Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA
Protect Grow Innovate

Grains Convo

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Contents

Enhancing barley resilience to heat stress

Project name

Maintenance of grain plumpness and transfer of heat tolerance into Australian barley germplasm (cultivars)

Project code

UMU00049

Threats to crop yields

Heat stress poses a major challenge to sustainable crop production in Australia.

In 2015, high-temperature stress during the grain filling stages, including unseasonal high temperatures in early October within the Australian grain belt, resulted in approximately $500 million in grain production losses, equating to about 6 per cent.

Since 1950, the average temperature has risen by 0.9 degrees Celsius, with predictions indicating a further

increase of 2-3 degrees Celsius and a 20-30 per cent reduction in rainfall in the grain belt over the next 20 years.

These climate changes and the increased frequency of heatwaves are expected to exacerbate economic damages to all major crops. In barley, heat stress leads to reduced grain plumpness and grain yield loss.

Grain plumpness, a key indicator of potential malt quality, has become a critical factor in downgrading malting barley to feed barley, resulting in up to a 30 per cent loss in market value for Australian barley growers.

This project was initiated by Murdoch University, the Western Australian Department of Primary Industries and Regional Development (DPIRD), InterGrain, and Australian Grain Technologies (AGT).

It is a consortium which brings together scientists from various disciplines to address the impact of heat stress on grain plumpness in barley during the grain filling stage.

The primary aim of the project was to identify barley germplasm, physiological traits and associated genomic regions tolerant to heat stress during the grain-filling stage. The objectives included:

- Sourcing novel barley germplasm for heat stress tolerance.
- Identifying physiological traits associated with heat stress tolerance.
- Identifying genomic regions and QTLs associated with heat stress tolerance.

The project aimed to deliver 3 key outputs:

Output 1 – identification and validation of effective and new sources of heat-tolerant barley germplasm from landraces, obsolete cultivars, wild relatives, and existing populations, including CIMMYT and ICARDA germplasm.

Output 2 – identification of physiological traits and associated phenotyping tools that correlate with heat tolerance, making them available to breeders.

Output 3 – identification of molecular markers or genes for heat tolerance, making them available to breeding programs in adapted germplasm, along with markers for major QTLs for marker-assisted selection.

Professor Chengdao Li said the outputs were delivered through several milestones, which facilitated studies on diverse barley germplasm under natural and controlled environments across seasons and regions.

“Researchers evaluated over 1200 barley germplasm of diverse origins, including single seed descent (SSD) lines from biparental crosses, Near Isogenic Lines (NILs) previously reported for root traits and tolerance to abiotic stress, international germplasm from ICARDA, current and historical Australian barley varieties, and non-commercial breeding lines from various Australian programs.

The project assessed highly diversified barley germplasm across more than 50 different environments to address complex genotype by environment interactions and identify novel germplasm and genomic regions associated with heat stress tolerance during the grain-filling stage.

Significant achievements

There were several significant achievements measured. These included:

Identification of novel germplasm and genomic regions linked to heat stress tolerance.

Genome-Wide Association Studies (GWAS) of 779 international barley germplasm identified approximately 69 highly significant QTL linked with grain plumpness using a 2.5mm sieve in 11 environments, and 39 QTL linked with grain screenings using a 2.2mm sieve in 5 environments.

These achievements will support the development of barley varieties with improved grain plumpness and stability, thereby increasing the reliability of malting barley supply.

New varieties with enhanced grain plumpness under heat stress conditions, compared to current benchmarks like Bass and Compass, will benefit Australian barley growers by reducing economic losses due to unpredictable and prevalent heat stress during the grain filling stage.

Continued research, incorporating newly developed genomic and pangenome resources of barley germplasm from Australia and international sources, including wild barley, will further enhance these achievements.

Funding partners / project collaborators

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Boosting canola crop establishment through collaborative research project

Project name

Reducing risks to canola establishment through an integrated understanding of genetics, management, and environment.

