WESTERN AUSTRALIA

MONDAY, 21 FEBRUARY
TUESDAY, 22 FEBRUARY
TUESDAY, 1 MARCH
THURSDAY, 3 MARCH
TUESDAY, 8 MARCH
THURSDAY, 10 MARCH

2022 GRAINS RESEARCH UPDATE, Perth

Program Book

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Proudly convened by:

GIWA
Grain Industry Association of Western Australia

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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Convenor
Grain Industry Association of Western Australia Inc. (GIWA)
PO Box 1081, BENTLEY WA 6983
researchupdates@giwa.org.au
P: 08 6262 2128 **W:** **giwa.org.au**
@GrainIndustryWA @GrainIndustryWA

Host
Grains Research & Development Corporation (GRDC)
Suite 5, 2a Brodie Hall Drive, Bentley WA 6102
western@grdc.com.au
P: 08 9230 4600 **W:** **grdc.com.au**
@GRDCWest @theGRDC

#GRDCUpdates

Welcome — GRDC Grains Research Update Perth proceedings

GRDC Senior Regional Manager – West, Peter Bird

Welcome to the 2022 annual Grains Research and Development Corporation (GRDC) Grains Research Update, Perth — Western Australia's premier grains research forum.

This year's Perth Updates will be delivered for the first time in a completely virtual format, with full-day sessions on February 21 and 22 and half-day sessions on March 1, 3, 8 and 10.

It's disappointing that the COVID-19 pandemic has impacted our ability to host these updates across a face-to-face setting, especially considering how valuable the event's networking opportunities are to growers and industry. I can assure you though, the quality of information and research set to be presented at the Updates won't be diminished by the online format. We have made it as easy as possible for everyone to attend.

These free virtual events will provide attendees across the state access to the latest research, technology, market development and management innovations to improve the productivity and profitability of the grains industry.

As a flagship GRDC event, the Grains Research Update, Perth, is critical in enabling growers, advisers, researchers and industry service providers to share knowledge to further the state's thriving export-focused grain industry, projected to be worth more than $8 billion in 2021/22.

Adding to this, 2021's record breaking harvest, estimated by the Grain Industry Association of Western Australia (GIWA) to be more than 24 million tonnes, has left the grains industry ideally placed to look at opportunities to invest in further improvements to increase the sustainability and profitability of farms and the wider industry.

This positive outcome has capped off a busy year at GRDC, with a number of initiatives and investments set to deliver future returns to WA growers.

In April the new National Oat Breeding Program was announced, which will be propelled into a new era under the leadership of commercial breeding company InterGrain, with co-investment from GRDC, AgriFutures and the WA state government.

The $11.5 million commercial breeding program will provide new varieties for milling and hay oats, along with a broad genetic base equipped to respond to the changing needs of Australian growers and exporters.

Evolving the way we approach applied RD&E with the Australian grain growing community has, and will continue to be, a major focus for GRDC.

In July we announced changes to the National Grower Network (NGN) model, which will see GRDC move to a more voluntary, inclusive and community-based approach.

The new system will have a more extensive geographic reach with direct local touch points and will utilise GRDC-branded forums and other mechanisms for identifying grower issues that are accessible to everyone.

The GRDC Western Regional Panel is a key part of this process, interacting with GRDC's Grower Network, farming systems groups and other interested parties to identify RD&E ideas and investment options.

I'd like to recognise the Perth Grains Research Updates program committee for the significant time and effort they have invested into ensuring the program best aligns with grower priorities.

Lastly, I extend my sincere thanks to GRDC Western region staff, GRDC Western Panel, and event convenor GIWA for their hard work, dedication and agility in bringing together this fantastic virtual offering.

So please sit back, get comfortable and prepare to explore the latest knowledge, innovation and research in the grains industry through the virtual GRDC Grains Research Update, Perth.

Peter Bird

GRDC SENIOR REGIONAL MANAGER – WEST

2022 Grains Research Update, Perth

Hosted by:

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There are no event sponsors however the GRDC would like to acknowledge the commitments of the following organisations.

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Need Information?

Online sessions

This year the Grains Research Update, Perth will take place virtually over six days during February and March. Registration for the livestream series is FREE and you only need to register once to receive access to all six sessions.

Please mark a placeholder in your calendar for the sessions.

Each session will be recorded and uploaded to the GRDC website shortly following the event days, unless not approved for online publication.

- **Monday, 21 February — Plenary presentations**
- **Tuesday, 22 February — Plenary presentations**
- **Tuesday, 1 March — Nutrition/Nitrogen from Legumes**
- **Thursday, 3 March — Crop Protection**
- **Tuesday, 8 March — Canola/Cereals — wheat, oats and barley**
- **Thursday, 10 March — Soils/Pulses**

Attending virtually

Reminders will be sent a day prior to the allocated event day. On the day of each event, you will receive an email containing a link to access the livestream event. ***This email will be sent to the email address that you provided at registration***. Be sure to check your Inbox and spam folder for this link. The link will take you to a webpage where you will attend the session automatically via Zoom.

Attendees will have the opportunity to ask questions after each presentation using Slido.com.

How to ask a question?

- On your handheld device or laptop, go to Slido.com
- Enter the Event Code '**GRDCUpdates**'
- When it's time for Q&A, submit your question/s for the Chair to ask of the presenter
- Due to time constraints, not all questions will be asked.

Tech troubleshooting tips

If you have any issues throughout the day, feel free to contact us on **08 6262 2128** or via email at researchupdates@giwa.org.au

Session breaks

Each event day has allocated breaks for you to re-charge and re-group. The breaks range from 15 to 30 minutes.

Virtual viewing habits

We know that sometimes sitting at your desk (or wherever you may be) for a long period of time can become quite uncomfortable. We have put together some viewing habits for you to utilise throughout the event days:

- Take advantage of the session breaks. Go for a short walk, get a drink, or have a stretch.
- Alternate between sitting and standing.
- Check your posture and adjust your monitor, laptop, or phone frequently.
- Keep a bottle of water handy to stay hydrated.

Presentations and papers

The Program Book contains summaries of presentations included in the 2022 Grains Research Update, Perth. This allows you to select which presentations you wish to attend virtually and provides key points for each presentation.

Attendees can access all complete papers in support of presentations at the Perth Update via the GRDC website **https://grdc.com.au/resources-and-publications/grdc-update-papers** when available.

Late papers will be made available on the GRDC website immediately following the event days, unless not approved for online publication.

Sessions are being recorded and will be made available on the GRDC website following the event. You will receive a link by email to access these.

Keep in touch

@GRDCWest **@theGRDC**

Join the conversation: **#GRDCUpdates**

We value your Feedback

We aim to continually improve each Research Update event by listening to your thoughts. You can help us by completing the evaluation polls on slido.com at the end of each session.

How to do a poll?

- On your handheld or laptop, go to **Slido.com**
- Enter the Event Code '**GRDCUpdates**'
- When the session nears the end a poll with pop up

Your involvement is very much appreciated.

GRDC
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Program DAY 1 — Monday 21, February

Plenary presentations

9.00 am	**Welcome and 'Seed of Light' presentation** – Darrin Lee, Chairman GRDC Western Panel
9.15 am	**Opening and future directions of GRDC** – John Woods, Chairman GRDC
9.40 am	**Greenhouse gas emissions of Australian grain production** – Maartje Sevenster, CSIRO
10.05 am	**Q&A with John Woods, GRDC and Maartje Sevenster, CSIRO**
10.15 am	**BREAK**
10.30 am	**Carbon neutral grain farming by 2050 – an example in calculating net emissions for a broadacre farm and strategies to reduce net emissions** – Mandy Curnow, DPIRD
11.00 am	**Market Outlook for the WA grains industry in 2022 and the longer term – challenges and opportunities** – PANEL DISCUSSION WITH: Cheryl Kalisch-Gordon, Rabobank; Jason Craig, CBH; John Orr, Premium Grain Handlers; and Richard Simonaitis, AEGIC
12 noon	**BREAK**
12.30 pm	**Australian soft wheat for Asian markets** – Ken Quail, AEGIC
1.00 pm	**Wheat agronomy management – managing risk versus potential** – Dion Nicol, DPIRD
1.30 pm	**Blackleg control in the upper canopy of canola crops** – Steve Marcroft, Marcroft Grains Pathology
2.00 pm	**BREAK**
2.15 pm	**Forewarned is Forearmed – new BoM tools for weather forecasting and climate services for agriculture** – Dale Grey, Agriculture Victoria
2.45 pm	**Lessons for growers from the hyper yielding crops and high rainfall zone farming systems projects in WA** – Nick Poole, FAR Australia
3.15 pm	**Day 1 concludes**

This program may be subject to change.

