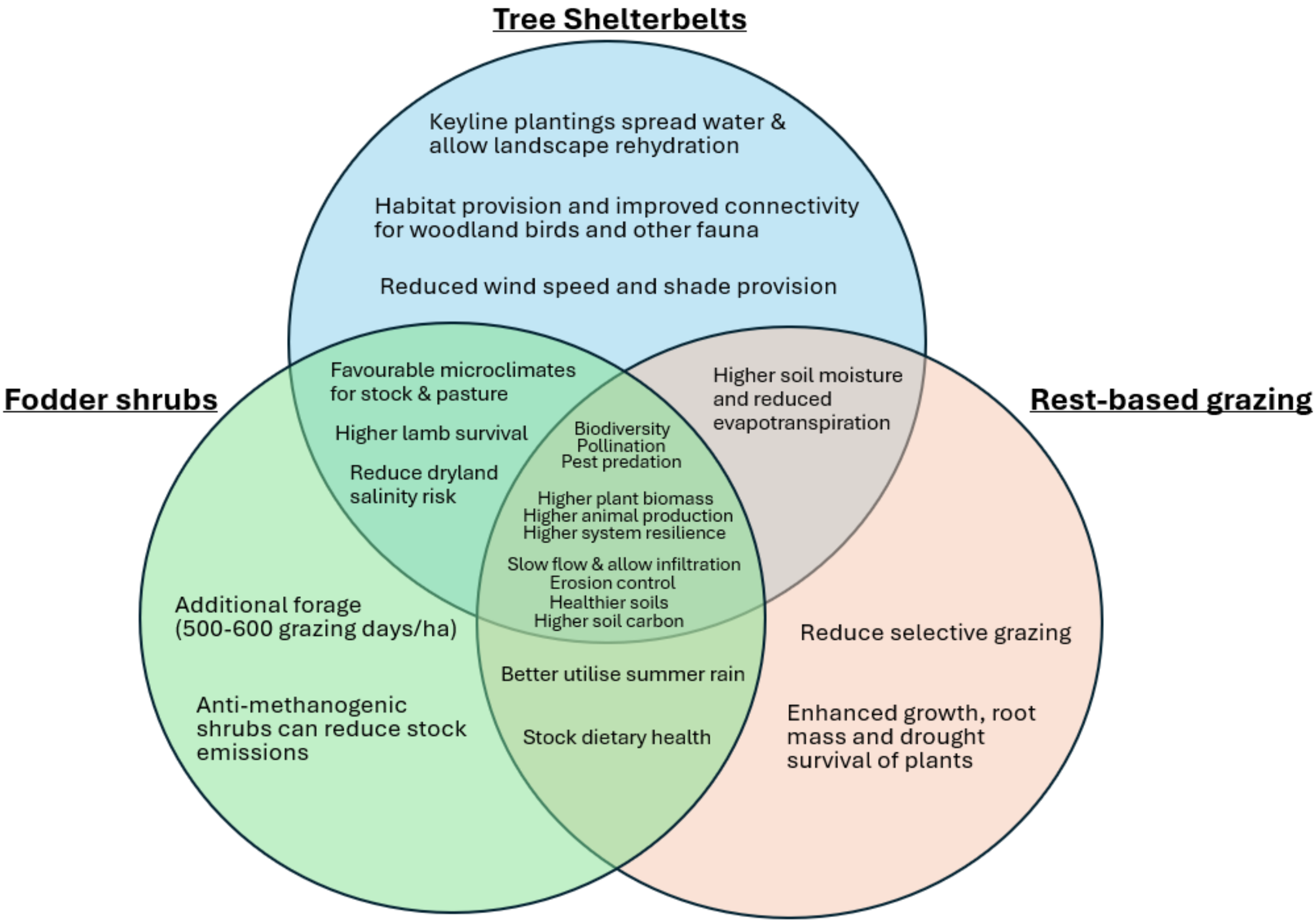
Production, Climate Resilience & Natural Capital Benefits

Natural capital opportunities were identified for Poonunda. These align with, and expand on the current Property Management Plan (PMP) developed in January 2022 with Dr Hugh Pringle. Broadly, the opportunities identified will help Poonunda to be a drought resilient and profitable property, as envisaged in the PMP.

