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GRDC

GROUNDCOVER SUPPLEMENT

NATIONAL GROWER NETWORK (NGN)

The NGN: Listening, learning and responding

By Peter Bird, Stephen Loss and Gillian Meppem

Senior Regional Managers – West, South and North

Photo: FarmLink

Rhizoctonia patches in a wheat crop.

■ Entrepreneurs have a golden rule for product development: engage with stakeholders and ensure there is actually a market for your innovation. Research, development and extension follows the same principle.

The responsibility of spending levy payer and taxpayer dollars means we have to be on the ground, engaging and listening to growers – truly understanding limiting factors or opportunities available to enhance their profitability, sustainability and resilience.

In 2021, GRDC recognised an opportunity to evolve how it undertakes stakeholder engagement. The goal was to develop a more open community or network approach to understanding and responding to grower issues across GRDC's regions.

As a result of these changes, GRDC's National Grower Network (NGN) involves GRDC staff – primarily grower relations managers – getting on the road, visiting grain growing communities and listening to how they would like their levy payer dollars spent. The NGN also provides the opportunity to dive deep on local issues to better understand impact, and GRDC's opportunity to invest, at a sub-regional level.

The key features of this national engagement process are the ability to:

1 Support meaningful engagement with growers, advisers and other industry stakeholders, including participation in the delivery of GRDC investments.

2 Improve our understanding of local issues and responsiveness to development, validation and extension investment opportunities.

3 Assist in the development of investments that are locally relevant, nimble, timely and have on-farm impact.

Since 2021 it has been exciting to see these local ideas flowing directly through to responsive, local investments across the country.

It has also been really rewarding to see that this approach has allowed GRDC to invest to address some issues that are small in scale, but highly impactful.

For example, hard-to-manage weeds such as Rosinweed and Star of Bethlehem have received attention, as profiled in this *GroundCover*™ Supplement, which might not have otherwise made it up national lists of prioritised weeds.

It is important to recognise that the opportunities and constraints identified through the NGN are vital to informing GRDC's entire RD&E portfolio.

In conjunction with our Regional Panels, stakeholder perspectives are integrated into the RD&E investment process and shape larger programs of work.

This Supplement is a snapshot of some of the fantastic investments that were prioritised and driven from the grassroots. The stories offer examples of the local and applied impact delivered by GRDC investment through the NGN, alongside its larger upstream research projects and riskier blue-sky investments.

We encourage you to engage with the NGN by attending a GRDC Grower Forum in your area or contacting your local GRDC grower relations manager (see outside back cover for their contact details). □

More information: https://grdc.com.au/about/our-industry/national-grower-network

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Workshops get to the root of soil diseases

A now-completed national extension program targeted the ability to diagnose soil-borne pathogens, with the resulting resources and manuals continuing to be available to growers and advisers

By Alan Umbers

on behalf of FarmLink Research

■ Conversations with growers, grower groups and advisers were the catalyst for launching an extension program that demystifies how cereal crops are diagnosed for soil-borne pathogens that cause root and crown diseases. The project was launched in 2019.

In 2022, growers and advisers at a local National Grower Network (NGN) meeting on Kangaroo Island raised concerns about the incidence and impact of soil-borne pathogens in their farming systems. In response, an NGN variation on an active GRDC project was devised and quickly launched. This mechanism allowed the relevant information to be delivered to growers in a timely manner.

The GRDC investment was a national partnership between 12 grower groups and the leading plant pathologists from state agencies.

Together, they delivered 15 interactive workshops and 15 demonstration sites designed to provide hands-on learning with live diseased plants and some management approaches for affected paddocks.

Being able to identify and diagnose soil-borne diseases requires examining plant roots and is the first step in managing these pathogens in affected paddocks.

However, the project coincided with COVID-19 restrictions that required changes to the way extension activities were delivered. Nonetheless, about 500 growers and advisers participated in the workshops and about 600 attended field days and crop walks at paddocks showcasing various diseases and control options. An additional 2000 people interacted with the extension activities online.

The project was led by FarmLink with assistance from the Grower Group Alliance in WA and the Birchip Cropping Group in Victoria.

The interactive activities included hands-on preparation and examination of live plant root systems, led by senior plant pathologists.

Workshop participants were invited to bring sample plants from their own paddocks to learn how to recognise typical symptoms of various diseases caused by soil-borne pathogens.

The importance of examining the roots was highlighted since many pathogens do not cause obvious foliar (above-ground) symptoms early in their infection cycle.

Examining roots is far more revealing for diagnosis. The correct way to sample plants and wash the roots was demonstrated and a video recorded.

A series of large-plot demonstration sites were also established by the grower groups to assess the impact of various disease management options on crop performance. At these sites, DNA testing was used to accurately determine the soil pathogen(s) type and quantity, with pathologists providing guidance about management options.

These options include the use of seed dressing(s), crop rotation using break crops (where feasible), cultivation and residue management.

How to track impacts from these treatments was also discussed using observations of crop establishment, disease expression and crop yield.

Growers were also advised about factors that can complicate a pathogen's impact on cereal crops, including:

- a change in how symptoms of soil-borne diseases express given a shift to earlier sowing; and
- the ability of some pathogens to co-exist and interact in ways that complicate visual identification of symptoms.

RESOURCES

- Investment information and resources: https://grdc.com.au/grdc-investments/investments/investment?code=FLR1912-003RTX https://www.gga.org.au/activity/soil-pathogen-eoi/
- Identifying and managing soilborne diseases in cereals and pulses video: https://www.youtube.com/watch?v=0E81_Ne3RCk&embeds_referring_euri=https%3A%2F%2Fgrdc.com.au%2Fgrdc-investments%2Finvestments%2Finvestment%3Fcode%3DFLR1912-003RTX&source_ve_path=MjM4NTE&feature=emb_title
- Guide to sampling: https://www.agric.wa.gov.au/taking-samples-plant-disease-diagnostics
- Videos that are more specific to individual pathogens: Rhizoctonia: https://www.youtube.com/watch?v=brMxotj5jxU&list=UUJJLoZcI5b7vbmfe2SU4wuA Root lesion nematode: https://www.youtube.com/watch?v=ttFltE-B4qA&list=UUJJLoZcI5b7vbmfe2SU4wuA&index=213
- Soil-borne pathogen identification manual entitled *A practical guide to identifying and managing cereal root diseases in South Australia* is available through the SA Research and Development Institute (SARDI).

OTHER RESOURCES:

https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2019/02/south-australian-cereal-root-disease-update-2019 □

GRDC Code FLR1912-003RTX

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Workshop participants were invited to bring sample plants from their own paddocks to learn how to recognise typical symptoms of various diseases caused by soil-borne pathogens.

Controlling milk thistle during the summer fallow is proving a key challenge for growers in central NSW.

Photo: Grains Orana Alliance

Grower networks raise awareness of 'under-the-radar' challenges

Investment through GRDC's National Grower Network allows weeds that pose localised challenges to cropping systems to come under examination as part of efforts to optimise control strategies

Rosinweed and Star of Bethlehem targeted in Victoria

By Kelly Angel Birchip Cropping Group

The management of various weeds that tend to be localised or geographically discrete is being facilitated by discussions and knowledge-sharing that takes place through the National Grower Network (NGN).

The network was set up to capture ideas, issues, constraints and opportunities for research, development and extension. It is open to all growers, advisers, researchers and industry parties. One example of research arising from this forum is a project now investigating two weeds that are proving hard to control in the Victorian Mallee and Wimmera cropping systems.

The first is rosinweed, a native plant that likes swampy and slightly saline soils. This soil type occurs on the southern reaches of the Mallee and northern parts of the Wimmera, especially near flood-prone river systems. The second is Star of Bethlehem, an ornamental species likely to have escaped from gardens. It is tolerant to herbicides and, when conditions are right, the plant is prolific at setting new bulbs.

These weeds tend to start out in small patches, but it is important to control them early before they reach levels that compete directly with crops (Star of Bethlehem) or draw off water and nutrients during the summer (rosinweed). In 2021, a project was launched to explore management options for these stubborn, locally significant weeds. It began with a systematic evaluation of herbicide options undertaken as pot trials by the University of Adelaide's Gurjeet Gill and Ben Fleet. To date, these pot trials have:

- identified paraquat and metsulfuron as able to reduce Star of Bethlehem bulb set; and
- identified root fragments as an important route for rosinweed proliferation rather than seed-set, which rules out cultivation as a control option.

Once herbicide efficacy is broadly understood, the project moves to the paddock to explore management strategies under cropping conditions.

Importantly, the protocols under development aim to fit with existing farm management practices and rotations. Special consideration is being given to avoid weed control issues already faced by Victorian growers, such as residue carryover and application timings that interfere with crop establishment.

At the paddock phase, researchers are engaging with growers to further refine the trial's design. Consultations will continue through the life of the project.

The field phase began in 2023. Metsulfuron and paraquat form the basis of a four-treatment field trial targeting Star of Bethlehem in the Wimmera. The rosinweed trials will begin in the Mallee during the summer of 2023-24, with the trial's design in the final stages of planning.

The assessments will include:

- initial weed population counts;
- marking of weeds in different categories of size or maturity;
- photos and scores using European Weed Research Council (EWRC) rating scales to determine herbicide efficacy; and
- multiple rounds of scoring in accordance with weed biology. □

GRDC Code BWD2112-001RTX

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The bane of the summer fallow in central NSW

By Maurie Street Grains Orana Alliance

After consulting with growers in central NSW over five NGN meetings in 2022, an emerging and escalating issue was identified relating to weed control during the summer fallow.

A key concern for growers is conserving soil moisture over summer by limiting weed growth with herbicides. Increasingly, however, spray applications are becoming less effective, more frequent and more expensive.

A closer look has revealed that the driving force behind the increased spraying frequency and cost is mainly being driven

Photo: Grains Orana Alliance

Fleabane (pictured), together with milk thistle, are the key drivers of weed control costs during the summer fallow in the Narromine region of NSW.