DAY 2 — Tuesday 22, February

Plenary presentations

9.00 am	**Gene editing: Building breeding 4.0 for growers and the grains industry** – Catherine Feuillet, Chief Scientific Officer, INARI, USA
9.40 am	**The interaction between wheat establishment timing and pre-emergent herbicides choice on annual ryegrass seed production** – Mike Ashworth, AHRI, UWA
10.10 am	**The fit of long coleoptile wheats in WA grain farming systems – observations from the 2021 growing season** – Michael Lamond, SLR Agriculture
10.40 am	**BREAK**
11.00 am	**Optimising fertiliser application – what level of precision can we achieve?** – Craig Scanlan, DPIRD
11.30 am	**Fertiliser strategies in response to higher prices** – PANEL DISCUSSION WITH: Peter McEwen, Agri-Access; James Easton, CSBP; Elizabeth Petersen, UWA; and Craig Scanlan, DPIRD
12.30 pm	**BREAK**
1.00 pm	**Tips for canola establishment** – Jackie Bucat, DPIRD and Matt Nelson, CSIRO
1.30 pm	**Oat varieties for 2022 and the new national oat breeding program** – Allan Rattey, InterGrain
2.00 pm	**BREAK**
2.15 pm	**Mice control** – Steve Henry, CSIRO
2.45 pm	**Why bother with artificial intelligence in agriculture? Because it can improve fertiliser management** – Jonathan Richetti, CSIRO
3.15 pm	**Day 2 concludes**

This program may be subject to change.

Program DAY 3 — Tuesday 1, March

NUTRITION	
9.00 am	**Carbon farming in WA** – Richard Eckard, University of Melbourne
9.30 am	**Potassium rundown in the Western grains region – where, why and what does it mean for crop yields** – Richard Bell, Murdoch University
10.00 am	**Does optimum wheat phosphorus requirement change with sowing time and conditions in WA?** – Mark Gherardi, Summit Fertilizers
10.30 am	**NEW RESEARCHER SNAPSHOT: The power of flux towers for measuring crop productivity and water use** – Caitlan Moore, UWA
10.45 am	**Session concludes**

NITROGEN FROM LEGUMES	
11.00 am	**Cereals after pasture legumes have higher grain protein levels** – Robert Harrison, CSIRO
11.25 am	**Profitability, costs and risks associated with establishing annual pasture legumes in cropping rotations** – Dean Thomas, CSIRO
11.50 am	**Optimising nitrogen fixation in legumes through improved rhizobia strains** – Ron Yates, DPIRD
12.15 pm	**NEW RESEARCHER SNAPSHOT: Soil moisture mapping in agricultural fields using electrical conductivity sensing** – Hira Shaukat, UWA
12.35 pm	**Day 3 concludes**

This program may be subject to change.

DAY 4 — Thursday 3, March

CROP PROTECTION	
9.00 am	**Ice nucleating bacteria and frost** – Amanuel Bekuma, DPIRD
9.25 am	**How well does assessment of outer florets of wheat heads following frost(s) relate to grain yield at the end of the season?** – Brenton Leske, DPIRD
9.50 am	**AHRI herbicide resistance update 2021 – most significant results from the field to the lab** – Roberto Busi, AHRI UWA
10.15 am	**NEW RESEARCHER SNAPSHOT: Electric weed control in Australia** – Miranda Slaven, DPIRD
10.35 am	**BREAK**
11.00 am	**Advances in controlling brome and barley grass** – Gurjeet Gill, University of Adelaide
11.25 am	**Maximising crops and minimising weeds with smart phase farming** – Yaseen Khalil, Kalyx Australia
11.50 am	**Yes, no, maybe – getting value from herbicide resistance testing** – Fiona Dempster, AHRI, UWA
12.15 pm	**Determining yield loss in canola following Sclerotinia stem rot infection** – Sarita Bennett, CCDM, Curtin University
12.40 pm	**NEW RESEARCHER SNAPSHOT: Spraying for yellow leaf spot in wheat – will you lose money?** – Anna Hepworth, DPIRD
1.00 pm	**Day 4 concludes**

This program may be subject to change.

Program DAY 5 — Tuesday 8, March

CANOLA	
9.00 am	**Effect of seed singulation and seeding rates of canola on yield and competition against ryegrass** – Glenn McDonald, University of Adelaide and Glen Reithmuller, DPIRD
9.30 am	**Canola pre-breeding for heat tolerance** – Sheng Chen, UWA
10.00 am	**Spring versus winter canola phenology across Australia – new insights for WA growers** – Jeremy Whish, CSIRO
10.30 am	**NEW RESEARCHER SNAPSHOT: Chemical cues used by natural enemies of the green peach aphid to find their prey in canola fields** – Andrew Phillips, Murdoch University
10.45 am	**Session concludes**

CEREALS – wheat, oats and barley	
11.00 am	**Understanding the fit of winter wheats for WA environment** – Brenda Shackley, DPIRD
11.25 am	**Pre-harvest sprouting management begins at seeding** – Jeremy Curry, DPIRD
11.50 am	**Growing a future for oats** – Ross Kingwell, AEGIC
12.20 pm	**NEW RESEARCHER SNAPSHOT: Genetic solutions to enhance spikelet fertility and grain plumpness during heat stress at flowering in barley** – Camilla Hill, Murdoch University
12.40 pm	**Day 5 concludes**

This program may be subject to change.

DAY 6 — Thursday 10, March

SOILS	
9.00 am	**New Soil Water Repellence reference book** – SoilsWest
9.15 am	**The combined influence of micro-water harvesting, deep ripping and gypsum on yield of barley in sodic soils** – Wayne Parker, DPIRD
9.40 am	**Sand and gravel mulches for sodic soils** – David Hall, DPIRD
10.05 am	**NEW RESEARCHER SNAPSHOT: Improving the understanding of soil water behaviour in re-engineered soil profiles** – Kanch Wickramarachchi, DPIRD
10.20 am	**NEW RESEARCHER SNAPSHOT: Efficacy of pre-emergent herbicides on renovated soil** – Bowen Zhang, DPIRD
10.35 am	**On farm experimentation – developing robust analysis for paddock scale trials** – Julia Easton, Curtin University, Luke Dawson, CSBP and Nathan Eaton, NGIS Australia
11.00 am	**Session concludes**

PULSES	
11.00 am	**Faba bean agronomy** – Mark Seymour, DPIRD
11.25 am	**Double break crop sequences with high value legumes – awesome when it rains!** – Nathan Craig, West Midlands Group
11.50 am	**Understanding and managing sclerotinia in lupins** – Ciara Beard, DPIRD and Pippa Michael, CCDM, Curtin University
12.15 pm	**Recent and impending changes to chemical MRL's in markets** – Gerard McMullen, National Working Party on Grain Protection
12.40 pm	**Day 6 concludes**

This program may be subject to change.

THE 2020-2022 GRDC WESTERN REGIONAL PANEL

January 2021

CHAIR - DARRIN LEE

Mingenew/Dongara, Western Australia

Darrin Lee was appointed to the Western Region Panel in 2014 and was appointed Panel chair in 2018. He has been farming in Western Australia's Northern Agricultural Region for more than 20 years, with property now at Mingenew and Dongara. Darrin has a keen interest in digital agriculture and has a background in banking and finance. He is a past member of the CBH Group Growers Advisory Council and

M +61 427 281 021 **E** blighleefarms@bigpond.com.au

DEPUTY CHAIR - JULES ALVARO

Merredin, Western Australia

Jules Alvaro is a director of a broadacre, predominantly cropping business in Nokaning WA. Jules has also been involved in off-farm industry roles including as a Western Region Panel Member since 2015, a non-executive director on the boards of Partners in Grain (now Rural Edge) and Agricultural Women Wheatbelt East, and is currently on the Muresk Institute Advisory Committee. Jules is an alumni of Leadership WA's Signature Leadership program. She is a graduate of the Aust. Institute of Company Directors and has completed the General Manager Program at the Australian Graduate School of Management (AGSM) at the University of New South Wales Business School.

M +61 429 141 668 **E** jules@windsorhart.com.au

JULIET MCDONALD

Coorow, Western Australia

Juliet is a Coorow grower and also works for Summit Fertilizers as an Area Manager. Juliet has a passion for agriculture having worked as a sales agronomist with Elders, area manager – Kwinana West, for GrainPool, marketing manager with Coorow Seeds and research agronomist and extension officer with the WA Department of Primary Industries and Regional Development. Juliet holds a Bachelor of Science in Agriculture from University of Western Australia and is qualified as a Fertcare® Accredited Adviser.