GRDC code

CSP2212-005RTX

Early sowing: risk and reward

Poor establishment of canola is a widespread issue in Australia, leading to problems with weed management, reduced yield potential, and sometimes the need for re-sowing.

While genetic research is ongoing, there is a critical need for a better understanding of the underlying processes affecting canola establishment and for developing effective strategies to mitigate these risks.

A 2022 survey of canola growers and agronomists across Australia identified limited soil moisture, incorrect sowing depth, and soil crusting as the most common causes of poor establishment.

In response to early rainfall, farmers are sowing earlier rather than waiting for traditional sowing times, which presents potential establishment risks but also offers higher yield potentials.

This project, funded by the Grains Research and Development Corporation (GRDC), is led by Andrew Fletcher from CSIRO with the team including Department of Primary Industries

and Regional Development (DPIRD), New South Wales Department of Primary Industries and EPAG Research, Living Farm, Birchip Cropping Group, Brill Ag, AgGrow, Grain Orana Alliance, and Aginnovate.

The main trials in this project are looking to identify the limiting factors to canola establishment, including soil moisture, soil temperature, and sowing depth.
By addressing these factors, the project aims to provide growers with management strategies to improve canola establishment when facing risky seeding conditions.

Additionally, the collected data will be used to test models of canola establishment developed by CSIRO.

In WA, trials are currently being conducted in Geraldton and Merredin, led by Bronte Wackett from DPIRD with the involvement of research scientist Muhammad Javid and technical officer Melanie Kupsch.

2024 Trial Program

The WA work in 2024 includes two main types of trials: Time of Sowing (TOS) trials and Sowing Depth trials.

The TOS trials explore four sowing dates ranging from late March to early May, and three irrigation rates (0mm, 20mm, and 40mm). Irrigation was applied 1-2 days before seeding to simulate different early rainfall events.

The depth trials involve treatments with three sowing depths (1cm, 3cm, and 5cm), two press wheel treatments (with and without), and two wheat stubble treatments (with and without).

Measurements for both trial types include bi-weekly plant emergence counts, gravimetric and volumetric soil moisture measurements, temperature at seeding depth, soil strength measurements, hypocotyl length, and establishment count.

The trials aim to benefit farmers by developing a decision framework to assess conditions for canola seeding and identify risks for poor establishment. This will enable farmers better tools to mitigate these risks effectively.

DPIRD Research Scientist Bronte Wackett said preliminary findings from the WA trials suggest that canola can potentially emerge from greater depths when press wheels are not used, depending on soil type and the type of press wheel.

However, sowing without press wheels can lead to furrow infill and potentially alter target sowing depth.

In the TOS trials, initial findings suggest early sowing is feasible when there is enough moisture in the soil to carry the crop through to the season break.

Interestingly, the results also indicate that adequate establishment can be achieved with early sown canola when there is significant gap until the season break, as long as the seedbed is completely dry.
These results highlight the importance of moisture for seed and seedling survival as well as emergence and establishment.

Data is still being collected on crop establishment and rigorous statistical analysis still needs to be applied to confirm the significance of the observed effects.

Moisture and temperature data will be analysed in conjunction with emergence and establishment to identify critical thresholds for making good sowing decisions.

More information

Click **here** to read the DPIRD article Canola essentials – growing a successful canola crop
Click **here** to read the DPIRD article Canola sowing time to maximise yield in Western Australia
Click **here** to access DPIRD's Canola Diagnostic tool
Click **here** to access DPIRD's Blackleg CM – Blackleg Management app
Click **here** to access DPIRD's Canola Seeding Rate calculator

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Craig Scanlan

Uncovering the impact of mechanical soil amelioration on crop nutrition

Project name

Nutrient re-distribution and availability in ameliorated and cultivated soils in the Western Region

GRDC code

DAW1801-001RTX

Enhancing crop nutrition

The area of soil used for crop production that is being modified with mechanical soil amelioration is increasing rapidly in the Western Region, but there are significant knowledge gaps for nutrient management.