The three key opportunities - tree shelterbelts, fodder shrubs, and rest-based grazing - are summarised briefly in the diagram below, noting the benefits they offer to the farm production system. All these benefits are explained in more detail in the full report along with linked reference materials. In particular, it should be noted that all three will increase on-farm carbon sequestration and offer opportunities for the generation of carbon credits or to offset farm emissions in property level carbon accounts.

All three will also help to restore degraded water and soil processes, which have been heavily targeted for action in the PMP, as well as biodiversity which can offer ecosystem services to the system such as pollination.

Finally, all three will help improve the economic resilience of the production system by improving the natural resource base on which it relies, boosting production, improving climate resilience and reducing costs on things such as autumn feeding.



Potential Environmental Planting Project

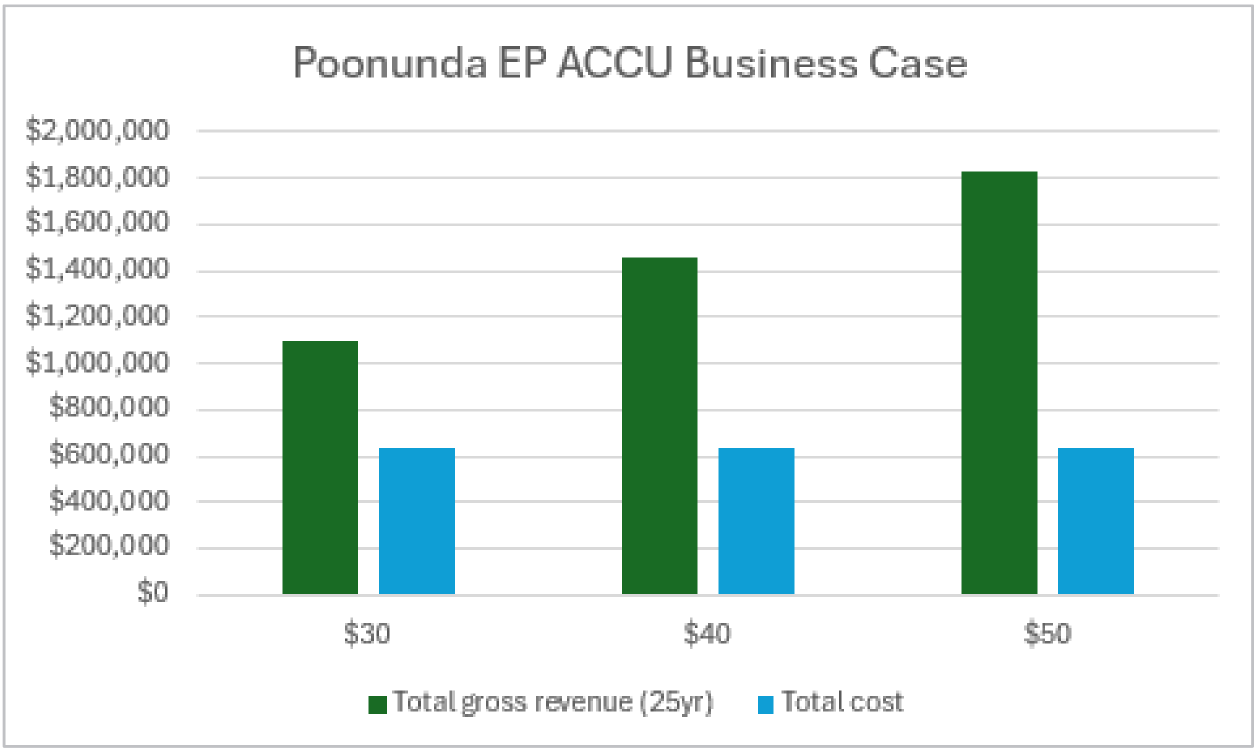
Building off the existing PMP and management goals, the proposed environmental planting project would be delivered according to applicable methodologies of the ACCU scheme and is designed to maximise benefits for production and landscape integrity. The key features include:

- **Keyline shelterbelts** consisting of belts of mallee trees planted parallel to the upslope keyline - totalling approx 254ha of planted area in 30-40m wide plantings. Designed to maximise ecological value and benefits, providing stock shelter and connecting habitats across the property while keylines hold water higher upslope and redirect flow to ridges to enable rehydration of the downslope landscape.
- **Block plantings** on the tops of rises near the western boundary, totalling 138ha in area. These plantings would likely target a mixed open grassy woodland, with species that have been historically lost in these locations through overgrazing, such as she-oaks, potentially being included.

Using the Australian Government's Full Carbon Accounting Model (FullCAM), the overall ~392ha planting area is estimated to sequester carbon at an average of 3.9t CO_2e^- per ha per year, totalling 38,494t of CO_2e^- for the 25-year crediting period.
This calculation assumed less than 1500 stems planted per hectare.

BUSINESS CASE

Initial indicative and generalised estimates of potential costs and revenue suggest the proposed project may be financially viable (without taking into account production system benefits). Project revenue will differ greatly depending on the ACCU price. The current ACCU spot price at time of writing is $35.45, and subject to change.



Project cost breakdowns are available in section 4 of the report and can be discussed in more detail with RegenCo.

Outside of the immediate financial return of a carbon credit-generating project, a business decision on the viability of a planting project should also factor in the benefits and outcomes listed above, and the following:

- Improved farm system production, productivity, and resilience.
- Potential to finance infrastructure improvements proposed under the PMP.
- Potential for participation in nature repair and biodiversity markets.
- Improvement or maintenance of market access via environmental credentials.

Ridgeview

Carbon & Natural Capital for Resilient Farming Systems
Status and Opportunities

Executive Summary

This executive summary provides an overview of the report entitled *Ridgeview: Carbon & Natural Capital for Resilient Farming Systems – Status & Opportunities* prepared by RegenCo. For further information and context, please refer to the main report.

Disclaimer
Any information relating to potential costs and revenue of a carbon project is general in nature, and for indicative purposes only. Nothing in this report is intended to constitute financial advice.

The carbon project described is intended to provide stakeholders with a prospective project plan and general business case for taking a project at Ridgeview towards registration as an ACCU-generating project. By providing this documentation, RegenCo is not providing an offer or invitation to proceed with a project.

Ridgeview Key Features

Landscape and Climate

Ridgeview has a unique position ecologically, sitting inside the Flinders Lofty Block bioregion, with the centre of the property being the junction of three subregions: Southern Flinders, Olary Spur, and Broughton. The property also sits at the border of the Australian Rangelands, representing ecologically and agriculturally transitional country where biodiversity is often maximised, and practices shift from cropping to low intensity grazing.

The report contains wind and rainfall data for the region. Modelled climate projections have substantial implications for Ridgeview's future management decisions, predicting:

- Declining rainfall projections.
- Increasing evapotranspiration.
- Increased heat stress (from 25 'hot days' - over 35C a year in 1965-1994 to 48 by 2070). This is accompanied by an increasing impact on sheep fertility.
- Cold exposure risk is slightly reduced.

Overall, historical trends and forecast climate modelling suggest an increased water deficit, and increased heat stress on livestock worsening cumulatively to 2030, 2050, and 2070.

Natural Capital Assessment

Broadly, natural capital at Ridgeview has been analysed against five parameters: woody biomass carbon, soil carbon, carbon footprint, vegetation condition, and a woodland bird assessment. Measurement and modelling has been performed using Australian Government datasets, methodologies, and models, as well as using Meat and Livestock Australia and Accounting for Nature tools and methodologies where appropriate.

Woody biomass

There are two main areas of significant woody biomass. The small block at the south-west of the property contains approx. 60ha of regenerating *Acacia victoriae*, contributing approximately 200 tonnes (t) of carbon dioxide equivalent (CO2-e) per ha per year. The area holds approximately 3,890t CO2-e.

Scrub paddock, north of the property, holds approx. 250ha of older regenerating *Acacia victoriae / Myorporum platycarpum* mixed tall shrubland, with an estimated 16,515t CO2-e in the area.

Soil carbon

Sampled in March 2024, soil organic carbon (SOC) was tested at 30 and 100cm depths at 27 sample points, and returned an average concentration of 0.48%, which equates to 187,734t CO2-e in the top 100cm of Ridgeview's soils.

Comparison of Ridgeview numbers with SA Govt datasets of SOC in the Upper North District places Ridgeview below the 25th percentile, in other words, the bottom 25% of results, leaving significant opportunity for SOC improvements via increasing plant biomass and soil cover.

Carbon footprint
Total farm emissions were found to be 229t of CO2-e per year. After subtracting the regenerating south-west block shrubland, net emissions were 36.8t CO2-e/year. Emissions intensity of sheep meat production was 0.5kg CO2-e better per kg liveweight than the industry benchmark.

Vegetation condition
Using the SEB (Significant Environmental Benefit) survey method, four sites were assessed across Ridgeview. Biodiversity score was best in the regenerating *Acacia victoriae* block in the south-west, and was poorest in the Seeded Paddock site - which is currently destocked reflecting the historical overgrazing and degradation.

Bird assessment
An environmental account for woodland birds has been registered and certified by Accounting for Nature, returning a condition score of 33/100. In total, 27 native bird species were identified. The account is available on the Accounting for Nature website. Total (informal) species sighted was 43, only 8 fewer than nearby Black Rock Conservation Park.

Key opportunities

Production, climate resilience & natural capital benefits

Opportunities align with, and expand on, the current Ridgeview Property Management Plan (PMP) developed in 2021 by Contour Consulting.

The three key opportunities are:

- Tree shelterbelts and block plantings
- Fodder shrub corridor plantings
- Rotational grazing system

Strategy	Key Impacts	Outcome
Tree Shelterbelts & Block Plantings	Reduced wind speed and shade provision	Economic outcomes are improved through increased production, lower energy requirements in stock, improved survival. Increases in average annual pasture growth of up to 20% have been recorded on sheltered farms. Reduced erosion and improved soil moisture within shelterbelt zone of influence. Habitat provision and improved connectivity for woodland birds and other fauna.
	Reduced cold exposure risk and improved lamb survival	
	Reduced water loss in pasture plants	
	Improved liveweight gain, wool production, and health under heat stress conditions	
	Improved pasture production and plant growth	
	Increased crop yields	
	Carbon sequestration in biomass and potentially nearby soils	
	Significant natural capital benefits	

Fodder shrub corridor plantings	Improved liveweight gain and animal health	Profit increase of up to 20% with perennial forage shrubs across 10-20% of farm. Lower emissions intensity of production, market access . Improved resilience to climate variability. Improved Natural Capital account and market access.
	Additional forage (500-600 grazing days / ha), including perennial fodder through the Autumn feed gap	
	Carbon sequestration in biomass and potentially nearby soils	
	Favourable microclimates for stock and pasture	
	Reduced risk of dryland salinity	
	Significant natural capital benefits	
Rotational grazing system	Improved pasture plant diversity, particularly native perennial grasses.	Improved conditions for carbon sequestration. Improved landscape resilience to changing rainfall trends and water availability. Improved plant and wildlife conditions for biodiversity and natural capital improvements.
	Better ability to take advantage of (predicted to increase) summer rains and improved rainfall use efficiency.	
	Even grazing pressure, improved pasture utilisation and enhanced growth and survival of plants, reduced soil erosion, and improved animal production.	
	Reduced selective grazing	
	Improved conditions for biodiversity	

There are other general impacts that the delivery of the three strategies will deliver concurrently:

- Improved natural capital benefits through improved diversity and cover of trees, grasses, and shrubs - providing corridors for woodland birds and other fauna.
- Improved resilience to climate changes over time, such as reduced rainfall and increased evapotranspiration, and changing rainfall periods and patterns.
- Improved market and financial access through improved biodiversity, reduced emissions intensity, and landscape restoration.

Opportunity - Environmental Planting Project

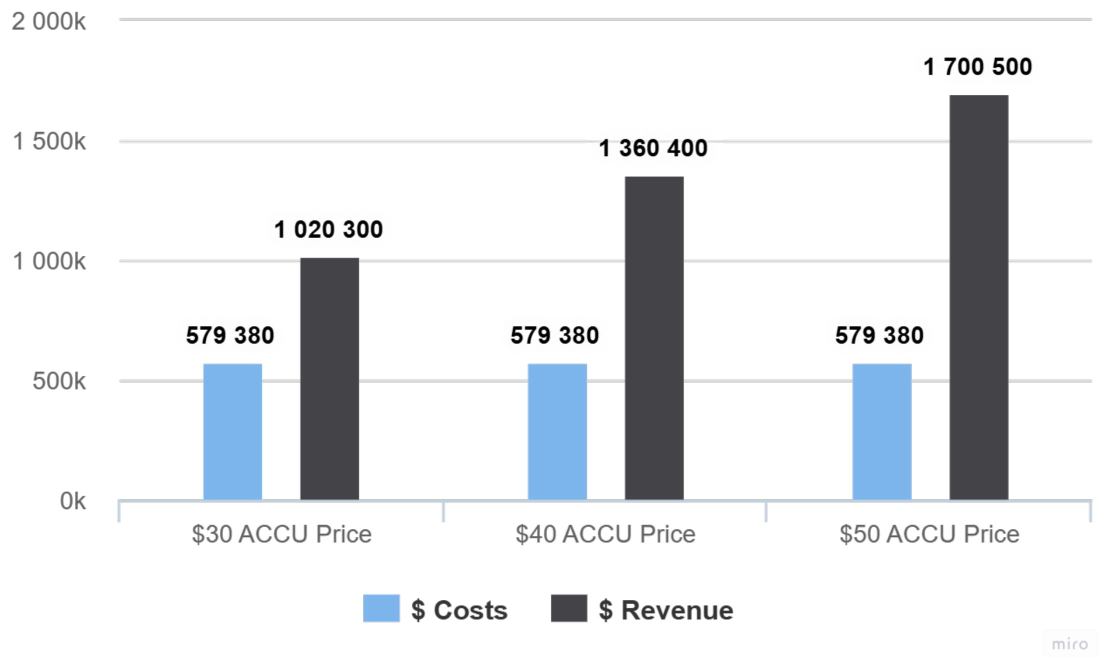
Building off the existing PMP, the proposed environmental planting project would be delivered according to applicable methodologies of the ACCU scheme and is designed to maximise benefits for production and landscape integrity. The key features include:

- **Block planting** 73ha area in the south-west block.
- **Fenceline shelterbelts** as planned under the PMP, with additional plantings to maximise ecological benefits. Totalling 79ha. Includes the establishment of 30km of fencing.
- **Drainage line shelterbelts** covering 30ha across the south and central-west of the property, to take advantage of drainage lines and gullies. Designed to mitigate wind risk.
- **Connecting shelterbelts** - 18ha in Brooks East and West paddocks to connect corridors, providing ecological services, and prioritise floristic and structural diversity.

Using the Australian Government's Full Carbon Accounting Model (FullCAM), the overall ~200ha planting area is estimated to sequester carbon at an average of 7.16t CO2-e per ha per year, totalling 35,787t of CO2-e for the 25-year crediting period.
This calculation assumed less than 75% of planted species to be trees (the rest being shrubs/understorey) and less than 1500 stems per hectare.

Business case

Initial indicative and generalised estimates of potential costs and revenue suggest the proposed project may be financially viable (without taking into account production system benefits). Project revenue will differ greatly depending on the ACCU price. The current ACCU spot price at time of writing is $34.25.



Project cost breakdowns are available in section 5 of the report.

Outside of the immediate financial return of a carbon credit-generating project, a business decision on the viability of a planting project should also factor in the benefits and outcomes listed above, and the following:

- Improved farm system production, productivity, and resilience.
- Potential to finance infrastructure improvements proposed under the PMP.
- Potential for participation in nature repair and biodiversity markets.
- Improvement or maintenance of market access via environmental credentials.

Conclusion

In general, the Ridgeview 'Growing Carbon' Pilot Project has demonstrated that management actions that focus on improving Natural Capital can improve both the production and, in particular, the climate resilience of agricultural systems in the Upper North Agricultural District. Emerging markets in carbon and nature repair, as well as shifting consumer preferences, can improve the business case for making these changes.

CARBON FARMING IN THE UPPER NORTH – *a Pilot Project*

The extended version of this publication is available on the Upper North Farming Systems website.

You can access it by scanning the QR code below.

Alternatively,

visit www.unfs.com.au, click on '**Resources**' in the top menu, then select '**UNFS Publications**'. The report can be found under the '**Growing Carbon Final Reports**' section.

If you experience any issues accessing the publication, feel free to contact us at
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UPPER NORTH FARMING SYSTEMS MEMBERSHIP LIST 2023 - 2024

Title	First Name	Last Name	Partners Name	Town or Business
Mr	Ashley	Afford	Les	Port Pirie
Mr	Jordan	Arthur		Booleroo Centre
Mr	Tim	Arthur		Melrose
Mr	Peter	Barrie	Di	Orroroo
Mr	Braden	Battersby	Emilie	Wilmington
Mr	Michael	Battersby	Catherine	Wilmington
Mr	Colin	Becker	Joy	Caltowie
Mr	Henry	Bennett	Adele	Tarcowie
Mr	William	Bennett	Emma	RSD Pekina
Mr	Dustin	Berryman		Northern Ag PL
Mr	Shaun	Borgas	Marisa	Booleroo Centre
Mr	Donald	Bottrall	Heather	Jamestown
Mr	Damian	Bradford		ADM Australia PL
Mr	Brendon	Bradtke		Jamestown
Ms	Anne	Brown		Wirrabara
Mr	Malcolm	Buckby		SAGIT
Mr	Ben	Bury	Bevin	Wilmington
Mr	David	Busch	Lisa	Tothillbelt
Mrs	Emily	Byerlee		Orroroo
Mr	Malcolm	Byerlee		Orroroo
Mr	Neil	Byerlee		Orroroo
Mr	Angus	Calder		Nutrien - Minlaton
Mr	Todd	Carey		Wilmington
Mr	John	Carey		Wilmington
Mr	John (JP)	Carey	Nicole	Booleroo Centre
Mr	John (Snr)	Carey		Booleroo Centre
Mr	Derek	Carkle		NAB
Mr	Ben (Jnr)	Carn		Quorn
Mr	Ben (Snr)	Carn	Susan	Quorn
Mr	Adrian	Carter		Nuseed
Mr	Andrew	Catford	Gilmour & Michelle	Orroroo
Mr	David	Catford	Andrea	Gladstone
Mr	Dion	Clapp		Peterborough
Mr	Luke	Clark	Dette	Jamestown
Mr	Scott	Clark	Jaimie	Jamestown
Mr	David	Clarke	Chloe	Booleroo Centre
Mr	Ian	Clarke	Sue	Booleroo Centre
Mr	Piers	Cockburn		Wirrabarra
Mr	Peter	Cockburn	Toni-Louise	Wirrabarra
Mrs	Anne	Collins	Glenn	Quorn
Ms	Amanda	Cook		SARDI - Minnipa
Mr	James	Cook		Nuseed
Mr	Michael	Cousins		CBH Group
Mr	David	Coyner		AgPay
Mr	Ben	Crawford	Beck	Georgetown
Mr	John	Crawford	Jan	Georgetown
Mr	Luke	Crawford		Jamestown
Mr	Mark	Crawford	Heidi	Georgetown

Title	First Name	Last Name	Partners Name	Town or Business
Mr	Trevor	Crawford	Christine	Jamestown
Mr	Chris	Crouch	Iris	Wandearah via Crystal Brook
Mr	Nathan	Crouch		Wandearah
Ms	Jenny	Davidson		SAGIT
Mr	Nicholas	Davis		Adelaide
Mr	Wayne	Davis		Davis Grain
Mr	Brad	Dennis	Ellie	Baroota
Mr	Matt	Dennis		Baroota
Mr	Robert	Dennis	Michelle	Baroota
Mr	Phillip	Dibben		Financial Services SA
Ms	Libby	Duncan		Landscape SA Northern & Yorke
Mr	Joel	Durnford		MGA
Mr	Colin	Edmondson		LongReach Plant Breeders
Mr	Damian	Ellery		Orroroo
Mr	Ian	Ellery	Sue	Orroroo
Mr	Luke	Ellery		Orroroo
Mr	Michael	Eyers	Holly	Field Systems Aust Ltd
Mr	Bentley	Foulis	Michelle	Willowie
Mr	Matt	Foulis		Willowie
Mr	Douglas	Francis		Quorn
Mr	Kym	Fromm		Orroroo
Mr	Neville	Gibb	Daryl & Ian	Orroroo
Dr	Gurjeet	Gill		Uni of Adelaide
Mr	Caleb	Girdham		Melrose
Mr	Brendan	Groves	Meridee	Booleroo Centre
Miss	Rebecca	Gum	Geoff	Orroroo
Mr	Trevor	Gum	Dianne	Orroroo
Mr	Jonathan	Hancock		Brinkworth
Mr	Kym	Harvie	Leeanne	Booleroo Centre
Mr	James	Heaslip	Kara	Appila
Mr	Jim	Heaslip	Genevieve	Appila
Mr	Will	Heaslip		Appila
Mr	Tim	Heath		BASF
Miss	Alison	Henderson		Caltowie
Mr	David	Henderson	Joy	Caltowie
Mr	Roger	Hilder	Cheryl	Quorn
Mr	James	Hillcoat		Pinion Advisory
Ms	Beth	Humphris		Elders
Mr	Neil	Innes	Anne	Booleroo Centre
Mr	Aaron	Jak		Fieldworks SA
Mr	Steve	James		Yongala
Mr	Tony	Jarvis		Booleroo Centre
Mr	Ben	Jefferson		Tarcowie
Mr	Paul	Jenke		Pioneer Seed
Mr	Brendon	Johns	Denise	Northern Grain
Mr	Leighton	Johns		Port Pirie
Mr	Phillip	Johns		Port Pirie
Mr	Steven	Johns		Port Pirie
Mr	Nick	Jordan		ADM
Mr	Bart	Joyce		Wandearah West
Mr	Ziek	Kay		Platinum Ag Services
Mr	Ian (Danny)	Keller		Appila

Title	First Name	Last Name	Partners Name	Town or Business
Mr	Chris	Kelly		Kelly Toyota
Mr	Shane	Kelly	Jo	Booleroo Centre
Mr	Andrew	Kitto	Maria	Gladstone
Mr	Jamie	Jody		Nuriootpa
Mr	Joe	Koch	Jess	Booleroo Centre
Mr	Lachie	Koch		Booleroo Centre
Mr	Robert	Koch	Joyleen	Georgetown
Mr	Jim	Kuerschner	Gaye	Orroroo
Mr	Sam	Kuerschner		Orroroo
Mr	Tom	Kuerschner		Orroroo
Mr	David	Kumnick	Katrina	Booleroo Centre
Mr	Jaxon	Kumnick		Booleroo Centre
Mr	Neil	Lange	Judy	Laura
Ms	Tracey	Lehmann		E.P.I.C.
Mr	David	Long		Advantage Grain
Mr	Tim	Luckraft	Christy	Orroroo
Ms	Stephanie	Lunn		AgXtra
Mr	Andrew	McCallum	Melissa	Booleroo Centre
Mr	Cameron	McCallum	Toni	Melrose
Mr	David	McCallum	Lyn	Melrose
Mr	Jamie	McCallum	Therese	Melrose – Gumview Pastoral
Mr	Jesse	McCallum	Jessica	Melrose – Gumview Pastoral
Mr	Nicholas	McCallum	Carly	Melrose Deerness Trading
Mr	Ras	McCallum	Jo	Flinders Machinery
Mr	Richard	McCallum	Michelle	Booleroo Centre
Mr	Warren	McCallum	Jennifer	Laura
Ms	Krystal	McMahon	Josie	S.A. & J.A. Wild
Mr	Brenton	Miller		Elders - Peterborough
Mr	Robert	Mills	Lurlene	Booleroo Centre
Mr	Darcy	Moore		Intergrain
Mr	David	Moore	Bec	Jamestown
Ms	Millie	Moore		S & W Seed Co.
Ms	Tanja	Morgan		Mallee Sustainable Farming
Mr	Tom	Moten		Pekina
Mr	Barry	Mudge	Kristina	Port Germein
Mr	Jonno	Mudge		Port Germein
Mr	Matthew	Nottle	Alice	Booleroo Centre
Mr	Morgan	Nutt	Joy	Orroroo
Mr	Stuart	Ockerby		Seednet
Ms	Molly	O'Dea		O'Dea Daughters Farming
Ms	Kim	Oldfield		Carrieton
Mr	Mitch	Orrock		Murray Town
Mr	Todd	Orrock	Brooke	Orrock Farming
Mr	Adrian	Paynter	Jane	Quorn
Ms	Kate	Pearce		Landscape SA Northern & Yorke
Mr	Darren	Pech		Elders
Mr	Marcus	Perry		Perrys Fuels
Mr	Nicholas	Piggott	Emily	Booleroo Centre
Mr	John	Polden		Booleroo Centre
Mr	Chris	Pole	Michelle	Port Germein
Mr	Thomas	Porter		Washpool
Ms	Courtney	Ramsey		GRDC

Title	First Name	Last Name	Partners Name	Town or Business
Mr	Patrick	Redden		Pinion Advisory
Mr	Mark	Reichstein		Appila
Mr	Brett	Reid	Ebony	Port Broughton
Mr	Kym	Reid	Iola	Port Broughton
Dr	Jodie	Reseigh		National Landcare/Red Meat & wool Growth Programs
Mr	Steve	Richmond		Nutrien Ag - Jamestown
Mr	Chris	Roberts		Nuseed
Ms	Penny	Roberts		MSF
Mr	Paul	Rodgers		Quorn
Mr	Joe	Ross	Lauren	Emu Downs
Mr	Stephen	Sanders	Elishia	Melrose
Mr	Ed	Scott	Catherine	Field Systems Australia Ltd
Mr	Craig	Shearer		E.P.I.C.
Mr	Keith	Slade	Lisa	Bangor
Ms	Sarah	Slee	Josh	Wilmington
Ms	Toni	Somes		GRDC
Mrs	Ruth	Sommerville	Damien	Rufous & Co
Ms	Kerry	Stockman		AgExcellence Alliance
Miss	Grace	Teate		Booborowie
Ms	Andrea	Tschirner		SA Arid Lands Landscape Board
Mr	Daniel	Vater		AGT
Ms	Narissa	Venables		Riverland Lending Service
Mr	Henry	Voigt		CentreState Exports
Mr	Andrew	Walter	Lydia	Melrose
Mr	Ken	Walter	Denise	Melrose
Mrs	Teesha	Whellum		MGA
Mrs	Jessie	White		Landscape SA Northern & Yorke
Mr	Nigel	Wilhelm		SARDI
Mr	Lachie	Williams		Booleroo Centre
Mr	Tim	Wilmshurst		Advanta Seeds
Mr	Andrew	Wilsdon		Viterra
Mr	Dion	Woolford	Chelsea	Solomon
Mr	Wayne	Young		Port Pirie
Mr	Andrew	Zanker		Laura
Mr	Bryan	Zanker		Booleroo Centre
Mr	Eric	Zanker	Raelene	Booleroo Centre
Mr	Graham	Zanker	Lyn	Laura
Mrs	Kim	Zohs	Jason	Crystal Brook
Mr	Michael	Zwar		Ag Tech Services

Collation and editing of this report was undertaken by Deb Marner on behalf of Upper North Farming Systems.