Photo: Birchip Cropping Group

Emerging Star of Bethlehem weed.

Photo: Birchip Cropping Group

Rosinweed, post-flowering.

by two weeds: milk thistle and fleabane.

Fleabane emerges beneath the winter crop and by the time of the summer fallow, its growth may be so pervasive that a double knock is required. Even then, the herbicide treatment may not succeed. In wet years the problem can become overwhelming.

With milk thistle, the problem is so prolific – and the herbicide choices difficult to get right – that controlling this weed is setting the cost for summer fallow weed control. Also, as more spray applications are required, the risk of developing herbicide-resistant weeds increases. Resistance then further increases a farm's weed-control complexity.

In response to these challenges, GRDC has invested in field trials that seek seek to reduce the demand, frequency and complexity of controlling summer fallow weeds, including fleabane and milk thistle, by exploring different herbicide treatment options. The trials started in 2023 in growers' paddocks using actual farming practices in the Narromine region.

A key focus with fleabane is to intercept germination that occurs beneath the winter crop in spring. For milk thistle, the trials will explore a range of treatments to identify options that can stop new plants germinating with each flush of rain. This will involve exploring chemical treatments that involve both new and old herbicides.

The NGN meetings that led to this investment in research were held in Canowindra, Trundle, Wellington, Narromine and Tottenham in NSW.

GRDC Code GOA2302-001SAX

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Marshmallow no soft touch in WA

By Garren Knell ConsultAg

In the western growing region, the introduction of no-till cropping enabled marshmallow weeds to migrate from sheep yards into cropping paddocks. The weed is proving difficult to control given its natural tolerance to glyphosate and its large canopy.

It also develops a deep root that sucks vital moisture from soils over the autumn fallow. It can survive most standard summer spray strategies that target melons and volunteers.

Marshmallow favours alkaline or higher pH soils and it can gain a toehold on clay patches within sandier paddocks. Consequently, controlling the larger plants requires more-expensive herbicide treatments: glyphosate spiked with a Group 14 herbicide, followed by a double knock with paraquat or Spray.Seed®.

The need for improved marshmallow management options and decision-making was raised by growers in southern WA. Of particular concern was early germinations during the fallow period (in late summer and early autumn), as these result in large plants being present at sowing. These plants are expensive and difficult to control and have often already dried the soil profile, making crop establishment harder.

These plants then have several adverse effects:

- they reduce crop yield through competition;
- they potentially cause grain contamination at harvest;
- they can be host plants for some insects; and
- their large canopy can potentially intercept pre-emergent herbicides from reaching the soil surface, thereby affecting the control of subsequent germinations.

An investment was made by GRDC for two years' worth of field trials to mitigate these effects. Field work began in 2023 led by ConsultAg.

The trials are attempting to identify best-practice techniques for both continuous cropping systems and rotations that include a legume pasture, such as medic.

For continuous croppers, the trials will focus on improved options to knock down pre-crop weeds in order to eradicate marshmallow from the paddock. These knock-down trials include evaluating new-generation Group 14 herbicides versus old Group 14 products, as well as evaluating a range of other registered herbicides.

For crop/pasture rotations, ConsultAg has identified that often marshmallow grows uncontrolled in pasture years, creating greater problems for the subsequent crop. The project will evaluate the control provided by a range of registered herbicides in legume pastures to help minimise the build-up of marshmallow.

In-crop trials have also been established where marshmallow has been left uncontrolled in autumn to generate in-crop survivors of large plants. A range of registered, in-crop broadleaf herbicides will then be evaluated for their efficacy in controlling these larger plants in-crop.

The trials are underway in growers' paddocks at three locations in WA: Narrogin, Lake Grace and Newdegate. In the first year, the trials are taking a broad-brush approach that casts a wide net on control options. In the second year, the focus will be to refine the strategy and optimise it to best-practice standards and extend the key findings to growers. □

GRDC Code TAR2211-001SAX

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Innovations to sowing time

Innovations around sowing time are transforming farming practices in ways that make yields more stable and cropping more adaptable to varying climate conditions

Wheat

By Elizabeth von Perger

Stirlings to Coast Farmers

■ Wheat varieties are being tested at a range of different sowing times to optimise options for growers facing increased seasonal variability in Western Australia.

While a broad range of research activities are underway, two projects driven by the National Grower Network (NGN) in particular are testing very early and late sowing times.

Growers have played pivotal roles in both projects, showing keen interest in sowing time innovations through the NGN and through direct involvement in the Stirlings to Coast Farmers group.

Photo: FAR Australia

Field day at the trial site for early sown canola in WA.

1. EARLY SOWING

The early sowing trial got underway this year, 2023, in the Albany port zone with the aim of better exploiting a climate trend towards more late-summer rainfall in the region. Winter wheats form the basis of these trials.

While this class of wheat might have started out in grain-and-graze enterprises, it is gaining popularity as a way to close the yield gap in crop-only systems. The winter wheat varieties are:

- RGT Accroc(Φ);
- DS Bennett(Φ);
- Illabo(Φ);
- IGW6755 (Intergrain);
- RGT Cesario(Φ); and
- Mowhawk(Φ).

The trials involve strip lengths of at least 250 metres, with the last 70 to 80m remaining fungicide free to understand issues around disease resistance.

The strips were sown in the first week of April. Yields and performance are due to be compared with an adjacent paddock of spring wheat (Scepter(Φ)) sown at a typical seeding date (mid-May).

The trials are being monitored for:

- soil characteristics;
- plant counts;
- plant tissue tests;
- disease scoring; and
- harvest yield.

2. LATE SOWING

Extensive issues with waterlogging throughout 2020–22 motivated efforts to understand how late a paddock can be sown while still achieving economic returns on WA's southern coast. This region is prone to waterlogging that can reduce yields by up to 36 per cent, so the trials are exploring an important local agronomic issue.

The 2022 trials pushed the envelope on sowing time to an extraordinary extent – with sowing taking place as late as September.

The project comprised four plot trials scattered from Albany (Green Range and Needilup) to Esperance (Munglinup and Condingup). Each site included:

- three sowing times – late August, mid-September and late September;
- a main season and a quick-maturing wheat variety (Scepter(Φ) and Vixen(Φ)) and three barley varieties (Maximus(Φ) CL, RGT Planet(Φ) and Rosalind(Φ)); and
- two nitrogen treatments (80 and 40 units of nitrogen).

Crop establishment, growth stages, yield and quality were all monitored. With seasonal conditions providing a soft finish, the trial was remarkably successful.

Barley did exceptionally well, returning yields as high as 8t/h in the Esperance region and more than 5t/ha further south-west towards Albany. Wheat did not lag too far behind, yielding at more than 5t/ha and around Albany wheat out-performed barley. It was also noted that a split nitrogen application regime (especially in wetter conditions) might further boost yield and grain protein.

Due to grower interest in understanding what happens to yield

and quality in a more typical season – with a more-characteristic dry and hot finish – the project is being extended in 2023. Overall, the trial demonstrates the adaptability of cereal cropping systems in this region and generates confidence in late sowing decisions where waterlogging has occurred.

GRDC Code SCF2208-001SAX, SCF2304-003SAX

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Long-coleoptile wheat

By Mike Lamond

SLR Agriculture

■ Increases in wheat coleoptile length have proven possible using the novel Rht18/Rht13 dwarfing genes. They allow an increase in coleoptile lengths from 40 to 60 millimetres in varieties such as Mace(ф) and Scepter(ф) to lengths of 120 to 140mm. This increased length opens the way to explore earlier sowing dates, even in the absence of a break, by chasing moisture deeper in the soil profile.

Scoping studies have been undertaken in WA to assess various aspects of including long-coleoptile wheats in WA farming systems. Six field trials were undertaken in 2021 followed by seven trials in 2022.

These studies found that the extra coleoptile length allows for greater sowing depths, which translates into numerous benefits. There are opportunities to chase moisture lower in the soil profile, especially during dry sowing early in the season.

The long coleoptile genes also translated into increased:

- vigour;
- weed competition; and
- avoidance of Rhizoctonia.

The genes also increased plant establishment rates and improved emergence:

- through warm soils;
- in ameliorated soils; and
- through furrow-fill from wind and rain events.

Overall, long-coleoptile wheat lines were found to have the potential to provide greater control around sowing windows. These characteristics could prove especially advantageous in the face of climate variability and a shift in main-season breaks.

GRDC Code SLR2103-001RTX

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Resources: https://grdc.com.au/grdc-investments/investments/investment?code=SLR2103-001RTX

Canola

By Chris O'Callaghan

The Liebe Group

■ In early 2022 in WA, weather forecasts detected the formation of a tropical cyclone system (Charlotte) with the ability to deliver high March rainfall.

Growers on the research and development committee at the Liebe Group saw the incoming rain as an opportunity to close an information gap around how early canola can be sown in the northern area of Kwinana West.

Within two weeks of the forecasts, the Liebe Group had finalised protocols and received investment from GRDC through the NGN to run the early sown canola trials. The cyclone system delivered 114mm in the Dalwallinu region between 26 and 30 March. These weather events could become more common as changes to climate see more late tropical low systems coming further south and providing a non-traditional season break.

A small plot trial was implemented in Xantippe to test whether non-conventional rain events present an early sowing opportunity. The trial compared yields from plots sown on 5 April versus 6 May. The following varieties were used:

- Emu: an early maturing TruFlex® hybrid;
- Battalion: an earlry maturing

hybrid with both TruFlex® and Clearfield® technologies;
- InVigor® R4022P: an early-mid maturing TruFlex® hybrid;
- Invigor® R4520P: an early-mid maturing TruFlex® hybrid; and
- GT53: a mid-maturing TruFlex® hybrid.

Yield data found that sowing any variety in early April outperformed any variety sown in early May. Pioneer® 44Y27 had the highest yield at 3.02t/ha. This was nearly double the yield achieved by this variety when sown a month later (1.8t/ha). In fact, a near-doubling in yield was observed for all varieties sown early.

There were no yield differences among varieties sown at the later date.

An economic analysis has been performed and more information is available through the Liebe Group, which is repeating the trial in 2023 and will be conducting field days at Boyd Carter's Jibberding property.

Early sowing trial of canola in WA.

Photo: FAR Australia

The 2023 trial also took advantage of an early break, but one that delivered less rainfall, and will test risks associated with early sown canola, given that 2023 is unlikely to deliver the soft finish seen in 2022.

GRDC Code LIE2204-002SAX

More information: Chris O'Callaghan, chris@liebegroup.org.au

Resources: https://grdc.com.au/resources-and-publications/all-publications/paddock-practices/2019/west/january/tips-and-tools-to-get-the-best-out-of-early-sown-canola-crops https://grdc.com.au/resources-and-publications/all-publications/publications/2018/ten-tips-to-early-sown-canola

Barley and wheat

By Tom Price and Nick Poole

Field Applied Research Australia

In western areas of NSW, when soil moisture allows, there are opportunities to sow early in April. However, the available range of winter barley and winter wheat varieties often experience heat and water stress in their critical growth period that reduces yields. Early sown, main-season barley and wheat types – typically spring germplasm – experience a high risk of frost damage.

In contrast, longer-season, faster-finishing cultivars offer opportunities to exploit early rain events, with a better balance of heat and frost risk.

With a view to exploiting these opportunities, a project was launched through the NGN to define the advantages and disadvantages of longer-season spring varieties compared with winter and early spring types. This approach aims at better water to grain conversion when faced with early sowing opportunities in typically low rainfall settings.

The project runs from 2022–24 and involves replicated field trials located at sites in Daysdale (hosted by Peter Hanrahan, managed by FAR Australia) and Beelbangera (hosted by Barry Haskins, managed by AgGrow Agronomy) near Griffith, NSW.

These trials are testing early sowing of long-season cereals and their management requirements. A mid-April sowing date will be compared with a mid-May planting in regions where lower rainfall and higher temperatures typically influence productivity.

The project is led by FAR Australia in collaboration with AgGrow Agronomy & Research.

Key measures being compared between the two sowing dates are:
- phenology;
- crop structure;
- dry matter production; and
- grain yield and quality.

The barley varieties included in the trial are:
- Newton (winter barley);
- RGT Planet$^{\Phi}$ (spring barley);
- Beast$^{\Phi}$ (spring barley); and
- Maximus$^{\Phi}$ CL (spring barley).

The wheat cultivars are:
- RGT Waugh$^{\Phi}$ (slow winter);
- Anapurna (slow winter);
- RGT Accroc$^{\Phi}$ (slow mid-winter);
- Illabo$^{\Phi}$ (medium winter);
- Mowhawk$^{\Phi}$ (quick winter);
- Longsword$^{\Phi}$ (quick winter);
- Stockade$^{\Phi}$ (very slow spring);
- LongReach Nighthawk$^{\Phi}$ (slow spring);
- LongReach Raider$^{\Phi}$ (slow spring);
- Rockstar$^{\Phi}$ (slow spring);
- LongReach Lancer$^{\Phi}$ (medium spring);
- Scepter$^{\Phi}$ (quick mid-spring);
- Sunmaster$^{\Phi}$ (quick mid-spring);
- Vixen$^{\Phi}$ (quick spring);
- Boree$^{\Phi}$ (mid spring) by FAR only; and
- Zanzibar (mid-late spring) by FAR only.

The trial design also allows an exploration on how best to manage the biomass of early sown wheat cultivars and how to adapt them to a lower-rainfall, higher-temperature region where too much biomass has the potential to negatively impact yield. This is explored through the use of seed rates and defoliation of early sown canopies. Field days for these trials are typically held in September. □

GRDC Code FAR2206-003RTX

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Resources: https://grdc.com.au/resources-and-publications/all-publications/publications/2020/ten-tips-for-early-sown-wheat

Sclerotinia management in WA's lupin crops

Ciara Beard with Sclerotinia-infected lupins at Mingenew, WA, in 2021.

Photo: DPIRD

The susceptibility of lupins and canola to sclerotinia stem rot has created the need to optimise disease control strategies when the crops are grown in close rotation in WA

By Ciara Beard DPIRD

WA growers have been managing sclerotinia stem rot in canola for many years. However, with lupins being susceptible and grown in close rotation to canola (which is also susceptible), growers are facing increasing disease pressure from Sclerotinia sclerotiorum across a range of crops. This is due to the increasing concentration in soil of sclerotia – hardy survival structures containing dormant pathogen – which can pose a disease risk for up to six years or more.

Concerns around sclerotinia in this cropping system had triggered investment by GRDC. However, in 2021, widespread basal infections (caused by mycelial germination of sclerotia) occurred in lupin crops in the Geraldton Port Zone and Kwinana North. The disease prevalence may have been promoted by wetter than average conditions and wet soil profiles in early winter in these locations combined with mild temperatures.

This type of infection is capable of causing significant yield losses.

The issue of basal infections was raised as a significant challenge at 2021 National Grower Network (NGN) meetings in the Geraldton port zone (Dongara Summer Sesh) and Kwinana West port zone (Badgingarra Open Meeting). This resulted in a variation on the GRDC's current sclerotinia investment that quickly provided funding to explore responses to basal infections in order to better protect lupin crops

That means research is now underway that targets both canopy and basal (or ground-level) infection in the field, glasshouse and laboratory, with growers being involved in these efforts. The project is due to be completed in 2025.

This research is exploring disease epidemiology to better understand how the infection processes cause yield and quality loss in lupins. The new insights can then be translated into integrated disease management strategies that allow growers to minimise losses from sclerotinia through optimal use of fungicides, rotations and cultural practices.

Research so far has found that sclerotinia can develop rapidly within lupin crops given favourable weather conditions. Yield impacts have ranged from zero to 23 per cent.

Disease risk is highest in paddocks with a history of sclerotinia, in crops with dense canopies and in response to certain weather conditions. Disease develops when vulnerable growth stages (such as flowering) coincide with wet weather and temperatures from 16°C to 25°C (temperatures that support canopy humidity).

It is a challenging disease to manage but a profitable response to foliar fungicide application is more likely if applied prior to widespread infection developing.

Additional key findings to date include:

- An early season break can mean the disease cycle might start earlier and last longer. Moisture and high humidity favour the disease, so dense, bulky crops and wet years are likely to be a higher risk.
- Foliar fungicide application should aim to protect main stem pods and emerging branch pods, which in WA equates to application around late flowering/early pod emergence on the main spike.
- Good coverage and penetration require using high water rates (at least 100 litres per hectare).
- If a preventive application has not been done, foliar fungicide should be considered as soon as possible after disease symptoms are observed in the canopy if the outlook is for ongoing moist and humid weather with temperatures of 16°C to 25°C.
- Foliar fungicides applied during crop flowering are generally not effective at reducing basal sclerotinia infection, which occurs at or below ground level.

The research is being led by the Department of Primary Industries and Regional Development (DPIRD) in collaboration with the Mingenew Irwin Group (MIG) and Centre for Crop and Disease Management (CCDM) as part of a co-investment with GRDC. More information on findings as they occur is available on DPIRD's website at: https://www.agric.wa.gov.au/grains-research-development/understanding-and-managing-sclerotinia-stem-rot-lupins. □

GRDC Code DAW2104-002RTX

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Mouse tracking project in WA

A project to track mouse populations in the WA grainbelt is helping to understand mouse outbreak risks and when timely baiting is needed

By Blake O'Meagher FARMANCO

During the autumn and winter of 2021, mice caused an increase in crop damage across the WA grainbelt. The conducive conditions meant that plagues could occur quickly, with high-yielding crops providing a large food source.

To avoid worst-case scenarios, the National Grower Network (NGN) helped to launch a mouse surveillance program across five agricultural zones in WA: Geraldton, Albany, Esperance, Kwinana West and Kwinana East. The project is led by FARMANCO.

Surveillance data was obtained from 10 sites within each zone during 2022 using a CSIRO protocol that uses white powder sprinkled at burrow entrances to reveal mouse activity, along with the use of bait cards. Monitoring at the 50 sites occurred at pre-seeding, post-seeding, mid-season and pre-harvest.

This data was used to estimate the number of mice per hectare. This was fed back to GRDC, which produced heat maps depicting mice numbers. The colour code assumes economic damage occurs at numbers greater than 200 mice per hectare. Plague densities are 800 to 1000 mice/ha.

These maps can be viewed at the Mouse Alert site at feralscan.org.au/mousealert/map.aspx.

At a certain threshold of mouse activity, the tracking program triggered alerts to growers and advisers to check paddocks and consider baiting with zinc phosphide to keep mouse populations low.

Additionally, the monitoring team provided extension services on effective baiting strategies, including workshops in affected areas, to ensure that lethal doses of zinc phosphide bait were delivered. This included assistance with bait choice and application.

Some key messages include:

- a preference for 50 gram per kilogram zinc phosphide baits over 25g/kg;
- an application rate of 1kg/ha;
- apply at night or early evening to maximise bait consumption;
- avoid applying on wet soils (or when rain is forecast) as baits will deteriorate when in contact with water;
- avoid spreading with other products; and
- assessing risk with the benchmark that phosphide treatment at 1kg/ha (20,000 lethal doses/ha) should give control of greater than 90 per cent.

With WA producing a record-breaking grain delivery in 2022 and mouse activity detected early in the season, the monitoring work detected high populations and signs that plague conditions were building. Despite the conducive conditions, plagues were avoided.

The surveillance work has been extended into 2023-24, with 10 additional sites added to the monitoring protocol.

Another change has growers taking over the surveillance work at the monitoring sites, thereby embedding the early detection alerts in the farming system into the future.

This project complements existing CSIRO/GRDC investment CSP1806-017RTX and was undertaken in consultation with CSIRO's Steve Henry. □

GRDC Code FMO2201-001SAX

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Photo: Ben White

Bait spreaders on air carts.

BAIT SPREADING TRIALS

By Ben White Kondinin Group

The spread patterns produced by various mouse bait-spreading methods and devices are the subject of a National Grower Network project now underway.

A research engineering team led by Ben White (in consultation with CSIRO's Steve Henry) aims to test several bait application systems and identify best-practice standards. The project will include ground systems – such as mouse-specific and adapted spreaders – as well as aerial spread via fixed and rotary wing aircraft.

The project will address the key spreading constraint – the need to achieve uniform spread at a low rate of just three baited grains per square metre (equivalent to 1kg per hectare).

The trials will deploy custom-built equipment to measure spread patterns. Three such measurement systems will undergo comparisons: the use of fluorescent bait and black light; trays with baffles; and the use of low-bounce ground sheets to capture the spread bait.

The best-performing option will then be used to collect data, with Statistics for the Australian Grains Industry (SAGI) assisting in the development of a test protocol. The project will then attempt to develop bait spreading protocols and distribution uniformity benchmarks that are as reliable as those for other granular products, such as fertiliser and lime.

The project will also visit growers who have successfully used innovative bait spreading practices to produce 15 case studies – five each in the GRDC northern, southern and western regions.

Videos of different mouse baiting options can be viewed here: youtube.com/watch?v=QmnX4li8s-c

GRDC Code BVW2302-001SAX

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Workshops localise crop-spraying know-how

Technical innovations and region-specific constraints have combined to create a need for local workshops on spray application technology and drift mitigation

Hands-on training attracts strong WA grower interest

By Bill Campbell Agronomist and spray application specialist, CampbellAg

■ During 2020–23, GRDC invested in workshops instructing grain growers on best-practice sprayer set-up and broadacre cropping application techniques. The primary target audience was Western Australian grain growers, their employees and other industry people, such as agronomists and consultants. Younger grain growers and farm employees in particular were encouraged to attend.

The workshops used face-to-face training, on-farm, with growers' own spray machinery. A minimum of two sprayers (standard nozzle sprayer and pulse width modulation) were used during the workshops. Where possible, multiple batching plant/mixing systems were used.

Locations were spread across WA's broadacre grain growing regions with local assistance. A post-workshop survey was incorporated into this investment to measure subsequent grower practice change.

KEY FOCUS AREAS INCLUDED:

1 **Sprayer calibration** – the basics of coverage from droplets and water volume through to nozzles and setting up the sprayer. A process was provided to help growers calculate flow rates, pressures and nozzle selection; and

2 **Spraying efficiency** – mixing and batching processes and equipment. Interest in this topic resulted in additional GRDC investment to produce a booklet titled *Mixing and Batching for Agricultural Chemical Application*, the first publication of its type.

A total of 677 attended the 20-workshop series, with 95 per cent of participants being growers, managers or employees. A majority – 66 per cent – had not previously attended a spray application workshop.

Participants had many different subjects of interest, resulting in every workshop having its own flow and dynamics depending on the region. As the workshop program was rolled out, content was modified to cater for seasonal conditions, such as summer rains, interest around Delta T, night spraying, plant stress considerations and adjuvants.

With water supply issues occurring in the Great Southern and eastern districts in 2021, water quality and supply became a key additional topic.

The 2021 season also highlighted drift issues, which allowed a focus on a new pre-emergent herbicide – with drift on to lupins a particular focus area of concern. The 2022 and 2023 workshops further targeted areas in WA that were previously under-serviced by spray training or extension workshops.

Survey responses showed that two out of three participants had not attended any similar type of spray training before. Instead, they accessed multiple sources of information that can be grouped into chemical reseller/agronomist and internet/GRDC resources. Feedback was positive and interest was high for most topics covered.

The project also highlighted that spray application extension is often overlooked compared to herbicide efficacy, weed resistance, soils and nutrition. Spray application equipment requires capital investments of hundreds of thousands of dollars. Services that support best-practice spray applications stand to drive substantial on-farm gains.

The *Mixing and Batching for Agricultural Chemical Application* publication produced as a result of this workshop series is available as hard copy or for download at the GRDC website: grdc.com.au/resources-and-publications/all-publications/publications/2022/mixing-and-batching-agricultural-chemical-application-grower-case-studies

Additional resources can be found on the GRDC website: https://grdc.com.au/grdc-investments/investments/investment?code=BCC1910-001SAX

GRDC Code BCC1910-001SAX

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Northern region spray day initiative

By John Cameron

Independent Consultants Australia Network

■ In the northern region, the high frequency of hazardous inversion conditions and the proximity of drift-sensitive cotton crops means that drift mitigation is a key consideration for how and when to spray. Applications during hazardous surface temperature inversions can lead to spray drift and damage to off-target crops kilometres away (see Figure 1).

Hazardous inversion conditions can form and dissipate at any time of night commonly occuring from an hour before dusk to an hour after sunrise. This has resulted in regulation that prohibits pesticide application during a hazardous inversion. To help growers in parts of the northern

Spray workshops are helping to address region-specific challenges.

region meet this regulatory requirement, an inversion drift hazard warning system has been established. The system draws on meteorological data captured by the Weather and Networked Data (WAND) tower network. WAND is the result of six years of collaborative research by GRDC and the Cotton RDC and has been delivered in partnership with Goanna Ag..

WAND delivers up-to-date weather data every 10 minutes reporting the Absence or Presence of a Hazardous inversion. The data can be accessed on the Goanna Ag website at goannaag.com.au/wand-network.

The system forecasts the likelihood of an inversion forming within the next two hours, which allows operators to make decisions around completing the current load and/or refilling and continuing to spray.

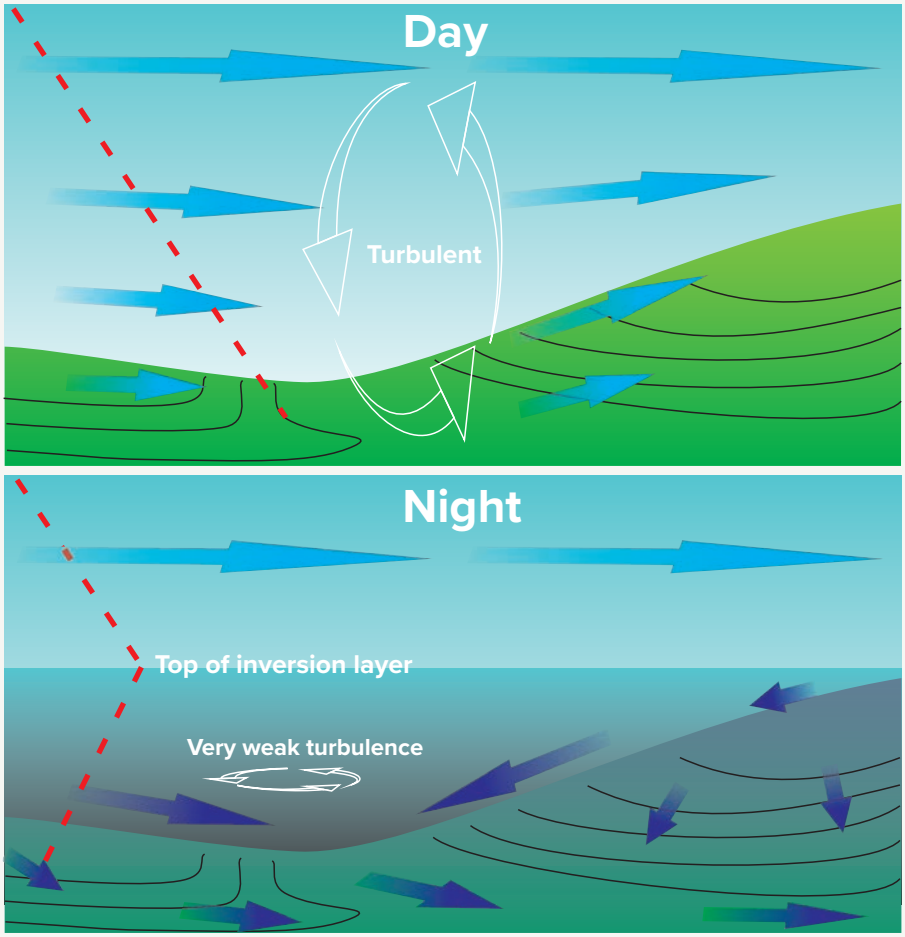
To help growers familiarise themselves with this decision-support tool, GRDC invested in a series of workshops delivered by Independent Consultants Australia Network. This NGN-driven project has delivered six GRDC industry spray days across the northern region during 2022-23.

These events provided a platform for communicating the latest developments in both spray application technology and stewardship. The format involved presentations from researchers followed by inspections of new technologies and hearing from technology developers.

The investment will also assess the value growers and industry partners obtain from these activities and, where possible, the rate of adoption of best spray and chemical management at the farm level. ☐

Photo: CampbellAg

Figure 1: Typical vertical temperature profiles during the day and night and their different propensities for creating an inversion layer.



Source: GRDC Factsheet

To further assist growers, several technical resources have been developed to promote the adoption of best spray and chemical management.
These include:

- GRDC Research Updates:
  Video: The new inversion tower network and reducing spray drift risk: grdc.com.au/events/past-events/2022/november/the-new-inversion-tower-network-and-reducing-spray-drift-risk-online
  Papers: Killing glyphosate resistant ryegrass? Application does matter: grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2022/02/killing-glyphosate-resistant-ryegrass-application-does-matter
  Spray drift hazard warning system: grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2022/07/spray-drift-hazard-warning-system
- GRDC Spray Drift webpage: grdc.com.au/resources-and-publications/resources/spray-drift
- Cotton Australia Spray Drift and Satacrop page: cottonaustralia.com.au/spraydrift-and-satacrop
- GRDC Hazardous Inversion Fact Sheet grdc.com.au/resources-and-publications/all-publications/factsheets/2022/hazardous-inversion
- Weather essentials for pesticide application (GRDC booklet) grdc.com.au/resources-and-publications/all-publications/publications/2022/weather-essentials-for-pesticide-application
- Meteorological principles influencing pesticide application (GRDC booklet) grdc.com.au/resources-and-publications/all-publications/publications/2022/meteorological-principles-influencing-pesticide-application
- Playlist of CottonInfo videos on pesticide application: youtube.com/playlist?list=PLQy8KAPn-DyqqLDLP3rJizTMuQ987MabB

GRDC Code ICN2203-002SAX

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Knowledge shared a key adoption driver

A national education program has produced resources to help growers reduce input costs through variable-rate technology

By Angelique McAvoy

Society of Precision Agriculture Australia

Photo: SPAA

Growers and agronomists participating in a variable-rate technology workshop in Merredin, WA.

The 2021 rise in urea prices caused costs to hit $1320 a tonne, creating serious challenges for cereal producers. In response, GRDC invested in a new project, 'Precision fertiliser decisions in a tight economic climate'. The project was led by the Society of Precision Agriculture Australia (SPAA).

Input costs make up a significant portion of a grower's budget, and price fluctuations can profoundly affect the bottom line. This project recognised the urgent need to provide growers and agronomists with strategies, such as variable-rate technology (VRT), and tools to manage input costs.

VRT accommodates differences in soil type, nutrient levels and other factors to enable growers to make more-informed decisions about their use of available resources.

This more-targeted approach can save money, reduce environmental impact and improve crop performance.

Urea prices have retreated from their previous highs. However, farming practices that reduce even moderate input costs will see an improved bottom line.

GROWER INVOLVEMENT

SPAA members, growers and agronomists from across Australia voiced their concerns about soaring fertiliser prices through a GRDC-supported survey conducted by SPAA's 'Hands-on Precision Agriculture Training' (HOPAT) project in 2020-21.

The survey showed that 55.4 per cent of the respondents were keen to use precision agriculture (PA) techniques but needed guidance on reducing fertiliser usage while maintaining crop yields.

The knowledge gaps identified by growers at the HOPAT workshops have informed the objectives of the current fertiliser project.

For the latest round of investment, SPAA engaged PA specialists from around the country to deliver a series of VRT workshops. These were designed in partnership with local grower groups. The grower groups were also vital in connecting the project team with other growers willing to share their experiences with on-farm experimentation, VRT and PA practices.

Grower groups involved in this process included Southern Farming Systems, Upper North Farming Systems, MacKillop Farm Management Group, AgriWest, Merredin and Districts Farm Improvement Group and Broomehill Cropping. Their participation and collaboration have been instrumental in ensuring the workshops addressed local concerns and circumstances.

The project kicked off in June 2022 as an education program designed to give growers the knowledge and confidence to adopt VRT and PA methods. It has delivered several outcomes, including face-to-face workshops, a national webinar, fact sheets, articles and grower profiles.

The final milestone was the release in December 2022 of the third edition of SPAA's manual, *PA in Practice*, a practical guide to PA tools and techniques.

PA in Practice helps growers navigate high-input-cost seasons, gain expertise in ground-truthing PA data, implement strategies successfully and evaluate results accurately.

KEY LEARNINGS

Several key lessons emerged from the project, particularly the power of peer-to-peer learning. For example, during one of the workshops in WA, local grower Mick Caughey demonstrated how to create a prescription map in real time.

It was knowledge exchange between growers and showed how there can be much more confidence when adopting technology that other local growers have implemented.

Resources

Resources produced by the projects can be accessed online at these sites:

- Video of the GRDC and SPAA National VRT Webinar – 11 May 2023: youtube.com/watch?v=VwYnFwDEwCU
- Factsheet 1: Proximal soil sensing systems: grdc.com.au/resources-and-publications/all-publications/factsheets/2023/proximal-soil-sensing-systems
- Factsheet 2: Improving nitrogen decisions with crop sensing, grdc.com.au/resources-and-publications/all-publications/factsheets/2023/improving-nitrogen-decisions-with-crop-sensing
- Factsheet 3: Satellite-based remote sensing for PA, grdc.com.au/resources-and-publications/all-publications/factsheets/2023/satellite-based-remote-sensing-for-pa ☐

GRDC Code SPA2201-001SAX

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Measuring harvest loss

An assessment of harvest losses in WA has led to recommendations on how best to recoup some of the estimated $320 million worth of grain left in paddocks in 2022 in WA

By Ben White Kondinin Group, Daniel Kidd and Mark Holland Grower Group Alliance and Dr Gulshan Mahajan

Photo: Grower Group Alliance

A project in WA measured harvest losses using drop trays to capture front and machine losses.

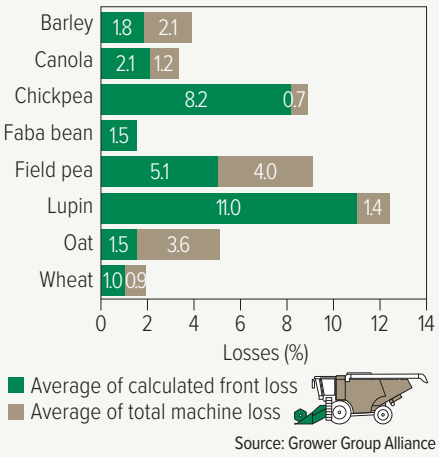
A National Grower Network-driven project that measured harvest losses in Western Australia found that they exceeded benchmarks for all crops assessed in the 2021 and 2022 seasons. When extrapolated to the WA crop area and multiplied by average commodity prices at harvest, the losses were estimated to be more than $300 million each season.

The study examined losses as growers harvested across 75 sites in all port zones. Losses were estimated for wheat, barley, oats, narrowleaf lupin, field pea, chickpea and faba bean crops (Figure 1). The value of the harvest losses was also estimated (Table 1).

Harvest loss measurements were made using drop trays to capture front and machine losses. The analysis included information about crop and ambient conditions, front losses (including front type, set-up and any additions or modifications such as knife guards or air reels) and the machine losses (with consideration to travel speed, rotor clearances, fan speed and sieve settings). There was also consideration for any weed seed control strategies.

The study found that in 2022, total loss figures for growers who owned trays was

Figure 1: Losses by front and machine losses by crop.



Source: Grower Group Alliance

Table 1: Average total losses in value terms by crop type in 2022.

	Yield averages as measured t/ha	Nominal average harvest commodity price ($/t)	Average front + machine losses (%)	Average value measured lost ($/ha)
Barley	5.03	295	3.9	$57.35
Canola	2.64	755	3.3	$66.07
Chickpea	1.06	520	8.8	$48.89
Faba bean	3.00	470	1.5	$21.61
Field pea	2.10	450	9.0	$85.23
Lupin	2.66	345	12.3	$112.90
Oat	4.58	305	5.0	$70.08
Wheat	3.90	353	1.9	$26.50

Source: Grower Group Alliance

about 0.8 per cent lower than those who did not own trays. Of these losses, it was suggested that up to half could be recovered with adjustments to harvester settings, machinery sensor calibrations and equipment modifications.

Extension activities run within the project raised awareness of these issues and provided recommendations through consultant and grower networks.

An immediate outcome has been increased confidence to invest in equipment to measure losses. The project is supported by harvester set-up workshops, which show growers how to adjust their harvester settings and better understand the benefits of specialist equipment.

Among the recommendations for machinery settings are:

- When optimising harvester performance, the best practice is to change one machine setting (or make one adjustment) in isolation before retesting to evaluate the impact of that change. Determining which component or adjustment should be made requires experience.
- There appears to be merit in threshing system optimisation with aftermarket accessories but further work is required to validate these findings.
- Arguably offering additional throughput and increased field efficiency, average losses measured with stripper fronts are significantly higher than draper fronts in cereals. Growers should consider this when calculating the benefits and costs of using a stripper front, for example in a strip-and-disc system.
- Cereal growers should also set the reel to penetrate the crop only enough to lay cut material on to the draper belt. This prevents the reel from knocking grain out of the head and on to the ground.
- Pulses can be particularly problematic for front losses with mitigation options including knife, reel and air adaptations (although the economics on these adaptations are still pending). While lentils are an emerging crop in WA, measured losses indicate a strong case for the use of an air reel to minimise losses.
- An adjustable knife front improved field efficiency in canola and barley, reducing losses.

The project was led by the Grower Group Alliance, with Primary Sales Australia, the WA Department of Primary Industries and Regional Development, Facey Group, Corrigin Farm Improvement Group, Stirlings to Coast Farmers and the Liebe Group. Project data has been uploaded to the Online Farm Trials database. More information is available at the Grower Group Alliance website at gga.org.au/activity/measuring-harvester-losses-in-western-australia.

For more detailed coverage of these projects, also see the September–October issue of *GroundCover*™ and the GRDC website: https://grdc.com.au/grdc-investments/investments/investment?code=GGA2110-001SAX □

GRDC Code GGA2110-001SAX, GGA2211-001SAX

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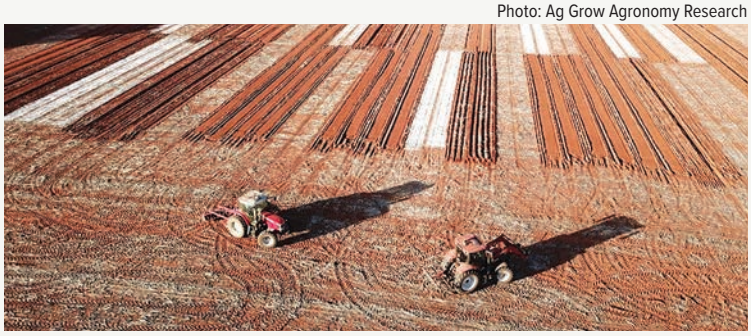
Research unravelling complex soil pH interactions

Lime-responsive and non-responsive soils have been targeted by NGN-driven research that is developing best-practice amelioration protocols

Photo: Ag Grow Agronomy Research



A trial in NSW is optimising ways to ameliorate soil acidity and free up phosphorus.

Non-responsive soils

By Barry Haskins Ag Grow Agronomy Research
and Jason Condon Charles Sturt University

In the lower central west of New South Wales, soil testing has revealed a gradual but persistent decline in pH. Historically, however, some of these soils have proven unresponsive to lime application and incorporation. GRDC investment has made it possible to ask why and already new knowledge is being generated on how best to manage soil-related yield constraints in this region.

The three-year project started in 2022 and is led by Ag Grow Agronomy Research, with Jason Condon at Charles Sturt University. The project also involves grower groups FarmLink, Holbrook Landcare Network and Central Farming Systems.

The trial is based at the Ag Grow Agronomy Research station near Griffith in paddocks with a wheat (2022), canola (2023), wheat (2024) and pulse (2025) rotation.

Central to advances being made is the observation that elevated phosphorus in these soils is not available for crop growth. The availability of phosphorus fertiliser is set by a pH-dependent process, with acidic soils known to lock up this important and expensive nutrient.

Trials have shown that liming the acidic soils of south-western NSW produces an increase in soil pH that increases phosphorus

availability. Responses around seven to eight milligrams per kilogram Colwell-P (a measure of available phosphorus) have been observed in limed versus unlimed plots.

These trials involve liming at three different rates using four incorporation methods – shallow, deep once, deep twice and rotary hoe – to mix lime into the top 25 centimetres of soil.

The magnitude of the response from these early findings has the potential to reduce fertiliser phosphorus costs by 20 to 30 per cent – a significant saving given an average cost of $100 per hectare for starter fertiliser. There are additional economic benefits given the treatment also produces yield gains irrespective of phosphorus. Additionally, the researchers became aware that growers were not seeing a yield response to micronutrient fertiliser applied as a foliar spray despite crops being deficient in zinc, copper and molybdenum.

A preliminary analysis shows that liming also promotes uptake of these micronutrients, resulting in yield gains in this trial worth an extra 0.5 tonne/ha.

Ultimately, the goal is to provide growers in south-western NSW with clear soil amelioration guidelines that result in economic benefits by reducing input costs and closing yield gap potential.

Ongoing progress will be reported at fields days, industry events and online.

GRDC Codes AGG2206-001RTX, UCS2204-001RTX

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Removing the acid handbrake on crop options

By Jason Condon Charles Sturt University

■ Many growers in southern NSW are applying lime every eight to 10 years at a rule-of-thumb rate of 2.5 tonnes per hectare to raise the pH enough to stop aluminium and manganese toxicity affecting crops. However, local research found that while these practices have often been beneficial, they have not prevented the formation of acid layers from about seven centimetres to 15cm in some of the best cropping country. Despite applying lime, acidity continues to affect the growth of susceptible plants, especially pulses.

A change in sampling practices is making tactical lime application more effective. This involves sampling in 5cm depth intervals, to 20cm, to find the depth and extent of acidity. This then informs the rate and application method.

If acid layers exist in the top 20cm, they can be remedied by adding enough lime to remove the acidity by incorporating the lime to the depth of acidity. If such incorporation is not practical, then maintaining soil pH near 5.8 pHCa above the acidity allows the liming effect to move down the profile to the site of the acid layer.

Over the past four years, Associate Professor Jason Condon (Charles Sturt University) and Helen Burns (NSW Department of Primary Industries) have been working with collaborators from FarmLink, Holbrook Landcare Network and Central West Farming Systems to establish a network of trial sites testing the new pH targets (5.8 pHCa) and methods of lime application.

A series of workshops that demonstrate how to develop better liming strategies is planned for 2023 through each grower group.

Often the benefits of liming are not seen in the first few years after liming. It takes time for the lime to dissolve and correct acidity. Once that handbrake is removed, growers are no longer constrained to grow only acid-tolerant crops and can make the most of pulse options.

The GRDC-invested cropping sequence program demonstrated the financial and system benefit of pulses in cropping rotations. This is only possible if acidity is not constraining pulse nitrogen fixation.

GRDC Code UCS2204-001RTX

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Responsive soils

By Sara Hely Riverine Plains

■ Subsoil acidity is a prevalent geographical feature of soils in the Riverine Plains of the southern region. Most growers need to ameliorate soil pH through liming. However, many have reported mixed results and, due to the costs involved, are keen for trials that help optimise practices and maximise benefits.

Those trials, led by Riverine Plains, are now underway in a two-year project. It was due for completion in 2024 but was extended to 2025 due to wet conditions in 2021 that caused waterlogging, slug and disease issues.

One replicated field trial has been established to demonstrate best-practice liming strategies using commercial-grade farming equipment on soils that have been fully characterised.

There is also a field demonstration site that highlights the impact of using different types and sources of lime. Other variables being investigated include:

- different incorporation methods – top-dressing, spading, discing and ripping;
- the interaction of lime and moisture;
- the depth of lime incorporation; and
- the timing of the lime application.

Analysis from this field work will include comparisons of both agronomic and economic returns using Acid Soils SA calculator tools. Impacts are being assessed by monitoring yields and soil chemistry.

Growers have been consulted early in the design of the trial and, as a result, a broad range of well-targeted extension activities are included in this project, such as:

- field days;
- an annual trial book; and
- a website of liming case studies. □

GRDC Code RPI2104-001SAX

More information: Dr Sara Hely, research@riverineplains.org.au

Photo: Riverine Plains

Plot trials are testing late-season sowing following waterlogging events in Condingup. Demonstrations of best-practice liming strategies are underway in the Riverine Plain.

Barley management to close yield gaps

Diverse issues relating to barley crops are being explored through NGN-driven projects

Photo: FAR Australia

Trials are underway to close the barley yield gap in the low and medium-rainfall zones of the southern and northern regions.

Closing the yield gap

By Tom Price and Nick Poole

Field Applied Research Australia

■ Growers in the low and medium-rainfall zones of the southern and northern regions have identified crop canopy constraints that prevent maximum attainable yield in barley. These constraints all relate to canopy characteristics such as head loss, brackling (stem buckling) and lodging control, plus disease management.

This in-the-field reporting contrasts with computer simulations that generally ignore canopy characteristics and suggest sowing time and nitrogen deficit are the biggest factors leading to a yield gap.

In the high-rainfall zones, however, recent research found that of these two possibilities – nitrogen versus canopy – it was actually canopy management that explained yield responses ranging from three to eight tonnes per hectare (based on studies that contrasted similar genetics). The management practices include the use of fungicides, time of sowing and use of plant growth regulators (PGRs).

To identify the true drivers of barley yield gaps in the low and medium-rainfall zones, GRDC invested in two National Grower Network-driven projects that are led by Field Applied Research (FAR) Australia.

These projects involve a series of replicated field trials designed to compare yield response to different management practices. Variables being investigated include:

- different barley varieties – RGT Planet(Φ), Cyclops(Φ) and Leabrook(Φ);
- time of sowing;
- nitrogen and canopy management through fungicides, PGRs and simulated grazing treatments; and
- PGR treatments to avoid head drop and lodging.

A key feature of the approach being taken is coordinating trials between the low-rainfall and medium-rainfall areas. By combining the operating plan for both investments it becomes possible to analyse three diverse agro-ecological zones that have yield potentials ranging from two to 7t/ha with the same treatments, varieties and measurements. The environments in these studies encompass:

- Birchip, Victoria: low-rainfall zone with two to 4t/ha yield potential;
- Hart, SA: medium-rainfall zone with a dryland yield potential of three to 6t/ha;
- Daysdale, NSW: medium-rainfall zone with a dryland yield potential of three to 7t/ha.

Measurements will include climate data, canopy temperature, soil sampling, normalised difference vegetation index (NDVI) data using GreenSeeker, phenology data, disease assessments, crop height, yield and quality plus observable yield-limiting factors such as lodging, brackling and head loss.

Trials started in autumn 2021, with the projects due for completion in 2024. Interested growers can attend field days planned for September at each of the sites or engage with trial results through Online Farm Trials (https://www.farmtrials.com.au).

GRDC Code FAR2204-002SAX, FAR2206-004RTX

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Agronomic strategies in the Geraldton Port Zone

By Barrett Sinclair and Peter Carlton

Kalyx Australia

■ In WA's Geraldton port zone, many growers are unsure how to manage a barley crop compared with wheat and how it fits within their farming system. Through grower surveys, a need for information about barley management and agronomic packages was identified.

This project tested different barley types against different nitrogen management options with early and late sowing opportunities in different environments.

Six barley varieties were grown in small plot trials over three years in soils typical of WA's northern wheatbelt. The varieties were RGT Planet(Φ), Spartacus CL(Φ), Rosalind(Φ), Buff(Φ), Bass(Φ) and Scope CL(Φ), which provided a range of maturities, herbicide tolerance, market end use and acid tolerance levels.

The wheat variety Scepter(Φ) was included to provide yield and gross margin comparisons.

The plots were subjected to site-specific nitrogen strategies that tested:

- whether nitrogen was best applied all prior to seeding or split with an early and post-emergent application; and
- if a higher rate was beneficial in above-average seasons.

The plots were then tested for yield,

Photo: FAR Australia

Strategies relating to canopy management are being investigated to close barley yield gaps.

grain quality and profitability against a well-adapted wheat. The project found that barley can be grown successfully in this region and can match wheat yields (and even produce a yield advantage).

However, barley could not compete with wheat financially as the first-choice cereal in a crop rotation. The yield benefit was not large enough, in the duration of this project, to overcome the price premium for wheat.

The three seasons sampled varied greatly in rainfall, the timing of rainfall and maximum temperatures during grain fill. However, extreme finishes with hot, dry winds and high spring temperatures were not encountered.

The 2020 growing season experienced decile 2-3 rainfall yet most sites experienced season-saving rainfall in August. This was accompanied by as many as 39 days above 30˚C during the grain-fill period.

Substantial autumn rainfall provided an ideal start to the 2021 growing season to test early sowing opportunities. Consistent cold fronts through July helped to maintain a high yield potential at each site. The grain-fill period experienced steadily increasing maximum temperature from mid-August.

In 2022, it was an average growing season judged by total rainfall, yet cold fronts through July and August allowed crops to compensate for low rainfall through May and June. August rainfall was accompanied by mild temperatures and temperatures greater than 30˚C were not recorded until the end of September.

Barley varieties were identified that consistently performed well across the three years. RGT Planet(ϕ) did well when sown early at Tenindewa and West Casuarinas, while Rosalind(ϕ) was better-suited to later sowing at these sites. Bass(ϕ) and RGT Planet(ϕ) were suited to early sowing at Northampton and Eradu.

A later sowing at Northampton showed no specific advantage for any barley. Buff(ϕ) was the best-performing barley on the acid sands locations such as at Binnu and Canna over the three years of the trial and was also suited to the later sowing at Eradu.

Malt-grade barley was successfully produced in the trials (at Binnu, Northampton and Tenindewa) but malt grain cannot currently be delivered to CBH facilities in the Geraldton port zone.

In general, applying all nitrogen upfront, prior to seeding, was a robust nitrogen strategy for the yellow sands at Binnu and the loam soil of Northampton. An active nitrogen strategy was more likely to be beneficial at Eradu, Tenindewa, Canna and West Casuarinas.

Barley yield was comparable to wheat at each site in 2021 and 2022 but cannot compete with wheat financially as the first-choice cereal in a crop rotation. The yield benefit was not large enough to overcome the price premium for wheat over the duration of this project. In 2021, the loss ranged from $49/ha to $528/ha at Eradu, Tenindewa and Canna (Figure 1).

Barley sown early could be more profitable, such as at Binnu and Northampton in 2021 and Tenindewa in 2022, yet this was on the back of a 1.1 to 2t/ha yield advantage and wheat failing to reach a premium grade.

Although barley cannot compete with wheat as a first-choice cereal, its ability to flower before August might make it a low-risk and profitable option as a third cereal before a break crop in a mixed-farming enterprise where the extra stubble has value for animals or as an option on acid soils.

Imidazolinone tolerance could provide a specific fit for a grower and barley's vigorous growth habit for weed competitiveness also offers advantages.

More information on trial results can be viewed at GRDC's Online Farm Trial website at farmtrials.com.au/trial/37355. Trial data was analysed by Statistics for the Australian Grains Industry (SAGI) West and economic analysis was performed by Agrarian Management.

Kalyx would like to acknowledge GRDC, Agrarian Management, SAGI West and the trial hosts for their valuable input.

GRDC Code KAL2003-002SAX

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Lodging mitigation using plant growth regulators

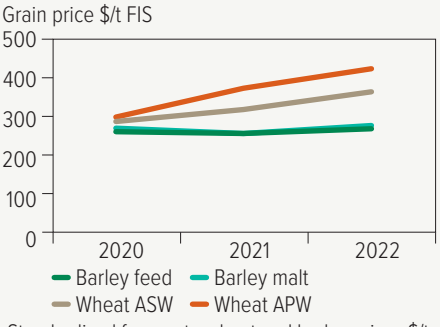
By Matthew Gardner AMPS Research

■ Lodging has been identified as a production constraint for barley crops in high-yielding seasons in the northern grain region.

Photo: Kalyx Australia

Trials in Geraldton port zone have found that barley can be grown successfully in this region but cannot compete with wheat financially.

Figure 1: Farmgate grain prices for wheat and barley for 2020–22.



Standardised farm gate wheat and barley prices $/t for the Geraldton Port Zone (FIS less CBH R&A less Levies & Royalties less averaged freight to port)

Source: Kalyx Australia

Currently, the use of a plant growth regulator (PGR) on dryland barley crops in northern NSW is estimated to be less than five per cent of the area and generally used only in five to 20 per cent of seasons (decile 8 or above).

Consultants and growers have cited variable and unreliable outcomes from the use of PGRs as a barrier to wider use in dryland barley. Instead, they rely on other management tools to manage lodging, such as paddock and varietal selection, nutrition management and time of sowing.

In some instances, lower-yielding varieties with better straw strength are selected over high-yielding varieties that are susceptible to lodging.

This project in northern NSW aims to better understand the use of PGRs in barley to increase confidence in their use and reduce the variability in responses by developing more-robust guidelines for the best situations to use them.

Led by AMP Research, PGR trials were conducted at Liverpool Plains, Gurley and Tulloona during 2022, a season that was highly conducive to barley lodging.

The study found that net returns could be increased by up to $699/ha in response to PGR treatment. However, lodging and yield responses varied, indicating that matching PGR treatment to variety and seasonal conditions is critical.

In all, four varieties were tested at the three trial sites: Leabrook(ф), Laperouse(ф), RGT Planet(ф) and Maximus(ф) CL. These varieties differed in their response to PGRs, with Leabrook(ф) proving highly responsive to all PGR treatments at Gurley, where lodging scores nearly halved (from 7.5 to less than 4.0) following PGR treatment.

However, the response to PGRs varied between sites. For example, lodging scores for Leabrook(ф) at Spring Ridge remained between five and three regardless of PGR treatment.

When comparing PGR treatments:

- All varieties responded to ethephon but improvement in lodging varied, with the largest response in Laperouse(ф).
- The Moddus® (Trinexapac-ethyl) early and Moddus late treatments could also reduce lodging scores, but the effect was inconsistent across varieties and sites.

When comparing yield, Leabrook(ф) was most responsive to PGR treatment, with yield increasing by up to 2.2t/ha for the most effective PGR applications at Spring Ridge and 1.2t/ha at Gurley. Overall, the late application of Moddus had one of the largest benefits when averaged across the sites, increasing yield by 0.9 to 2.2t/ha at Spring Ridge, 0.11 to 1.1t/ha at Gurley and 0.28t/ha at Tulloona.

When comparing impacts on gross margins at Spring Ridge:

- Leabrook(ф) margins increased in response to all the PGR treatments, averaging between $183/ha and $384/ha.
- Early single applications of Moddus could also increase yield and margins, but not consistently; and
- Across all four varieties, Moddus applied late increased partial gross margins by $136/ha to $384/ha.

At Gurley, the financial benefits followed a similar trend, but impacts were smaller. For example, late applications of Moddus at Gurley changed returns by -$13/ha to $271/ha, while the most effective treatment increased partial gross margins by -$4/ha to $303/ha.

Overall, the 2022 trials indicate that while substantial increases in yield and net returns can be achieved in response to PGR treatment, a greater understanding is needed of the interaction with variety, environment and management practices. Trials in 2023 are exploring these interactions to further refine understanding of the yield response and risks associated with the most-effective treatments.

Four trials are underway in 2023 that are assessing nine PGR treatments across a range of sowing time, plant available nitrogen and soil water. The trials are also addressing three key areas when it comes to selecting a PGR treatment:

1 Despite variable yield results, ethephon remains a potential PGR treatment given the low product cost. Therefore, the trial is exploring crop safety and yield benefits in different environments.

2 Understanding how Moddus applications can be manipulated through single or double applications, application timing and rate to maximise yield benefits.

3 Evaluation of alternative PGRS that are yet to be registered for use in barley.

GRDC Code AMP2205-004RTX

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Lodging mitigation on the Darling Downs

By Majella Bathurst Censeo Field and Lab

On Queensland's fertile Darling Downs, the best barley-yielding seasons can often end in lodging and head loss, making a potential six to 8t/ha crop a headache for harvesters and leading to losses of up to 30 per cent. This is an example of a regionally specific problem brought to the attention of GRDC through local NGN groups.

Participants at the Brigalow Grower Group NGN Forum reported significant crop losses in the 2021-22 season when barley growers in Queensland lost an estimated $10 million due to lodging.

With their understanding of local soils and conditions, they asked GRDC for support to evaluate agronomic solutions that fit their needs. Specifically, could management of rapid growth in the early and late vegetative periods reduce lodging and head loss, without reducing yield potential?

A GRDC investment made it possible for Censeo Field and Lab to investigate the use of commercial plant growth regulators (PGRs) to manage periods of excessive growth, extend the grain-filling period, better manage crop standability and increase crop yield.

Three trial sites have been established on the Western Downs and the inner Darling Downs where barley lodging has been a problem: Jandowae (Caloola Farm), Oakey (Devon Park, irrigated) and Warra.

PGR treatment protocols use commercially available products (ethephon and trinexapac-ethyl) within the confines of their label use.

Barley varieties were selected based on growers' preferences and include:

- RGT Planet$^{\phi}$ – mid-season, high-yield spring barley that is adaptable to early or late season finishes;
- Yeti$^{\phi}$ – the highest-yielding variety in the northern region, with a vigorous plant type and reduced height;
- Leabrook$^{\phi}$ – a medium-tall barley with early maturing and high yield; and
- Maximus$^{\phi}$ CL – a high-yielding, quick-mid maturing, imidazolinone-tolerant barley with a short coleoptile and erect plant type.

The trials will be assessed for lodging, yield, grain quality, grain fill, ear size, days to flowering and crop height. □

GRDC Code CFL2303-001RTX

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The response to wet years

Subsoil drainage, mitigation strategies, replacement crops and workshops were among the NGN-driven projects that tackled waterlogging impacts during the consecutive La Niña years

Western Australia: subsurface drainage

By Sophie Willshire

South Coast Natural Resource Management

Strategies to improve the management of waterlogging are being investigated to lift the economic sustainability of grain growing in Western Australia's south-eastern cropping region. Some three million hectares of agricultural land are prone to waterlogging, with the Esperance region particularly at risk due to its sandy, duplex soils and wet winters.

Adapting farm management systems and employing tools such as subsurface drainage could alleviate the effects of waterlogging, improve unproductive soils and provide additional water sources for future drought-proofing. While subsurface drainage opportunities are being explored in many agricultural landscapes, a limited understanding of the economic

Table 1: Gross margins and break-even yields across the crop replacement trial.

Crop type	Break-even yield (t/ha)	Average yield (t/ha)	Gross margin ($/ha)
Barley (Streatham)	1.79	3.13	$382
Barley (Hamilton)	1.79	2.69	$255
Field pea	1.29	1.31	$7
Chickpea	1.33	0.70	–$264
Canola	0.74	0.30	–$324

Photo: South Coast NRM

South Coast growers at the first installation of the tile drain in February 2020, with drainage contractor Subsurface Water Management.

efficacy of this management tool poses a significant barrier to adoption.

Meanwhile, the issue of waterlogged crops is becoming increasingly important for southern growers. The need for effective management solutions was raised with GRDC through the National Grower Network (NGN). In response, GRDC contracted South Coast Natural Resource Management (South Coast NRM) to investigate the profitability of subsurface drainage.

The first drains were installed in February 2020, attracting a large crowd of curious growers to the trial paddock. Since then, South Coast NRM has been collecting and monitoring field data to support the return-on-investment analysis due for release in April 2024. This work was guided by the project's technical advisory group, which includes local growers, hydrology and earthmoving experts, and research representatives.

Preliminary results show that the subsurface drainage system is effective at moving water away from the root zone and maximising yield potential. This indicates that well-designed drains can effectively create normal soil conditions in previously inundated land.

The project found it is critical to utilise experts when designing a drainage system. These include an experienced drainage contractor, catchment or Landcare group, Department of Primary Industries and Regional Development representative, or Natural Resource Management group. The adverse effects of a poorly designed drainage systems are severe and can have impacts far beyond the farm gate.

Further insights into the trials are available through the following resources:

- Subsurface drainage video, youtu.be/84eMcGUzkHM
- Subsurface drainage podcast: The war on waterlogging, https://grdc.com.au/news-and-media/audio/podcast/sub-surface-drainage-roi-trial-the-war-on-waterlogging
- Downloadable resources at the South Coast NRM's Southern Soils website, https://www.southernsoils.org.au/subsurfacedrainageroi

GRDC Code SCN2005-001SAX

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Southern HRZ: mitigation and crop options examined

By Greta Duff Southern Farming Systems

When wet conditions in 2021 caused waterlogging at trial sites in western Victoria, Southern Farming Systems (SFS) seized the opportunity to run reactive trials that explored waterlogging mitigation strategies and replacement crop options.

The crop replacement trials were spring-sown canola, barley, chickpeas and field peas at Streatham and Hamilton in Victoria. Two varieties for each crop were trialled. The trials, however, suffered from slugs, followed by summer heat stress ahead of a February harvest.

The best-performing spring-sown crop was barley, delivering a positive gross margin and yields averaging 3.13 tonnes per hectare. Field peas broke even but canola and chickpeas had a negative gross margin return (Table 1).

Overall, favourable spring conditions, rainfall, few heat events at critical growth periods and reduced disease pressure all play a role in the success of spring-sown crops.

These crops, however, can provide other benefits such as soil cover over spring and summer, reduced weed pressure and the potential of drying the soil profile for the next crop.

The mitigation option involved crop nutrition trials, given that waterlogging causes nitrogen loss through denitrification and leaching while also diminishing the crop's ability to take up nutrients, resulting in yellowing of leaves.

This trial tested whether additional nitrogen (and trace elements) can be used to minimise losses in wheat (Hamilton, Victoria, and Hagley, Tasmania), canola (Streatham, Victoria), and faba beans (Vite Vite North, Victoria).

Three types of nitrogen products were tested alone and in combination: liquid nitrogen, urea and sulfate of ammonia.

The applied nutritional products did not influence grain yield except at the Hagley wheat trial, where a yield response was observed with different rates of nitrogen. In Tasmania, the average yield was 9.5t/ha. The two highest-yielding treatments were urea and sulfate of ammonia at full rate with 10.3t/ha and urea at full rate with 10.28t/ha.

Additionally, the crop growth stage at waterlogging was found to have a large influence on yield. Established plants are most affected when they are rapidly growing, making waterlogging during warmer spring periods the most damaging to yields.

This means crops in the trial that presented with waterlogging symptoms were nonetheless able to yield exceptionally well: faba beans at 7t/ha and canola at 4.1t/ha.

Additional information and digital resources regarding these trials are available, including:

- Three videos:
  youtube.com/watch?v=fiDNS23U9TM
  youtube.com/watch?v=05XsKr19Ubc
  youtube.com/watch?v=2i00Y1hnYrU
- Podcast: https://grdc.com.au/news-and-media/audio/podcast/recovering-waterlogged-crops
- Online resources: Trial reports are available at: sfs.org.au/project/strategies-for-waterlogged-crops-in-the-high-rainfall-zone-of-the-southern-region

GRDC Code SFS2109-001SAX

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Storm recovery workshops

By David Foxx AgCommunicators

In January 2022, the Upper Eyre Peninsula region of South Australia received its entire average annual rainfall in a single weekend. Growers in the Kimba district were the hardest hit. Run-off flowed across cropping land, eroding topsoil on farms in elevated areas before gouging deep channels through downstream paddocks.

Many kilometres of fencing and roads were destroyed and there were significant issues with widespread debris, paddock trafficability and road damage inhibiting vehicle access.

Despite these difficulties, it was also recognised that this was a once-in-a-

Photo: South Coast NRM

GRDC grower relations manager (west) Luke Dawson with growers from the Esperance port zone watching subsurface drainage installation in action at the Dalyup Demonstration Day on 16 February 2023.

Photo: South Coast NRM

Discharge point of the subsurface drainage system, expelling perched water away from the crop root zone and into an open drain at the Dalyup trial site.

lifetime event offering full soil moisture profiles across the district.

To help growers manage the multifaceted impact of this unprecedented flood event and take advantage of the seasonal opportunity, GRDC recognised the need for information support. Front of mind was the need to prioritise paddock repair in time for sowing in 12 weeks so the upside yield potential would not be lost.

Working with Grain Producers SA (GPSA) and the Department of Primary Industries and Regions (PIRSA), GRDC supported a series of 'Cropping after the storm' workshops.

In partnership with GPSA, PIRSA staff led by Mary-Anne Young were quickly able to assess the flood damage, tour affected farms and provide insights into what needed to be done. GRDC representatives took the team to see the damage first-hand and consult with growers.

The NGN provided local connections and contacts who could explain growers' needs and ground-truth the planned support.

GRDC grower relations manager (south) Courtney Ramsey says grower input was vital for making sure the workshops delivered targeted, relevant advice.

"Having a network that connects us directly with growers allowed us to consult on the ground. This helped define the information we needed to provide and the range of speakers we invited to contribute," she says.

"We were able to hear what they felt they needed and sound out our own recommendations on areas they may not have considered."

The team was able to stage the 'Cropping after the storm' workshops just four weeks after the flood, with presenters addressing the potential effects on soil structure, paddock restoration and soil amelioration. Soil constraints, nutrient management, weed pressure and redistribution, nitrogen management and farm finances were also covered.

The NGN was also instrumental in providing input from Western Australian growers Peter and Lena Daw, who experienced a comparable 300-millimetre rainfall event on their Ravensthorpe farm in 2017. The Daws provided a viewpoint from five years on, sharing the importance of task prioritisation and recognising that some jobs would have to be left for later.

Ms Ramsey says that growers they met were often overwhelmed by the amount of work to be done and unsure where to start. "But there was also a strong undercurrent of excitement about the potential for the season ahead," she says.

"We deliberately made the workshops in-person events so there was a community-strengthening, social aspect. It gave growers a chance to get together and talk about their shared experience."

She says that hearing presenters such as Peter and Lena reinforce the message that the recovery process extends across years helped growers to focus on what needed to happen first to get the next crop in.

"From there, the more practical advice around managing crops for high yield potential and understanding changes to weed and nutrient distribution was designed to help growers prioritise through the season."

In the end, virtually every affected grower was able to establish a cropping program in time and reap the benefits of a significant rain and stored soil moisture after several tough years.

For Ms Ramsey, a key takeaway was how responsive the NGN allowed GRDC to be.

"The NGN allowed GRDC to be much more than an industry research and development corporation in this situation, with the two-way interaction contributing to our overall strategy and informing our reaction to grower needs on the ground.

"'Cropping after the storm' was a great reflection on the value of that two-way engagement between growers and GRDC.

"It has also given us a response template that can serve a wide range of situations – from climate emergencies to biosecurity events, to new market and crop opportunities." □

- PIRSA's 'What to do after a flood' guide can be downloaded at pir.sa.gov.au/emergencies_and_recovery/storms_and_floods/after_flood

GRDC Code ACO2202-002SAX

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National Grower Network (NGN)

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

The National Grower Network (NGN), a GRDC initiative, is open to all growers and grains industry stakeholders. GRDC staff and Regional Panels engage directly to capture, understand and respond promptly to issues and opportunities

The NGN has been established to:

Support meaningful engagement with our growers

Improve our understanding of local issues

Assist development of locally relevant RD&E that has on-farm impact.

GRDC NGN Grower Forums can be held as stand alone events but we are also happy to be invited to industry-organised events where local issues are being identified and prioritised, to reduce industry duplication.

GET INVOLVED

The NGN initiative is coordinated by GRDC Grower Relations Managers (GRM). Please reach out to any of us, any time.

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