Mechanical soil amelioration is being completed with mouldboard ploughs, rotary spaders, disc ploughs and deep rippers. All of these mechanical approaches introduce spatial variation in soil nutrient supply, root growth, or both, which may impact crop performance.

Researchers from the Department of Primary Industries and Regional Development (DPIRD) with support from the Grains Research and Development Corporation (GRDC) have aimed to address this through the project Nutrient re-distribution and availability in ameliorated and cultivated soils in the Western Region.

The key project outcome is to: research new knowledge on the impact of mechanical soil amelioration practices on nutrient re-distribution through the soil profile.

The objectives of this project are to:

- Identify changes in nutrient management that are required to maximise profit where mechanical amelioration of soil constraints has been done.
- Deliver this knowledge to grain producers and consultants.

Key findings to date: Interactions between deep ripping and fertaliser placement
Researchers set up 3 field experiments at different locations (Arrino, Tammin, Meckering) to see if deep ripping could increase crop yields.

Results at the Arrino Site: Over 3 years, the biggest crop yield increases were seen when both deep ripping and potassium (K) fertiliser were used together, especially in areas where the soil had low nutrient levels.

Tammin Site: In the first year, placing phosphorus (P) fertiliser deeper into the soil boosted crop yields more than just deep ripping alone.

However, this effect was not seen in the second year, suggesting the benefit was likely due to better root growth and access to water deeper down, rather than just the fertiliser.
Meckering Site: The first year showed a yield increase due to deep ripping, but no lasting benefits were observed in the second year.

Interactions between soil amelioration and nitrogen fertiliser

Different responses were noted at sites depending on whether soil compaction or water repellence was the main issue.

Tammin: Deep ripping significantly improved how well nitrogen (N) fertiliser worked, increasing both yield and efficiency.

Wathingarra: By adding both inversion tillage and N fertiliser improved yields, the 2 treatments didn't significantly affect the other's performance.

Fertiliser placement effects on use-efficiency on ameliorated soils

Overall, crop growth was mostly unresponsive to the K treatments applied in this trial series.

Goomalling: The very small treatment effects detected for grain yield were attributed to the relatively high subsoil K levels for sandy soils, ranging from 19 to 27 mg kg-1.
Dandaragan: Yield response to K was modest, but leaching did not appear to be the cause.

The wheat plants were able to access fertiliser K at this site; and in some treatments over 50% of plant K was estimated to have been derived from fertiliser.

The lack of response to K treatments at Regans Ford, despite low soil K levels, is attributed to leaching of the applied K associated with very high rainfall in June (100 mm) and August (165 mm), but it also likely there were several nutrients constraining growth at this site, including boron (B), zinc (Zn) and P.

The use of rubidium (Rb) as a tracer in field experiments has the potential to be a valuable research tool for monitoring the fate of applied fertiliser K.

The team used the dilution method developed by Hafez and Stout (1973) which utilises the lower Rb to K ratios in fertilisers compared to soils to calculate percent K derived from fertiliser.

The use of this method provided some insight into the capture of fertiliser K by wheat, which was determined to be higher for surface-applied K than banding where 40 kg K ha-1 or more is applied.

However, this method has limitations due to its sensitivity to the 2 ratios.

The use of Rb-enriched K fertiliser should be considered for future field experiments.
Using spatial variation in yield response to identify limiting factors after soil amelioration
At the on-farm experiment at Tammin, analysing variations in how different parts of a field responded to N fertiliser helped identify that low potassium (K) levels in the subsoil were a major limit to crop growth after soil compaction was alleviated.

Key findings cont: Impact of Soil amelioration on soil sampling strategy
DPIRD Senior Research Scientist Craig Scanlan said soil amelioration affects how soil samples should be collected for testing.