M +61 429 945 332 **E** madgrub123@gmail.com

ROHAN FORD

Binnu, Western Australia

Rohan and his wife Carole farm east of Binnu growing wheat, lupins and canola in a low rainfall zone with highly variable precipitation. They have been using controlled traffic farming methods for 20 years. The Fords have also been involved in trial work and projects related to a variety of areas that help to improve farming outcomes and increase knowledge. Rohan is also involved closely with the local grower group, holding various positions over many years and helping to provide mentoring for younger farmers.

M +61 429 331 045 **E** rohan@nookanderri.farm

SUZANNE WOODS

Calingiri, Western Australia

Suzanne Woods is an owner of Emdavale Farms, a 3400-hectare mixed farming enterprise in Calingiri, north-east of Perth. Oaten hay comprises 50 per cent of the cropping program, with the remainder being wheat, barley, canola and lupins. The business operates a small cattle and sheep enterprise as well as a farm contracting business, concentrating mostly on mowing, baling and carting hay and straw. Suzanne is a founding shareholder in Hay Australia, a large export hay company and is a director of the Australian Fodder Industry Association and Regional Early Education and Development Inc. She sees R&D as the key to ensuring that Australian farming businesses and communities continue to be at the forefront of new technologies and applications.

M +61 438 297 191 **E** swoods@wn.com.au

GARY LANG

Wickepin, Western Australia

Gary, a grower for 37 years has grown the farm from a 1000ha Merino stud enterprise to a 5600ha cropping-focused business. He grows wheat, barley, oats, canola and lupins across 87 per cent of the farm, Gary was a catalyst in initiating frost research confirming that high levels of stubble could increase frost damage to grain crops. He is the president of the Facey Group and was previously the grower group's cropping coordinator, secretary and vice president.

M +61 427 881 034 **E** garyjlang@bigpond.com

JOHN BLAKE

Albany, Western Australia

John is a research and development consultant with Stirlings to Coast Farmers and an adviser in Western Australia's northern, central and southern agricultural regions. He has led RD&E projects with GRDC, MLA, National Landcare Program and Royalties for Regions investment. John has a degree in Agricultural Science from the University of WA and has extensive skills in agricultural sustainability, diagnostics for precision agriculture and farming systems analysis.

M +61 438 761 950 **E** john@blakeshare.com

NATASHA AYERS

Vasse, Western Australia

Tash is the co-founder and managing director of AgriStart, a WA company connecting key players in the agri-food innovation space. She has an agricultural scientist background, with a PhD in plant biology and a Bachelor of Science in Agriculture, and has qualifications in university teaching, research commercialisation and leadership. She is a graduate of the Aust. Institute of Company Directors. She is an experienced trainer and facilitator and has spent the past seven years leading strategic research and innovation projects in WA.

M +61 8 9755 4997 **E** tash@agristart.com.au

RICHARD WILLIAMS

Perth, Western Australia

Richard has worked across the Australian grain supply chain in operations; market research and big data analysis; strategic planning; stakeholder management and international customer relations. His own consultancy business grolQ published big data research findings internationally. He has recently returned to the CBH Group in a logistics quality planning role. Richard has a PhD from Curtin University and a Bachelor of Agricultural Science from the University of WA.

M +61 427 593 778 **E** Richard.williams@cbh.com.au

DAN MULLAN

Perth, Western Australia

Dan Mullan, a wheat breeder with InterGrain is committed to delivering improved grain technology to growers. He spent his early career with CSIRO and the International Maize and Wheat Improvement Centre (CIMMYT), which provided him with excellent skills in high level science and a global perspective of RD&E. Dan regularly engages with Australian grain end markets to understand and extend information about market requirements. He maintains a close working relationship with researchers, breeders and management groups across Australia and the global plant breeding community. His focus is on improving the stability and profitability of the Australian grains industry.

M +61 403 595 141 **E** dmullan@intergrain.com

DR PETER CARBERRY

Toowoomba, Queensland

Peter is general manager of GRDC's Applied Research , Development and Extension business group. Prior to joining GRDC, he was director-general of the international Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad, India. Previously he had spent 29 years with CSIRO as a research scientist.

T +61 419 656 955 **E** peter.carberry@grdc.com.au

2022 GRAINS RESEARCH UPDATE, Perth

Day 1 – Contents

PLENARY PRESENTATIONS

Day 2 – Contents

PLENARY PRESENTATIONS

Note: Presenters are listed. Where there are multiple authors of papers full authorship should be taken from the final papers, located on the GRDC website at **grdc.com.au/resources-and-publications/grdc-update-papers**, as and when they become available.

GIWA
Grain Industry Association of Western Australia

The Grain Industry Association of Western Australia (GIWA) Inc is a not-for-profit, member based association, representing the interests of the entire Western Australian grain value chain.

GIWA holds public meetings each year to discuss market and seasonal developments, standards, variety rationalisation, and value chain issues for wheat, barley, oilseeds, oats and pulses; connecting the WA supply chain from plant breeders, growers, grower groups, agronomists, farm business advisors through to processors and the trade.

2022 Events

Wednesday, 22nd June - GIWA Pulse Forum (The UWA Club)

Monday, 25th July - GIWA Barley Forum

GRDC Grains Research Updates events postponed to July / August

Wednesday, 5th October - GIWA AGM and GIWA Forum (Perth)

Monday, 10th October - GIWA Oat Field Day (Northam)

Monday, 10th to 13th October - International Oat Conference (Crown Perth)

RSVPs Essential Online

Visit **www.giwa.org.au/events** for further details or call GIWA on 08 6262 2128.

GIWA - Facilitating an effective and efficient Western Australian grain industry

www.giwa.org.au/events

@GrainIndustryWA

Day 1 – Monday 21 February

Plenary Presentations

Welcome and 'Seed of Light' presentation

Darrin Lee, Chairman, GRDC Western Panel

Darrin Lee was appointed to the GRDC Western Region Panel during 2014 and was appointed Panel Chair during 2018. He has been farming in WA's Northern Agricultural Region for more than 20 years, with property now at Mingenew and Dongara. Darrin has a keen interest in digital agriculture and has a background in banking and finance. He is a past member of the CBH Group Growers Advisory Council and a previous Board member of Mingenew Irwin Group. Darrin is passionate about family, rural life, food production, technology, and agriculture in general.

Opening and future directions of GRDC

John Woods, Chairman, GRDC

John is partner and manager of a broadacre agribusiness based in northern New South Wales and southern Queensland. He has responsibility for all business aspects, including financial management, production and crop husbandry, marketing and logistics, resource management and work health and safety.

He is also Chair of R&R Hire Services in Queensland.

John has a long history of working collaboratively with a range of public and private organisations in the development, extension and adoption of new technology.

He was Chairman of the Science Advisory Group of the National Agricultural Monitoring System (NAMS) between 2005 and 2009, and a member of the NAMS Advisory Reference Group and Steering Committee. He also spent six years, to 2005, on the National Rural Advisory Council.

John was Chairman of ChemCert Training Queensland from 2002 to 2004 and has held positions with Cotton Australia and Farmsafe Queensland.

Greenhouse gas emissions of Australian grain production

Maartje Sevenster, CSIRO

As part of CSIRO's Climate Smart Agriculture group, Dr Maartje Sevenster works on the quantification of direct and indirect impacts of agriculture and other economic activities. The aim is to make this kind of information accessible to a range of stakeholders so they can improve decision making. Maartje's main area of expertise is Life Cycle Assessment (LCA) which provides a framework to quantify environmental, social and economic impacts of a system. Agriculture and food are both driving climate change and strongly impacted by it, and the goal is to make the role of externalities, such as ecosystem services, in problems as well as solutions, more visible.

Maartje is leading projects focusing on improving environmental accounting for Australian agriculture, developing the Farmprint tool and working with a broad group of stakeholders on defining a common greenhouse-gas accounting methodology. As part of the Trusted Agrifood Exports mission, she is leading an evaluation of the increasing role of sustainability metrics in trade and market access. Maartje was on the board of the Australian LCA Society for eight years until 2021.

Summary

Key points include:

- Potential to increase production without significantly increasing overall on-farm emissions, improving emissions intensity by 20 per cent, is possible by optimising N applications based on seasonal conditions and rotations.
- Improved N management is a clear option to reduce greenhouse-gas (GHG) intensity but by increasing production by 30-40% would result in an industry wide emissions increase.
- Monitoring and improving the GHG intensity of our grain production systems is critical to remain competitive in global markets and provide evidence of Australia's low-emissions credentials.
- On-farm emissions (Scope 1 in Abstract) comprise 61% of total emissions, most of which comes from application of lime and fertiliser (26%), denitrification losses (20%) and fuel use (11%).
- Fertiliser is the largest contributor (38%) to GHG emissions both from the production and the use of fertiliser.
- The GHG emissions intensity of Australian grain crops is relatively low, producing around 315 kg CO^2 equivalent per tonne of grain with regional differences evident.
- To achieve reduction in overall absolute emissions, with increasing production, significant reductions of emissions associated with the production of fertilisers and other inputs will be needed.

Australian agriculture has defined ambitious climate change objectives, such as in the *2030 Roadmap of the National Farmers' Federation*, which aim to contribute to Australia's emissions reductions. Emissions reductions also keep our commodities competitive in export markets that increasingly require evidence of low-GHG emissions credentials. GHG credentials are established using GHG accounting to estimate the GHG's emitted directly or indirectly by a farming enterprise or emitted in a chain of processes resulting in a particular product. At sector level, establishing GHG baselines provides a reference to estimate GHG emissions reductions associated with climate change mitigation strategies.

Climate change mitigation strategies also need to be assessed for GHG emissions reduction potential to guide the Australian grains industry towards a low GHG emissions future. This is important because it will allow the grains industry to contribute to state/national emissions reduction targets and ensure access to key international markets is maintained.

(Continued on following page...)

GRDC commissioned this study to establish a detailed and robust GHG emissions baseline for the Australian grains sector and explore mitigation pathways that maintain or increase production. An estimate of the GHG emissions associated with grain production during 2005 was developed based on management practices and production statistics for that year (a static baseline) based on 25 leviable crops; wheat, barley, oats, maize, triticale, millets, cereal rye, canary seed, lupins, fieldpeas, chickpeas, faba beans, vetch, peanuts, mungbeans, navy beans, pigeon peas, soybeans, cowpeas, lentils, canola, sunflowers, safflower and linseed. The same approach was used to develop an estimate of current emissions for industry and used data for 2016 because that was the most recent year with the required data available. The study also developed a dynamic baseline that estimated the business-as-usual scenario over the period 1991–2019 using APSIM simulations of common rotations used in grain production systems on a regional basis. The emissions reduction potential of a number of strategies (Table 1 in Abstract) was assessed by either running APSIM models with modified management or by undertaking a static assessment using different emissions factors.

Click here for additional information on what the GRDC is doing on GHG emissions for the grains industry.

Reference

Australian Grains Baseline and Mitigation Assessment

Maartje Sevenster[1], Lindsay Bell[2], Brook Anderson[2], Hiz Jamali[3], Heidi Horan[4], Aaron Simmons[5], Annette Cowie[6], Zvi Hochman[4]

CSIRO Agriculture and Food [1]Black Mountain ACT, [2]Toowoomba QLD, [3]Mayfield West NSW, [4]St Lucia QLD; New South Wales Department of Primary Industries [5]Taree, [6]Armidale

Carbon neutral grain farming by 2050 — an example in calculating the net emissions for a broadacre farm and strategies to reduce net emissions

Mandy Curnow, Department of Primary Industries and Regional Development

Mandy is based in the Livestock Directorate of the Department of Primary Industries and Regional Development (DPIRD) Albany office, working predominantly in the sheep industry for the last 20 years. Prior to this, Mandy led a number of projects as part of the '*Doing More with Agriculture*' program that introduced Farmers Markets, Community Builders, Diversifying Agriculture and leadership training programs. She started in the department in catchment planning and landcare and still retains an interest in environmental management.

Co-managing the family's Merino breeding enterprise developed Mandy's knowledge and interest in sheep management and reproduction. This interest and passion for the sheep industry has led Mandy into; research as part of the highly successful Lifetime Wool project; the development of many tools in sheep management; and the designing and rollout of adoption programs.

Recently Mandy has taken on driving DPIRD's activities around farm and industry carbon accounting in the agricultural sector, specifically livestock, and assisting producers to understand carbon budgeting.

Summary

Greenhouse Gas (GHG) accounting takes place at many different levels from state and national, industry and at the farm gate. Each has its own set of questions to be answered and value in providing a benchmark on progress (or otherwise) towards the community and consumers expectations towards lowering GHG emissions and global warming.

At the farm gate there are several tools that support producers in understanding and the opportunities to mitigate their GHG product emissions. It is important to understand the limitations of these tools but also their value in identifying 'hotspots' in emissions so that effort can be focussed on areas where the biggest impacts can be made. Cropping enterprises in WA generally have higher emissions than eastern state counterparts, mainly due to higher inputs such as nitrogenous fertilisers. Emissions from cropping enterprises are generally higher for canola and lowest for legumes. Our opportunities to sequester carbon in low rainfall, high temperature environments are often less than other states, making the task of offsetting emissions more difficult. There are, however, some real opportunities to do so and the goal of carbon neutrality for the cropping enterprise is within reach for most grain producers.

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Grains Research and Development Corporation – Western Office
P Suite 5, 2a Brodie Hall Drive, Bentley WA 6102 **T** +61 8 9230 4600 **E** western@grdc.com.au

Grains Research and Development Corporation – Canberra Office
P Level 4 | 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604 **T** +61 2 6166 4500 **E** grdc@grdc.com.au

Market Outlook for the WA grains industry in 2022 and the longer term — challenges and opportunities

A panel discussion with Jason Craig, CBH Group; Cheryl Kalisch-Gordon, Rabobank; John Orr, Premium Grain Handlers; and Richard Simonaitis, AEGIC

Jason Craig

CBH Group

Jason was appointed Chief Marketing and Trading Officer in April 2012 and is responsible for CBH's Marketing and Trading and Fertiliser divisions. Jason has vast experience in international trade, supply chains, shipping, food processing and agricultural inputs. He has held previous roles as President Director with PT Eastern Pearl Flour Mills (Indonesia) and in various marketing and trading roles with the Grain Pool (now CBH Marketing and Trading).

Jason holds a Bachelor of Commerce in Banking and Finance, Postgraduate in Applied Investment and Finance and attended the Advance Management Program at INSEAD. Since 2015 Jason has been a board member of Grain Trade Australia and the Chair of the Grain Trade Australia, Trade & Market Access Technical Committee.

Cheryl Kalisch Gordon

Rabobank Research Food & Agribusiness

As part of the Rabobank Global Grains & Oilseeds Strategy team, Cheryl is responsible for forecasting key grains and oilseeds pricing and the Australian crop and trade outlook and analysing global trends. Cheryl also engages with rural and corporate clients on strategic issues and is the lead author of Rabobank reports on the Australian Feed grain Squeeze, the Black Sea Region Grains Outlook, Opportunities from De-bulking, the impact of Trade Wars on the grains sector and Getting Granular with Plant-Based Meat Alternatives. Prior to joining RaboResearch in early 2017, Cheryl spent four years as the Trade and Economics Manager at the grain farmer representative organisation, Grain Growers. In this role Cheryl was responsible for the economic evaluation of policy and negotiation of grains outcomes in the China-Australia Free Trade Agreement, the Trans-Pacific Partnership, and the Indonesia-Australian Comprehensive Economic Partnership Agreement and at the WTO, on behalf of Australian grain farmers. Cheryl has extensive experience in the grain industry and the broader Australian agriculture sector, including working as a trading assistant, consultant, and lecturer at the University of Sydney. Cheryl has a PhD in Economics and grew up on a cropping farm in New South Wales.

(Continued on following page...)

John Orr

Premium Grain Handlers

John Orr is the Managing Director at Premium Grain Handlers, an integrated grain production, storage, cleaning, container packing and export business, with facilities in WA and Melbourne. Prior to establishing Premium Gain Handlers in Fremantle during 1995, John worked at the Grain Pool of WA. John grew up on a family grain/sheep farming operation and completed an Associate Diploma in Agriculture; Batchelor of Business Degree; Post Grad Diploma in Business Management and Master of Business Administration.

Richard Simonaitis

Australian Export Grains Innovation Centre

Richard Simonaitis has broad experience in export-focused commodities industries, having worked in logistics and product quality roles in the iron ore industry and in senior management roles in the grain industry across logistics, operations and marketing and trading. With the CBH Group, Richard led the national Accumulations Team for five years.

Richard has a strong understanding of grain growers, the grains industry across Australia and of the markets Australian grain is sold into. He also has international experience developing several grain infrastructure projects in Indonesia. Richard is an inaugural board member of the Australian Grains Institute capacity building project, a fellow of the Australian Rural Leadership Foundation, a Member of the Australian Institute of Company Directors and has a Graduate Certificate in Business with the University of Western Australia (UWA). He is on the Grain Trade Australia Trade and Market Access Committee, the Wheat Quality Australia Wheat Classification Council and is part of the Grains Industry Market Access Forum.

Australian soft wheat for Asian markets

Ken Quail, Australian Export Grains Innovation Centre

Ken has worked in agricultural research for 40 years. His work has taken him to more than 30 countries and provided him with some amazing experiences and a unique perspective on Australian grain exports.

Ken spent his early career working on crop physiology with CSIRO and then moved to AWB to focus on grain quality and markets. Later working with BRI Australia he honed his understanding of the impact of grain quality on food processing and final products. With Grain Growers and now the Australian Export Grains Innovation Centre (AEGIC) he has continued to build connections between growers, industry, international markets, and cereal researchers.

Summary

There is a significant market for soft wheat in Southeast Asia, with an estimated demand for more than two million tonnes by 2030.

Drought on the west coast of the United States of America has left Southeast Asian flour millers seeking alternatives to Soft White Wheat (SWW) from the USA for cookie applications.

Low protein Australian Noodle Wheat (ANW2) provides an immediate, short-term supply solution to meet Asian market demand for soft wheat. WA is well placed to meet the long-term demand for soft wheat in Asia, with this market opportunity providing growers with a new low protein crop option.

Work on the development of soft wheat lines that provide a viable option for WA growers, and meet market requirements, continues as a long-term supply opportunity.

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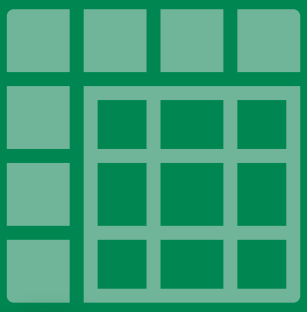

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Wheat agronomy management — managing risk versus potential

Dion Nicol, Department of Primary Industries and Regional Development

Dion Nicol is a wheat physiologist and agronomist with DPIRD based at the Merredin Dryland Research Institute. Dion possesses expertise in plant physiological responses to abiotic stresses and nutrition, agronomy and on-farm experience in the eastern wheatbelt. Dion is the wheat commodity leader at DPIRD, sits on the GIWA Wheat Council and is an Adjunct Lecturer with the School of Agriculture and Environment at UWA.

Summary

With high 2022 input prices, but likely above average grain prices, wheat variety choices may significantly improve profit outcomes. An overview of the GRDC National Variety Trial data is still showing the fast-maturing Vixen is the top yielding variety over the last four years, Scepter is still among the top performers as the mid-fast maturity and Rockstar is remaining the highest yielding in the mid-slow maturity. The relative risk and opportunity of varieties will be presented from this data and available agronomic information of the varieties.

Across the DPIRD time of sowing datasets, optimum flowering periods relate most consistently to water availability and peak biomass over multiple seasons more than frost and heat events. Therefore, variety and sowing time choices, while never perfect, can improve the overall potential with considerations of risk across a range of scenarios.

Deep sowing of wheat is often touted as an opportunity to better control germination date and a heavy focus of this subject is a wheat varieties' coleoptile length, however, soil conditions and seeder-setup are critical for ensuring relative risks of poor establishment and yield impacts. Other factors often interact, for example, flowering time was found in several trials to be delayed by deep sowing. An overview of the likely risks and opportunities will be discussed.

Reference

Wheat variety and agronomy decisions – managing risk versus potential

Dion Nicol, Jeremy Curry, Brenda Shackley, DPIRD

Blackleg control in the upper canopy of canola crops

Steve Marcroft, Marcroft Grains Pathology

Steve Marcroft has been working on diseases of canola for the past 25 years and has developed many of the cultural practices currently used in Australia to minimise the impact of blackleg. Steve leads the field-based components of the research carried out by Marcroft Grains Pathology in collaboration with the University of Melbourne. Marcroft Grains Pathology also do work on the national blackleg ratings, blackleg resistance groups (genetic of resistance), fungicide efficacy work, fungicide resistance, upper canopy blackleg management and the BlacklegCM App.

Prior to establishing Marcroft Grains Pathology 18 years ago, Steve worked for SARDI at Minnipa, South Australia, for four years on low rainfall canola production. He also worked for Agriculture Victoria for seven years in the canola breeding program.

Summary

Key points include:

- Increased canola area will result in increased canola stubble in subsequent years and therefore increased blackleg spore density.
- Spore density can (but does not always) result in increased disease severity.
- Increased canola stubble and canola crop area will reduce the ability of growers to maintain a 500m buffer between one-year-old stubble and current crops.
- Stubble quantity rather than stubble management has the largest effect on blackleg disease.
- Seasonal conditions will influence the relative significance of crown canker or upper canopy infection and whether control is warranted. It will be rare to have severe forms of both versions of blackleg in the same year.
- Crown canker years occur from late sowings, which results in plants remaining as seedlings during the winter infection period.
- Upper canopy infection years will likely result from early sowing times, which results in plants commencing flowering in late July/early August. Early flowering will result in increased infection and will provide the fungus with more time to cause damage prior to harvest.
- The canola industry is likely to become more reliant on fungicides due to increasing canola production (and the subsequent inability to avoid canola stubble).
- The decision to use a fungicide is not clear cut. The first step in the decision-making process is to understand the disease risk profile of your crop.
- Before sowing, use the BlacklegCM decision support tool to identify high risk paddocks and explore management strategies available to reduce yield loss.
- Fungicide application for upper canopy infection is a separate decision-making process from crown canker control. Fungicide control of upper canopy infection can result in very variable yield returns. It is important to understand the disease risk before applying a fungicide.

Reference

Will increased canola density change blackleg and/or sclerotinia management decisions?

Steve Marcroft, Marcroft Grains

Useful resources

- NSW DPI Winter Crop Variety Sowing Guide (Disease updates, variety resistance, fungicide products).
- SclerotiniaCM App for iPad and android tablets

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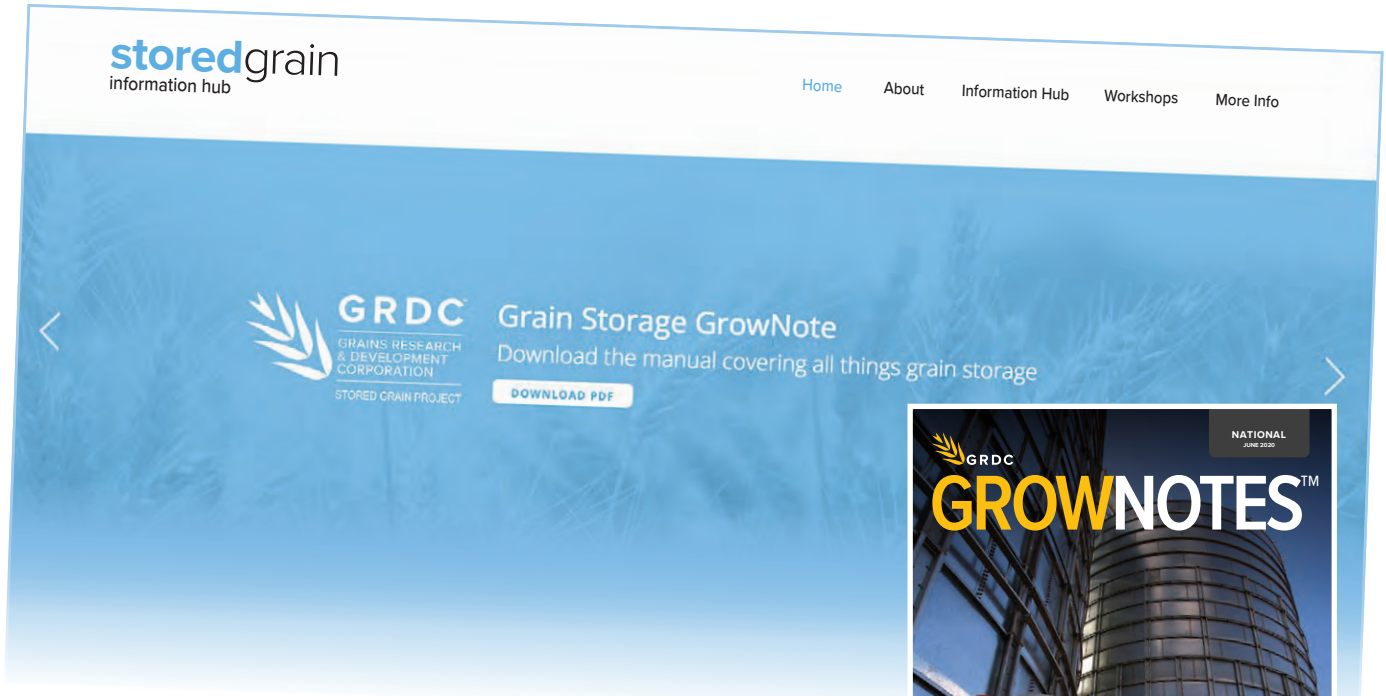
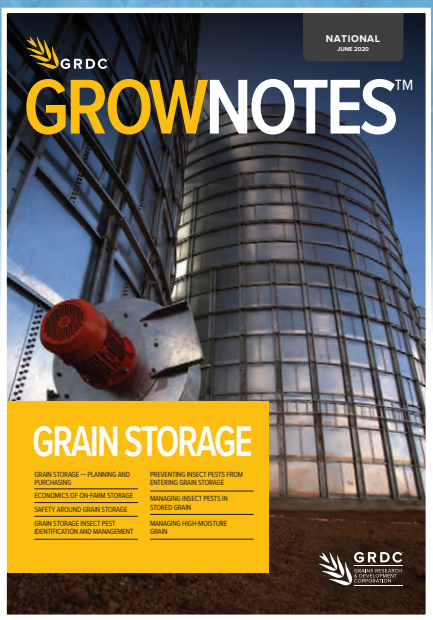


The complete manual for on-farm grain storage



Call the National Grain Storage Information Hotline **1800 WEEVIL** (1800 933 845) to speak to your local grain storage specialist for advice or to arrange a workshop.

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Forewarned is Forearmed — new BoM tools for weather forecasting and climate services for agriculture

Dale Grey, Agriculture Victoria

Dale Grey is a Seasonal Risk Agronomist with Agriculture Victoria where he has worked for 27 years. Dale provides agronomy, climate and weather analysis for farmers, agribusiness, government and the media across Southeast Australia and has been interpreting climate models from around the world every month since 2008. He is the author of the *Fast Break* climate newsletters for Victoria, South Australia, Tasmania and southern New South Wales and produces a monthly YouTube climate update. For the last three years Dale has worked as part of a large multidisciplinary team on the *Forewarned is Forearmed* project, gathering insights on hot, cold, wet, dry extreme forecasts from the Bureau of Meteorology (BoM) ACCESS model.

Summary

New forecasts from the BoM ACCESS model have been developed to give insight to hotter, cooler, wetter or drier conditions out weeks, fortnights and months. This work bridges the gap between weather forecasts good out to seven days and the climate forecasts that go out to three months.

The predictions of extreme weather events are specifically looking at the chances of receiving decile one and two events, or decile nine and ten events. It is hoped these forecasts will allow growers to plan farm operations in the murky zone past the weather forecast, for planting, harvesting, topdressing and haymaking logistics. Predictions are available for rainfall, maximum and minimum temperature.

The new products are seamlessly embedded into the existing BoM ACCESS graphical forecasts and have a 'point at your location' feature. For the first time ever, growers will be able to get a quintile (five section) forecast for rainfall to provide better detail to the current bimodal (two section) chance of above median forecast. The forecasts are constructed every day using the most recent three days of forecasts to provide a total of 99 separate model runs. This allows the variability of the model to be plotted in a probabilistic fashion.

As with all probabilistic forecasts they never tell you exactly what will happen but show the range of odds of various amounts of rainfall or temperature occurring. When all the model runs are stacked up in a particular direction, users can be confident that the overarching climate and weather setup is causing that to happen; but just like 100:1 chances can win horse races, so too can unlikely events occur in weather and climate.

Many times though, forecasts show a great spread (or neutral) forecast which some people falsely interpret as average being the most likely. This is not correct, as such forecasts more correctly show that anything is possible! Forecasts such as these are not worth agonising over.

The *Forewarned is Forearmed* project was funded by the Federal Government's Rural R&D for Profit program and included contributions from the grains, dairy, red meat, pork, sugar, wine and cotton industries. The project was enacted by a large consortium including BoM, University of Melbourne, Monash University, University of Southern Queensland, SARDI, Agriculture Victoria and Birchip Cropping Group. Industry stakeholder groups were used to provide continued feedback on the actual forecast products and their visual appearance.

Lessons for growers from the hyper yielding crops and high rainfall zone farming systems projects in WA

Nick Poole, Field Applied Research Australia

Nick Poole has more than 38 years' experience as a research agronomist, in Australia, New Zealand and the United Kingdom. Nick is now based in Geelong, Victoria, as the Managing Director of Field Applied Research (FAR) Australia; an applied research and extension organisation serving the cropping industry in Australia. Nick started his career working for Arable Research Centres in the UK and moved to the southern hemisphere during 2003 working in both New Zealand and Australia. His specific interests are farming systems research, disease and canopy management, crop establishment and challenging the current boundaries of wheat productivity worldwide.

Summary

Key points include:

- Ameliorated sandplain soils that were deep ripped to a depth of 800mm were associated with yield increases of approximately 0.5t/ha in wheat and a cost benefit ratio of just less than $2 return for every $1 spent.
- Winter wheat cultivars extend our ability to sow early (early – mid-April) on large acreages, however, with yields of 6-8t/ha (2020 and 2021) high rainfall zone (HRZ) project results have to date shown no difference in yield between the best winter and spring cultivars on ameliorated soil in a frost-free environment.
- Increased inputs, particularly nutrition have been the key to cost effective yield increases in wheat trials over the last two seasons, whilst in barley both disease management and nutrition hold the key to higher output in seasons of higher yield potential.
- The principles of canopy management are more applicable to the increased yield potentials of ameliorated soils and to maximise crop yields in the better seasons of the WA HRZ.

The aims of the project were to examine the productivity and profitability of cereal crops sown in mid-April as part of a soil ameliorated farming system, and to examine the suitability of April sown winter versus spring germplasm on sandplain and forest gravel in coastal HRZ regions of WA to increase productivity.

The results from the HRZ project in 2020 and 2021 illustrated that there was a significant yield advantage of 0.45 and 0.47 t/ha respectively to deep ripping to a depth of 800mm on a deep sandy duplex prior to establishing wheat. With ripping costed at $80/ha and grain at $310/t, soil amelioration produced an approximate return of just under $2 for each $1 spent (assuming benefits were only apparent for one year). Although APSIM modelling of the Esperance research site clearly shows a yield advantage to sowing winter wheat over spring wheat in mid-April, results to date have indicated no difference in yield in this relatively frost-free environment, despite spring wheats flowering in August prior to the recognised optimal flowering window of mid-September. In 2021 plot yields of wheat and barley in project trials achieved of 7–8t/ha at Esperance and 7.5–9t/ha at Frankland River. Side by side trials planted on the same site in mid-April have shown no yield advantage to winter wheat cultivars over spring wheats sown in mid-May at the Esperance research site. Increased expenditure on inputs, particularly nutrition has been the key to higher yields in wheat in WA trials over the last two seasons, whilst in barley disease management and nutrition hold the key in seasons of higher yield potential such as 2021. Although N rates of 180–225kg N/ha have been associated with the highest yields in our research projects in WA, increasing N fertiliser levels above 200–225kg N/ha has failed to give higher grain yields in other HYC project research, indicating that there will be a limit to just how much yield can be generated by routinely applying more artificial N fertiliser.

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After two seasons, deep ripping sandplain soils has shown to be cost effective. Winter wheat cultivars extend our ability to sow early (early – mid-April) on large acreages, stabilising flowering dates from a larger sowing window preventing cereal crops from flowering too early in frost prone environments. However, HRZ project results with yields of 6-8t/ha has to date shown no difference in yield between winter and spring germplasm sown on ameliorated soil in a frost-free environment despite flowering up to one month apart from early sowing. To date there has been no evidence from side-by-side trials on the same site to suggest that mid-April sown winter wheat is higher yielding than mid-May sown spring wheat, although APSIM modelling suggests it is possible and faster developing winter wheats may be required.

Reference

Lessons for growers from the Hyper Yielding Crops (HYC) and High Rainfall Zone (HRZ) Farming Systems projects in WA

Nick Poole[1], Kenton Porker[1], James Rollason[1], Tracey Wylie[1] and Jeremy Curry[2]
[1]Field Applied Research Australia, [2]DPIRD Esperance

Day 2 – Tuesday 22 February

Plenary Presentations

Gene editing: Building breeding 4.0 for growers and the grains industry

Catherine Feuillet, Inari, USA

Catherine Feuillet is the Chief Scientific Officer at Inari, leading a team of scientists focused on unlocking the full potential of seed to help build a more sustainable food system. Combining AI-powered predictive design and multiplex gene editing, Inari is deciphering and engineering plants' most complex systems to dramatically increase yield and reduce water and fertiliser needs.

Prior to joining Inari, Catherine led the international effort to sequence the bread wheat genome as founder and co-chair of the International Wheat Genome Sequencing Consortium (IWGSC). She also led the team at the Institut National de la Recherche Agronomique (INRA) in France that first cracked the genetic code of the largest wheat chromosome. She then went on to become the head of trait research at Bayer CropScience.

Catherine received her Ph.D. from the Paul Sabatier University in Toulouse (France) and spent 10 years in Switzerland for postdoctoral studies and as assistant professor at the University of Zurich. Her research has garnered her multiple awards and recognitions, including being elected the French "golden woman of the year for research" in 2008 and receiving the 'Prix Foulon' from the French Academy of Sciences in 2009. She received the Legion of Honour in 2010, was elected a Fellow of the American Association for the Advancement of Science in 2011 and received the 'Prix J. Dufrenoy' from the French Academy of Agriculture in 2012. Catherine has supervised the work of more than 30 masters, PhDs and postdoc scientists and published more than 120 scientific papers in peer reviewed journals and books.

Summary

Historically, plant breeding and management improvement have together enabled significant progress in our ability to provide food, feed, and fibre to a rapidly growing population. In recent decades, however, agricultural production has faced critical challenges that classical breeding methods have not been able to address in a timely and efficient manner — namely, the rapidly changing climate. In addition to enhancing yield, protecting harvest, and improving quality, plant breeding should also help address the environmental impact of crop production and at a pace that keeps up with fast-evolving conditions. It is essential that we (1) develop new varieties that ensure optimal crop performance with a minimal use of natural resources and input in very rapid cycles, and (2) do so with a business model that enables all farmers to access technologies adapted to their needs.

Plant breeding has always benefited from advancements in science and technology, from Breeding 1.0 (incidental selection by farmers) to Breeding 2.0 (development of the science of breeding) to Breeding 3.0 (linking phenotypes with molecular information to support and accelerate breeding decisions). Today, we are at the beginning of a new era, Breeding 4.0, which is described by Wallace et al[1] as the genome-wide ability to combine any known alleles into desirable combinations. It is enabled by the convergence of novel technological revolutions such as genome editing and artificial intelligence, combined with the genomics revolution that enables us to produce large amounts of data at

(Continued on following page...)

reasonable costs. This represents a unique opportunity to address and embrace the complexities of improving crop performance, in a cost- and time-effective manner through (1) accelerated gene/causal sequences discovery in crops; (2) increased power to be predictive rather than prescriptive, enabling the design of ideotypes for optimal performance in local conditions; (3) sped up breeding cycles and increased accuracy of selection; and (4) the ability to better leverage and create novel genetic diversity.

Breeding 4.0 is under way, with genome-edited crops already in the pipeline of public and private entities and several recently approved for commercialization in South America and Japan[2]. The vast majority of genome-edited products to date have been obtained through single gene deletions; however, crop improvement requires a more sophisticated editing strategy that will enable the modification of many genes at the same time and perform different types of modifications such as deletion, insertion, gene expression modulation, and gene replacement. Inari Agriculture[3], the SEEDesign™ company, is developing a unique technology platform that captures the latest advancements in genomics, genome editing and artificial intelligence to perform predictive design and advanced multiplex gene editing. Our objective: to develop resilient seeds that require fewer natural resources and inputs, in a drastically shorter time at a lower cost than current approaches.

While wheat is now fully benefiting from the genomics revolution – in particular since the achievement of a high-quality reference genome for bread wheat[4] – it has not yet captured the full benefits of Breeding 4.0. Inari aims to change that. We are committed to deploying our SEEDesign technology platform to dramatically enhance wheat's yield potential and secure the crop's long-term viability.

[1]JG. Wallace, E Rodgers-Melnick, and ES. Buckler- 2018- Annual Review of Genetics, Vol. 52:421-444

[2]J Menz, D Modrzejewski, F Hartung, R Wilhelm and T Sprink. 2020. Front. Plant Sci., https://doi.org/10.3389/fpls.2020.586027

[3]https://www.inari.com/

[4]International Wheat Genome Sequencing Consortium, 2018, Science 361, (6403):eaar7191

Reference

Genome Editing: Building Breeding 4.0 for Growers and the Grain Industry

Catherine Feuillet, Chief Scientific Officer, Inari Agriculture

The WeedSmart Big 6

Weeding out herbicide resistance in winter & summer cropping systems.

The WeedSmart Big 6 provides practical ways for farmers to fight herbicide resistance.

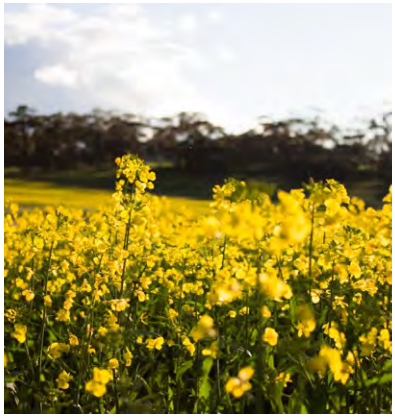
How many of the Big 6 are you doing on your farm?

We've weeded out the science into 6 simple messages which will help arm you in the war against weeds. By farming with diverse tactics, you can keep your herbicides working.

Rotate Crops & Pastures

Crop and pasture rotation is the recipe for diversity

- Use break crops and double break crops, fallow & pasture phases to drive the weed seed bank down,
- In summer cropping systems use diverse rotations of crops including cereals, pulses, cotton, oilseed crops, millets & fallows.



Mix & Rotate Herbicides

Rotating buys you time, mixing buys you shots.

- Rotate between herbicide groups,
- Mix different modes of action within the same herbicide mix or in consecutive applications,
- Always use full rates,
- In cotton systems, aim to target both grasses & broadleaf weeds using 2 non-glyphosate tactics in crop & 2 non-glyphosate tactics during the summer fallow & always remove any survivors (2 + 2 & 0).

Increase Crop Competition

Stay ahead of the pack

Adopt at least one competitive strategy (but two is better), including reduced row spacing, higher seeding rates, east-west sowing, early sowing, improving soil fertility & structure, precision seed placement, and competitive varieties.

Double Knock

Preserve glyphosate and paraquat

- Incorporate multiple modes of action in the double knock, e.g. paraquat or glyphosate followed by paraquat + Group 14 (G) + pre-emergent herbicide
- Use two different weed control tactics (herbicide or non-herbicide) to control survivors.

Stop Weed Seed Set

Take no prisoners

- Aim for 100% control of weeds and diligently monitor for survivors in all post weed control inspections,
- Crop top or pre-harvest spray in crops to manage weedy paddocks,
- Consider hay or silage production, brown manure or long fallow in high-pressure situations,
- Spray top/spray fallow pasture prior to cropping phases to ensure a clean start to any seeding operation,
- Consider shielded spraying, optical spot spraying technology (OSST), targeted tillage, inter-row cultivation, chipping or spot spraying,
- Windrow (swath) to collect early shedding weed seed.

Implement Harvest Weed Seed Control

Capture weed seed survivors

Capture weed seed survivors at harvest using chaff lining, chaff tramlining/decking, chaff carts, narrow windrow burning, bale direct or weed seed impact mills.

WeedSmart Wisdom

Never cut the herbicide rate – always follow label directions
Spray well – choose correct nozzles, adjuvants, water rates and use reputable products,
Clean seed – don't seed resistant weeds,
Clean borders – avoid evolving resistance on fence lines,
Test – know your resistance levels,
'Come clean. Go clean' – don't let weeds hitch a ride with visitors & ensure good biosecurity.

The interaction between wheat establishment timing and pre-emergent herbicides choice on annual ryegrass seed production

Mike Ashworth, Australian Herbicide Resistance Initiative, University of Western Australia

Mike Ashworth is a research agronomist working within the Australian Herbicide Resistance Initiative (AHRI) located at the UWA. Mike studied Engineering, Agricultural production and Weed science before working as a field agronomist. Mike currently conducts research on agronomic opportunities to improve the control of multi-herbicide resistant weed populations in dryland crops and lectures at UWA on conservation agriculture and crop protection.

Summary

It has long been advised that delaying seeding of weedy paddocks in order to maximise the weed control effectiveness of knockdown (glyphosate/paraquat) applications results in optimal weed control. However, with the development of more pre-emergent residual herbicides for use in no till farming systems, early seeding may now be the optimum weed control strategy. When crops are sown early into increased soil temperatures, crop growth rates are increased, increasing their competitive advantage against weeds. However, earlier crop seeding into warm soils can also make weed control more problematic as residual pre-emergent herbicides may degrade faster, reducing their effectiveness. This research aims to investigate the effect of wheat time of sowing and seeding rate, on the effectiveness and degradation of pre-emergent herbicides commonly used to control annual ryegrass in no tillage farming systems.

The fit of long coleoptile wheats in WA grain farming systems — observations from the 2021 growing season

Michael Lamond, SLR Agriculture

Michael is the CEO of SLR Agriculture, a boutique agricultural RD&E business with strong links to growers through the footprint of the Synergy and other agronomy extension networks. Michael is a hands on, experienced agronomist with business management and board experience. He is a proven leader with extensive field trial management experience across Australia with a history of quality results and high strike rate of successful research projects in Agronomy, Plant Breeding and Biotechnology. He has experience across most areas of crop production in WA and the winter crop regions across Australia and has been a leader of several privately owned agricultural Research and Development businesses since 1992.

Michael is on the GIWA Oilseeds Council and previous board member and author of monthly GIWA Crop Report. Michael is previous GRDC Western Panel Member and chair of the NVT advisory committee.

Michael was the National Leader Agronomy for Eurofins from 2013–2016, Director and Principal Plant Breeding and Biotechnology Agrisearch from 2002–2013, Director/Research Agronomist Michael Lamond and Associates 1999-2002, Director/Research Agronomist Lamond Burgess and Associates 1996-1999, Director/Research Agronomist Farmanco research and Development Consultants 1992–1996.

Summary

This GRDC project concentrated on the risks and benefits associated using long coleoptile wheat. The trials focused on the long coleoptile trait impact on time to emergence, soil temperature, planting depth and their combined effect on crop establishment in the targeted environments.

The major objective of the project was to provide a business case to growers of the risks and benefits long coleoptile wheats offer them. The field trials compared existing systems of establishment with sowing following an opportunistic rainfall event that would not normally be sown into as well as main season plantings. The data gathered will form the validation of the technology in dollar benefits to growers.

Varieties with Rht18 gene were compared with traditional wheat varieties grown in WA and elite breeder lines selected with longer coleoptiles. There were six trial site locations in WA during 2021. One was sown at the end of March in York specifically to gain detailed emergence data under heat. This was not planned to be harvested as the genetic material in the trial was not suited for very early planting. The other main four sites were sown in April (3) and May (1), these all had the same varieties and measurements taken including planned harvest. One site was sown in June at Bodallin at the request from growers in the low rainfall regions to give them a look at shallow and deep planting.

The trials were seeded with an 8 Tyne DBS plot seeder. The closing plate was extended to full depth and an extra tube added to seed delivery boot to position the seed at 120mm for the deep sowing. The closing plate was lifted, and the extension tube removed leaving the ripping point at the same depth for the shallow sowing treatment.

(Continued on following page...)

The main findings and themes of the project included:

1. Wheat varieties with the Rht18 gene emerged from the deep sowing (120mm) with more plant numbers per square meter and produced more tillers than those without the Rht18 gene under a range of soil types, sowing dates and moisture profiles at seeding.
2. Wheat varieties with the Rht18 gene emerged from the shallow sowing (40mm) with more numbers per square metre and produced more tillers than those without the Rht18 gene where there was furrow fill and/or transient waterlogging at emergence.
3. Wheat varieties with the longer coleoptiles without the Rht18 gene emerged from the deep sowing with more numbers per square metre and produced more tillers than those with shorter coleoptiles and where there was furrow fill and/or transient waterlogging sown shallow, the varieties with longer coleoptiles also emerged with more plants per square meter and produced more tillers than those with shorter coleoptiles.

The main advantages observed from the sites in the 2021 growing season were found to be:

1. Seedling emergence with furrow fill from wind or rainfall events was improved with the long or longer coleoptile varieties, particularly where there was pre-emergent herbicide interaction.
2. Ability to chase moisture down from an autumn rainfall event gave a growth stage advantage over sowing dry.
3. Ability to emerge is main season plantings where there was a full moisture profile or transient waterlogging.
4. Demonstration of the biological/growth habit differences observed between short, long and longer coleoptile varieties sown deep and shallow.

Michael will highlight observations from the 2021 growing season and discuss the main observations from the project. He will also touch on observations made that were not considered initially in the project scope, such as improvement where there was furrow fill from wind or rainfall, particularly where there was pre-emergent herbicide interaction, improvement in emergence where there was transient waterlogging and the impact of early crop vigour with lines with the Rht18 gene. These observations have implications for main season plantings as well as early season opportunistic plantings which was the initial reason for the project to be initiated.

Optimising fertiliser application — what level of precision can we achieve?

Craig Scanlan, Department of Primary Industries and Regional Development

Craig has 20 years' experience working in nutrient management in grain production in WA. Craig began his career working in decision support for nitrogen and potassium fertiliser, and then undertook further study at UWA to complete a PhD. Since that time, Craig has worked in a series of research projects on nutrient management and currently leads two GRDC projects. He has adjunct positions at UWA and Murdoch University and is working across organisations as part of the Soilswest collaboration.

Summary

Optimising the application of nitrogen (N), phosphorus (P) and potassium (K) fertiliser is an ongoing challenge because grain producers are attempting to address multiple objectives. Grain producers are trying to strike a balance between maximising their gross margins at a paddock or enterprise level, maximising the chance of capitalising on good years by removing nutritional constraints to yield and minimising the overall financial risk to their business in poor years. This presentation examines one of these objectives; the precision in rate required to maximise gross margins from N, P and K fertiliser.

Analysis suggests a low level of precision of N, P or K fertiliser is sufficient to maximise net return from fertiliser. Based on the case studies presented, fertiliser rates that are ± 20, 5 and 15 kg/ha of the predicted optimum for N P and K are likely to fall within the 90% confidence interval of the optimal rate.

Economic analysis also suggests that the magnitude of grain yield response to fertiliser has a greater impact on the optimal rate than grain or fertiliser price. It showed that the optimal rate increases as the level of yield response increases, and the sensitivity of optimal rate to grain or fertiliser price decreases. Fortunately, the influence of yield response on optimal rates can be assessed using current decision support tools used by fertiliser advisors by assessing different scenarios of target yield and soil and residue nutrient supply.

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Russell Burns
russell.burns@sa.gov.au
0401 122 115

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NORTHERN REGION*

*NORTHERN NSW AND QUEENSLAND
CONTACT:
Rob Long
lab@crownanalytical.com.au
0437 996 678

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Fertiliser strategies in response to higher prices

A PANEL DISCUSSION WITH: **Peter McEwen,** Agri-Access Australia; **James Easton,** CSBP; **Elizabeth Petersen,** UWA; and **Craig Scanlan,** DPIRD

Peter McEwen

Agri-Access Australia

Peter McEwen is the founder and Principal of Agri-Access (WA) Pty Ltd (AAWA). AAWA was established in 2012 to provide fertiliser pricing advice, and pricing awareness for WA growers highest cost input. AAWA has more than 180 farmer clients who purchase in excess of 180,000mt of fertiliser.

Peter graduated from the UWA with a Bachelor of Science Degree with First Class Honours in Chemistry. He also holds a Graduate Diploma in Engineering (Chemical) and a Company Directors Course Diploma. Peter is a Fellow of the Australian Institute of Company directors. Peter commenced employment with CSBP during 1980 and held management positions in production, distribution and personnel management. He joined Summit Fertilizers in 1992 and held the position of Managing Director/CEO until 2010. He was a Director of Fertilizer Australia 1997–2010 and Chairman 2003–2007.

James Easton

CSBP

James is a Senior Agronomist at CSBP, where he has worked for more than 30 years since graduating from UWA with a degree in Agricultural Science, with Honours, in 1987. James has enjoyed his long association with the Company's Field Research program. Results from the trials have highlighted many opportunities for improving nutrient use efficiencies and making more profitable fertiliser decisions. He will share some agronomic tips to help growers deal with the increased fertiliser prices.

Elizabeth Petersen

University of Western Australia

Liz has worked within the agricultural sector in Australia and internationally for the last 25 years. After completing her undergraduate degree, Liz worked as an Economist with the DPIRD (formerly Agriculture WA) in Albany. She moved to Perth in 1997 to complete her PhD and then to Canberra in 2000 to work as a Post-doctoral Fellow and Fellow at the Australian National University. Liz returned to Perth in 2003 to establish a consulting firm, Advanced Choice Economics Pty Ltd. She has led almost 100 consultancy projects over the last 20 years and held part-time specialist appointments at DPIRD from 2013 to 2018.

Liz is currently Director and Principal Applied Economist at Advanced Choice Economics Pty Ltd, Adjunct Senior Lecturer at UWA and Senior Research Fellow at the University of Queensland.

Craig Scanlan

Department of Primary Industries and Regional Development

Craig has 20 years' experience working in nutrient management in grain production in WA. Craig began his career working in decision support for nitrogen and potassium fertiliser, and then undertook further study at UWA to complete a PhD. Since that time, Craig has worked in a series of research projects on nutrient management and currently leads two GRDC projects. He has adjunct positions at UWA and Murdoch University and is working across organisations as part of the Soilswest collaboration.

Tips for canola establishment

Jackie Bucat, Department of Primary Industries and Regional Development, and **Matt Nelson,** CSIRO

Jackie is a Research Scientist at DPIRD, with a recent focus on early seeding for canola, where she is also the canola commodity lead.

Summary

Recent DPIRD research has shown that a successful canola crop can be sown from mid-March in WA. