RIVERINE PLAINS

2026 TRIAL BOOK

RESEARCH FOR THE RIVERINE PLAINS

CONTENTS

STANDARD UNITS OF MEASUREMENT:

Through this publication, commonly-used units of measurement have been abbreviated for ease of reading. They include:

Centimetres — cm

Hectares — ha

Kilograms — kg

Litres — L

Metres — m

Millimetres — mm

Tonnes — t

Other commonly used abbreviations:

Mono ammonium phosphate — MAP

Urea ammonium nitrate — UAN

DISCLAIMER

CEREAL GROWTH STAGES

A growth stage key provides a common reference for describing crop development. The most commonly used growth stage key for cereals is the Zadok decimal code, which splits the development of a cereal plant into 10 distinct phases of development and 100 individual growth stages, denoted with the prefix GS or Z (e.g. GS39 or Z39). Zadock growth stages are described below:

0 GERMINATION

00 Dry seed
01 Start of imbibition (water absorption)
03 Imbibition complete
05 Radicle (root) emerged from seed
07 Coleoptile (shoot) emerged from seed
09 Leaf just at coleoptile tip

1 SEEDLING GROWTH

10 First leaf through coleoptile
11 First leaf emerged
13 3 leaves emerged
15 5 leaves emerged
17 7 leaves emerged
19 9 or more leaves emerged

2 TILLERING

20 Main shoot only
21 Main shoot and 1 tiller
23 Main shoot and 3 tillers
25 Main shoot and 5 tillers
27 Main shoot and 7 tillers
29 Main shoot and 9 or more tillers

3 STEM ELONGATION

30 Pseudostem (leaf sheath) erection
31 First node detectable
32 2nd node detectable
33 3rd node detectable
34 4th node detectable
35 5th node detectable
36 6th node detectable
37 Flag leaf just visible
38 Flag leaf half visible
39 Flag leaf ligule just visible

4 BOOTING

41 Early boot - flag leaf sheath extending
43 Mid boot - boots just visibly swollen
45 Full boot - boots swollen
47 Flag leaf sheath opening
49 First awns visible

5 INFLORESCENCE (EAR/PANICLE) EMERGENCE

51 First spikelet of inflorescence just visible
53 Inflorescence 30 % emerged
55 Inflorescence 50% emerged
57 Inflorescence 70% emerged
59 Inflorescence 90% emerged

6 ANTHESIS (FLOWERING)

60 Whole spike visible
61 Early – 20% spike with yellow anthers
63 30% of spikes with yellow anthers
65 Mid- 50% of spikes with yellow anthers
67 70% of spikes with yellow anthers
69 Late – 90% of spikes with yellow anthers

7 MILK DEVELOPMENT

71 Kernal watery ripe, clear liquid
73 Early milk, liquid off-white
75 Medium milk, contents milky liquid
77 Late milk, more solids in milk
79 Very late milk, half solids in milk

8 DOUGH DEVELOPMENT

81 Very early dough, more solids and slides when crushed
83 Early dough, soft, elastic and almost dry, shiny
85 Soft dough, firm, crumbles but fingernail impression not held
87 Hard dough, fingernail impression held, spike yellow brown
89 Late hard dough, difficult to dent

9 RIPENING

91 Kernal hard (difficult to divide)
92 Caryopsis hard (not dented by thumbnail)
93 Caryopsis loosening in daytime
94 Over-ripe straw dead and collapsing
95 Seed dormant
96 Viable seed giving 50% germination
97 Seed not dormant
98 Secondary dormancy induced
99 Secondary dormancy lost

ACHIEVEMENTS AT A GLANCE

MEMBERSHIP & REACH

2025 CALENDAR YEAR
472 MEMBERS

LOCAL GOVERNMENT AREAS REPRESENTED 16

STAFF 16

FOCUS AREAS

- SOILS
- LIVESTOCK
- CLIMATE
- GRAINS
- FODDER
- DROUGHT
- BUSINESS
- PEOPLE
- SUSTAINABILITY

PROJECTS

118	7	21	17
DELIVERY PARTNERS	NEW PROJECTS	CURRENT PROJECTS	COMPLETED PROJECTS

R, D & E DELIVERY & INNOVATION

TRIAL SITES
26

TRIAL TYPE

4	15	7
REPLICATED	DEMONSTRATION	MONITOR

EVENTS

TOTAL EVENTS 26

823 ATTENDEES AT EVENTS

- SYKESY'S BURAJA MEETING
- LADIES LUNCHEON
- IN SEASON UPDATE

EVENTS 2025

Irrigation field walk and Hyper-profitable crops discussion

Ri$kwise workshop

Sykesy's Buraja Meeting

Ladies Luncheon

Harvest wrap-ups, Oaklands, Rutherglen

Harvest wrap up & farm water planning day, Culcairn

Just the facts on carbon farming, Howlong, Wagga Wagga, Violet Town

Every drop counts: Farm water management field day

Every drop counts: Farm webinar series 1 & 2

Farm succession planning workshop, Talgarno

Dry-season workshop, Howlong

Hyper profitable crops: Farm business workshop

First Aid for Rural properties Rutherglen

Hyper profitable crops and crown rot field walk

Drought resilience practices and crown rot management field day, Moorilim

In-Season Update

Alternative N sources field day, Sanger

Grain Automate Workshop, Rutherglen

Evan Moll Gerogery Field Day

Annual Pasture options in cropping systems field walk, Howlong

Farm Office & Xero efficiencies workshops, Yarrawonga and Wagga Wagga

THANK YOU TO OUR 2025 HOST FARMERS

Thank you to the members who very generously donated their time, paddocks and experience to enable Riverine Plains to undertake research, extension and validation locally. Your contribution to our region is very much appreciated.

The Brown family
John and Sarah Bruce
Joe & Andrew Corrigin
The Coulthard family
Gus and Sue Campbell
Jane and Barry Clarke
Nico and Allison Courtney
Adam Feuerherdt and the Bird family
Ben Goldsworthy
Roy, Leanne and Michael Hamilton
Simon Lavis
Nathan and Kara Lawless
Tony Ludeman
The Marshall family
Luke Matthews
Lee Menhennett
Pat Molloy and the Fisher family
The Moll family
James and Andrew Nixon
Don Piper
Kate and Neville Reilly
Andrew and Sue Russell
The Sandral family
Damien and Carissa Schneider
Murk Schoen
Zac Smith
The Spence family
Bronwyn Thomas
Peter Tressider
Tim and Lara Trevethan
The Webster family
Rhys Wolfenden
Ian, Kaye and Jack Wood

PROJECT PARTNERS

FUNDING PARTNERS

PROGRAM PARTNERS

ORGANISATIONAL PARTNERS

DELIVERY PARTNERS

Riverine Plains was proud to collaborate with the following research and extension partners:

NEW PROJECTS

During 2025 Riverine Plains commenced the following new projects:

SUPPORTING THE DEVELOPMENT OF STANDARDISED ON-FARM EXPERIMENTATION APPROACHES IN THE NORTHERN REGION

TERM DATE: 2025–2028

This project aims to develop methods that can improve the quality of data from on-farm trials, using commercial-scale precision agriculture machinery and software to capture variability across paddocks and seasons. The project is establishing standardised approaches, validating them at paddock scale, and building the skills of growers, advisors and industry groups to design, deliver and interpret on-farm experiments, enabling confident adoption and scaling of effective farming practices.

This project is an investment of the Grains Research and Development Corporation (GRDC).

SCOUT FOR AUSTRALIAN FARMERS

TERM DATE: 2025–ONGOING

SCOUT for Australian farmers is a capacity building program, led by Riverine Plains, that supports farmers and their advisors to identify local technology and innovation gaps, scout for relevant solutions and opportunities and trial them in local, real-world conditions.

Leveraging Australia's trusted farming system group network, SCOUT builds the capacity of those already delivering on-farm trials to validate the new technologies that will support the prosperity of Australia agriculture in the future.

RAINSTICK SMALL PLOT VALIDATION

TERM DATE: 2025–2026

This project builds on Riverine Plains' previous work with Rainstick's bioelectrical seed treatment technology, which involved early-stage problem and market validation through farmer consultation, connecting with seed breeders, and ensuring locally adapted canola varieties were validated in the lab under the project SCOUT: Rainstick – improving canola establishment.

This new project delivers a replicated small plot trial at Rennie, NSW, to evaluate the technology in the field. The trial aims to move technology validation from the lab to the small plot stage gate by assessing the agronomic performance and early crop development benefits of two seed treatments applied to canola. The aim is to generate high-quality field data to inform decision-making under commercial cropping conditions.

This project is supported by funding from Rainstick and Riverine Plains.

IMPROVED DECISION MAKING FOR CLIMATE-SMART FLOCK MANAGEMENT

TERM DATE: 2025–2028

This project aims to empower farmers to adopt climate-smart flock management practices that boost productivity, improve soil and water health and reduce emissions. Through hands-on demonstrations, workshops and decision-support tools, farmers gain practical skills, knowledge and confidence to make informed, sustainable choices for their flocks and the broader agricultural landscape.

This project is led by Central West Farming Systems and supported by the Australian Government through funding from the Climate-Smart Agriculture Program under the Natural Heritage Trust.

LOW CARBON LANDSCAPES: PRACTICAL CARBON PROJECT DESIGN FOR FARM PROFITABILITY AND LANDSCAPE BENEFITS

TERM DATE: 2025–2028

The project will see Riverine Plains partner with up to 18 commercial farm businesses across three target landscape areas in southern NSW, spanning dryland and irrigated cropping, mixed farming and grazing systems.

The project aims to support farmers in progressing their carbon abatement ideas and designs, up to the point where they are ready to secure investment.

Over the life of the project, Riverine Plains and partners will develop detailed property assessments, landscape plans and business cases for a suite of emissions reduction activities.

This project is supported by the NSW Government through a Low Carbon Landscapes grant, delivered under the Primary Industries Productivity and Abatement Program within the Department of Climate Change, Energy, the Environment and Water.

INNOVATIVE SOIL TECHNOLOGIES TO FOSTER RESILIENCE AND CLIMATE-SMART CROP PRODUCTION

TERM DATE: 2025–2028

This project is evaluating innovative soil technologies and amelioration techniques to address local soil constraints in the Riverine Plains, supporting climate-smart and sustainable on-farm practices.

As part of this project, Riverine Plains is delivering a two-year field trial at Bidgeemia, NSW to investigate the impact of a range of soil amendments on a soil with a known constraint.

This project is led by the University of Adelaide and is funded through the Australian Government's National Heritage Trust: Climate-smart Agriculture Program (Partnerships and Innovation).

SCOUT: PAIRTREE (VISUALISING FARM DATA)

TERM DATE: 2025–2027

This project aims to demonstrate how aggregating farm data from multiple digital platforms can improve decision-making, reduce administrative burden, and deliver measurable return on investment for farm businesses.

Working with Riverine Plains members and advisors, the project is piloting the Pairtree Plus data platform to integrate information from multiple sources into a single farmer-controlled dashboard. Through pilot farms, case studies and benchmarking, the project is assessing time savings, compliance efficiencies and operational insights when farm data is centralised and accessible in real time.

This project is funded by the Riverine Plains SCOUT for Riverine Plains program.

EXTENDING RESULTS FROM THE SOIL CRC PLANT DIVERSITY PROJECT

TERM DATE: 2025 (SHORT-TERM PROJECT)

This project builds upon the Building Resilient Soils and Enhancing Carbon Stocks in Cropping Systems through Plant Diversity initiative by the Cooperative Research Centre for High Performance Soils (Soil CRC).

It aims to support farmers in adopting land management practices that protect soils and enhance soil moisture retention, to improve overall resilience to drought. By providing local insights into cover cropping and intercropping, the project is supporting farmers to make informed decisions about their role in the Riverine Plains, based on both trial results and practical, real-world considerations.

This project of the Regional Drought Resilience Planning program is supported through funding from the Australian Government's Future Drought Fund and the Victorian Government.

CURRENT PROJECTS

Projects that continued during 2025:

EVALUATING NOVEL APPROACHES FOR DROUGHT RESILIENCE THROUGH AN ESTABLISHED NETWORK OF LONG-TERM TRIALS

TERM DATE: 2024–2028

Addressing subsoil constraints often requires considerable time to change key soil properties including organic matter, infiltration rates and water holding capacity. This project supports a long-term replicated field trial originally established at Burramine in Victoria, in 2020 as part of the Building resilient soils and enhancing carbon stocks in cropping systems through plant diversity and Plant based solutions to improve soil performance through rhizosphere modification initiative by Soil CRC, with the aim of improving soil health and soil water storage outcomes.

This project is funded by the Soil CRC and is an activity of the Long-term Trials of Drought Resilient Farming Practices program, funded by the Australian Government's Future Drought Fund.

NEXT GENERATION TOOLS TO SUPPORT HIGHER PERFORMING SOILS

TERM DATE: 2024–2027

This project aims to bring the past seven years of Soil CRC research effort in soil constraint modelling and analytics into the hands of growers and other agricultural decision makers. The project is focused on developing a suite of novel decision support tools designed to assist farmers and advisors in soil amelioration decisions, based on models and algorithms developed in previous research conducted by the Soil CRC.

Riverine Plains is involved in validation and testing, via an existing trial site at Rand, and will also be involved in workshop participation, to ensure tools are easy to use.

This project is funded through the Soil CRC.

LONG-TERM TRIALS OF DROUGHT RESILIENT FARMING PRACTICES IN VICTORIA

TERM DATE: 2024–2026

This project is investigating innovative cropping, grazing and mixed farming practices through the lens of drought resilience and associated risk management. The project supports the trialling and demonstration of practices that have the potential to contribute to drought resilience related to on-farm productivity and natural capital. As part of this project Riverine Plains has established a trial site at Murchison, Victoria.

This project received funding from the Australian Government's Future Drought Fund, and is led by the University of Melbourne.

LONG-TERM TRIALS OF DROUGHT RESILIENT FARMING PRACTICES IN NSW

TERM DATE: 2024–2026

This project is investigating innovative farming practices that support drought resilience and associated risk management in New South Wales. The project supports the trialing and demonstration of practices that have the potential to contribute to drought resilience related to on-farm productivity and natural capital, with sites established at Corowa and Burrumbuttock in NSW.

This project is funded by the Australian Government's Future Drought Fund, through the Southern NSW Drought Resilience Adoption and Innovation Hub and is led by Charles Sturt University.

SOLUTIONS FOR EMISSIONS REDUCTION IN LIVESTOCK

TERM DATE: 2025–2027

Riverine Plains, in collaboration with the University of Melbourne, is conducting a six-month feeding trial on a commercial sheep property to evaluate two feed additives—Agolin and Polygain—both individually and in combination.

The trial is assessing impacts on enteric methane emissions, lamb growth rates and productivity, on-farm management implications and the potential for carbon project participation. Data will be collected using innovative technologies including in-paddock weight monitoring and methane measurement tools.

This project is supported by the Australian Government through funding from the Climate-Smart Agriculture Program under the Natural Heritage Trust, and is led by The University of Melbourne.

CARBON FARMING OUTREACH PROGRAM

TERM DATE: 2024–2026

The Carbon Farming Outreach Program is a national initiative providing independent information to farmers and land managers about carbon farming strategies. This project is supporting Riverine Plains' staff to deliver workshops to increase knowledge and skills on farm and land emissions, as well as carbon storage.

This project is funded by the Grower Group Alliance of Western Australia (GGA Inc) through the Australian Government's Department of Climate Change, Energy, the Environment and Water.

COMPANION CROPPING LEGUMES FOR LOWER COST NITROGEN SUPPLY IN FARMING SYSTEMS

TERM DATE: 2024–2027

Grain growers are increasingly reliant on inorganic fertiliser nitrogen for crop production and are looking at innovative ways of reducing synthetic nitrogen inputs. Incorporating legumes can help farmers add nitrogen to the soil that can be taken up by subsequent non-leguminous crops.

This project is testing nitrogen fixation in companion cropping scenarios at different desiccation timings, to establish the impact on the non-leguminous crop. It is also testing the nitrogen-fixating contribution to the farming system, as well as the costs associated with sowing and desiccation.

This project is an investment of the GRDC.

OPTIMISING SLUG MANAGEMENT

TERM DATE: 2024–2026

Slugs are becoming an increasingly difficult to manage problem across the Riverine Plains. This project involves the monthly monitoring of slug populations in dryland and irrigated paddocks located in NSW and Victoria, as well as the design and establishment of annual spring baiting trials, including non-chemical treatments, in collaboration with SARDI. Extension events and activities will support farmers in better understanding and managing their slug populations

This project is an investment of the GRDC.

HYPER PROFITABLE CROPS

TERM DATE: 2024–2027

The Hyper profitable crops (HPC) project initiative aims to boost on-farm profitability for wheat and barley growers in Australia's high rainfall zones by bridging the gap between current crop yields and their full profitability potential.

The project builds on the successes of previous GRDC Hyper yielding crops and Hyper yielding cereals work. Its focus is on closing the yield gap through informed decisions on variety selection, sowing dates, fertiliser use, and disease management.

This project is an investment of the GRDC and is led by FAR Australia.

FARM DATA: LOCAL WEATHER DATA FOR IMPROVED DECISION MAKING

TERM DATE: 2024–2026

This project is exploring how farm weather and soil moisture data can support improved decision making on-farm, increasing farm business resilience and farmers' ability to prepare and adapt to changing climate conditions.

This project received funding through the Victoria Drought Resilience Adoption and Innovation Hub.

CURRENT PROJECTS

RISKWI$E: ENTERPRISE FINANCIAL DECISIONS

TERM DATE: 2024–2028

Grain growers are continually making decisions, ranging from strategic, to tactical, to the day-to-day. Decisions are made within a continually changing operating environment and this project is helping to better understand the processes, considerations, distractions and stresses that can manifest during the decision-making process

This project is an investment of the GRDC and is part of the larger GRDC RiskWi$e program, which aims to increasing farmers' confidence in managing risks inherent to decision making in their businesses.

LINK BETWEEN CEREAL STUBBLE, SUBSURFACE ACIDITY AND CROWN ROT

TERM DATE: 2023–2026

Sampling conducted as part of a previous project identified high levels of Fusarium crown rot at sites with high stubble loads and subsurface acidity across the Riverine Plains. The build-up of Fusarium crown rot has likely been favoured by recent consecutive good seasons, along with stubble retention and tight cereal rotations in the region.

This project is investigating the potential link between Fusarium crown rot, subsoil acidity and stubble management techniques through demonstrations, surveys and trials to help farmers mitigate yield loss.

This project is an investment of the GRDC.

PACKAGING SOIL CRC TOOLS TO ENHANCE THE ADOPTION OF IMPROVED SOIL MANAGEMENT PRACTICES

TERM DATE: 2023–2026

The Soil CRC has delivered learnings and outcomes that support grower groups, advisors and extension officers to extend soil management information to farmers.

As part of this project, Riverine Plains and other grower groups are designing and testing extension packages that improve project delivery, resulting in better engagement and improved adoption of outcomes from all Soil CRC projects.

This project is funded by the Soil CRC.

ORGANIC FERTILISERS FOR CROP NUTRITION

TERM DATE: 2022–2026

In partnership with FAR Australia, this project is looking at the value of faba bean stubble with and without organic manures in restoring fertility and increasing yield in the following wheat crop. The impact of two different timings of nitrogen application on the faba crop in the subsequent wheat crop will also be assessed.

This project is an investment of the GRDC.

BUILDING SOIL RESILIENCE AND CARBON THROUGH PLANT DIVERSITY

TERM DATE: 2023–2026

This project, led by Southern Cross University, follows on from the 'Plant based solutions to improve soil performance' project. The project continues to investigate changes in soil function, resilience and carbon stocks under a range of agronomic practices that incorporate plant diversity in cropping systems.

The project also investigates how much carbon from rhizo-deposits from cover crop and intercrop species is stabilised in soil and its contribution to soil aggregation.

This project is funded by the Soil CRC.

COMMERCIALISING THE PENETROMETER

TERM DATE: 2023–2026

A previous Soil CRC Smart Soil Sensors project led to the development of the 'Smart Penetrometer'. Once completed, this farm-ready tool will be able to simultaneously measure soil moisture, penetration resistance (compaction) and salinity while being driven into the soil.

Riverine Plains is providing technical guidance to the project and will participate in the testing of this tool, once ready.

This project is funded by the Soil CRC.

VICTORIA DROUGHT RESILIENCE ADOPTION AND INNOVATION HUB

TERM DATE: 2021–2027

The Victoria Drought Resilience, Adoption, and Innovation Hub is led by the University of Melbourne's Dookie Campus and is conducted in association with Deakin, La Trobe, and Federation University and Agriculture Victoria.

Riverine Plains leads the Northeast Victoria "Node", consulting the agricultural industry through farmers, councils, businesses, health organisations, and community groups in their region about building drought resilience at the local level. This process has led to the development of pilot projects to address specific knowledge or technical skill gaps identified through the hubs, capacity building and the brokering of knowledge between nodes.

This project is funded through the Australian Government's Future Drought Fund.

SOUTHERN NSW DROUGHT RESILIENCE ADOPTION AND INNOVATION HUB

TERM DATE: 2022–2026

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

The outcome of this partnership is user-driven innovation, research and adoption and the facilitation of transformational change through the co-design of research, development, extension, adoption, and commercialisation activities.

This project is funded through the Australian Government's Future Drought Fund.

REWARDING SOIL STEWARDSHIP

TERM DATE: 2022–2026

This project, led by Charles Sturt University, configured, trialed and evaluated novel financial mechanisms to reward soil stewardship.

The project is working to improve connections among soil scientists, growers and the finance sectors and review the benefits, costs and uncertainties related to different soil stewardship practices, as well as the available returns from different markets/sources.

This project is funded by the Soil CRC.

COMPLETED PROJECTS

Projects that concluded during 2025

SMALL FARM DAM SUITABILITY ASSESSMENT

TERM DATE: 2022–2025

This project was led by Southern Farming Systems and aims to create a spatial tool to rapidly calculate the likely runoff (frequency and volume under current future climate scenarios) into existing farm dams to help prepare, cope, and recover from drought. This type of calculator does not exist, with current approaches designed for flood rather than drought planning.

This project is funded by the Australian Government's Future Drought Fund.

MACHINE LEARNING FOR MANAGING SOIL CONSTRAINTS

TERM DATE: 2023–2025

This project aimed to find the best ways to manage multiple soil constraints such as sodicity, acidity, and salinity to help farmers make informed soil management decisions to maximise productivity and profitability.

The project used data and a computer-based approach to predict which management and amelioration practices will work best for a particular soil, to enhance soil productivity and profitability for farmers.

This project was funded by the Soil CRC.

ASSESSING SOIL WATER STORAGE

TERM DATE: 2022–2025

This project aimed to improve the understanding of crop access to water and resources. Through installation of field sensors, the project quantified changes in soil water infiltration, storage, drainage, and crop interaction, due to the diagnosis and management of soil constraints at an existing Soil CRC project site at Burramine. This allowed the development of tools supporting soil management for increased access to soil water and gave a better understanding of the competition for water and resources between mixed species cover crops and impacts on soil water availability.

This project was funded by the Soil CRC.

SCOUT: RAINSTICK – IMPROVING CANOLA ESTABLISHMENT

TERM DATE: 2024–2025

Riverine Plains supported novel bioelectrical technology startup, Rainstick, through early-stage problem and market validation. This technology has the potential to increase crop resilience through increasingly variable climate conditions, including unfavorable sowing conditions.

Rainstick merges First Nations knowledge with modern bioelectrics to enhance sustainable agriculture. The company focuses on using electricity to improve crop yield. Their key technology, the Variable Electric Field (VEF) treatment, mimics the natural effects of lightning, which has been traditionally associated with boosting plant growth.

This project was funded by the Victorian Drought Resilience Adoption and Innovation Hub and the Riverine Plains SCOUT program.

BUILDING SOIL CARBON THROUGH LAND MANAGEMENT STRATEGIES

TERM DATE: 2024–2025

This project supported NSW farmers in the Riverine Plains to explore their soil carbon potential and showcased eligible land management practices best suited for potential soil carbon projects.

The focus of the project was on understanding soil carbon in the Riverine Plains region and supporting farmers to develop strategies to increase or maintain soil carbon through effective land management techniques.

This project was supported by the Soil CRC as part of the 'Soil Carbon Capacity Building Resources for Farmers and Advisors' project, supported by the NSW Government as part of the Primary Industries Productivity and Abatement Program.

NON-CHEMICAL SLUG CONTROL

TERM DATE: 2024–2025

This project provided information on key trends in the presence or absence of slugs on-farm, to inform future projects. The project aimed to understand the potential for non-chemical strategies for slug control, to help farmers avoid the significant costs associated with chemical control. In doing so, the project also aimed to increase business and system resilience, as well as sustainability.

This project was funded by the Australian Government's Future Drought Fund, through the Victoria Drought Resilience Adoption and Innovation Hub.

ON FARM WATER MANAGEMENT

TERM DATE: 2023–2025

Managing water effectively can minimise the impacts of drought on livestock, pastures, soil health, and natural assets, ultimately improving production during and after drought.

This project supported farmers in developing farm water management strategies to improve water quality, maintain livestock health, and preserve soil and natural assets. The project also supported landholders in developing farm water management plans to ensure their dams, tanks and waterways meet stock and domestic needs, especially during drought.

This was a Southern NSW Drought Resilience Adoption and Innovation Hub project, funded by the Australian Government's Future Drought Fund.

IRRIGATION DISCUSSION GROUPS

TERM DATE: 2023–2025

This project linked new and innovative research investments by GRDC with local farmer-driven groups to improve the adoption of practices that improve the efficiency and sustainability of irrigated crop production.

The project followed on from the Facilitated Action Learning Groups to support profitable irrigated farming project.

This project is an investment of the GRDC and was led by the Irrigation Farmers network.

DEMONSTRATING RYEGRASS CONTROL STRATEGIES

TERM DATE: 2023–2025

Cereals form a key part of the rotation for growers in the Riverine Plains region, with increased ryegrass numbers being observed in this phase due to limited control options. This has been exacerbated by poor trafficability in wet and waterlogged paddocks over recent years, with excessively wet conditions also impacting pre-emergent weed control for some product uses.

This GRDC National Grower Network project evaluated diverse ryegrass management strategies, with the aim of enhancing crop yield and combating herbicide resistance.

This project is an investment of the GRDC.

HELPING REGIONAL COMMUNITIES PREPARE FOR DROUGHT – GOULBURN COORDINATION

TERM DATES: 2023–2025

This project helped strengthen drought preparedness and drove local action in the Goulburn region through the coordination of Community Impact Program activities and evaluation administration.

This project was supported by FRRR through funding from through the Australian Government's Future Drought Fund.

RIVERINE PLAINS INNOVATION EXPO EVENTS

TERM DATES: 2023–2025

This project aimed to build depth of social connection and increase skills, knowledge and understanding of the risks posed by drought and climate change by delivering Innovation Expo and In-season Update events, awareness and education activities from 2023-2025.

This project was supported by FRRR through funding from the Australian Government's Future Drought Fund. The Riverine Plains 2023 Innovation Expo was also supported by; Alvan Blanch Australia, Uncle Tobys, Bayer Crop Science, New Edge Microbials, GRDC, Australian Grain Technologies, ANZ, Thera Capital Management, Wiesners, Goldacres, AgriFutures Australia, Agriculture Victoria and Moira Shire.

LADIES' LUNCHEON

TERM DATES: 2023–2025

This project built depth of social connection, a shared sense of purpose and longer-term community belonging that can be drawn upon in future drought by hosting Ladies' Lunches in 2023 and 2025. The lunches celebrated the role and achievements of rural women in the Riverine Plains region, reducing social isolation and building local networks and social supports for women in this remote region.

This project was supported by FRRR through funding from the Australian Government's Future Drought Fund. The 2023 Ladies Luncheon was also supported by Riverine Plains Project Partner, Grain Growers.

YOUTH IN AG

TERM: 2023–2025

This project built depth of social connection, a shared sense of purpose and longer-term community belonging that can be drawn upon in future drought through the facilitation of two mentoring and networking events for youth in the region and two 'Youth in Ag' dinner events.

This project was supported by FRRR through funding from the Australian Government's Future Drought Fund. The 2023 and 2024 Youth in Ag Program was also supported by Riverine Plains Youth in Ag Program partners, Corteva Agriscience and Elders Rural Services, Elders Shepparton, Elders Yarrawonga, Elders Albury.

BEST PRACTICE LIMING

TERM DATE: 2021–2025

This project aimed to increase awareness of the speed of acidification and stratification of soils in the region and the availability of tools to assist in the management decision process.

It involved a replicated lime treatment field trial at Lilliput, Victoria, which demonstrated best practice liming methods and how the incorporation of top-dressed lime can improve its distribution down the soil profile, lessening the impacts of soil acidity on subsequent crops.

This project is an investment of the GRDC.

SOIL EXTENSION ACTIVITIES

TERM DATE: 2023–2025

The project aimed to give farmers a better understanding of their soils and how soils can be managed to improve production and water retention. This project supported land managers by promoting the benefits of increased frequency of extensive soil sampling and testing to inform soil management decisions and take action to improve soil health.

This project was funded by the Australian Government through the National Landcare Program Smart Farms Small Grants initiative. This project was co-funded by the GRDC.

SUPPORTING GREENHOUSE GAS INVENTORIES AND LIVESTOCK DATA DEVELOPMENT IN FIJI

TERM DATE: 2023–2025

Riverine Plains supported the delivery of an international research project in Fiji, funded by the Australian Centre for International Agricultural Research (ACIAR). This project was the first of its kind for Riverine Plains and focused on National Inventory (greenhouse-gas accounting) and livestock data development in Fiji.

The project aimed to co-develop an improved measurement, reporting and verification system for livestock in Fiji. This project is one way Australia is supporting Pacific Island Countries meet the larger commitment of 'Net-Zero by 2050' under the Paris Agreement.

DE-RISKING EARLY SOWN CROPS

TERM DATE: 2023–2025

Dry and early sowing of cereal crops is a practice commonly used by farmers in southern Australia to combat erratic and late opening season rainfall, and to effectively manage the sowing program on increasingly large farms.

This collaborative project aimed to enhance the adoption of strategic dry sowing crop management techniques to help farmers reduce their production risk and better manage increasingly large sowing programs.

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

THE 2025 YEAR IN REVIEW: SEASONAL CONDITIONS AND KEY EVENTS

KEY MESSAGES

- **March rain allowed early-sown April crops to establish, with crops dry-sown during the traditional sowing window emerging after rain in May.**
- **Late-winter rain, backed by carry-over reserve subsoil moisture and a late October rain, supported grain production.**
- **Many crops yielded above expectations, with barley a standout.**
- **Livestock generally did well, despite the day-to-day labour demands of feeding and watering stock.**

2024/2025 SUMMER RAINFALL

While the 2024 harvest was interrupted by wet conditions, January–February 2025 rainfall across the Riverine Plains was generally decile 3–6, with the Bureau of Meteorology (BoM) reporting Victoria's averaged summer rainfall was 22% below the 1961–1990 average — the driest Victorian summer since 2013–14. South east NSW generally held up better, thanks to summer storm events, with January–February rainfall decile 6 at Albury and decile 6–8 at Culcairn (Table 2). This meant surface soil moisture was low heading into autumn.

AUTUMN SOWING CONDITIONS

Autumn opened with a mid-March rain, with rainfall well above average at most locations (deciles 7–9). This was useful for farmers prepared to risk an early April sowing, with biomass accumulation in early crops providing grazing opportunities and maximising the growth period for winter-type cereals and canola. Some early crops suffered moisture stress from the lack of follow-up rain post emergence.

The season then tightened quickly, with April rainfall very low almost everywhere (deciles 1–2). May was mostly below average, particularly in north-east Victoria (Miepoll and Dookie, decile 1), with several farmers observing that it "didn't really rain until May" in some areas. In southern NSW, May rainfall was mostly decile 4–5.

Often, dry-sown crops sat for several weeks before May rains triggered germination, highlighting the success of dry-sowing as a risk management strategy, assuming rules of thumb were followed. However, pockets of moisture in some paddocks caused staggered germination, especially in canola, complicating in-crop operations.

WINTER–SPRING CONDITIONS

July rainfall was mostly near-average (deciles 5–7), supporting mid-winter growth, however some locations remained drier, including Miepoll and Urana. In August, most sites across the Riverine Plains recorded decile 2–3 rainfall.

September brought a small lift in rainfall and farmer optimism, with most locations at decile 3–4. Dookie remained below average (decile 2), while conditions were comparatively better at Lockhart (decile 5).

Decile 2–3 rainfall during October kept spring on the dry side. However, late October rains proved season-saving for many, with wheat better able to capitalise than barley, which had already finished filling.

Although disease pressure was low overall, there were reports of unexpectedly high levels of crown rot, sclerotinia and black leg, especially in southern NSW.

Frost damage, although reported, was not widespread. Had a spring frost event occurred, it's likely that many early crops would have risked yield loss.

A relatively dry spring and early October allowed hay crops to cure quickly, meaning quality was generally higher than the previous year.

Farmer feedback highlighted late-winter rainfall as a key turning point, helping shift paddocks from low confidence to a harvestable outcome and validating major decisions, including taking crops through to grain rather than cutting for hay.

SLUGS

A Riverine Plains trial showed that slug damage in 2025 was lower than in 2024 in the irrigated wheat and canola crops, but slug numbers were higher in barley in spring. The higher spring slug pressure in barley was likely driven by earlier canopy closure and higher soil moisture, which created a cooler, wetter microclimate than wheat and canola, and lined up with the main spring breeding period.

BETTER-THAN-EXPECTED HARVEST

Excepting early rain in November, harvest was mostly dry, allowing farmers to complete harvest quickly. December rainfall was patchy, driven by highly localised storms which delivered 10–60 mm over short distances. High winds were frequent, leading to harvest interruptions, as well as windrow losses. There were also numerous reports of header fires, which spread quickly in the windy weather.

Despite very low rainfall (decile 1–2), growers noted crop performance was largely carried by reserve subsoil moisture from the previous year, topped up by timely late-winter rain. Many paddocks achieved yields well above the French and Schultz benchmark (Table 1), consistent with crops drawing on subsoil reserves during grain fill and likely benefiting from milder spring conditions. This matches the Yarrawonga 30-day average temperature pattern which showed that summer–autumn was warmer than normal, while winter–spring tracked close to the long-term average, reducing heat stress and slowing moisture loss during key growth stages, and grain fill (Figure 1).

Barley was a stand-out in 2025, with its shorter growing season likely giving it an advantage over other cereals.

Table 1 Potential yield at decile 5 at various locations across the Riverine Plains as predicted in October, 2025

	Miepoll	Rutherglen	Dookie	Yarrawonga	Cobram	Albury	Culcairn	Corowa	Lockhart	Urana
Wheat (t/ha) – Decile 5	2.6	3.8	2.5	3.4	2.4	5.0	3.3	4.2	2.6	2.1
Canola (t/ha) – Decile 5	1.3	1.9	1.3	1.7	1.2	2.5	1.7	2.1	1.3	1.0

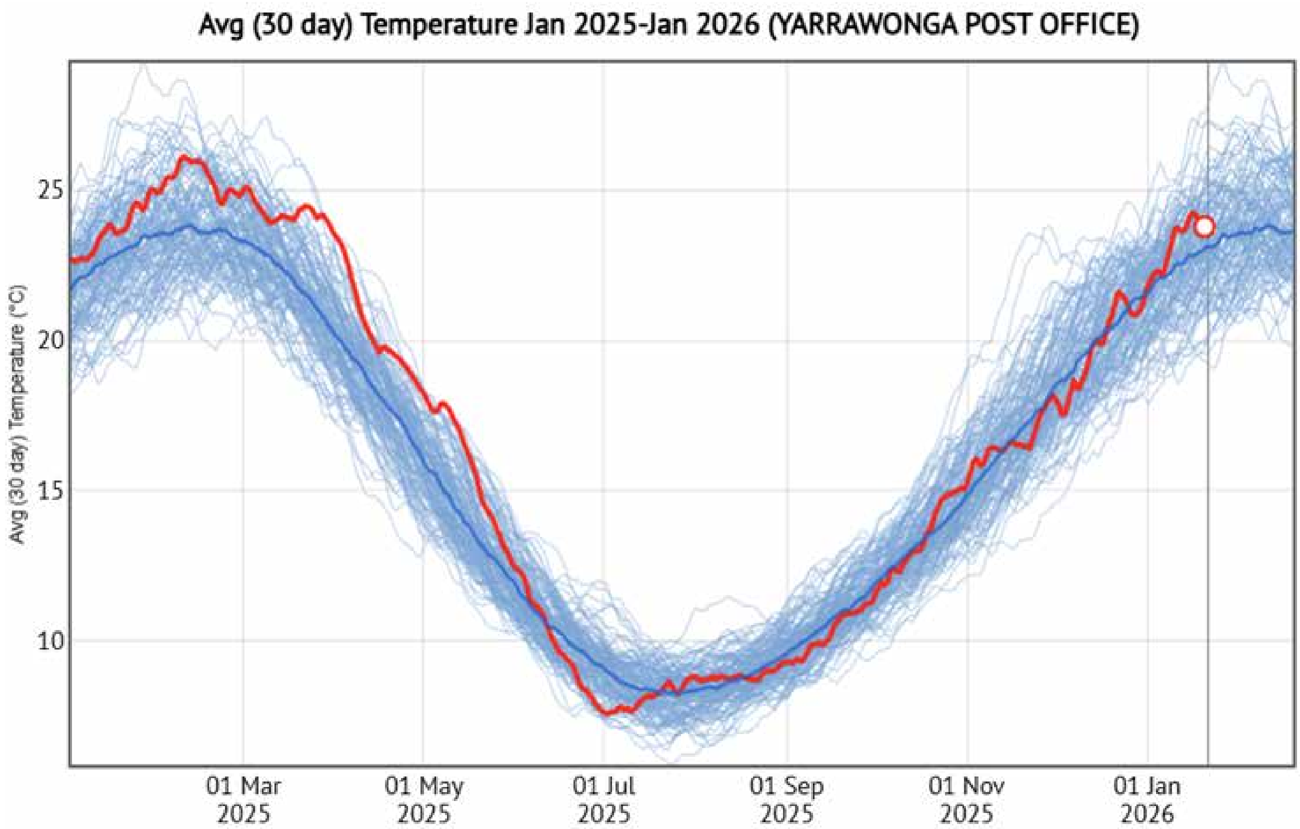


Figure 1 Yarrawonga 30-day average temperatures (°C), January 2025–January 2026 (red), compared with the long-term average (1990–present; bold blue); thin blue lines show individual past years and the historical range. (source CliMate, 2026)

LIVESTOCK

Livestock producers began supplementary feeding early in the season, and although there were short breaks, this mostly continued through the year. Dual-purpose, long season cereal and canola varieties helped fill the early feed gap, performing well when sown after the mid-March rains, providing they had access to follow-up moisture. Sheep producers looked to off-load underperforming stock and weaned early, to preserve ewe health and maximise available feed and pasture resources.

Farmers continued to increase their use of containment feeding areas, with nutritionists helping to develop cost-effective feeding and supplementation strategies.

The dry spring saw dams begin to dry out, with tanks and troughs supporting delivery of clean water to stock. Many farmers took this opportunity to clean out dams.

Livestock prices remained solid, with many farmers reporting good returns despite continuous feeding and low dam levels.

Table 2 Monthly rainfall and deciles (Dec) for various locations across the Riverine Plains, 2025

	Miepoll	Dec	Rutherglen	Dec	Dookie	Dec	Yarrawonga	Dec	Cobram	Dec
January	9	3	21	4	12	3	19	5	10	4
February	4	3	10	3	12	4	8	3	4	3
March	47	8	58	8	52	8	55	9	46	8
April	7	2	3	1	1	1	6	2	3	1
May	4	1	27	3	9	1	23	4	19	3
June	47	5	63	6	42	4	63	7	44	6
July	42	4	58	6	49	5	41	6	40	6
August	27	3	18	2	22	2	22	2	15	2
September	22	3	33	4	16	2	29	4	22	3
October	31	4	15	2	29	3	13	2	9	2
November	28	5	38	5	33	5	31	5	14	3
December	24	5	17	4	23	5	28	6	31	6
Year (Jan-Dec)	292	1	362	1	300	1	338	2	257	1

	Albury	Dec	Culcairn	Dec	Corowa	Dec	Lockhart	Dec	Urana	Dec
January	45	6	29	6	14	4	24	6	11	3
February	34	6	52	8	23	6	15	5	3	2
March	55	7	34	6	56	8	31	6	43	7
April	7	2	6	1	6	2	3	1	11	3
May	33	4	36	5	31	4	27	5	26	5
June	58	4	42	4	59	6	38	5	29	4
July	70	6	48	5	62	7	36	5	20	3
August	44	3	22	2	27	2	16	2	19	3
September	36	3	20	4	38	4	30	5	24	4
October	26	3	16	2	18	2	11	2	10	2
November	31	4	19	3	22	4	26	5	15	4
December	57	8	54	7	38	6	25	5	16	5
Year (Jan-Dec)	496	2	377	1	395	2	282	1	227	1

Dec = decile

Rainfall totals sourced from Bureau of Meteorology, ClimateARM Riverine Plains and Dookie Land Management Group on-farm weather stations.

RAIN AND TEMPERATURE

Overall, 2025 rainfall was below average to very much below average across southeast New South Wales and north east Victoria (Figure 2a, 2b).

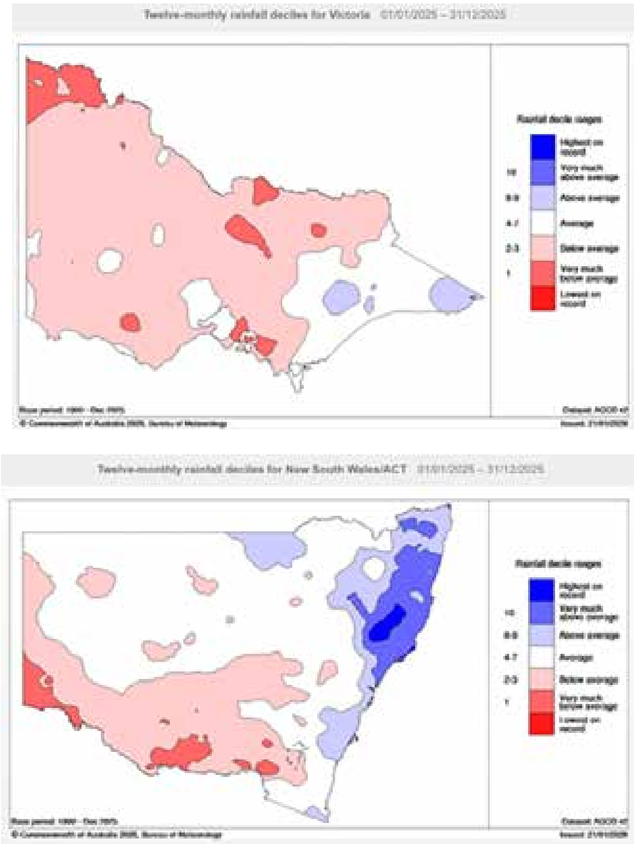


Figure 2a and 2b Full year rainfall deciles across Victoria and NSW during 2025 (source BoM, 2026)

Last year was the fifth-warmest year for NSW since records began in 1910, with an annual mean temperature 1.49 °C above the 1961–1990 average. Victoria recorded its eighth-warmest year since 1910, with an annual mean temperature 0.94 °C above the 1961–1990 average.

SUMMARY

The 2025 season was driven by below-average rainfall and a warm background, with outcomes largely determined by rainfall timing and access to stored moisture at depth. Winter–spring rainfall was uneven with late-winter rain reported as the turning point that restored confidence to take crops through to grain. Despite limited "filling rain", many paddocks yielded above French and Schultz benchmarks, likely supported by reserve subsoil moisture and moderated spring lower drying conditions.

Author: Peter Chen, Riverine Plains

Email: peter@riverineplains.org.au

TRIAL RESULTS

SCOUT FOR THE RIVERINE PLAINS: RENNIE TRIAL BLOCK UPDATE

KEY MESSAGES

- **Not all agtech is created equal and Riverine Plains is keen to explore what happens when it's put to the test in the paddock.**
- **In 2025, Riverine Plains established the SCOUT trial block at Rennie, NSW, to find out what actually stacks up in terms of new technologies.**
- **We hosted a malt barley variety trial, bioelectrical seed treatment, and a microbial Olympics, all while building the trial skills and protocols to improve our knowledge and ask the right questions.**

RAINSTICK

Since 2024, Riverine Plains has been working with novel technology startup, Rainstick, to scale up their variable electric field technology (VEFT). Initially we delivered this through the SCOUT: Rainstick—Improving canola establishment project, supported by the Victoria Drought Resilience Adoption and Innovation Hub, before establishing a small-plot trial in conjunction with Rainstick at Rennie in 2025.

This technology, which mimics the effect of lightning, merges First Nations knowledge with modern bioelectrics to enhance seed germination, with a focus on boosting plant establishment and growth to improve crop yield.

This trial involved applying Rainstick treatments to a selection of canola varieties adapted to the region. While this technology has been successful under lab conditions, including in horticultural crops, this was the first time the technology had been evaluated on canola in the field.

These results will be used to inform further research on whether VEFT can improve canola establishment under challenging environmental conditions.

MICROBIAL OLYMPICS

Microbial products are one of the most exciting and most difficult frontiers in modern agronomy.

Unlike a herbicide or fertiliser, you can't see a microbe working. The biological processes involved are invisible to the naked eye, highly sensitive to soil temperature, moisture, pH, and existing microbial populations, and can vary dramatically across a paddock, as well as from paddock to paddock and from season to season.

That variability makes trialling microbial products genuinely complex: a result that holds in one soil type may not translate next door, let alone across a catchment. Also add to that the challenge of establishing a reliable baseline.

As a result, this trial was designed to ask two main questions: what does the microbial community in a paddock look like before you intervene, and how do you measure change meaningfully?

Riverine Plains is working through those questions methodically, building the measurement frameworks and trial rigour needed to give farmers confidence.

MALT BARLEY VARIETY TRIAL

In 2025, Riverine Plains also delivered a trial with Malteurop, comparing 20 barley varieties under local conditions, to better understand how disease management and nutrition interact with varietal genetics to influence grain yield and malting-related quality traits.

Results from this replicated variety trial are presented on the following pages.

SUMMARY OF THE RENNIE SMALL PLOT TRIALS

Riverine Plains is continuing to investigate a range of new technologies that could have practical applications for farmers, while also developing trial protocols so that their potential can be realised earlier.

For more information about our trials program, please contact Riverine Plains' Head of Farming Systems, Jane McInnes, by emailing jane@riverineplains.org.au.

MALT BARLEY PERFORMANCE IN THE RIVERINE PLAINS: RESULTS FROM THE 2025 TRIAL AT RENNIE

KEY MESSAGES

- **Dry and variable conditions limited yield potential and elevated grain protein across most entries in a malt and malt-potential barley variety trial at Rennie during 2025.**
- **Two in-season fungicide applications reduced visible foliar disease symptoms, however, yield and grain quality responses were small, highlighting the importance of varietal resistance under moisture-limited conditions.**
- **High screenings observed across most varieties highlighted that there was insufficient moisture to fill grain.**
- **Nitrogen supply was high relative to yield potential (total ~130 kg N/ha from urea + (MAP), with excess nitrogen going to protein as a result of the unrealised yield potential.**

BACKGROUND

For barley, malt versus feed grade outcomes often remain uncertain until harvest. Price spreads between these grades can make variety choice difficult and result in "high-risk" in-season nitrogen timing and disease management decisions, particularly in seasons with short finishes.

A 2025 Riverine Plains trial, delivered with Malteurop and monitored by Eurofins Kalyx, compared 20 barley varieties under local conditions, to better understand how disease management and nutrition interact with varietal genetics to influence grain yield and malting-related quality traits.

AIM

To benchmark the yield and grain quality of 20 malt and malting-potential barley varieties and assess the impact of an in-season fungicide program under conditions experienced in the Riverine Plains.

Table 1 Trial management summary for Barley trial.

ITEM	DETAILS
Location	Riverine Plains' trial site, Rennie, NSW
Sowing date	3 June 2025 (direct drilled at ~40 mm depth)
Harvest	25–26 November, 2025
Design	Randomised complete block design; 4 replicates x20 varieties
Disease management factor	Replicates 1–3 received two fungicide sprays; replicate 4 received nil in-season fungicide. Note: seed was treated with Systiva® prior to sowing to ensure consistent establishment protection.
Nutrition	MAP + Impact® 80 kg/ha at sowing; urea 80 kg/ha at GS25 (15 August) and 100 kg/ha at GS32 (1 September); total urea 260 kg/ha (~120 kg N/ha) plus MAP (~10 kg N/ha).
Weed management	Pre-sowing: glyphosate + Boxer Gold® + Sharpen® + Hasten®; in-crop: Mateno Complete® (31 July, GS23).
Growing season rainfall (GSR)	160 mm measured at the GoannaAg weather station, Coreen. Rainfall was sporadic with the largest event (~22mm) on 10 September.

Barley variety trial at the Riverine Plains Rennie NSW trial site, 26 June 2025

RESULTS AND DISCUSSION

The main objective of this trial was to assess barley varieties in terms of their ability to achieve malt-grade specifications—with yield outcomes a secondary measure—under conditions typical of the Riverine Plains (Table 1).

During 2025, growing season rainfall (160 mm) was sporadic, meaning crops experienced periods of moisture deficit. At this site, rainfall amount and timing, combined with genetic differences in the barley varieties tested, were the main drivers of yield performance.

All commercially available varieties were sown within their optimal sowing window (first week of June), which provided favourable conditions for establishment to maximise yield potential.

ESTABLISHMENT

Plant establishment averaged 108 plants/m^2 across varieties (range 91–127 plants/m^2). The site was sown at 80kg/ha, so this represents an establishment rate of 61 percent, which is regarded as low compared to the benchmark 80 percent. The reason behind the poor establishment is unclear, with potential variables including soil nutrition, timing, soil moisture and size possibly at play.

Plants emerged between 10–14 days after sowing and were consistent across all plots. Due to the dry start to the year, sowing took place on 3 June, making use of the 28 mm of mid May rainfall. Post sowing, the site received 34 mm of follow-up rain to the end June.

GRAIN YIELD

Yield and grain quality

The 2025 growing season was characterised by dry spring conditions and a relatively cool finish, which likely contributed to the observed variability in yields. Varieties representing a range of maturities—Neo mid, Planet (mid, with elastic maturity), Spinnaker (early mid), and Maximus (quick–mid)—varied in their yields, with no clear trend based on maturity.

Yields ranged from 3.58 to 4.58 t/ha across varieties, with an overall mean of 4.12 t/ha (Figure 1). The least significant difference (LSD, P=0.05) for yield was 0.49 t/ha, with Neo CL yielding significantly more than RGT Planet, but not better than the other commercially available varieties RGT Asteroid, Spinnaker or Maximus CL. The numbered variety SCA25-Y007 yielded the most (4.59 t/ha) in this trial.

Paddock constraints identified through soil testing included an acidic layer at 5–15 cm depth and significant soil compaction below 60 mm. This, combined with low growing season rainfall, likely contributed to the yield variations seen in Figure 1.

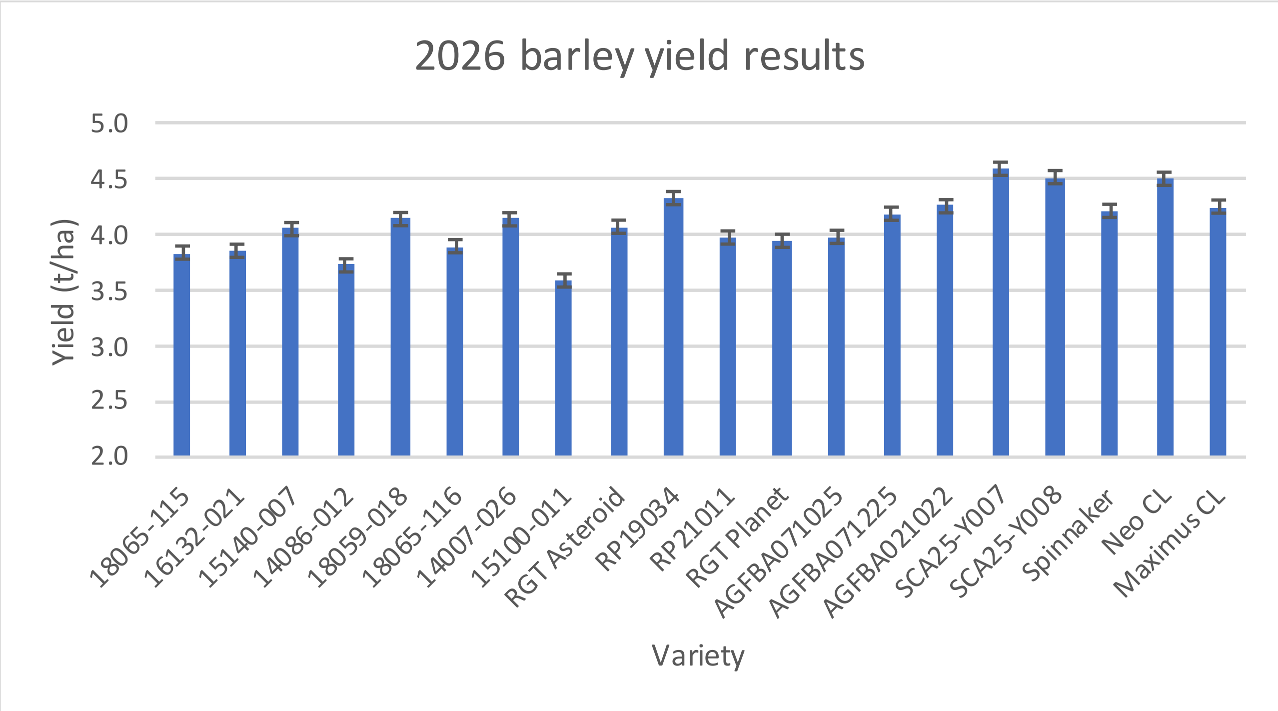


Figure 1 Grain yield (t/ha) of barley varieties at the Riverine Plains Rennie trial site in 2025. Mean of three replicates, LSD(P=.05) = 0.49 t/ha.

PROTEIN

Protein was generally high in 2025, consistent with a dry finish and a relatively high nitrogen program (Figure 2). Variety means ranged from 11.43–14.3 percent. LSD (P=0.05) for protein was 0.76 percent.

The elevated protein levels observed across the trial meant that all varieties exceeded minimum malt-grade specifications, which was attributed to consistent nitrogen applications.

Additionally, Colwell P concentrations (24–48 mg/kg in the 0–15 cm soil layer, and lower levels of 0–15 mg/kg at 15–30 cm depth), may have influenced protein accumulation. This is because sub-optimal phosphorus availability at depth can contribute to reduced yields, which can then increase grain protein concentration.

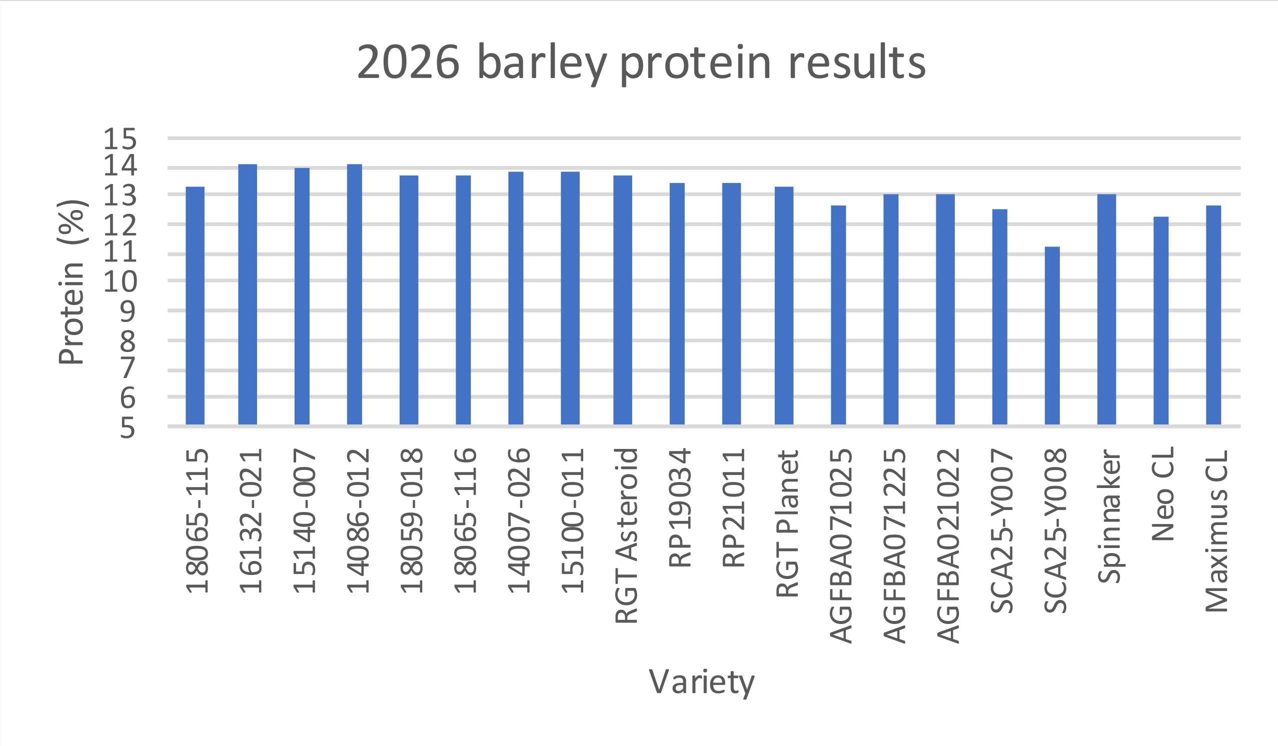


Figure 2 Grain protein (%) by barley varieties sown at the Riverine Plains trial site at Rennie, NSW, in 2025. Mean of three replicates, LSD (P=.05) = 0.86 percent

GRAIN SIZE (RETENTION AND SCREENINGS)

Screenings were variable across the trial, ranging from 5.9–32.8 percent (Figure 3), while retention (>2.5 mm) ranged from 30–87 percent (data not shown). The least significant difference (LSD; P = 0.05) was 8.0 percent for screenings and 16 percent for retention.

Elevated nitrogen application rates, combined with low in-season rainfall likely contributed to increased screenings across most varieties at harvest. Based on the Malt 1 classification threshold of ≤7% screenings, only the variety Maximus CL met this specification, highlighting the benefits of matching a quicker variety with an early June sowing.

These findings highlight the challenge of matching nitrogen to expected yields in a moisture-limited season.

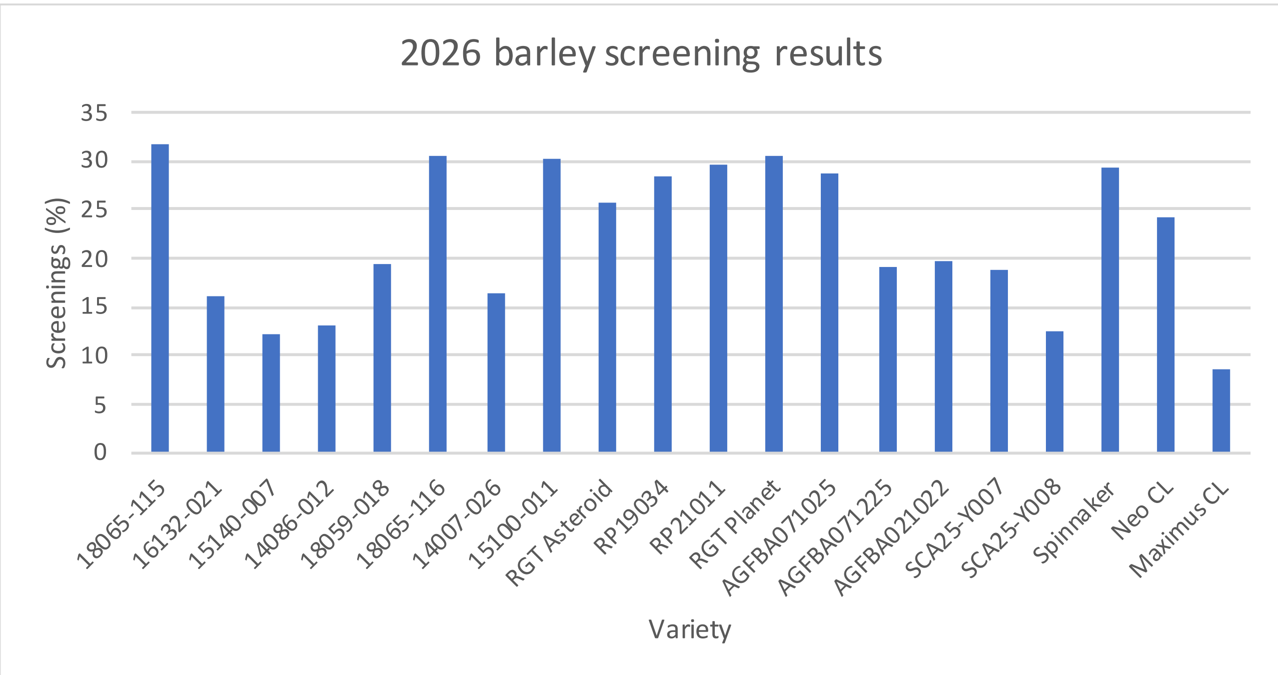


Figure 3 Screenings (%) by variety (means across three replicates). LSD (P=0.05) = 8.01%.

DISEASE

The net form and spot form of net blotch, as well as scald, were observed mid-season following rainfall events. Disease scoring during late winter/early spring indicated higher pressure in the unsprayed replicate, while sprayed replicates had reduced symptoms, with disease seen primarily in the upper canopy.

In 2025, this reduction in disease did not consistently translate to higher yield or improved grain size, likely because limited moisture was a key driver of crop performance.

NDVI AND SOIL CONSTRAINTS

Multispectral imagery was collected on 24 July (GS20–29) prior to the first in-crop urea application, with results presented in Figure 4.

Normalized Difference Vegetation Index (NDVI) is a satellite-derived measure of green biomass and canopy vigour that provides an indication of crop growth and ground cover.

Maximus CL is generally better suited to low–medium rainfall environments and is a quick–mid maturity variety, whereas Neo CL is adapted to medium–high rainfall environments and has a mid–slow maturity. Observed differences in NDVI between these varieties may, in part, be influenced by their contrasting growth habits.

Further, Maximus CL exhibits a more erect growth habit, while Neo CL tends to be semi-prostrate. These structural differences in canopy architecture may affect how biomass is detected by satellite imagery. A more erect canopy (Maximus) may present less ground cover at certain growth stages compared to a semi-prostrate type (Neo), potentially leading to lower NDVI values despite comparable biomass production.

Consequently, varietal growth habit and plant architecture should be considered when interpreting NDVI at field scale.

NDVI results

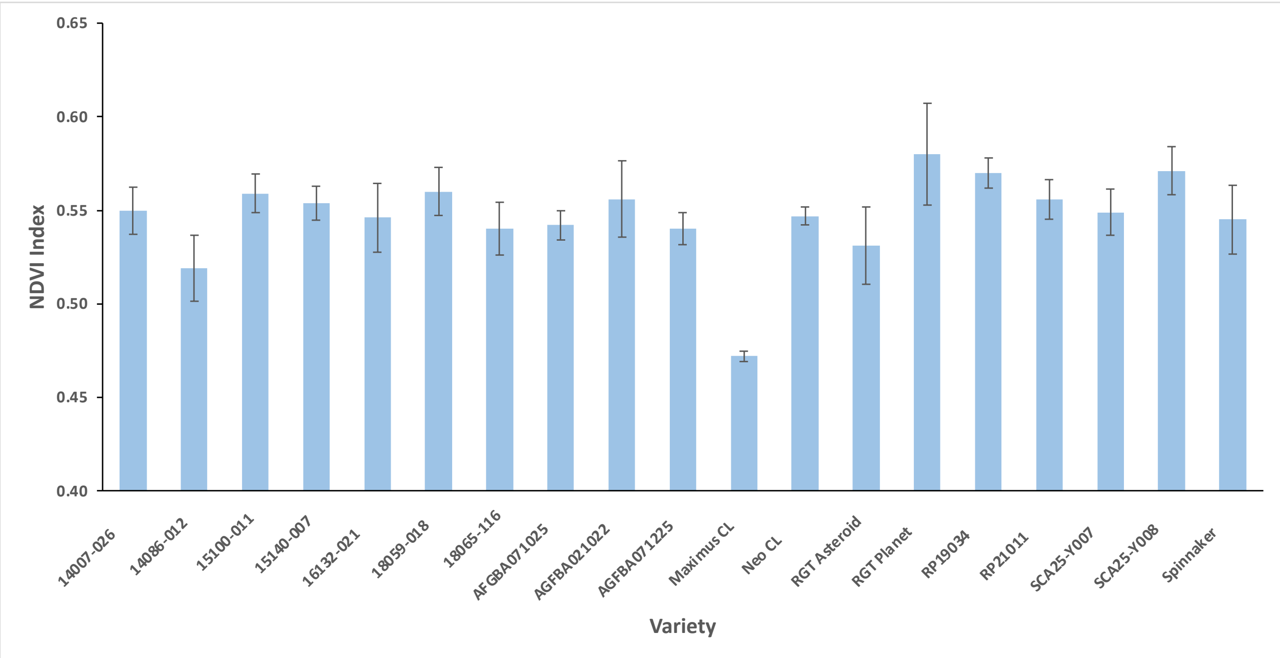


Figure 4 NDVI imagery values taken on 24 July (approximately GS20-29)

SOIL CONDITIONS

Pre-sowing soil testing identified sub-surface acidity in the 5–15 cm layer and visible shallow rooting/compaction constraints. While topsoil pH ($CaCl_2$) was generally within a suitable range, acidity at depth may have restricted rooting and access to stored moisture, contributing to within-site variability during a dry season.

CONCLUSIONS

To achieve malt 1 grade specifications, barley needs to achieve protein between 9–12 percent protein, screenings less than 7 percent and hectolitre weight greater than 70 kg/HL. Assessing against these requirements, none of the grain samples met the malt 1 standards.

Key messages from the trial were:

- 2025 conditions were moisture-limited, resulting in modest yields and generally elevated protein.
- Varieties differed significantly for yield, protein, test weight and grain size. These differences provide a useful shortlist for further local evaluation
- Fungicide reduced foliar disease, but yield and grain quality benefits were small in 2025. In seasons with higher yield potential, or earlier disease onset, responses may be larger.
- Future work will focus on refining nitrogen strategies (rate and timing) to better match seasonal yield potential and improve the probability of meeting malting specifications, alongside continued benchmarking of varietal disease resistance.

ACKNOWLEDGEMENTS

Riverine Plains thanks Malteurop for funding the trial collaboration and Eurofins Kalyx for trial operations and analysis. Thank you to Bull Plain Farms (Rennie, NSW) for providing the site and support throughout the season.

Author: Matthew de Roos, Riverine Plains

Email: matthew@riverineplains.org.au

COMPANION CROPPING LEGUMES FOR LOWER-COST NITROGEN SUPPLY: RESULTS FROM THE SANGER REPLICATED TRIALS

KEY MESSAGES

- **Growing wheat with vetch increased soil nitrogen in 2025, particularly under low nitrogen input conditions. However, lack of moisture in 2025 limited crop growth, so the extra nitrogen fixed by the vetch did not translate into higher wheat yields compared to wheat on its own.**
- **Termination timing of vetch is critical: an early September termination minimised competition for water and nutrients and maintained wheat yield, while a mid-October termination increased competition and reduced wheat yield.**
- **Higher yield did not necessarily result in higher grain protein, highlighting that both nitrogen availability and seasonal moisture determine grain quality.**
- **Companion cropping vetch and wheat can improve soil nitrogen status, but cereal performance depends on seasonal rainfall and careful management of legume termination timing.**
- **Despite a late June sowing and decile 1 growing season rainfall in 2025, vetch yielded 0.26 and 0.36 t/ha under low and high nitrogen conditions respectively, reflecting well on its performance in challenging years.**

BACKGROUND

Nitrogen fertiliser is one of the biggest and most variable costs in grain farming systems. High prices and uncertain seasonal conditions increase the financial risk of applying large amounts of nitrogen early in the season. As a result, grain growers are increasingly looking for new ways to supply nitrogen more efficiently and at lower cost, while maintaining crop yield and profitability.

Legume intercropping is where two or more species are grown and harvested together. This practice has increased in popularity due to the ability of legumes to fix atmospheric nitrogen into plant available forms, offering opportunities to enhance soil nitrogen and reduce reliance on synthetic nitrogen fertilisers.

Companion cropping differs from intercropping in that the legume species (i.e. vetch) is terminated before it competes with the main crop for resources or reduces yield. In this system, the companion legume supports the main crop by fixing nitrogen, before being removed from the system. This practice, also referred to as temporary intercropping, has the potential to provide nitrogen benefits while maintaining the productivity of the main non-leguminous crop.

AIM

This project is testing the effects of different desiccation timings of companion legumes (vetch) on the non-leguminous crop, as well as the nitrogen fixation contribution to the farming system and the costs associated with sowing and desiccation.

METHOD

A replicated trial was originally established at Sanger, in southern NSW, in 2024, with the trial repeated in 2025. Treatments sown in 2025 were the same as 2024 (Table 1), except for the timing of nitrogen fertiliser application and vetch termination, which were adjusted due to late sowing caused by dry seasonal conditions. Vetch termination occurred at the same wheat growth stage as in 2024.

Soil sampling

Incremental deep soil nitrogen (DSN) sampling was conducted at depths of 0–10, 10–30, 30–60 and 60–90 cm in June 2025. This aimed to determine the impact of different vetch termination timings from 2024 on soil nitrogen levels and moisture, before the 2025 treatments were sown. Soil sampling was repeated at anthesis on 20 October.

Site preparation

The site was sown to Matador wheat at a rate of 60 kg/ha and Morava vetch at a rate of 40 kg/ha on 28 June 2025, using a plot seeder with a row spacing of 23 cm. Matador was chosen as it is slightly better suited to late sowing than Scepter (sown in 2024) and offers stronger resistance to crown rot and yellow leaf spot, reducing risk in stubble-retained paddocks. Seed was placed at a depth of 3 cm under approximately 60 percent stubble cover. Granular MAP was applied at 80 kg/ha as a starter fertiliser across all treatments. As in 2024, spreading in-crop granular urea proved challenging due to the dry conditions; therefore, liquid UAN was applied in September at a rate of 60 L/ha to the low-nitrogen treatments and 120 L/ha to the high-nitrogen treatments (Table 1).

For comparison, two additional buffer strips were added in 2025 to see how changing the wheat seeding rate to 40 kg/ha and 80 kg/ha affected vetch performance due to competition.

Vetch grown as a companion crop with wheat was terminated at different timings during August, September or October, depending on the treatment. Termination was achieved using Amicide Advance 700 (700 g/L 2,4-D present as the dimethylamine and monomethylamine salts), applied at a rate of 1.5 L/ha.

Wheat, as the main crop, was harvested on 6 December using a plot harvester, with wheat quality analysis also conducted. The vetch only (monoculture) treatments (high nitrogen and low nitrogen) were harvested on the same day as the wheat, to provide a baseline vetch yield.

Table 1 Treatment details for the Riverine Plains and GRDC wheat and vetch companion cropping trial at Sanger, 2025

TREATMENT	CROP	NITROGEN APPLIED EARLY SEPTEMBER	VETCH TERMINATION DATE
Wheat + low nitrogen	Wheat	UAN 60 L/ha	Nil
Wheat + high nitrogen	Wheat	UAN 120 L/ha	Nil
Vetch + low nitrogen	Vetch	UAN 60 L/ha	Nil – vetch taken to harvest
Vetch + high nitrogen	Vetch	UAN 120 L/ha	Nil – vetch taken to harvest
Companion crop terminated august	Wheat/vetch	UAN 60 L/ha	End August
Companion crop terminated september	Wheat/vetch	UAN 60 L/ha	Early September
Companion crop terminated early October	Wheat/vetch	UAN 60 L/ha	Early October
Companion crop terminated mid October	Wheat/vetch	UAN 60 L/ha	Mid- October
Companion crop terminated early October + high nitrogen	Wheat/vetch	UAN 120 L/ha	Early October

Field measurements

Crop establishment counts were conducted on 30 July 2025. Wheat and vetch biomass samples were collected before each vetch termination, then oven-dried for 48 hours at 70˚C to determine final dry matter. Nodulation scoring was conducted on 22 September at flowering, when nodules were fully formed and actively fixing nitrogen. Nodulation scoring was done only in the vetch terminated in early October + high nitrogen and vetch terminated in early October treatments, as the remaining companion cropping treatments had already been terminated. Harvest index was measured on 5 December to assess how efficiently the treatments converted total biomass into grain (data not presented).

RESULTS & DISCUSSION

Emergence

Although total summer rainfall (January–April) at the site was 79 mm in 2025, conditions remained dry from mid March to late May, which had the effect of delaying sowing to late June.

Wheat emergence ranged from 80 plants/m^2 in the straight wheat + high nitrogen treatment to 122 plants/m^2 in the companion crop terminated in mid-October treatment, with emergence in other treatments falling between the two (Table 2). However, emergence between these treatments was not statistically significant, with the higher establishment in the mid-October termination treatment likely due to paddock variability at sowing. For vetch, the highest emergence (79 plants/m^2) was observed in the straight vetch + high nitrogen treatment, while the lowest was in the straight vetch + low nitrogen treatment and companion treatment terminated early October (58 plants/m^2). Emergence in the companion treatments was similar, ranging between the two, with no significant difference in vetch emergence between treatments.

Vetch emergence is often lower when it is sown alongside wheat in companion cropping systems. This is because wheat has a strong early growth advantage, while vetch emergence is often lower due to hard seed coat dormancy, slower germination, and greater sensitivity to sowing depth.

Biomass

Biomass was measured for wheat and vetch in the companion cropping treatments only. There was an increase in mean biomass between July and October, reflecting the normal pattern of plant dry matter accumulation over the growing season (Table 2). Biomass for both wheat and vetch was low (0.30 t/ha and 0.02 t/ha respectively) in the companion crop terminated July treatment, which was in-line with its early termination and shortened growing season. Both wheat and vetch biomass was highest in the companion crop terminated mid October treatment (wheat: 4.35 t/ha and vetch: 0.57 t/ha), highlighting the rapid biomass accumulation that occurs during spring.

Despite higher crop emergence in 2025, wheat produced 34% less dry matter than in 2024 (average 1.73 t/ha in 2025 vs 2.63 t/ha in 2024). This decline aligns with lower in-crop rainfall in 2025 (172 mm), compared to 2024 (228 mm), indicating that moisture stress likely limited crop growth.

Nodulation

Nodulation was assessed on 22 September and was low overall in vetch, likely due to delayed sowing and dry spring conditions. Root examination showed moderate nodulation (5–20 nodules per plant; nodulation score 3) in the vetch + low N treatment and in both the low and high nitrogen companion cropping terminated in early October treatments.

In contrast, the vetch + high nitrogen treatment had low nodulation, averaging about 5 nodules per plant with a nodulation score of 2. In this treatment, some plants had no nodules or only a few small, ineffective nodules, indicating poor symbiotic performance (Table 2). This response is consistent with the well-established effect of high soil nitrogen suppressing biological nitrogen fixation—whereby legumes preferentially use readily available mineral nitrogen rather than investing energy in making their own—while low nitrogen conditions are more likely to encourage nitrogen fixation in properly inoculated legumes.

In the companion cropping treatments, wheat probably competed strongly for soil nitrogen, with its faster root growth and wider root distribution acting to reduce nitrogen concentration in the rhizosphere (the area surrounding the nodules). This in turn may have stimulated the vetch nodules to fix more nitrogen.

Interestingly, relatively higher nodulation scores and moderate nodule numbers were observed in the companion cropping + high nitrogen treatment, which appears contradictory to the general expectation that higher soil nitrogen suppresses nodulation. This may have been caused by relatively low initial (pre-sowing) soil nitrogen levels, which may have stimulated early nodulation before fertiliser nitrogen became available to the crop. Further, the nodulation assessment on 22 September corresponded to GS30–GS32 (stem elongation) when wheat is rapidly accumulating biomass and nitrogen demand is high. During this period, wheat likely competed strongly for available soil nitrogen, potentially reducing nitrogen availability to vetch in the rhizosphere. As a result, vetch may have increased nodulation to compensate for limited nitrogen access.

Based on the rule of thumb that legumes can fix 20 kg N/ha per tonne of dry matter produced, the amount of nitrogen fixed in the companion cropped vetch was estimated to be between 1.4 kg N/ha and 11.2 kg N/ha, depending on the timing of termination (Table 2).

Example of nodulation (pink large nodules) in the companion crop + high nitrogen, terminated early October treatment

Table 2 Emergence, biomass, estimated nitrogen fixation and nodulation score for the different companion cropping termination timings, Sanger, 2025.

TREATMENT	EMERGENCE		BIOMASS		ESTIMATE OF NITROGEN FIXED BY VETCH	VETCH NODULATION
Unit	(plants/m²)		(t/ha)*		(kg N/ha)	Score (0-5)
	Wheat	Vetch	Wheat	Vetch		
Wheat + low nitrogen	95	-	-	-	-	
Wheat + high nitrogen	81	-	-	-	-	-
Vetch + low nitrogen	-	59	-	-	-	3
Vetch + high nitrogen	-	76	-	-	-	2
Companion crop terminated August	90	67	0.2	0.1	1.4	-
Companion crop terminated September	98	66	0.4	0.2	3.8	-
Companion crop terminated early October	93	59	1.7	0.3	6.4	3
Companion crop terminated mid October	122	67	4.4	0.6	11.2	-
Companion crop terminated early October + high nitrogen	98	64	1.9	0.4	7.4	3

*Biomass cuts taken on 19 August, 2 September, 27 September and 13 October, depending on termination treatment

Total soil moisture, nitrogen at sowing and anthesis

After the 2024 harvest, there were no significant differences in soil moisture between the companion treatments with different vetch termination timings at either sowing or anthesis in 2025. However, early termination of vetch in 2024 resulted in lower soil water at the following year's (2025) sowing, compared with later termination timings (data not shown). This likely happened because earlier termination leaves less time for vetch to grow and accumulate biomass, meaning that there was less residue to protect the soil from evaporation or trap water runoff.

At anthesis, soil moisture was lower for all treatments than at sowing, which was expected given wheat water use peaks during flowering and grain filling. During these stages, the crop has a large canopy and high transpiration, so it extracts more water from the soil. Poor late winter and spring rainfall also contributed to lower soil moisture at anthesis compared to sowing, because soil moisture reserves were not replenished during this time.

Results from 2025 show that straight wheat + low nitrogen had the lowest nitrogen at sowing, although this was not significantly different to the other treatments in the trial. This was as expected given this treatment also had low fertiliser inputs (60 L/ha UAN) in 2024, which was not enough to increase soil mineral nitrogen. Unlike vetch, wheat does not add nitrogen to the system, instead removing soil nitrogen for biomass and grain production.

Treatments involving vetch, either sown on its own in a monoculture or in a companion crop, increased soil nitrogen through biological nitrogen fixation and residue mineralisation. There was a trend for the vetch monoculture to have higher nitrogen than the companion crops, because it fixed a higher amount of total nitrogen due to its greater biomass (Figure 1). From sowing to anthesis, total soil nitrogen decreased across all treatments as nitrogen was taken up by the crop during growth. The greatest reduction occurred in the wheat + high nitrogen treatment, where abundant soil nitrogen likely stimulated greater biomass production and nitrogen demand. Wheat has a dense and competitive root system and relies heavily on soil mineral nitrogen, resulting in a larger decline in soil nitrogen. In the companion treatments, there was a lower reduction in nitrogen to anthesis compared to the wheat + low nitrogen treatment.

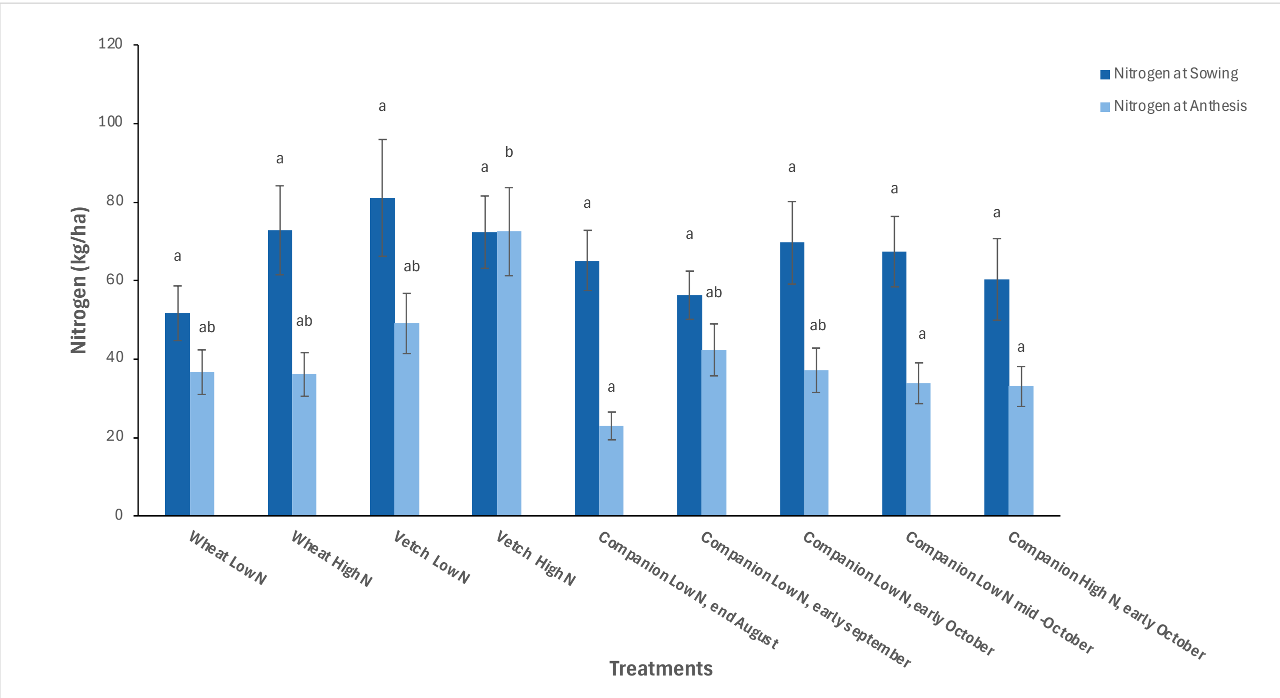


Figure 1 Nitrogen comparison at sowing and anthesis for treatments sown as part of the Riverine Plains companion cropping trial, Sanger, 2025

Notes: Numbers followed by the same letter are not significantly different from each other (P < 0.05)

Wheat competition on vetch (low seeding rate vs high seeding rate buffer strip demonstration)

Two additional buffer strips were sown to compare how changing the wheat seeding rate to 40 kg/ha and 80 kg/ha affected vetch performance due to competition. These buffer strips were sown as a demonstration alongside the main replicated trial, which had a wheat sowing rate of 60 kg/ha.

Lower wheat seeding rates in the companion cropping treatments visually reduced competition and allowed vetch to grow more vigorously. While the statistical analysis showed no differences in terms of yield, protein and screening in these two buffer strips, there was a trend to higher yield and protein with higher seeding rate.

Yield and grain quality results

In dryland cropping systems, grain yield is primarily determined by water availability and nitrogen supply. In Australia's southern cropping zone, rainfall after July is critical for achieving high wheat yields, while stored soil moisture plays a key role during grain filling and in helping the crop avoid terminal drought, which can lead to shrivelled grains and yield loss.

Rainfall from July-October 2025 was 92 mm, which was much lower than the long-term average (Figure 2). As a result, both total dry matter and grain yield were lower across all treatments compared with 2024. This was driven by dry spring conditions that limited water availability during critical growth stages, which reduced biomass accumulation and yield for wheat growing under moisture stress.

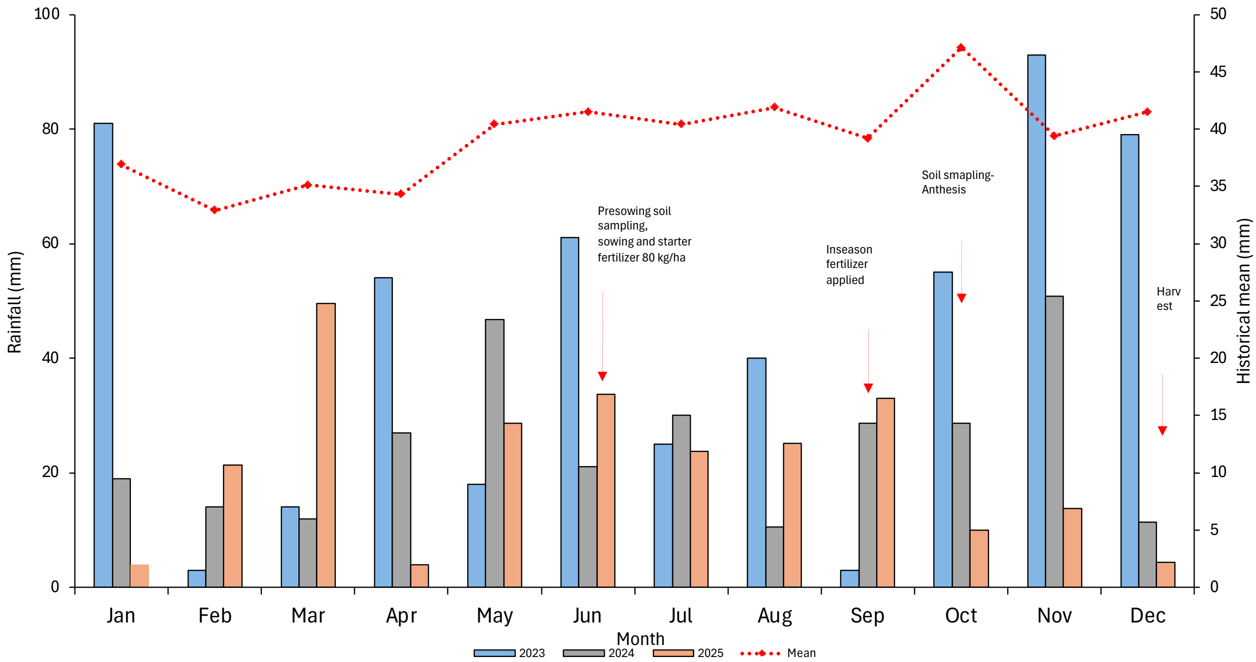


Figure 2 Monthly total rainfall (2024 and 2025) and long-term mean rainfall at the Riverine Plains companion cropping trial site, Sanger, 2025. (ARM Online, Agricultural Risk Management Tools), Oaklands General Store, Australia.

The highest wheat yield (1.9 t/ha) in the companion cropping treatments was observed in the companion crop terminated early September treatment, which was significantly greater than the high nitrogen companion treatment terminated in early October treatment (Figure 3) by nearly 14 percent. The increased wheat yield observed in the September termination treatment is attributed to improved resource use, due to less competition with vetch. Conversely, the reduced wheat yield in the October terminated high nitrogen treatment was likely due to greater soil water depletion caused by longer vetch growth. Leaving the vetch in the system for too long relative to the season at hand probably used up soil water that the wheat could have used later, contributing to water stress at important growth stages and reducing yield.

In 2025, the wheat-only treatments produced the highest yields overall, with little difference between the low and high nitrogen rates (1.99 and 2.16 t/ha respectively).

The vetch-only treatments were harvested to produce a baseline yield, with the high nitrogen treatment yielding 0.36 t/ha and the low nitrogen treatment yielding 0.26 t/ha, which were not significantly different from each other. The vetch-only yield was considerably higher in 2025 than in 2024 for both the high and low nitrogen treatments, despite being sown almost four weeks later. This might be because the establishment of vetch was better in 2025 compared to 2024. Further the cooler and drier filling conditions in 2025 might have favoured vetch growth compared to the wetter spring and harvest experienced in 2024.

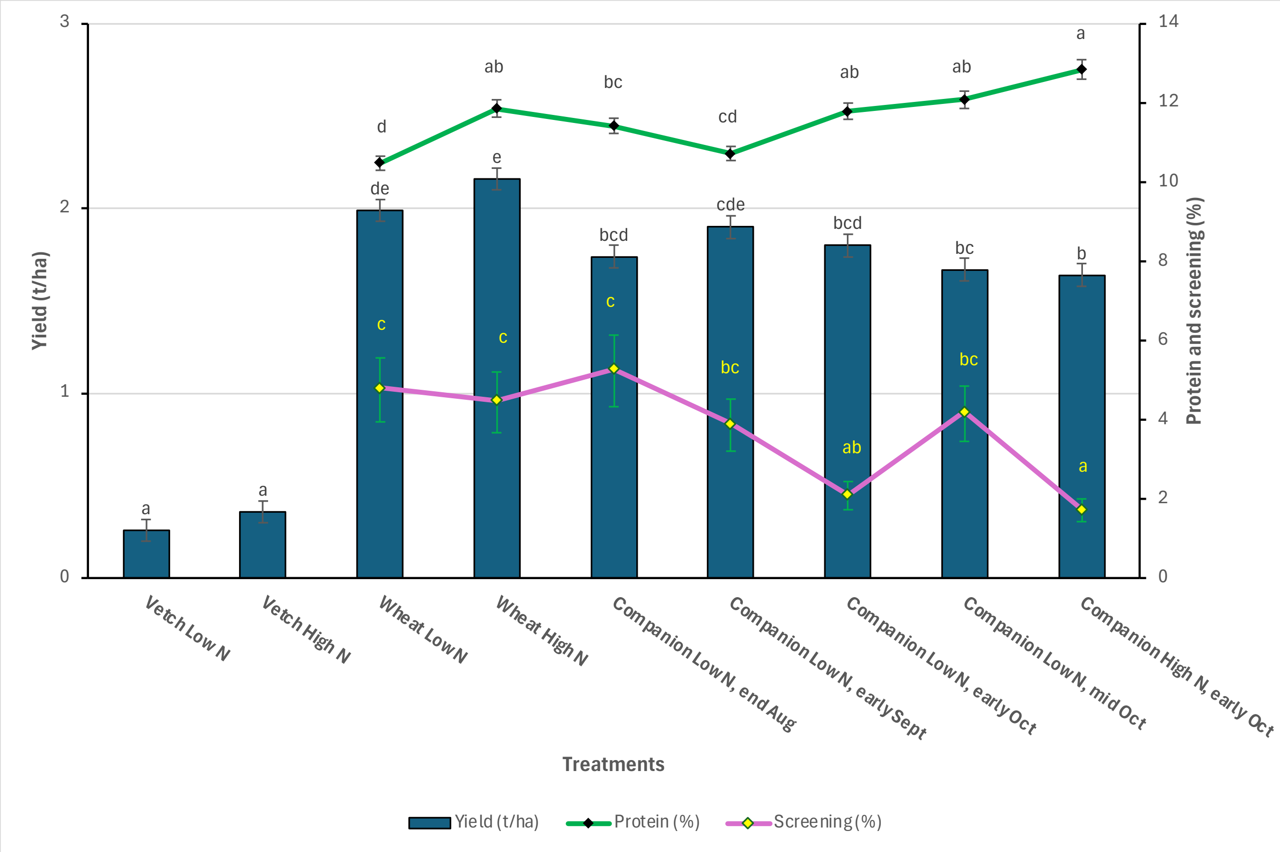


Figure 3 Wheat yield, protein and screenings across different treatment at the Riverine Plains Companion Cropping trial site, Sanger, 2025

Notes: Numbers followed by the same letter are not significantly different from each other (P < 0.05)

Post-anthesis nitrogen supply is very important for grain protein. The highest protein was observed in the high-nitrogen companion, terminated early October treatment, however, this did not differ significantly from the high-nitrogen wheat monoculture or other companion treatments. In contrast, the early September termination had significantly lower grain protein (Figure 3), which may be related to the comparatively low level of nitrogen fixed by vetch in this treatment (3.9 kg N/ha). The limited biomass produced by this treatment at the early termination timing was much lower than in the later termination treatments and, as a result, the nitrogen contribution from vetch residues was insufficient to increase grain protein concentration in this treatment.

In contrast, later termination allowed greater vetch biomass production, leading to higher nitrogen fixation. However, this also increased competition between vetch and wheat for water and nutrients in later-terminated treatments, which acted to reduce wheat yield. Despite the lower yield, grain protein concentration increased in these treatments, likely due to the greater nitrogen contribution from vetch residues and a concentration effect associated with reduced yield.

Overall, screenings were high across the treatments due to the dry finish during grain filling, ranging from 1.7–5.3 percent. The companion crop + high nitrogen terminated early October treatment had significantly lower screenings than the other treatments, possibly due to its slightly lower yield, which may have improved its ability to fill grain. Also, the termination of vetch in early October may have freed up water and nutrients for the wheat during the critical grain filling period, reducing competition for soil moisture at the time when the crop needed it most. There were no differences observed in grain weight among the companion cropping treatment (data not shown).

OBSERVATIONS AND COMMENTS

All companion cropping treatments sown in 2025 resulted in higher soil nitrogen than straight wheat with low nitrogen, reflecting the ability of vetch to fix atmospheric nitrogen.

Mineralisation of vetch residues gradually contributes to the soil nitrogen pool, which can benefit the following crop. However, 2025 was an extremely dry year, and the nitrogen contribution of the vetch was relatively low, ranging from 1.4–11.2 kg N/ha. As such, there was no measurable increase in wheat yield across the companion cropping treatments. Overall, wheat yield was approximately half of the 2024 harvest, highlighting the strong dependence of cereal yield on moisture availability during the critical spring growth period.

Amongst the companion crop treatments, the vetch terminated early September treatment achieved a yield most like the wheat-only + low nitrogen treatment. This is likely because early termination reduced competition for water and nutrients between wheat and vetch, allowing the cereal to develop effectively. These results indicate that vetch termination timing is critical in companion cropping systems: early termination can minimise competition and support wheat performance, whereas while late termination can boost nitrogen fixation through biomass production, it may come at the cost of reduced cereal yield. Wheat sown on its own with high nitrogen yielded significantly higher than the companion cropping treatments, highlighting the trade-off for farmers for achieving higher yields and the extra cost of synthetic nitrogen fertiliser.

Grain protein was influenced by nitrogen availability during the season. Higher yield did not necessarily result in higher protein, highlighting the complexities of nitrogen management, especially in dry years.

Legumes regulate nodulation depending on soil mineral nitrogen levels. Under high nitrogen conditions plants suppress nodule formation, while under low soil nitrogen conditions nodulation and nitrogen fixation is often stimulated (assuming good inoculation and the absence of major soil constraints). This is because fixing nitrogen is energy expensive, so if mineral soil is available, the plant prefers taking nitrogen up from the soil rather than investing energy in symbiosis.

SUMMARY

This trial is highlighting how vetch can be used to supply nitrogen to wheat in temporary companion cropping systems. While the nitrogen contribution of vetch to the soil has been relatively low over the past two years due to dry conditions restricting biomass production, different results may be seen where moisture is not limiting. This trial is also highlighting how termination timing can impact yield by affecting access to water, nutrients and light, and how the "sweet spot" for termination likely changes in response to the season at hand.

ACKNOWLEDGEMENTS

This article was produced as part of the GRDC NGN project Companion cropping legumes for lower cost nitrogen supply in farming systems. Riverine Plains acknowledges Julia Tennent from Kalyx Australia for contributing to this research trial and Adam Feuerherdt as a farmer cooperator.

AUTHORS

Jane McInnes and Sabita Duwal

Riverine Plains

Email: sabita@riverineplains.org.au

RAINFALL FORECAST ALIGNMENT WITH RIVERINE PLAINS' WEATHER STATION DATA

KEY MESSAGES

- **Our comparison of several forecasting apps showed BoM's range midpoints and Jane's Weather single-number forecast aligned most closely with actual rainfall received at Riverine Plains weather stations, with Weatherzone (Elders) also useful for its narrow ranges and decent accuracy.**
- **YR presents a forecast from a single model, so is best used as a quick cross check alongside other apps to reduce the risk of forecasts bouncing around.**
- **Alignment with local gauges drops off the further out the forecast period is, so forecasts beyond a few days are best used as a heads-up for planning.**
- **Heavy rain is hardest for every app to predict, because storms can deliver 10–60 mm differences over short distances.**
- **No single app is perfect: the best strategy is to check for consensus across apps and confirm with local gauges and radar before making key operational decisions.**

BACKGROUND

Rainfall drives many high-cost decisions in broadacre and mixed farming systems. Seasonal outlooks help set an overall season plan, but day-to-day calls such as spraying, urea applications, sowing depth, irrigation timing and harvest logistics depend on short-term rainfall forecasts. Because different apps use different models and present rainfall in different ways, growers can benefit from knowing which apps tend to line up best with what's measured at local gauges.

AIM

To compare how closely four rainfall forecast apps — Bureau of Meteorology (BoM), YR, Jane's Weather, and Weatherzone (Elders) — aligned with rainfall recorded across the Riverine Plains weather station network, to support day-to-day farming decisions.

WHAT WE DID

We compared nearly two months of daily rainfall forecasts from 17 July to 14 September, 2025, against observed rainfall from five Riverine Plains weather stations at Miepoll, Rutherglen, Burramine, Urana, and Culcairn. Due to technical issues, Miepoll station data were only included up until late August.

Apps present rainfall forecasts differently. While YR provides a daily rainfall forecast value (i.e. 5 mm), BoM and Weatherzone provide a forecast range (i.e. 5–10 mm), with Jane's Weather providing both a single value and a range. To compare apps on the same basis, range forecasts were converted to a single value using the midpoint of the predicted range (i.e if the range was 5–10 mm, the midpoint would be 7.5 mm), then compared with the recorded weather station rainfall total.

Results are reported by Lead Day, which is how many days ahead the forecast was issued. Lead Day 1 is the forecast for the next day, while Lead Day 10 refers to the forecast for 10 days' time. Performance was summarised using mean absolute error (MAE), which is the average difference in mm between the forecast rainfall and what the local gauge recorded. We calculated MAE for each Lead Day, with a separate analysis for heavy rain days where the station recorded more than 10 mm.

We also assessed range quality using "range reliability", which is the percentage of days where the recorded station rainfall fell within the app's forecast range. Average width is the size of the forecast range in mm. These metrics were used to assess the trade-off between range reliability and precision (narrower ranges).

LEAD DAYS 1 TO 6: DAILY RAINFALL FORECAST PERFORMANCE

BoM performed best overall when assessed by its range midpoint, with a midpoint error of about 1.21 mm (Table 1), often being very close to the actual rainfall received at a site from Day 1 up to Day 6 of the forecast.

Jane's Weather was second best overall, with an average difference of about 1.30 mm from the local station rainfall and was the top performer on some individual lead days (for example, Lead Day 1 and Lead Day 3).

YR was straightforward to read, but its average difference from station rainfall was larger at about 1.59 mm, and it tended to drift further from station totals as lead time increased.

Weatherzone provided clear ranges, but when assessed by its range midpoint it had the largest average difference from station rainfall in this comparison, about 1.72 mm.

Rainfall totals were low during the period of analysis, which is reflected in the small differences seen in Table 1.

Table 1 Daily rainfall forecast error (MAE) by lead day and app

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Days 1–6	Overall
App	Ave difference between forecast rainfall and local gauge reading (mm)											
BoM	1.07	1.02	1.19	1.20	1.31	1.45	—	—	—	—	1.21	1.21
JANE's	0.98	1.24	0.99	1.36	1.60	1.65	—	—	—	—	1.30	1.30
YR	1.11	1.40	1.39	1.39	1.98	2.25	2.77	2.80	—	—	1.59	1.89
Weatherzone	1.24	1.43	1.56	1.97	2.05	2.06	2.94	2.20	2.10	2.84	1.72	2.04

* BoM and Weatherzone results refer to the midpoint of their forecast ranges

HEAVY-RAIN DAYS OVER 10 MM

On heavy rain days where the station recorded more than 10 mm, every app aligned less closely with local station totals. BoM's range midpoint and Jane's Weather single-number were closest to actual totals in the shorter lead window, while YR and Weatherzone's range midpoint were generally less aligned the longer the lead time.

For Lead Days 1 to 6, the average differences were 5.3 mm for both BoM and Jane's Weather (Table 2), compared with 6.1 mm for YR and 6.4 mm for Weatherzone. As lead time increased, heavy rain forecasts became less dependable for all apps. From Lead Day 6 onwards, differences blew out beyond 10 mm, with fewer heavy rain events to compare.

Table 2 Rainfall forecast error on heavy -rain days (>10 mm) (MAE, mm) by Lead Day and App

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Days 1–6	Overall
App	Ave difference between forecast rainfall and local gauge reading (mm)										
BoM*	2	5.2	4.1	4.1	4.5	11.9	—	—	—	5.3	5.3
JANE's	2.8	6.4	4.6	3.8	5.8	8.4	—	—	—	5.3	5.3
YR	3.5	9.4	1.4	4.4	6	11.9	12.2	16.2	—	6.1	8.1
Weatherzone*	4.2	7.8	8.3	6.2	5	6.6	15.9	14.2	13.9	6.4	9.1

* BoM and Weatherzone results refer to the midpoint of their forecast ranges.

RAINFALL RANGES: RANGE RELIABILITY VS WIDTH (FORECAST RANGE)

Weatherzone generally presented narrower ranges and still achieved reasonable range reliability. However the midpoint of the range aligned less closely with station rainfall, so its overall error result was higher (Table 3).

BoM had the highest range reliability, but it achieved this with the widest ranges (Table 4), which is a more conservative style that provides less specific forecasts for decision-making.

Jane's Weather provided narrower forecast ranges than BoM, based on the spread of multiple models on its platform. In this analysis, the narrower ranges resulted in more misses, with actual rainfall falling outside the forecast range more frequently.

Table 3 Rainfall forecast ranges: range reliability (%) by Lead Day

App	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Days 1–6
	% of days that recorded station rainfall fell within the app's forecast range									
BoM	82.1	71.2	74.7	84	85.6	86.3	—	—	—	80.7
JANE's	55.7	57.3	65.7	63	65.6	67.5	—	—	—	62.4
Weatherzone	73.7	74.7	73.9	65.1	67.1	66.7	52.3	61.5	57.4	70

Table 4 Rainfall forecast ranges: average width (mm) by Lead Day

App	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Days 1–6
	Size of the forecast range (mm)									
BoM	4	4.3	4.3	4.3	4.2	4.4	—	—	—	4.3
JANE's	2.4	2.7	2.8	4	4.3	5.6	—	—	—	3.6
Weatherzone	1.8	2	2.1	2.5	2.4	2.5	2.9	2.4	2.4	2.2

*Jane's Weather rainfall ranges the lowest to highest rainfall forecast across multiple weather models, not a single Jane's Weather model.

SINGLE-MODEL FORECAST VS BLENDED FORECAST APPS

Some apps, such as YR and Windy, show rainfall as one number pulled from a single computer model. It's easy to read, but it is only that model's best estimate for one grid point, and it can change a lot between updates, especially when looking several days ahead. These apps can also miss localised storm rain because falls can be patchy and smaller than the model grid, so the main rain band may land 5 to 50 km away (Table 5).

Other apps, such as BoM, Weatherzone, and Jane's Weather, show rainfall as a range, or as a single number with a range in brackets. This is usually based on a blend of models plus short-term meteorologist oversight. The range helps show how much the weather models agree. A wide range usually means a hit-and-miss rainfall event, like showers or storms, while a narrower range more often points to a more even system, such as from a front. Blending can smooth out extremes when models disagree, so treat "big rain" calls as an early heads-up until closer to the day, then confirm with radar and nearby gauges.

Table 5 Our summary of the characteristics of single-model forecast apps vs blended forecast apps

Forecast type	App examples	Main strength	Main watch-out
Single-model forecast	YR, Windy	Easy to read and compare	Can change quickly and may miss localised storm rain
Blended forecast	BoM, Weatherzone, Jane's Weather	Usually steadier and less reliant on one model	Can smooth out extremes, so "big rain" calls still need checking closer to the day

CONCLUSIONS

Over this comparison period, BoM's rainfall range midpoint and Jane's Weather single-number forecasts most often lined up the best with Riverine Plains station rainfall, making it slightly more useful for day-to-day planning (noting that differences were small due to low total rainfall received during this period).

All apps aligned less closely the further ahead the forecast period. On days when gauges recorded more than 10 mm, every app forecast was less aligned with the station totals, reflecting the reality that storm rain is patchy and can vary by 10 to 60 mm over short distances.

We found that YR and Weatherzone (Elders) are most useful as cross-checks, instead of on their own. YR reflects a single model output and is popular because it provides an "exact" rainfall number for specific postcodes up to 10 days ahead. Weatherzone adds value through its narrow rainfall ranges which deliver reasonable range reliability.

Overall, the best approach is to look for a consistent story across multiple apps, confirm it against local gauges and radar, and use seasonal forecasts to manage risk and probabilities, rather than to seek absolute certainty.

ACKNOWLEDGEMENTS

This project is supported by Victoria Drought Resilience Adoption & Innovation Hub (Vic Hub) investment, through funding from the Australian Government's Future Drought Fund. Riverine Plains is the Vic Hub's North East Node lead.

Special thanks to the farmer co-operators of the Riverine Plains weather station network for providing the ground-truthed data.

Full Project Title: SCOUT: Weather Forecast Accuracy Validation

Author: Peter Chen, Riverine Plains

Email: peter@riverineplains.org.au

HPC GEROGERY NVT TRIAL – VARIETY BY FUNGICIDE MANAGEMENT

KEY MESSAGES

- **In 2025, stripe rust was still present at yield limiting levels in susceptible varieties. RGT Zanzibar (rated R-MR for stripe rust) was the only variety with sufficient genetic resistance to not show a yield response to applied fungicides.**
- **Septoria tritici blotch (STB) was also present at significant levels (>15%) in Leverage and Scepter, which likely contributed to yield loss.**
- **Except for RGT Zanzibar, yields were maximised with at least one fungicide application made early in the growing season in comparison to a full fungicide package (three foliar applications).**
- **A full fungicide program was not needed in 2025 and, in some circumstances, resulted in yield penalties compared to a single application in August. This highlights the importance of educated decision making when managing disease.**

AIM

The following trial was completed under the FAR Australia led GRDC Hyper Profitable Crops (HPC) initiative (FAR2403-002SAX). As part of this project, HPC discussion groups are invited to design small plot validation and demonstration trials which are established next to a National Variety Trials (NVT) site. In 2025, the Riverine Plains HPC discussion group decided to evaluate different levels of disease control in a range of wheat varieties commonly grown in the region. This trial was established at the NVT site in Gerogery, NSW, with trial operations conducted by the local NVT service provider, Kalyx.

METHODOLOGY

This trial aimed to test the value of disease management in a range of commonly grown varieties in the region. These varieties, along with their disease ratings, are listed in Table 1.

These varieties were tested using three (3) different fungicide management strategies –

1. a nil control (no fungicide),
2. control until August involving one fungicide application (Amistar Xtra 800mL/ha applied on 21 August), and
3. a full control involving three fungicide applications (Amistar Xtra 800mL/ha applied on 1 September, Aviator Xpro 500mL/ha applied on 26 September and Opera 1000mL/ha applied on 24 October).

Trial operations, including spray applications, were undertaken by the local NVT service provider, Kalyx. A single disease assessment was completed by FAR Australia on 10 October.

Table 1 Varieties tested and their respective disease ratings for disease found in the trial.

VARIETY	DISEASE RATING[1]		
	Stripe Rust	Septoria Tritici Blotch	Powdery Mildew
Scepter	S	S	S-VS
RGT Zanzibar	R-MR	MS-S	R-MR
Stockade	MR	MS	S-VS
Genie	MS-S	S	S-VS
Illabo	MR-MS	MS-S	R-MR
Leverage	MR-MS	S	S-VS

VS= Very susceptible, S= Susceptible, MS= Moderately susceptible, MR= Moderately resistant and R= Resistant

1 Department of Primary Industries and Regional Development 2025 NSW Winter crop variety sowing guide.

RESULTS

RGT Zanzibar produced the highest average grain yield with 5.67 t/ha. While this variety was not statistically better yielding than Scepter or Leverage, RGT Zanzibar was the only variety that gave no response to applied fungicide (Table 2). Yield was not statistically improved in any variety by applying a full disease management package compared to control until August.

The two long season varieties, Illabo (winter) and Stockade (very slow spring) gave a negative response to the full fungicide program in comparison to control until August. This can occasionally happen when conditions are dry and fungicides are applied late to a clean crop. While no phytotoxicity was observed, it is possible that the crop had a reaction to the spray which has resulted in yield loss.

Stipe rust was the main disease present in the trial, with Scepter, Leverage and Genie showing the highest levels of infection (Table 3, Figure 1). Leverage took on significantly more stripe rust compared to Illabo, despite them both being rated MR-MS for stripe rust. RGT Zanzibar was the only variety that had no stripe rust present in the untreated plots and was the only variety to show no response to any level of fungicide intervention.

Table 2 Effect of wheat variety and disease management strategies at Gerogery, NSW. Yield uncorrected for moisture.

YIELD (T/HA)				
	Untreated	**Control until August**	**Full fungicide**	**Mean**
Scepter	5.05 c	5.80 ab	5.76 ab	5.54 ab
RGT Zanzibar	5.60 ab	5.81 ab	5.61 ab	5.67 a
Stockade	4.88 c	5.51 b	5.10 c	5.16 d
Genie	5.01 c	5.58 b	5.65 ab	5.41 bc
Illabo	5.04 c	5.51 b	5.11 c	5.22 cd
Leverage	5.11 c	5.79 ab	5.94 a	5.61 ab
Mean	5.11 -	5.67 -	5.53 -	
LSD Fungicide Strategy (p = 0.05)		0.43	P value	0.052
LSD Variety (p = 0.05)		0.20	P value	<0.001
LSD Fungicide Strategy by Variety (p = 0.05)		0.35	P value	0.023

Table 3 Influence of fungicide strategy and wheat variety on stripe rust, Septoria tritici blotch and wheat powdery mildew infection (Plot score % leaf area infected).

	PLOT INFECTION (%) ASSESSED 10 OCTOBER 2025					
Fungicide Strategy (mean of all varieties)	Stripe Rust		Septoria Tritici Blotch		Wheat Powdery Mildew	
1 Untreated	11.2	a	9.7	a	0.1	-
2 Control until August	0.8	b	2.7	b	0.0	-
3 Full fungicide	0.0	b	1.5	b	0.0	-
LSD (p = 0.05)	3.6		2.6		ns	
P value	0.002		0.002		0.111	
Variety (mean of all fungicide strategies)						
1 Scepter	13.7	a	9.6	a	0.0	b
2 RGT Zanzibar	0.0	c	3.8	cd	0.0	b
3 Stockade	1.1	c	0.8	e	0.0	b
4 Genie	3.1	bc	4.9	bc	0.2	a
5 Illabo	0.6	c	1.8	de	0.0	b
6 Leverage	5.6	b	6.9	b	0.0	b
LSD (p = 0.05)	3.8		2.5		0.1	
P value	<0.001		<0.001		0.007	
Fungicide Strategy by Variety						
Untreated						
1 Scepter	38.3	a	16.7	a	0.0	b
2 RGT Zanzibar	0.0	d	8.7	b	0.0	b
3 Stockade	3.3	cd	1.7	d	0.0	b
4 Genie	8.3	c	10.7	b	0.7	a
5 Illabo	1.7	d	3.0	d	0.0	b
6 Leverage	15.7	b	17.3	a	0.0	b
Control until August						
1 Scepter	2.7	cd	8.0	bc	0.0	b
2 RGT Zanzibar	0.0	d	1.3	d	0.0	b
3 Stockade	0.0	d	0.7	d	0.0	b
4 Genie	0.8	d	3.0	d	0.0	b
5 Illabo	0.0	d	1.7	d	0.0	b
6 Leverage	1.2	d	1.7	d	0.0	b
Full fungicide						
1 Scepter	0.0	d	4.0	cd	0.0	b
2 RGT Zanzibar	0.0	d	1.3	d	0.0	b
3 Stockade	0.0	d	0.2	d	0.0	b
4 Genie	0.0	d	1.0	d	0.0	b
5 Illabo	0.0	d	0.8	d	0.0	b
6 Leverage	0.0	d	1.7	d	0.0	b
LSD (p = 0.05)	6.6		4.3		0.2	

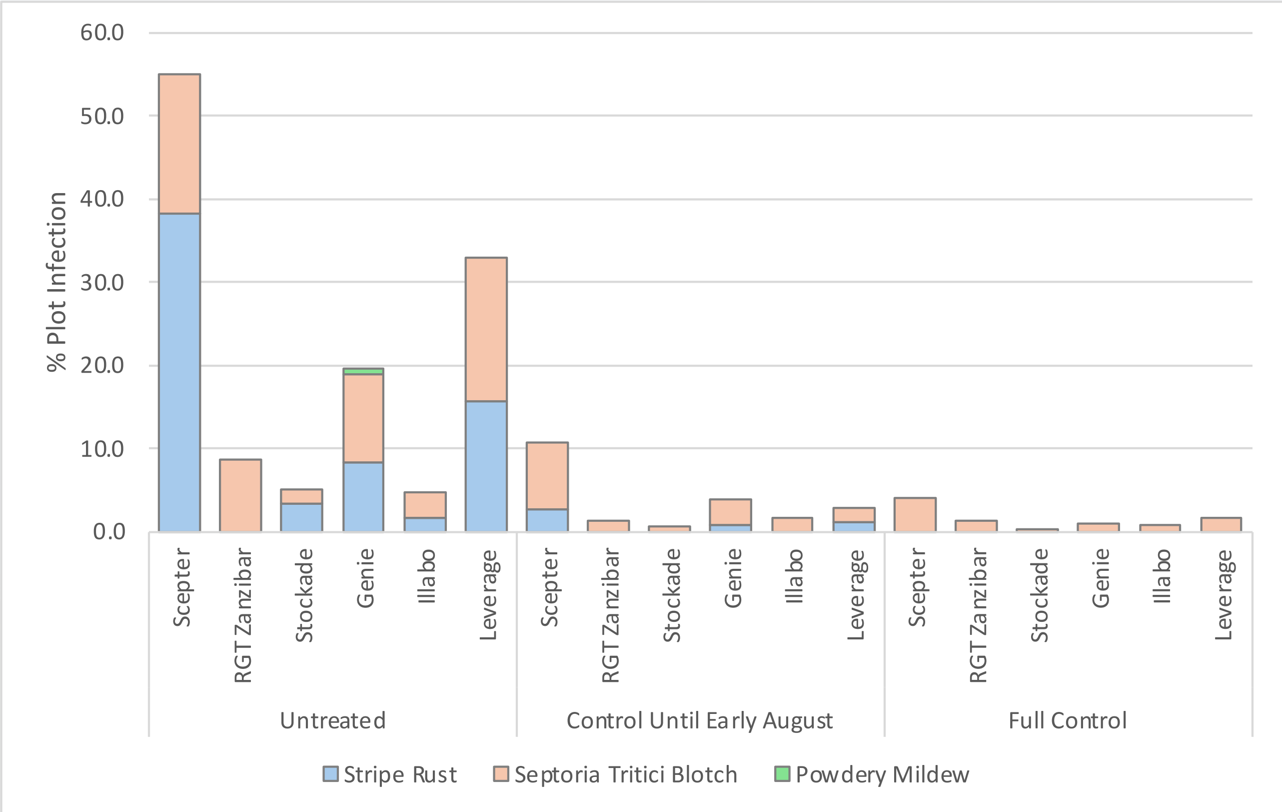


Figure 1 Influence of fungicide strategy and wheat variety on stripe rust, Septoria tritici blotch and wheat powdery mildew infection (Plot score % leaf area infected). See table 3 for details of statistical analysis.

SUMMARY

Even in a below average rainfall season, significant levels of both stripe rust and Septoria tritici blotch were present in untreated canopies of Scepter, Leverage and Genie. Low levels of both diseases were also present in Stockade and Illabo, all of which gave significant yield response to fungicide application. RGT Zanzibar, with a rating of R-MR to stripe rust, was the only variety with sufficient genetic resistance to have no response to fungicide.

Applying excess fungicides to clean crops in a drier than average season can result in a negative response to fungicide, reinforcing the need for a change in attitude to fungicides away from prophylactic spraying to more educated decision making (i.e. do I need this fungicide?).

ACKNOWLEDGEMENTS

The Hyper Profitable Crops project is funded by GRDC (FAR2403-002SAX). Thanks to the GRDC NVT team and NVT service provider, Kalyx, for organising, resourcing and conducting the trial and for providing operational and yield details. Thank you also to trial hosts, the Moll family.

Authors: Tom Price, Rebecca Murray, Field Applied Research (FAR) Australia

BREAK CROP FERTILITY AND ORGANIC MANURES

KEY MESSAGES

- **Nitrogen combined with manure can help achieve hyperyields in a good season.**
- **Chemical fertiliser containing phosphorus (P), potassium (K) and sulfur (S) can achieve the same results as manure.**
- **High rates of manure achieved the highest yields in a good season but were not economical.**
- **Low rates of manure were economical in the long term but depend on the price.**
- **Farmers and advisors should determine which nutrients are required that may be available in manure and consider using manure if it is a cheaper than chemical fertiliser.**

BACKGROUND & AIM

There is an abundance of organic amendment options in northeast Victoria, due to the proximity of feedlots and other intensive livestock operations. Consequently, there is local interest in using these by-products to supply nutrients for grain production systems and to improve any soil constraints.

Nitrogen fixation provides most of the nitrogen demand of grain legume crops at high yields (assuming adequate rhizobia function). A large part of this fixed nitrogen is exported in grain, which can affect the pulse crop's potential to restore fertility to the soil and therefore may not be enough to sustain higher-yielding wheat and canola crops the following season.

This project was designed to evaluate whether the benefits of nitrogen fixation by legume crops can be amplified in a subsequent wheat and canola crop with added organic amendments as manure. It also looks at whether this can buffer the farm business from high synthetic fertiliser inputs.

METHOD

A faba bean crop was sown and harvested at Bundalong South, Victoria, in 2022. To leverage the fertility of this crop's legacy, a manure trial was established the following year, with 16 treatments established on paired plots. The first treatments were established in early September 2022 when parts of the faba bean crop (which was at early to mid flower) were slashed and removed to create a 'fallow' effect while in other areas, the beans were slashed and spread evenly on the surface to create a 'green manure' effect.

Prior to sowing wheat in April 2023, three rates of manure (2.5 t/ha, 5.0 t/ha and 10 t/ha, all at 23 percent moisture) were spread on the surface. Other treatments, including the nitrogen value of 5 t manure and the N-P-K-S value of 5 t manure, were spread prior to sowing (Table 1). A small amount was withheld while awaiting final test results for the manure and then applied on 1 June, 2023.

The whole trial was fertilised with the same rate of urea that the grower used on the surrounding paddock. Each pair of plots was split, with half of each treatment allocated an extra 75 kg/ha of nitrogen. This amount was applied as top-dressed urea on 4 August at early stem elongation (GS32).

Table 1 Nutrients applied prior to sowing (5t/ha manure equivalent). Ammonium sulphate, monopotassium sulphate, muriate of potash and urea were used.

Application	Nutrients applied (kg/ha)			
	Nitrogen	Phosphorus	Potassium	Sulphur
1	32.7	16.9	50.2	10.6
2	13.6	10.5	3.8	4.4
Total	**46.3**	**27.4**	**54.0**	**15.0**

RESULTS

Year 1 wheat, 2023

Grain yields averaged 9 t/ha across the trial (Table 2). The lowest yield recorded was 7.93 t/ha in the fallow treatment with no extra nitrogen, but while impressive, this yield demonstrates the benefits of additional fertility. Applying 10t/ha of manure with an extra 75kg/ha of nitrogen was able to leverage an extra 1.75 t/ha of grain, producing the highest yield of 9.68 t/ha.

There was no interaction between manure treatment, nitrogen treatment and grain yield. However, supplying an additional 75kg/ha of nitrogen during the growing season increased yield by 0.63 t/ha, from 8.69 t/ha to 9.32 t/ha.

When yields were averaged across nitrogen treatments, use of a fallow was found to decrease grain yield by 0.61 t/ha, from 9.05 t/ha to 8.44 t/ha. Applying 10t/ha of manure increased grain yield by 0.29 t/ha to 9.34 t/ha. The NPKS 5 t/ha manure equivalent gave statistically the same yields as the 10t/ha of manure, however where only the nitrogen was applied (nitrogen value 5t/ha manure) the yield was lower than the control.

Protein results are presented in Figure 1.

Table 2 : Influence of manure treatment on wheat grain yield (t/ha), 2023. Data followed by the same letter in the same column are not significantly different at p=0.001

Treatment	**Grain yield (t/ha)**					
	Standard N		**+ Extra 75 N**		**Mean**	
Nil	8.70	-	9.40	-	**9.05**	**bc**
2.5t/ha manure	8.87	-	9.36	-	**9.11**	**abc**
5t/ha manure	8.73	-	9.46	-	**9.09**	**abc**
10t/ha manure	9.01	-	9.68	-	**9.34**	**a**
N value 5t/ha manure	8.56	-	8.98	-	**8.77**	**d**
NPKS value 5t/ha manure	9.16	-	9.47	-	**9.31**	**ab**
Fallow	7.93	-	8.94	-	**8.44**	**e**
Green manure	8.53	-	9.24	-	**8.89**	**cd**
Mean	**8.69**	**b**	**9.32**	**a**		
Manure	LSD	0.27		p<0.001		
Nitrogen	LSD	0.14		p<0.001		
Manure x nitrogen	LSD	ns		p=0.300		

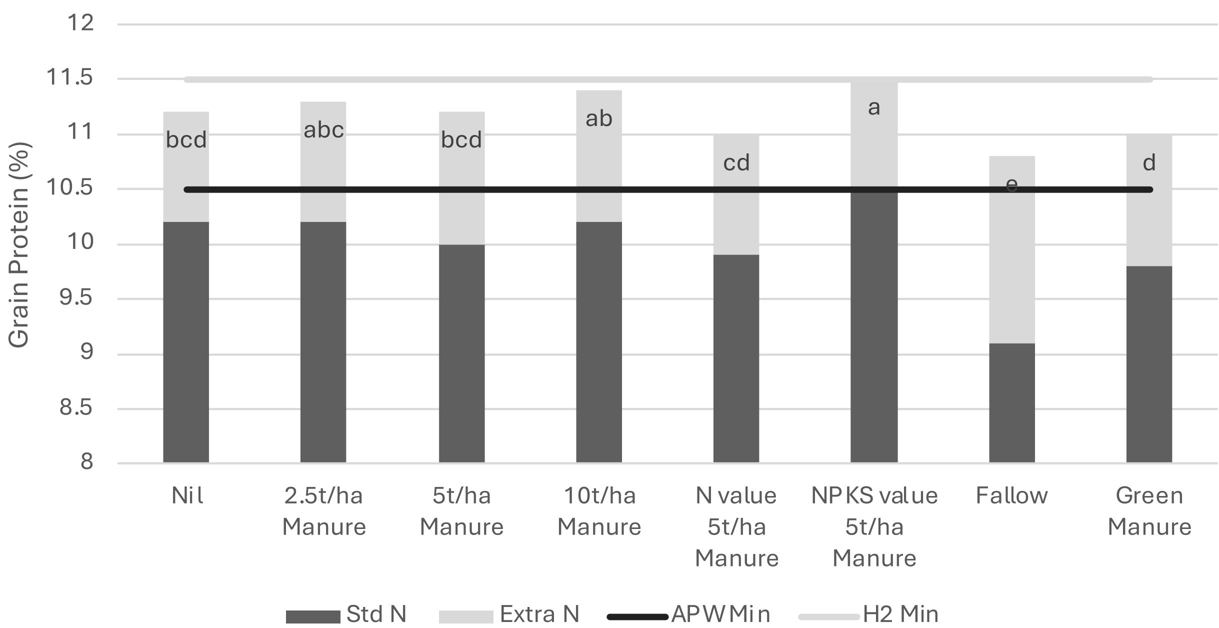


Figure 1 Influence of manure treatment on protein content, 2023.

Year 2 canola, 2024

The objective of this trial was to assess the legacy of organic amendments and biologically fixed nitrogen strategies compared with inorganic-based approaches. The trials details were as follows:

Location: Bundalong, Vic

Cultivar: PY525G

Sown: 5 April 2024

Harvested: 24 November 2024

Rotation position: wheat (2023), faba beans (2022), barley (2021), canola (2020)

GSR: April–October 206.9mm

Crop Nutrition:

- MAP – 30kg/ha spread pre-sowing and 60kg/ha incorporated at sowing (9 N total)
- Urea – Total of 400kg/ha spread over three applications (mid-May, mid-June and early July) (184 N total).

Harvest biomass

Dry matter (DM) cuts were taken on 6 November to measure the total biomass accumulated at maturity, with no differences detected between treatments (Table 3). Harvest index was calculated with an average figure of 27.2 percent, again with no differences detected between treatments.

Nitrogen content was measured in the harvest biomass (Table 4). The treatments where the extra nitrogen was applied had a slightly higher percentage of nitrogen (1.11% compared to 0.95%). When nitrogen uptake was calculated, there were no statistical differences in the total nitrogen (kg/ha).

Table 3 Harvest dry matter (t/ha) and harvest index (%) assessed for key treatments, 6 November, 2024.

Treatment	Harvest dry matter (t/ha)						Harvest index (%)					
	Standard N (Year 1)		+ Extra 75 N (Year 1)		Average		Standard N (Year 1)		+ Extra 75 N (Year 1)		Average	
Nil	11.72	-	11.92	-	**11.82**	-	30.8	-	28.7	-	**29.7**	-
10t/ha manure	13.44	-	14.26	-	**13.85**	-	27.6	-	24.6	-	**26.1**	-
N value 5t/ha manure	11.21	-	14.27	-	**12.74**	-	29.9	-	24.2	-	**27.0**	-
Green manure	13.91	-	12.62	-	**13.26**	-	24.6	-	27.3	-	**26.0**	-
Mean	**12.57**	**-**	**13.27**	**-**			**28.2**	**-**	**26.2**	**-**		
Treatment	LSD	ns			p=0.280		LSD	ns			p=0.553	
Nitrogen	LSD	ns			p=0.483		LSD	ns			p=0.456	
Treatment x Nitrogen	LSD	ns			p=0.480		LSD	ns			p=0.724	

Table 4 Harvest dry matter nitrogen (%) and nitrogen removal (kg/ha) measured on key treatments, 6 November, 2024. Data followed by the same letter in the same column are not significantly different at p=0.001

Treatment	Dry matter nitrogen %						Dry matter nitrogen removal (kg/ha)					
	Standard N (Year 1)		+ Extra 75 N (Year 1)		Average (Year 1)		Standard N (Year 1)		+ Extra 75 N (Year 1)		Average (Year 1)	
Nil	1.10	-	1.02	-	**1.06**	-	131.6	-	122.8	-	**127.2**	**-**
10t/ha manure	1.00	-	1.12	-	**1.06**	-	131.1	-	159.9	-	**145.5**	**-**
N value 5t/ha manure	0.78	-	1.25	-	**1.01**	-	87.1	-	182.6	-	**134.8**	**-**
Green manure	0.92	-	1.07	-	**0.99**	**-**	127.4	-	133.6	-	**130.5**	**-**
Mean	**0.95**	**b**	**1.11**		**a**		**119.3**	**-**	**149.7**		**-**	
Treatment	LSD	ns			p=0.853		LSD	ns			p=0.742	
Nitrogen	LSD	0.10			p=0.019		LSD	ns			p=0.084	
Treatment x Nitrogen	Lsd	ns			p=0.054		LSD	ns			p=0.161	

Grain yield

Plots were harvested with a plot harvester on 24 November (Table 5). There was no interaction between manure treatment and nitrogen treatment. Where the extra 75kg of nitrogen was applied in 2023, the yield increased by 100kg/ha. The 2.5t/ha of manure treatment increased yield by 0.22t/ha compared to the nil treatment. Adding nitrogen fertiliser to the equivalent found in 5t/ha of manure decreased the yield by 0.9t/ha compared to the nil treatment, and although this was not significant, it was significantly lower than the 2.5t/ha and 5t/ha manure treatments and the NPKS treatment. All other treatments were statistically the same as the nil treatment. It could be surmised that when applying large amounts of nitrogen, additional nutrients (P, K, S) are needed to positively impact yield.

Table 5 Grain yield (t/ha), harvested 24 November, 2024. Data followed by the same letter in the same column are not significantly different at p=0.001

Treatment	Yield (t/ha)					
	Standard N (Year 1)		+ Extra 75N (Year 1)		Average	
Nil	3.58	-	3.69	-	**3.63**	**bc**
2.5t/ha manure	3.89	-	3.81	-	**3.85**	**a**
5t/ha manure	3.67	-	3.95	-	**3.81**	**ab**
10t/ha manure	3.54	-	3.73	-	**3.63**	**bc**
N value 5t/ha manure	3.54	-	3.55	-	**3.54**	**c**
NPKS value 5t/ha manure	3.72	-	3.81	-	**3.76**	**ab**
Fallow	3.60	-	3.85	-	**3.72**	**abc**
Green manure	3.72	-	3.68	-	**3.70**	**abc**
Mean	**3.66**	**b**	**3.76**	**a**		
Treatment	LSD	0.19		P=0.048		
Nitrogen	LSD	0.07		p=0.007		
Treatment x Nitrogen	LSD	ns		p=0.117		

Year 3 Wheat 2025

The objective of this trial was to assess the legacy of organic amendments and biologically fixed nitrogen strategies compared with inorganic based approaches. The trials details were as follows:

Location: Bundalong, Vic

Cultivar: Matador

Sown: 7 May 2025

Harvested: 27 November 2025

Rotation position: Canola (2024) wheat (2023), faba beans (2022)

GSR: April–October 210.5mm

Crop Nutrition:

- MAP – 40kg/ha spread pre-sowing and 60kg/ha incorporated at sowing (10 N total)
- Urea – Total of 300kg/ha spread over two applications (138 N total).

Grain yield

Plots were harvested with a plot harvester on 27 November. There was no interaction between manure treatment and nitrogen treatment. There was no difference in grain yield where the extra 75 kg/ha of nitrogen was applied in 2023.

The 2.5t/ha of manure treatment increased yield by 0.27t/ha compared to the nil treatment (Figure 2). The fallow treatment from 2022 also increased yield in 2025 by 0.28 t/ha. The other treatments were statistically the same as the control treatment. Statistical differences in grain quality were minor and had no effect on receival grade as all grain had high screenings (average 16.5%) and was classified as feed.

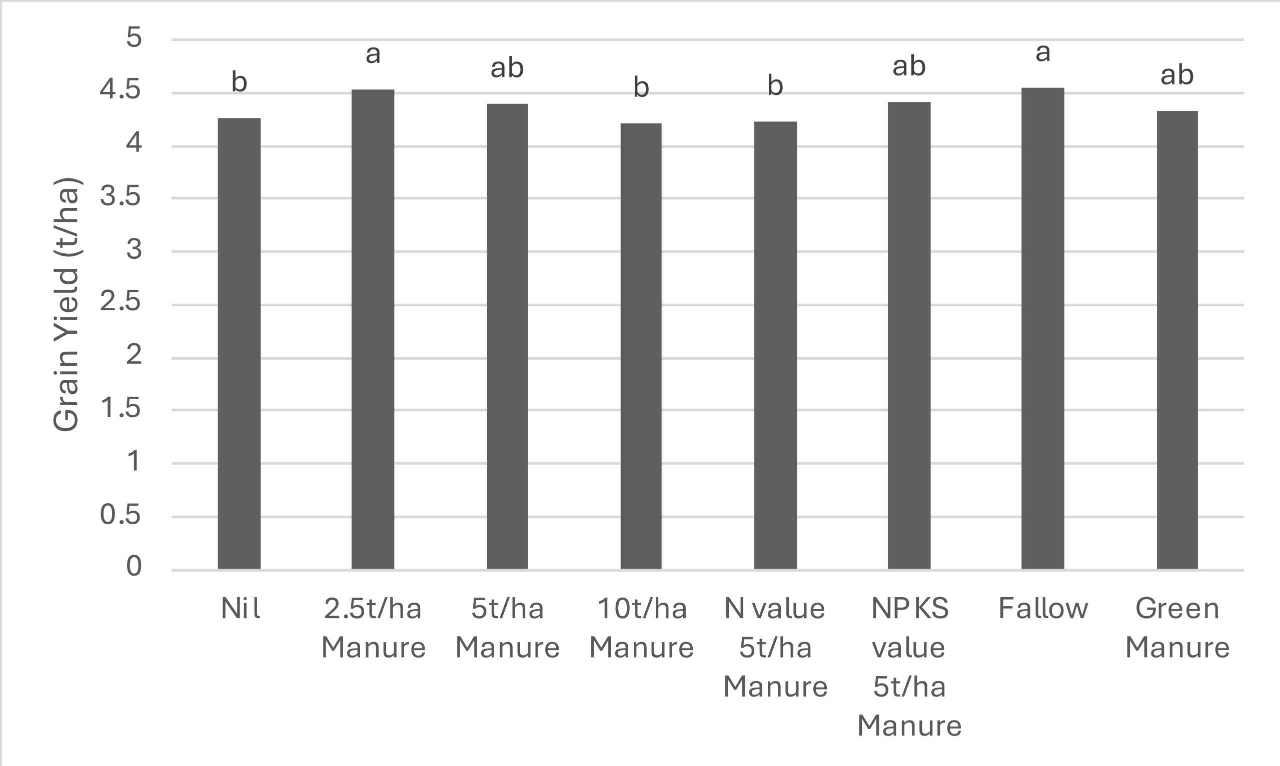


Figure 2 Influence of manure treatment on grain yield, 2025.

CONCLUSION

The wheat results from 2023 clearly demonstrate that nitrogen remained the dominant driver of yield in this high-yielding system, but that nitrogen efficiency was strongly influenced by nutrient balance. Only the highest manure rate (10t/ha) significantly increased yield when averaged across nitrogen treatments, and nitrogen-only strategies equivalent to manure performed poorly relative to balanced N-P-K-S nutrition. This confirms that organic amendments deliver benefits through a package of nutrients rather than nitrogen alone, and that imbalances can constrain yield and protein.

Interpretation of the 2024 canola and 2025 wheat results are less certain. Yield responses to manure and green-manure strategies were generally small and inconsistent, and while nitrogen applied in the previous season continued to influence yield in 2024, there was little clear evidence of a positive manure legacy effect. However, this should not automatically be interpreted as a simple 'wearing down' of manure-derived nutrients. It is equally plausible that canola is inherently less responsive to residual manure effects, particularly where nutrient release patterns do not align well with canola demand or where other constraints dominate yield formation.

The absence of strong biomass or nitrogen-uptake differences in canola supports the view that manure legacy effects may be masked in this crop, rather than absent. As such, firm conclusions regarding manure persistence or decay cannot be drawn from the canola phase alone.

It is also plausible that the effects of the manure were not evident in 2025 due to the lower yield potential and it is possible that a legacy may appear in another high yielding season.

ECONOMICS

The total price of manure applied to a paddock is influenced by a range of factors. These include price at feedlot, distance from feedlot, spreading rate and whether the farmer uses their own equipment or engages a contractor. The variance in these factors, particularly the distance to feedlot, mean that a single benchmark price is unobtainable. For the economic calculations we have used three prices for manure; $30, $40 & $50 per tonne.

By adding up the grain value in each of the three seasons (2023-25) and subtracting the cost of manure (for the manure treatments) or fertiliser (for the fertiliser treatments), a net margin was calculated (Figure 3). Note that no value for lost production was afforded to the green manure and fallow treatments.

The 2.5 t/ha rate of manure was the most profitable treatment regardless of price. The 5 t/ha manure rate was only competitive with the Nil treatment at the lowest manure price ($30/t). Other treatments lost money compared to the nil treatment.

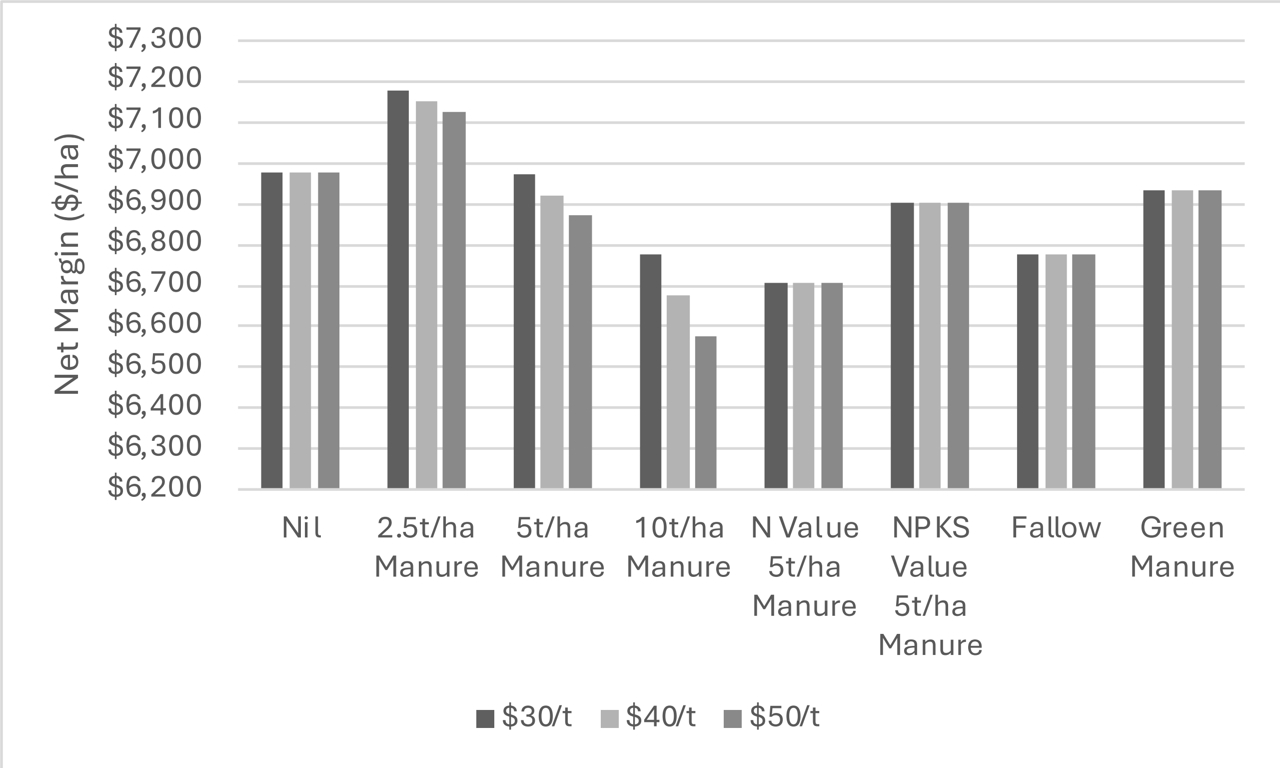


Figure 3 Economics of manure application.

ACKNOWLEDGEMENTS

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the authors would like to thank them for their continued support. This project is supported by GRDC through the National Grower Network (NGN) under GRDC project code: RPI2206-003SAX. Thanks go to the Inchbold family and their staff, as grower co-operators.

Authors: Ben Morris, Tom Price and Rebecca Murray, FAR Australia

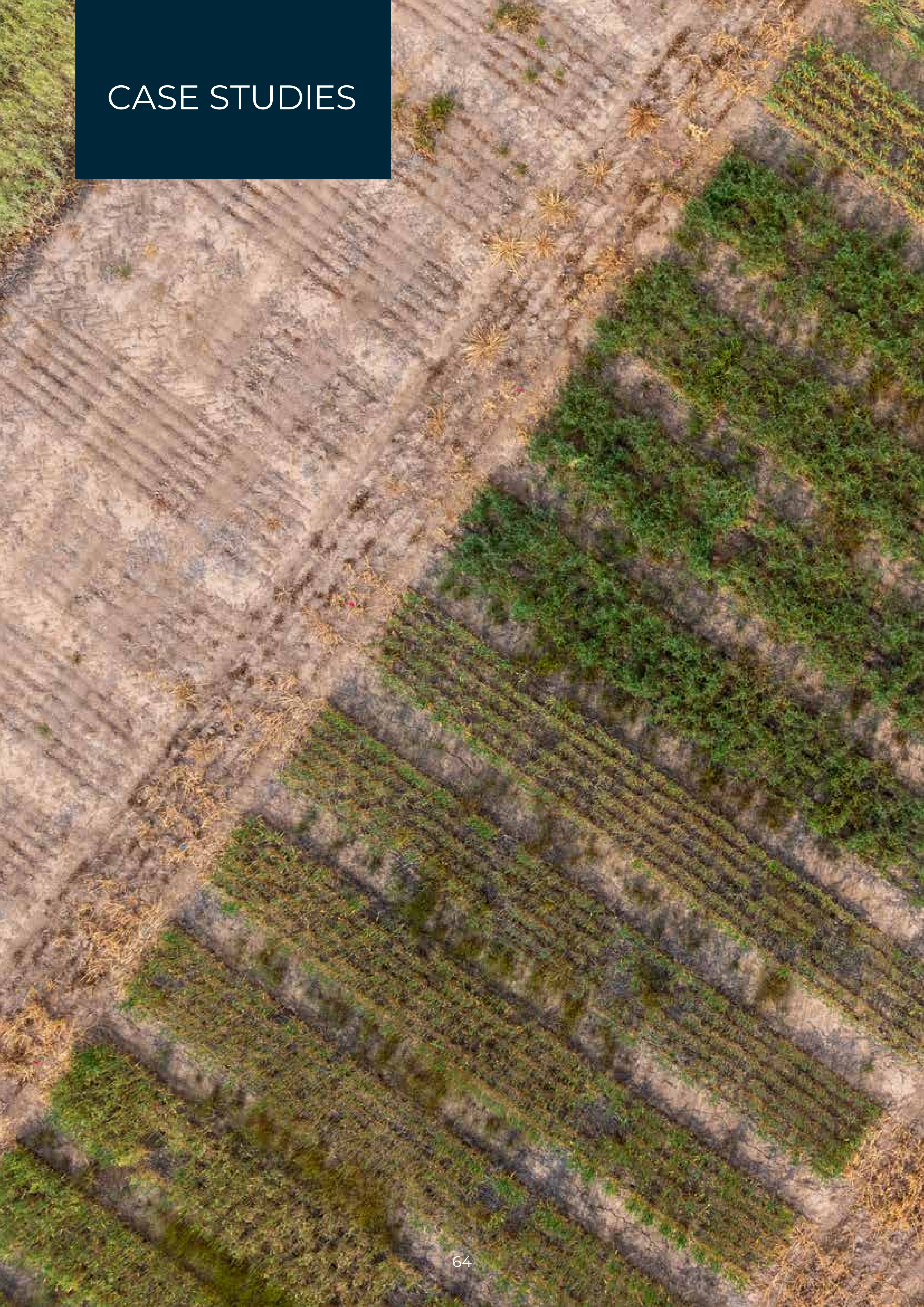
Ben Morris

FAR Australia
Shop 12, 95–103 Melbourne Street,
Mulwala NSW 2647

0400 318 334

ben.morris@faraustralia.com.au

CASE STUDIES



NSW DROUGHT RESILIENT MIXED FARMING SYSTEMS LONG TERM TRIALS IN THE RIVERINE PLAINS

KEY MESSAGES

- **Demonstration trials at Corowa and Burrumbuttock are investigating the effect of brown manuring, hay and different annual pasture species on biomass production nodulation and nitrogen fixation, as well as moisture carryover to the next crop.**
- **At Corowa, early vetch biomass production was relatively low, but the crop rebounded to produce a reasonable hay yield.**
- **The combination of drier conditions and different species growth habits likely affected the amount of biomass measured at Burrumbuttock by mid September.**
- **Acidic topsoils and dry conditions likely limited nitrogen fixation at both sites, limiting the potential for nitrogen accumulation.**
- **Follow-up soil sampling in 2026 will highlight any differences in carry-over moisture and soil nitrogen between treatments.**

WHY THIS WORK MATTERS

Mixed farmers across the Riverine Plains are constantly balancing risk and opportunity. They need cropping and livestock systems that remain productive through dry conditions, patchy rainfall and rising input costs. This makes every paddock decision critical: what to sow, how to manage it, and whether it can deliver more than one benefit within the rotation.

This challenge is the focus of the *Long-term trials of drought resilient farming practices in NSW* project, led by Riverine Plains. As part of this project, two demonstration sites were established on mixed farms near Corowa and Burrumbuttock to investigate the role of annual grazing legumes in crop rotations within mixed farming systems.

Riverine Plains' Field Trial Manager, Matt de Roos, explained that the demonstration site at Corowa is comparing the effects of brown manuring vetch and when it is cut for hay, while the Burrumbuttock site is looking at the effects of three different annual grazing legume species, including vetch, Persian clover and Arrowleaf clover.

"In both demonstrations, which each run for three years, we're assessing the impacts of these treatments on soil nitrogen, soil moisture and subsequent crop production in mixed farming systems," he said.

"By looking at the soil and crop benefits of including annual grazing legumes in crop rotations, Riverine Plains is aiming to support practices that improve drought resilience, reduce the reliance on costly nitrogen fertiliser, maintain soil moisture and provide valuable livestock feed in mixed systems," he added.

These demonstrations support a central replicated trial site established at Charles Sturt University's Wagga Wagga Campus, consisting of replicated 'mini farms' that represent different farming systems. Riverine Plains is using findings from these central hub trials, and input from farmers and advisors, to shape the paddock-scale demonstrations.

VETCH AT COROWA

WHAT WE DID

On 20 May 2025, Benetas vetch was sown in a 73 ha irrigatable centre pivot paddock, which was then managed by the farmer as a hay crop. Within this paddock, eight brown manure and hay cut demonstration boxes measuring 3 x 3 m2 were established at the edge of the centre pivot, with four irrigated treatments within the centre pivot area and the other four treatments in the dryland section. Although irrigation was available, it wasn't applied during the 2025 growing season.

Biomass samples were collected early in August, before the paddock was cut for hay. Nodulation assessments were also carried out, with plants scored from 1–5.

Soil samples were collected in late January 2026 to determine treatment impacts on nitrogen and moisture.

WHAT WE FOUND

Seasonal conditions

Dry conditions and extended periods without rainfall created challenging conditions in 2025. The Corowa demonstration site received slightly higher and timelier in-season rainfall (197 mm, May to November), than the Burrumbuttock site, supporting stronger growth and higher biomass production.

Biomass & below-ground assessments

In mid August, vetch biomass was relatively low and variable, with averages ranging from 1.3–3.0 t DM/ha across the treatments.

"Although biomass was relatively low in mid August, and the vetch appeared slow to get going, the farmer reported that the paddock rebounded to produce an average 3.7 t/ha of baled hay," said Matt.

Below ground, the picture was more nuanced.

"While nodule formation was relatively low overall, nodulation was noticeably higher in the irrigated demonstration strips than the dryland strips, likely because residual moisture and soil conditions were more favourable for rhizobial function.

"Soil testing also showed nitrogen was concentrated in the 0–10 cm depth within the profile, with much lower levels from 10–90cm, which was possibly linked to the previous year's irrigated canola crop," added Matt.

Acidic topsoil (pH Cacl2 4.1–4.7) across the 0–30 cm depths may have influenced nodulation and limited the crop's ability to fix nitrogen effectively.

"Overall, the first year's results from Corowa suggest that vetch can rebound to produce a good hay yield, even when early growth is modest.

"It also highlighted that legume performance is affected by seasonal conditions and soil constraints, that are not obvious from above ground" added Matt.

In 2026, the trial site will return to a grain crop, with follow-up measurements to include establishment, biomass, pre-sowing soil sampling, yield and grain quality.

COMPARING VETCH AND CLOVERS AT BURRUMBUTTOCK

WHAT WE DID

In 2025, a randomised strip trial was established in May within a 32 ha paddock near Burrumbuttock. The trial involved sowing 9 m x 600 m strips, each containing a different annual grazing legume species—vetch, Persian clover and Arrowleaf clover— with each strip replicated twice to compare their effects of on soil nitrogen and moisture.

Due to limited feed availability elsewhere on the farm, the paddock was grazed by 180 ewes and lambs for 26 days over late winter, before biomass cuts were taken in mid September. Nodulation assessments were also completed during the season to see how the various species treatments responded.

The paddock was sprayed out at the end of September, before livestock were returned to the paddock to graze the remaining biomass.

Soil samples were collected in late January 2026 to determine treatment impacts on nitrogen and moisture.

WHAT WE FOUND

Seasonal Conditions

At the Burrumbuttock site, 181mm rainfall was received from May–November. Dry conditions stalled early growth through the colder months, with the different pasture species never fully making up that lost ground.

Biomass & below-ground assessments

Biomass cuts in mid September showed vetch as the strongest performer of the three annual legumes, having roughly 50 percent more biomass after grazing than the Arrowleaf clover and nearly 60 percent more biomass after grazing than the Persian clover.

Matt explained that this was probably due to the different growth habits of the species.

“Persian clover is known for its ability to produce good spring feed, while Arrowleaf clover tends to produce more bulk in late-spring and early summer, while vetch was able to produce more bulk by September than the other species.

"We also noted a high proportion of other species, including grasses and other grazing weeds, present at varying levels across each treatment," he added.

Below ground, although nodules were present across all treatments they were generally small, which indicated that nitrogen fixation was limited, likely due to the drier seasonal conditions.

"Soil testing identified an acidic subsurface layer between 5–15 cm, which may have also contributed to slower growth and poorer nodule development as a result of suboptimal conditions," explained Matt.

"Overall, the Burrumbuttock demonstration site highlighted how annual legumes can provide flexible options under challenging seasonal conditions, in this case contributing nitrogen for next year's crop, while also providing a grazing option for livestock in 2025," added Matt.

In 2026, the site will be sown to wheat, with further measurements to determine the legacy effects of these annual pasture species.

Looking ahead

While these are only the first-year results, the longer-term value of the trials will come from following those paddocks through the next season.

The key questions now are practical ones: how much benefit carries through to the following crop, how consistent those benefits are across seasons, and how can annual pasture legumes offer more than one return—either as feed for livestock, support for nitrogen management, or as another tool for building resilience in an increasingly variable climate.

ACKNOWLEDGMENTS

This project is led by Charles Sturt University and received funding from the Australian Government's Future Drought Fund. Thanks to our farmer hosts Murk Schoen, Corowa and Joe Corrigin, Burrumbuttock, and to representatives of the project reference group.

For further information please contact Riverine Plains' Field Trial Manager, Matt de Roos by emailing matthew@riverineplains.org.au.

Australian Government Department of Agriculture, Fisheries and Forestry
Future Drought Fund
SOUTHERN NSW Innovation Hub SUSTAINABLE AGRICULTURE, LANDSCAPES AND COMMUNITIES
RIVERINE PLAINS

This project is supported by Southern NSW Innovation Hub, through funding from the Australian Government's Future Drought Fund

BUILDING DROUGHT RESILIENCE WITH VETCH IN MIXED FARMING SYSTEMS AT MURCHISON: A DEMONSTRATION

KEY MESSAGES

- **A demonstration trial at Murchison is exploring the effects of grazing a vetch/oat mix, while also considering the flow on effects of hay or brown manuring the crop.**
- **Despite poor early biomass production linked to a dry start, the vetch/oat mix supported Merino ewes grazing sections of the crop at 42– 84 DSE/ha for three weeks in August.**
- **Ungrazed areas of the vetch/oats mix produced up to 6150 kg DM/ha, highlighting the potential for the crop to have multiple end-uses (grazing, hay or brown manuring), for system flexibility**
- **Future monitoring will explore how retaining or removing biomass through hay or brown manuring affects ground cover and soil function, as well as different options for the mechanical breakdown of standing brown manure.**

TESTING A VETCH & OAT MIX IN A DRY SEASON AT MURCHISON

In 2025, a three-year demonstration site was established near Murchison to explore how vetch can be managed within the cropping phase to improve drought resilience in mixed farming systems. The demonstration is also extending insights from The University of Melbourne's central trial at Dookie.

Riverine Plains Head of Farming Systems, Jane McInnes, explained that while the region has an average annual rainfall of 523 mm, establishment of the demonstration coincided with a notably dry year (decile 2), creating an opportunity to observe how these systems perform under stress.

"This context shaped both the decisions made during the season and the outcomes from the trial, providing insights into how flexible management can support resilience in dry years," she said.

Designing the demonstration: grazing and end-use decisions

Morava vetch (sown at 40 kg/ha) and Wintaroo oats (sown at 14 kg/ha) were established as a mixed crop in 2025 to explore two key management questions: how does grazing influence crop performance, and how do different end-uses affect system outcomes?

To do this, different treatment areas were established to compare the effects of grazing on areas set aside for either hay production or brown manuring.

"Seasonal conditions played a major role from the outset, with the dry start delaying germination and limiting early growth, and this created uncertainty about whether grazing would be viable due to low biomass," explained Jane.

"As a result, there was initial hesitation to introduce livestock, however, discussions at a mid-winter field day led to a decision to proceed with grazing, albeit later than usual.

"This decision reflects a common challenge in mixed systems, where timing is often dictated by seasonal conditions, rather than pre-determined or historical management windows," said Jane.

On 1 August, 74 Merino ewes were introduced into the grazing area for five days, before an additional 73 head were added from the same original mob, to increase the grazing pressure to 84 DSE/ha. This mob was then removed 16 days later, on 22 August.

Each ewe was estimated to have a grazing pressure of 1.71 DSE, based on their age (14 months), condition score of approximately 3.5, a growth estimate of 50-60 g/day and an annual greasy fleece weight production of 5.5 kg.

"The livestock performed well on the mix, suggesting that the vetch and oats mix was able to support animal requirements," said Jane.

WHAT WE FOUND

Biomass cuts taken in mid September, 20 days after the end of grazing, showed 500 kg DM/ha of vetch and 1400 kg DM/ha of oats in the grazed treatment area, while the ungrazed treatment had 1050 kg DM/ha of vetch and 5100 kg DM/ha of oats.

"This result highlights the value of vetch/oats as a standing feed source for grazing animals, as well as its potential for hay or green manuring—with flexibility being key to its place in mixed systems," said Jane.

In mid October, the whole paddock was crop topped with glyphosate, before being mown for hay five days later, in keeping with withholding period requirements.

The vetch and oaten hay was baled on 20 October, yielding 6.5 t/ha, while the brown manured areas, totaling 1.4 ha, were left standing.

Jane explained that residue management is an important aspect of brown manuring, and the farmer used a stubble cruncher in February 2026 to help break down the mass ahead of sowing.

"There was a fair amount of standing brown manure, which took two passes with the stubble cruncher to get through — while this matter hadn't completely broken down by sowing, the farmer didn't report any blockages, noting that dry conditions at sowing probably helped the seeder track through more easily than if the material had been wet.

"By comparing the effects of biomass removal as hay, and biomass retention through brown manuring, the trial is providing insights into how residue management can contribute to soil health and moisture conservation in subsequent seasons," she added.

KEY TAKEAWAYS

The demonstration highlighted how strongly seasonal conditions influence both decision-making and outcomes in mixed farming systems.

While the dry year reduced overall biomass production, which in turn affected the timing and intensity of grazing, the crop functioned well as a feed source. Additionally, good biomass results in ungrazed treatments in mid September reinforced hay or brown manuring as a viable alternative to grazing.

"This supports the idea that mixed species pasture crops such as vetch/oats can provide multiple end-use options for farmers in dry seasons, highlighting the benefits of system flexibility rather than following a fixed plan," said Jane.

LOOKING AHEAD

This demonstration highlights the potential for vetch-based crops to support drought resilience in mixed farming systems.

Successful systems are those that balance competing priorities and adjust to seasonal conditions. By continuing to monitor these treatments over multiple seasons, the project will provide further insight into how these decisions influence productivity, soil health and resilience over time.

ACKNOWLEDGEMENTS

This demonstration trial was established as part of the Long-term economic, environmental, and social outcomes of drought resilience practices in mixed farming project (Victoria), led by the University of Melbourne, which received funding from the Australian Government's Future Drought Fund. Thank you to our farmer host, Rob Brown, Murchison.

AUTHOR

For more information on the project, please contact Riverine Plains Head of Farming Systems, Jane McInnes jane@riverineplains.org.au.

INVESTIGATING LONG TERM WEATHER OUTLOOKS: AGROMETEOROLOGY AUSTRALIA CLIMATE OUTLOOK

Can long-lead climate indices support decision-making in variable seasons, to support earlier risk management?

KEY MESSAGES

- **Monthly AgroMeteorology reports were shared with Riverine Plains Weather farmer co-operators between March and November 2025, to support early whole-farm season planning.**
- **Growers said they used the report most for the climate summary, indices and yield maps to compare nearby locations and check how the district was tracking.**
- **When the AgroMeteorology outlook tended drier in April, several growers thought it matched what later unfolded, but most said confidence in the forecasts would build only with regular use over time and more seasons to compare.**
- **Feedback from farmers suggested shorter, clearer summaries would improve usability. The north east and south east region split within the report confused farms near the boundary, so it's recommended to cross-check with other sources, including the BoM forecast and Agriculture Victoria Fast Break newsletter, then ground-truth with local gauges and recent rainfall, to refine decisions as the forecast period approaches.**

BACKGROUND

Australia has the highest crop-yield variability of any major grain-producing nation, making early decisions about inputs and yields target particularly risky. Traditional climate drivers such as the Southern Oscillation Index (SOI) and Indian Ocean Dipole (IOD) often do not give a clear signal until May or June, after many paddocks are already sown.

Long-range weather forecasting service provider, AgroMeteorology Australia (AgroMeteorology), has recently introduced new long-lead and now-time indices. These two indices are promoted as being able to pick up early climate signals that can develop into drier or wetter patterns from as early as February. If these indices are proven as reliable, they could provide advance warning of challenging seasonal conditions up to 12 months ahead, giving farmers greater planning opportunities.

In 2025, Riverine Plains subscribed to AgroMeteorology's, monthly long-range forecast reports. These were also shared with a select group of Riverine Plains Weather Station farmer co-operators for their feedback.

THE PROBLEM IN THIS REGION

A big challenge for Riverine Plains region growers is the sowing window forecast "blind spot", where key calls on logistics and expensive inputs often have to be locked in early, before there is a clear climate signal for the growing season. If the season turns drier, the farmer incurs costs through reduced paddock performance (yield) and increased budget pressure.

Agrometeorology is a commercially available long-term weather forecasting product that Riverine Plains is testing with local farmers over a two year period.

HOW THE DEMONSTRATION UNFOLDED

We tested whether the AgroMeteorology Climate Outlook report could support Riverine Plains growers in setting a whole-farm season plan earlier, instead of just using it as a forecast.

From April to November 2025, we shared the monthly report with a small group of growers hosting Riverine Plains weather stations, and encouraged them to use it alongside the Bureau of Meteorology (BoM) outlook when thinking about input risk and logistics.

After harvest, we reviewed which sections they used most, such as the climate summary, indices and maps, and interviewed growers about what they understood and trusted, and whether the report influenced any plans, timing or spend. We also asked what would make the report easier to use, then compared this with how they used the BoM outlook.

BENEFITS

Some growers said the Agrometeorology report gave them a different heads-up to that provided by BoM. When the April outlook leaned drier, several felt it matched what later played out, better than the BoM outlook at the time.

The main benefit was not any single forecast, but the regular monthly check-ins, which helped growers build a practical feel for the season and pay closer attention to stored soil moisture before spending on nitrogen. Growers also valued the report's yield maps to compare nearby locations and check whether their farm was tracking with the wider district.

TRADE-OFFS AND CHALLENGES

For most of the growers interviewed, the Agrometeorology report did not drive clear plan changes: it mainly acted as a heads-up, not a rule. One long-term subscriber still questioned how dependable it is across seasons, noting it can line up well some years and miss in others, and no forecast is right every time. Several growers said confidence would build with regular use over more seasons.

The biggest barrier was readability. Long paragraphs and technical language meant some growers did not use the report as often as they could have. The north east and south east region split also confused farms close to the boundary.

Confidence was another challenge. Some growers prefer multi-model products because when several forecasts point the same way, it is easier to act. For example, Agriculture Victoria's Fast Break newsletter summarises recent climate drivers and brings together three-month model guidance on oceans, rainfall and temperature for Victoria, providing greater confidence in the information.

AGROMETEOROLOGY VS BOM

BoM and Agrometeorology forecasts can show different signals because they summarise the climate in different ways. BoM reports model probabilities and presents maps such as the chance of above-median rainfall, with notes on confidence and key climate drivers, and it updates these outlooks regularly. Agrometeorology places more weight on weather patterns and uses indices, similar past seasons and a crop model to turn the climate signal into soil moisture and yield ranking guidance, backed by a written interpretation for cropping.

CLARIFYING BOM TERMINOLOGY

- Neutral does not mean "average rainfall". It means there is no strong signal, so the chances are roughly one-third each of drier, near-median or wetter conditions. In practice, it means plan for any outcome.
- Likely to be above average (60% to 80% chance) means that out of 100 model runs, about 60 to 80 were wetter than the median, leaving a 20% to 40% chance of the opposite outcome.

THE PRACTICAL TAKEAWAYS

The Agrometeorology report mostly worked as a heads-up, rather than a trigger for specific plan changes. Shorter summaries and less technical language would make the reports easier for growers to read and use.

BoM and Agrometeorology add value in different ways. BoM shows the probabilities, while Agrometeorology puts the climate patterns into a cropping context, providing soil moisture and yield guidance.

Confidence improves with regular use over time, more seasons to compare, and when a few sources tell the same story. The biggest benefit was the regular check-ins that help build a practical feel for the season, rather than relying on one forecast.

PROJECT ACKNOWLEDGEMENTS

This case study validation was supported by funding from the Victoria Drought Resilience Adoption & Innovation Hub, through funding from the Australian Government's Future Drought Fund. Riverine Plains is the Vic Hub's North East Node lead.

Thank you to Agrometeorology Australia for allowing 13 farmers to test the service for free. Special thanks to the farmer co-operators of the Riverine Plains weather station network for providing feedback on these new forecast products.

Author: Peter Chen, Riverine Plains

Email: peter@riverineplains.org.au

GROWERS JOIN FORCES TO TACKLE STUBBLE-BORNE DISEASE

KEY MESSAGES

- **Two years of break crops (faba beans followed by canola) reduced Fusarium crown rot levels from 'high' to 'below detection' in northern Victoria, demonstrating the benefit of crop rotation in controlling the disease.**
- **PREDICTA® B testing across the Riverine Plains catchment in southern NSW and northern Victoria in March 2025 showed 57% of paddocks had medium to high levels of Fusarium crown rot.**
- **Soil acidity is thought to exacerbate Fusarium crown rot severity.**

With Fusarium crown rot estimated to cost Australian growers about $404 million a year in lost production, Riverine Plains is exploring ways to mitigate losses now mounting in southern New South Wales and northern Victoria.

Management measures to overcome yield losses to Fusarium crown rot (FCR) – once considered a predominantly northern problem – are now being trialled in growers' paddocks in southern New South Wales and northern Victoria.

With GRDC investment, Riverine Plains and the NSW Department of Primary Industries and Regional Development (DPIRD) are leading the work by raising awareness of the disease in southern regions where many growers are reported to be unaware this stubble-borne disease is present.

NSW DPIRD Senior Scientist Dr Steven Simpfendorfer says all cereal crops host the FCR fungus, but pulses and canola do not. This makes break crops an obvious strategy; however, the effectiveness of a break crop in reducing FCR risk depends on the season. Moisture is needed to break down cereal stubble and remove the pathogen from the host.

"The pathogen survives inside the stubble of the cereal plant and, in high production years, a lot of inoculum goes back into the system," Dr Simpfendorfer explains.

"As a consequence, FCR is not a single-year disease. You have to think about how well cereal stubble has been broken down over an extended period."

White heads and stem browning at the base of plants are typical symptoms in a dry seasonal finish. In favourable cropping seasons, FCR can reduce yields without showing any symptoms.

Riverine Plains Head of Farmer Engagement Kate Coffey says this can be why most growers do not think they have FCR because they have not observed symptoms.

"Also, many growers think it's a northern NSW and Queensland disease."

VICTORIAN TRIALS

On a cold morning in July, about 20 growers gathered in the corner of a paddock at Lee Menhenett's farm near Arcadia (south of Shepparton) in northern Victoria. They were there to learn about a trial exploring the activity of a seed treatment to suppress the disease.

The trial is evaluating Victrato® (cyclobutrifluram), a new seed treatment that aims to suppress FCR in cereal crops.

Among the gathering was Riverine Plains Project Officer Sabita Duwal, who said Lee's soil and stubble from where Scepter wheat was sown in 2024 were sent for PREDICTA® B testing in March 2025. The results showed a high risk of FCR for Lee's 2025 wheat crop.

Subsequently, a replicated strip trial was established to assess seed treatment strategies. Riverine Plains will assess the treatments at grain fill and after harvest for:

- FCR stem browning and whitehead incidence
- yield and quality
- post-harvest PREDICTA® B soil test and cereal stubble test for FCR levels.

Researchers and advisers often suggest growing barley when FCR is a threat because it generally has a shorter growing season. Barley still hosts the fungus, but it completes grain filling before late-season moisture stress, resulting in less yield loss compared to wheat.

SYSTEM SIMPLICITY

Sending soil and cereal stubble for PREDICTA® B testing is recommended as the best way to avoid planting another cereal crop into a paddock with a high risk of FCR. However, tackling FCR also comes down to different approaches to risk management according to growers' individual cropping regimes.

While Lee Menhenett knew growing wheat after wheat was not ideal, he would prefer not to grow barley because it added extra complexity to his system.

Speaking at the gathering on his farm, he said he understood that he could potentially lose yield from the second wheat crop. Nonetheless in 2024, one of his wheat-on-wheat crops yielded 6.2 t/ha despite a tighter finish.

After 2 wheat crops, he grows a double break of faba beans followed by canola. This is crucial (mainly to drive down the annual ryegrass population), but also because these crops do not host FCR.

He hoped that Victrato® (cyclobutrifluram) would suppress FCR in his second wheat crop.

INTER-ROW SOWING

Although Lee was keen to see the effects of the new seed treatment on wheat yield, he said his primary FCR mitigation strategy was inter-row sowing.

This involves planting wheat seed between the rows of the previous year's cereal stubble to minimise the new crop coming into contact with inoculum.

Dr Simpfendorfer's research across locations and seasons in NSW has shown that inter-row sowing can roughly halve the number of wheat plants that become infected with FCR.

Standing in Lee's paddock, Riverine Plains' Sabita Duwal said 70 to 76% of the FCR fungus resided 7 cm upwards from the base of the wheat plant.

Riverine Plains Head of Farmer Engagement Kate Coffey added that, further to this stem infestation, the fungus was also found below ground.

"Even if you burn the stubble, the (root) crown of the wheat plant can remain in the soil, allowing the fungal pathogen to persist."

STUBBLE RETENTION

For his part, Lee rarely burns stubble. The exception is when there has been a complete disaster with lodging, a rare occurrence in newer wheat varieties.

To increase the breakdown of previous wheat stubble and to minimise trash flow issues at sowing, he smashes his canola and faba bean stubbles using a double knife roller. Residual wheat stubble is also pulverised at this time.

LIMING AND ROTATION

Another experiment being undertaken is exploring the effects of liming and rotations on FCR.

In 2021, Riverine Plains started a stubble management trial on Paul Brown's paddock near Murchison, Victoria.

The following year, the researchers discovered an acid layer with a pH_{Ca} of 4.5 in the top 10 to 15 cm of soil.

To ameliorate the acid layer, in March 2022, Paul applied 6.7 t/ha of lime and incorporated it with heavy tillage machinery.

In 2023, the researchers identified medium to high levels of FCR across all treatments.

In response, Paul burnt the stubble and sowed the paddock to faba beans in 2023 and canola in 2024. PREDICTA® B tests in early 2025 showed non-detectable levels of FCR.

The demonstration site showed that the treatments that had mechanical incorporation of lime lifted pH_{Ca} in the 10 to 15 cm layer.

Surface application of lime was not effective in increasing pH below the surface.

"It is worth incorporating lime to ensure you are moving the ameliorant to the depth of the acid band," Paul said.

"The surface-applied lime is still on the surface, even though it was applied 2 years ago, and so is doing nothing to ameliorate the subsurface acidity."

ACID-SOIL-FCR LINK

Ms Coffey said that although there was no proven link between soil acidity and FCR, a Riverine Plains liming demonstration with replicated treatments at Rutherglen, Victoria, showed limed treatments had low levels of FCR, while the unlimed treatments had high levels of FCR.

"FCR will block the capacity of plants to take up water during spring," she said. "If you have an acid soil limiting root growth, it's like a double whammy.

"The plants have aluminium toxicity and FCR working against them."

Ms Duwal added that acid soil also suppressed beneficial soil organisms, which enabled FCR to dominate the microbial community.

Along with Lee's paddock and Paul's paddock, Riverine Plains is monitoring 14 other paddocks through southern NSW and northern Victoria for FCR.

"GRDC investment is enabling us to record the FCR levels with PREDICTA® B tests until 2026," she said. "This will allow us to verify the FCR level each year and at the end of the rotation."

More information: Steven Simpfendorfer, steven.simpfendorfer@dpi.nsw.gov.au

Kate Coffey, kate@riverineplains.org.au

Sabita Duwal, sabita@riverineplains.org.au

Lee Menhenett, lmenhenett@bipond.com

Paul Brown, paulbrown1986@hotmail.com

This article first appeared in GRDC's GroundCover magazine, issue 179, November-December 2025. It is published online at groundcover.grdc.com.au.

GRDC Code: RPI2309-002SAX

Author: Nicole Baxter

RIVERINE PLAINS

CASE STUDY: With Tony Ludeman

WHEAT AND VETCH AS A COMPANION CROP

The *Extending results from the Soil CRC Plant Diversity* project is looking at the benefits and challenges of using cover and companion cropping to increase diversity and improve soil health in the Riverine Plains.

As part of this project, we spoke with Waggarandall farmer, Tony Ludeman, about his experiences of companion cropping wheat and vetch, including vetch termination and brown manuring.

Q: Tell us a little about your farming system

We crop about 2400 hectares at Waggarandall, near Dookie, in north east Victoria.

Our soil types vary quite considerably from nice rising red country, down onto some high pH black soils, to a light loam then into some heavy clays. Our normal annual rainfall is about 525 mm.

We're trying to get into a three-year rotation of wheat and canola, with beans as our legume.

Q: Why did you first look at companion cropping wheat and vetch?

We tried wheat and vetch as a companion crop in our system when we were trying to get a legume going on lighter soils. We grew beans on the better soils, but on the lighter soils, we were struggling to get them to go the first year.

So we tried sowing wheat and vetch together as a hay crop, as there’s a reasonable market for good quality hay, particularly vetch hay with some cereal in it.

It worked fine for the first year or so, but then we ran into some wet springs, which made it quite challenging trying to dry hay.

Q: What did you try next?

Our next thought was to sow wheat and vetch together, then spray an area of vetch out in one year — this meant that we could have some flexibility if the season was going to be wet and if we needed, we could go back to just harvesting wheat.

We tried it on a little area and it seemed to work pretty well.

That year, we had a pretty good spring, and the wheat where we sprayed the vetch out yielded just under 5 t/ha, while wheat-only crops in the area were doing around 8 t/ha. So, it was back a bit, but still yielded quite well, with extremely good protein and huge grain.

Q: Have you had a look at different termination timings of vetch?

We did another strip in the same area to compare different times of spraying (termination). The first strip was sprayed out in August to knock the vetch right down and the other strip was sprayed out in October, after the wheat had flowered.

The later termination didn't yield anywhere near the same, at about 2.3 t/ha, so it definitely paid to take out the vetch early.

Q: What worked well ?

Sowing vetch and wheat together gave us an option if we thought the season was going to be too wet for the hay, or if hay prices were down. Having an option to spray out the vetch and just take the wheat through to harvest is good, because it's a lot easier logistically.

Q: What did you find challenging?

The challenging side of it was actually controlling the vetch as it tended to want to come back. When terminating the vetch late, for example in the second year that we did it, we weren't able to get that 100% control, meaning the vetch seeded and we've had to control it in future crops.

Q: Did you see a nitrogen effect?

Yes, there was, but we didn't see any difference where we took out the vetch earlier compared to later. It was just a good legume crop.

Q: Have you tried brown manuring?

In another trial with our vetch and wheat, we left an area in a paddock that went to hay. We sprayed out the crop in this area, knocked it flat on the ground with a stubble cruncher and just left it. It went into wheat the following year and we couldn't see any difference between where we brown manured and where we cut for hay.

However, the following year it went into canola and it really stood out. While we tried to get a yield off it, we had a huge hailstorm that spring — it was nearly a wipeout — so, unfortunately we didn't get any results out of that trial.

Q: What about disease and agronomy?

The reason for having a cereal of sort in the in the mix is to try and keep the vetch up and disease out of it.

For our wheat and vetch companion hay crop, we sowed at a rate of about 45 kg/ha vetch and 10 kg/ha wheat. While there weren't many wheat plants in it, it was surprising how well it yielded.

When we tried sowing wheat and vetch together again the following year, we increased the wheat rate up to 15 kg/ha, to try and get a little bit more wheat there and hopefully yield a little bit better, but it didn't really.

We didn't see any disease, but we did spray fungicides out for disease in the vetch. Our agronomist made the point that having a cereal in there and then going back to a cereal meant we could be carrying leaf disease through the two cereal crops in a row. But that could be fixed with going to canola the second year.

Q: Would you do it again?

We trialled the vetch and wheat for hay on really light country, where we didn't think the beans would perform as well. And we did have a market for hay, so it gave us an option at the time.

But since then, we've been able to get the bacteria (rhizobia) going in the soils after a couple of crops of legume, and the beans on that lighter country are performing quite well.

So, we haven't done it again since — the wetter conditions meant that we've just stayed with beans as our legume.

Q: How did it stack up financially?

On our poorer soils, the vetch and wheat hay was a good option, but then as we started to get some wetter springs, hay was hard work.

Did it stack up financially? Probably not, but it did provide us with an option in those years.

Where we sowed vetch and wheat together, then sprayed out the vetch early leaving just the wheat, it performed well financially at the end.

However, while it did work, financially we've gone back to the faba beans as our main legume.

I guess if we get back into some drier seasons, normal seasons where you're prepared to take the risk on hay and you wanted to spray out some vetch, we'd look at it again.

ACKNOWLEDGEMENTS

Thanks to Tony Ludeman, Ludeman Ag, for being part of the Extending results from the Soil CRC Plant Diversity project case study. This project of the Regional Drought Resilience Planning program is supported through funding from the Australian Government's Future Drought Fund and the Victorian Government.

RIVERINE PLAINS

CASE STUDY with Abe Gibson, Southern Cross University

SUMMER COVER CROPPING & COMPANION CROPPING IN THE RIVERINE PLAINS

EXTENDING RESULTS FROM THE SOIL CRC PLANT DIVERSITY PROJECT

As part of the *Extending results from the Soil CRC Plant Diversity* project, Riverine Plains is examining the potential role of summer cover cropping and winter companion cropping to increase diversity, improve soil health and increase drought resilience in the region.

In this Case Study, Southern Cross University Researcher, Abe Gibson shares his insights and experiences of summer cover and winter companion cropping, referencing results from a long-term trial established during 2019 at Burramine, near Yarrawonga in north east Victoria.

Q: How could summer cover crops and companion crops benefit the Riverine Plains?

In the Riverine Plains region, grain farmers typically follow a wheat/canola rotation, with pulses making up a smaller part of the rotation due to their sensitivity to acid soils and inconsistent yields and pricing.

The issue is that monoculture systems—where only one species is sown at a time—tend to have a high export of product from the paddock and this depletes soil organic matter.

Researchers think that increasing the level of diversity in the system can add more biomass and diverse root exudates (secretions) to the soil, helping to promote healthy soil nutrient cycling and a healthy soil ecosystem.

This increased biomass also has potential to increase soil organic matter and soil carbon.

Since 2019, we've been running a trial near Yarrawonga, Victoria, as part of Soil CRC projects looking at the role of plant diversity in building soil resilience. We've been looking specifically at two options—summer cover cropping and companion cropping—for their potential to build plant diversity and contribute to drought resilience in the longer term.

Q: Briefly, can you describe summer cover cropping and companion cropping?

Summer cover crops are grown over the summer fallow period and aim to provide a living ground cover for soils, compared to retained stubble. They can provide protection from wind

RIVERINE PLAINS

and water erosion, increase infiltration rates and provide a potential source of nitrogen and root material. They're different to summer crops grown for grain (eg. maize).

Companion cropping uses winter rainfall to grow more biomass during the season and involves sowing two (or more) crops together at the same time. Wheat and vetch are commonly used because farmers can obtain the nitrogen fixation and diversity benefits from the vetch, while also being able to carry the wheat through to harvest.

In our trial we've been looking at two different types of companion cropping; **temporary** and **synchronous companion cropping**.

Temporary companion cropping involves sowing more than one species at the same time, then terminating one species and carrying the other through to harvest. Temporary companion cropping wheat and vetch offers an easier way to introduce diversity to systems because farmers don't have to harvest two species at once, or separate seed.

Synchronous companion cropping involves sowing and harvesting two or more species together. In this project, we're looking at faba bean and canola sown together (beanola) and field pea and canola sown together (peaola). In this system, both crops are taken through to harvest, with the different seeds separated using a grader after harvest.

Q: Which crops have you compared?

So far, we've had six years of summer cover crops, and since 2023, our summer cover crop treatments have included:

- Low diversity, three species summer cover crop mix of sunflower, millet and cowpea
- High diversity, nine species mix of sunflower, safflower, sorghum, millet, cowpea, buckwheat, radish, turnip and sunnhemp
- Fallow

We've also had three years of temporary companion cropping, with clover/wheat and two years of vetch/wheat. In 2024, we had synchronous companion cropping with beanola and peaola.

Q: Broadly, what are you looking for?

Overall, we're seeing if we can promote yields by increasing diversity within a system, or, whether summer cover or companion crops negatively impact the main winter crop yield by using up soil water, soil mineral nitrogen, or competing for other resources.

We're also interested in the soil health impacts—so looking at things like soil carbon cycling, soil nitrogen cycling, soil respiration and microbial activity—to see how these impact the bottom line, and if they can be used to demonstrate sustainability credentials.

Q: Do you think summer cover cropping has a place in the Riverine Plains?

Since 2019, we've observed some benefits but also some drawbacks to summer cover cropping.

Having living ground cover over the summer fallow period is a nice idea, and where we've had years of 1.5–3 t/ha of biomass, we've seen some soil health improvements. When you can generate that level of biomass over the summer, it also provides options for livestock grazing or hay, if that suits your system.

However, we've also seen that establishing this biomass can be quite difficult. And while we've had a couple of good years, we've also had some ordinary ones where we've only had 200–300 kg/ha biomass. This is because over our summer periods, rainfall usually occurs during intense storm events, followed by long, dry, periods of high evaporative demand, drawing up soil moisture and making it hard for summer cover crops to grow.

Compared to stubble retention, having a living ground cover can provide benefits to soil, when that high biomass can be produced. But, in dry years, seed and starter fertiliser costs are sunk costs, and are a potential loss for the farmer.

Q: What does summer cover cropping do to soil moisture ahead of the next winter crop?

Summer cover crops can definitely deplete soil water available for the next winter crop.

While we haven't seen statistically significant individual impacts on soil moisture or soil nitrogen on a year-to-year basis, there's been a general trend to depleting the amount of soil water and mineral nitrogen available at sowing with increasing summer cover crop biomass. This can lead to a 1–3 percent, decrease in the main winter crop yield, sometimes even as high as 10 percent in high biomass production years.

As such, farmers need to consider the trade-off between the benefits of havinga living ground cover over summer, and the next winter crop yield.

Q: How do livestock fit in with summer cover cropping?

Although we haven't looked specifically at any grazing benefits, or integration of livestock in this trial, having a living cover provides an opportunity to produce better quality feed and maintain livestock condition over that summer fallow period, *when* you can generate that biomass.

Q: Does companion cropping have a fit in the Riverine Plains?

In our temporary companion cropping treatments, where we've sprayed out the vetch and taken the wheat to harvest, we've generally seen a slight suppression of wheat biomass when the vetch was terminated after 6–8 weeks of growth, compared to the wheat-only treatment. However, favourable conditions over the last few years meant wheat biomass has tended to catch up by flowering.

Overall, we've seen up to 1 t/ha vetch biomass produced, which is considered additional biomass on top of the wheat biomass we've produced. Although we've produced this additional biomass, we still haven't quite seen any changes to soil organic matter and soil organic matter cycling as a result of that.

Beanola and peaola were included for the first time in 2024 as part of the synchronous companion cropping trial. The 2024 season was very favourable for faba bean growth, with the beanola treatment yielding higher per unit of land area than canola or faba bean sown on their own. However, in 2024 the site also experienced a late frost, which impacted field pea yields. This resulted in the peaola combination giving higher yields per unit of land area compared to the field pea monoculture.

In terms of synchronous companion cropping with beanola and peaola, there's potential to increase the yield per unit of land area, which can then improve gross margins compared to growing a monoculture of the same crop. If farmers can partner those yield improvements with improvements in their margins, along with improvements to soil health, that has potential for being more resilient to climate extremes and operating more sustainably in the long term.

Q: Financially, which systems performed the best?

For the synchronous companion cropping system in 2024, a one-year analysis showed the gross margins on the beanola was nearly double that of canola and considerably more than faba beans grown on their own.

We had a really good year for faba beans in 2024, due to high yields and good pricing, and their return was also a lot higher than the monoculture canola.

Our field peas suffered from frost, so they actually represented a loss for us from an operating point of view. Peaola returned a gross margin slightly higher than canola alone.

We also conducted a two-season rotational gross margin for all treatments from 2023–2024.

A key message was that poor summer cover crop establishment was a risk, with only two good summer crops in six years due to unreliable rainfall. The more expensive the summer cover crop establishment cost (seed, fertiliser, weed control etc), the greater the negative economic impact of poor growth.

The analysis did not show a significant enough difference between all the other options to confidently choose summer cover crops based on the results of this trial. Further analysis, including nutrient availability and water storage, may alter these results.

Q: Were there any soil water changes from cover or companion cropping? Could this improve drought resilience?

After a high-rainfall summer which generated 2–3 t/ha of summer cover crop biomass, we found an increase in soil infiltration. The theory is that the summer cover crop, as a living ground cover, creates lots of roots under high biomass conditions, which in turn can lead to better soil aggregation. This aggregation can improve infiltration, while the root channels also provide more pathways for water to infiltrate the soil.

While we only saw this in one year of the trial, we're looking to investigate the principles and processes that could lead to better infiltration. If we can achieve higher infiltration through higher plant diversity, this offers potential to buffer farming systems against drought by capturing more water and allowing it to be stored at depth.

In the future, we'll also be looking more closely at aggregate stability and any increases in soil organic nitrogen, which is important for getting soil particles to stick together and form aggregates.

We'll also be looking at whether the addition of organic matter results in any changes to water holding capacity. From this, we're hoping to see possible outcomes for building soil health. This is a slow process because it's an incremental addition of biomass year-by-year. We're heading into our seventh year in 2026—and it's between here and potentially the tenth year that we really think that the soil health results are going to come through.

Q: What are the key messages for farmers about summer cover cropping and companion cropping in the Riverine Plains?

The trials so far tell us that while summer cover cropping can provide benefits by being a living cover through that summer fallow, it's an opportunistic practice that is only really leveraged when summers are going to be wet and you can guarantee that that biomass is going to be generated.

On the other hand, our in-crop companion cropping options, whether temporary or synchronous, are showing real promise because they suit our winter dominant rainfall patterns, which are more reliable.

Our companion crop treatments have provided additional biomass, and in the case of the case of synchronous companion cropping with beanola and peaola, they've provided additional yields and better gross margins. Temporary companion cropping with wheat and vetch (terminated 6-12 weeks after sowing) also hasn't shown any yield suppression of wheat as a result of competition mechanisms. It also offers nitrogen fixation benefits and the potential for diversity to build soil health.

For further information, visit
www.riverineplains.org.au

ACKNOWLEDGEMENTS

This Case Study was produced as part of the Extending results from the Soil CRC Plant Diversity project. This project of the Regional Drought Resilience Planning program is supported through funding from the Australian Government's Future Drought Fund and the Victorian Government.

Thanks to Abe Gibson, Southern Cross University, and Eric Nankivell, Farmanco, for their contributions. This article features outcomes from the Building soil resilience and carbon through plant diversity and Increasing Plant Diversity projects, funded by the Soil CRC. The Increasing Plant Diversity project was supported by the Goulburn Broken CMA through funding from the Australian Government's National Landcare program.

RIVERINE PLAINS
SOIL CRC

Australian Government Department of Agriculture, Fisheries and Forestry | Future Drought Fund
AGRICULTURE VICTORIA
GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY
GOULBURN DROUGHT RESILIENCE PLAN IMPLEMENTATION GROUP

RIVERINE PLAINS

A CASE STUDY WITH DON PIPER

INSIGHTS INTO SHEEP STOCK CONTAINMENT AREAS

Stock containment areas are valuable livestock management tools that can increase drought resilience, protect soils and improve efficiency and productivity.

As part of the Victoria Drought Resilience Adoption and Innovation Hub, delivered through funding from the Australian Government's Future Drought Fund, Riverine Plains has been working with farmers in north east Victoria to raise awareness of stock containment areas.

In this article, Don Piper — a mixed sheep and crop farmer from Earlston near Violet Town — shares his experiences of using stock containment areas, including their benefits and design.

For Don Piper, stock containment areas have become an important tool for managing soil health and enhancing productivity.

Joining approximately 3400 ewes annually, their self-replacing Merino and composite sheep flocks are the main part of the family's farming operation. The Merinos comprise 60 percent of the total flock, with the composites making up the other 40 percent on the 1420 ha farm.

Through targeted genetic selection, Don is developing a more "dual-purpose" Merino flock, with improved do-ability and meat yield.

The ewes are joined in late January to lamb in June and July, aligning stock feed demands with feed supply curves. Broadacre cereals are also grown, mainly for livestock feed on-farm.

IMPROVING PERFORMANCE

Don is passionate about continuously improving the performance and sustainability of his livestock, pastures, crops and soil.

This has led Don to expand and improve his existing containment area, so that it now has the capacity to hold over half his flock at a time.

"The main reason behind the move was to achieve our minimum ground cover target of 90 percent to address our soil health concerns.

"By achieving this, we've found the country responds very quickly to autumn breaks, and does more on less rain than bare paddocks.

"Secondly, it allows us to carry more breeding ewes without turning the paddocks to dust".

It's recommended that pastures be kept at a minimum 70 percent ground cover to prevent erosion — when this threshold is reached, stock should be moved to a paddock with greater ground cover, or to a stock containment area.

Don places a high value on having an area to hold stock, as it provides pastures the opportunity to recover between grazings, following rain, or during a dry period.

"It also allows us to build a feed wedge before ewes are reintroduced to the paddocks," he said.

CONTAINMENT AREA DESIGN

Before beginning, Don did a lot of research and consultation to ensure the purpose-built yards — which are set up for multiple uses beyond drought feeding — would meet their needs.

A major challenge was deciding on the most suitable size and number of stock for the containment feeding pens.

"Despite information suggesting small areas are best, we went with larger to provide more room for exercise," Don explained.

"Our pens are 100 x 50 m, with separate feeding pens of 25 x 100 m, which is a different design to a lot of pens. This allows us to put out feed trails without the risk of running over sheep, and we've found it reduces wastage as the animals tend to spread out quickly across the feed trail, rather than running along chasing and trampling feed.

"In a feedlot situation it also means we can use the feedout pens as feedlot pens, and have smaller lots of lambs in some pens and bigger lots in others, allowing for more weight groups.

A stocking density of 5 m^2/sheep or lamb is recommended to reduce dust and decrease infrastructure costs per head.

"We tend to put a maximum 800–850 crossbreed or composite ewes and a maximum of 700–750 merinos in these pens. While we have pushed it to 950, we noticed a higher percentage of shy feeders in comparison to having lower numbers."

More information on stocking densities and stock containment areas can be found at [Stock containment areas | NSW Government].

ACCESS TO LANEWAYS & YARDS

A laneway connects the stock containment area to nearby yards and paddocks, with Don finding the laneways valuable for allowing ewes to 'stretch their legs' while in containment.

"On a weekly basis the sheep roam a laneway for a day, which helps them remain active, and we've found this helps a lot with ease of lambing later on," he said.

SITE DESIGN AND LEARNINGS

The site was built around established gum trees that provide shade for a large proportion of the pens. Water is sourced from a nearby rainfed dam, reticulated to troughs within each pen.

In March 2023, Don hosted a Riverine Plains Demonstration Day, featuring discussions on stock containment area design, use and benefits.

"The day prompted you to really consider important aspects including location, slope, shade, and proximity to water and yards," he said.

Don also says that simple things like planning where excess water will go in the pens, and keeping feed and water at separate ends, can help avoid pens becoming bogged.

FEEDING

Don uses a feed mixer pulled behind a tractor to supply feed into troughs in each pen.

When feeding, a key learning was to be able to draft shy feeders into a separate pen and not to mix different sheep breeds within pens.

"At first, when we didn'thave enough pens, I boxed some Merinos and composites together and the Merino's were bullied," he said.

Don also recommends using a ruminant nutritionist to help tailor the feed mix, using feedtests from the feed you have available.

NOT ONE SIZE FITS ALL

A stock containment area needs to be tailored to each operation, which means they often vary greatly between farms. Each aspect of the design, location, materials, feed and water systems should be considered within the landscape, livestock class and overall operation — which also means they require detailed planning.

"When first starting out, I'd encourage people to go look at some pens people have made and used," Don recommends.

MULTIPLE USES

Stock containment areas can serve multiple purposes beyond drought management.

Given the nearness of Don's stock containment area to his yards, the area also serves as valuable holding pens for stock prior to entering the yards. This reduces stress on the animals and increases handling efficiency, allowing Don to check his stock more often, which helps with timely management.

"We get them in quite regularly to do condition scoring, and this allows for much more even lines of ewes. I'm also sure this equates to higher conception rates and more foetuses carried through," he added.

As with any on-farm innovation, there are always opportunities to improve and Don is looking into automatic feeders to see if they can improve feeding efficiency and reduce the time required.

ACKNOWLEDGEMENTS

This Case Study was produced as part of a Victoria Drought Resilience Adoption and Innovation Hub project, through funding from the Australian Government's Future Drought Fund.

Riverine Plains is the North East Node Lead for the Victoria Drought Resilience Adoption and Innovation Hub. We sincerely thank Don Piper for sharing his experiences and insights.

Riverine Plains Inc.
Shop 9
95-103 Melbourne Street
MULWALA NSW 2647
ABN 95 443 809 873