“After amelioration, the number of samples needed to accurately assess soil properties can change significantly, depending on the type of equipment used and the specific soil property being tested.

These findings help in understanding the complex interactions between soil treatments and nutrient management, guiding better agricultural practices for improved crop production,” he said.

More information

For more details about the project click **here**
Read the SoilsWest Aggregate article Soil amelioration can boost wheat response to nitrogen **here**

Collaborators

Grains Research and Development Corporation (GRDC)

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Combating Cucumber Mosaic Virus (CMV) in pulses

Project name
Effective virus management in grain crops

Project code
DAW2305-003RTX

Detection is key
Cucumber mosaic virus (CMV) can cause yield losses of up to 90 per cent in narrow-leafed lupin and can also impact other pulse crops.

The virus spreads primarily through infected seeds which then germinate to provide a source of plant-to-plant spread by a wide range of aphid vectors, making it crucial to assess infection levels in seed stocks.

Many farmers reuse seeds from previous harvests, which carries the virus across to crops in the next season.

To address this issue, this project, supported by the Grains Research and Development Corporation (GRDC), with researchers from the Department of Primary Industries and Regional Development (DPIRD), aims to tackle CMV through comprehensive seed testing initiatives.

By determining the prevalence of CMV in seed stocks, the project provides farmers with essential information for informed decision-making, helping to prevent the virus's spread and reduce crop losses.

The project objectives are:

Quantifying CMV Infection Levels: Assess CMV infection in seed stocks across Western Australia (WA), New South Wales, and South Australia using reliable diagnostic tools.

Enhancing Grower Awareness: Increase knowledge among growers about CMV, its transmission, and impacts on yield and quality.

This educational initiative aims to alter practices that contribute to CMV spread, improving crop health and yield.

Key benefits and advancements in CMV management

Effective management of CMV infection levels can lead to healthier crops with higher yields and better quality.

Planting with CMV free seed is essential to crop health.

Comprehensive seed testing provides growers with crucial information about seed stock health.

This aids in better seed selection and management practices, ensuring more robust crop production.

However, there isn’t a reliable diagnostic tool to detect CMV.

This project focuses on developing reliable tools to improve the accuracy and efficiency of identifying infected seeds, facilitating timely interventions.

Identifying lupin lines with varied responses to CMV is another critical advancement. This supports breeding efforts to develop genetically resistant varieties, ultimately saving both time and costs.

Additionally, the correlation study between CMV titre in plant tissues and seed transmission rates offers valuable insights into the virus's behaviour when it infects a plant. This aids in crafting targeted disease management strategies.

By reducing CMV prevalence and improving yields, this supports sustainable pulse crop production and promote environmentally friendly farming practices.
The findings lay the groundwork for further research into CMV and other seed-transmitted viruses, encouraging ongoing innovation in agricultural practices.

Continued research and field trials

DPIRD research scientist Nazanin Nazeri said preliminary findings show a positive correlation between CMV concentration in plant parts and seed transmission rate, highlighting the importance of managing CMV levels to avoid infection build-up in seed stocks.

This is crucial for lupin lines susceptible to CMV, where effective management could reduce seed transmission rates.

Despite promising outcomes, the findings require cautious interpretation due to the glasshouse setting and the need for replication.

Continued research, including further experimentation and field trials, is essential to understand these interactions under natural conditions better.

Confirming these results in field trials would empower growers with targeted management strategies, potentially reducing CMV spread and optimising lupin cultivation for improved yield," she said.

The benefit of keeping plants free of CMV has been shown in another one of our experiments, she said.

Plants inoculated with rhizobium but not CMV showed the highest yield, underscoring the potential of rhizobium inoculation in CMV-free environments.

"However, these findings are based on a glasshouse experiment and may not reflect field conditions.

The overall yield observed was low, necessitating repetition to validate these findings.

Funding partners / project collaborators

Grains Research and Development Corporation

More information

Read the DPIRD webpage **Cucumber mosaic virus in narrow-leafed lupins**
Read the DPIRD webpage **Diagnosing cucumber mosaic virus in narrow-leaf lupins**

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Meet the Grains Convo team

The ‘Grains Convo’ was established by the Grains communications manager and officer at the Department of Primary Industries and Regional Development (DPIRD) in April of 2023.

The Grains Convo is made up of a newsletter and podcast.

Both publications focus on all DPIRD grains projects. Including new projects, completed projects and project highlights and milestones.

It’s the go-to for all research findings and cutting-edge developments from the DPIRD Grains Team.

The team is made up of Amber Atkinson, Grains Research, Development and Extension Communications Manager, the editor of the Grains Convo newsletter.

Amber began at the Department and the Grower Group Alliance in 2021 and has held Senior Journalist and Editor roles with Farm Weekly newspaper, Farming Ahead magazine, WA Grower magazine and various other industry/trade publications.

Amber currently provides communications services with DPIRD research and extension through a number of outputs including stakeholder engagement.

Adrianna Jakimowicz is a DPIRD Grains Communications officer and the writer of the Grains Convo newsletter, and producer of the Grains Convo podcast.

Prior to this, she held a newsreader role at Triple M and HitWA radio.

Research scientist Cindy Webster is one of the hosts of the Grains Convo podcast. Raised on a mixed crop and livestock farm near Pingelly, Cindy now enjoys being able to take her own two children out to visit and learn on the family farm.

Cindy previously held roles editing the former Department AgMemo and AgTactics newsletters, has been the PestFacts WA editor since 2016 and is project lead for the PestFacts WA service.

Research scientist Janette Pratt also hosts the Grains Convo podcast.

Janette grew up on a mixed farm and station north of Northampton on the Murchison River before moving to Perth to complete a Bachelor of Science at Murdoch University. She is currently based at the DPIRD Moora office in the Crop Protection portfolio.

As well as hosting the podcast, Janette the editor of the Protecting WA Crops newsletter and the communications officer for the Disease epidemiology and management tools project.

If you have a project you'd like to see in the Grains Convo, contact:

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Significant milestone for the Australian Society of Agronomy

The Australian Society of Agronomy is gearing up for a landmark event as it prepares to celebrate its 21st conference at the Albany Exhibition Centre on 21-24 October.

The biennial event, first held in 1980 in Queensland, is the premier event for the society, which has a proud history cultivated on the agronomic innovation and research that underpins Australian farming systems.

The theme for the 21st conference is ‘Adaptive agronomy for a resilient future’ and will feature presentations, panel discussions, workshops and field trips showcasing the latest research and innovations in agronomy.

Internationally renowned precision agriculture expert, Professor Raj Khosla of Kansas State University, United States, is the lead keynote speaker for the Conference.

Prof. Khosla is an internationally renowned expert in the precision agriculture field, supporting its global growth and acceptance by growers and industry.

Representing over 500 members, including academics, consultants, government, universities, research institutes and the private sector, the society is currently led by Western Australian Department of Primary Industries and Regional Development (DPIRD) Primary Industries Development Chief Scientist Dr Ben Biddulph.

“The society has laid a strong foundation that I aim to build on by challenging and transforming current practices – encouraging and engaging the next generation of curious and progressive industry professionals who will carry our legacy forward,” Dr Biddulph said.

“Registrations for the conference have opened and I invite interested people to get involved, share their thoughts and let us know how we can better drive innovation and excellence in agronomy to shape the future of Australian agriculture.”

Early bird registrations close 22 August.

“We will be highlighting issues specific to WA farming systems, such as soil amelioration and broader environmental issues, and delve into the Traditional Owners systems approach to landscape management.”

Five field tours are planned for the final day of the conference with itineraries and stops to highlight WA production systems.

For more information and registrations visit the Agronomy Australia website **https://www.agronomyaustralia.org/** or the conference website **https://agronomyconference.com/**

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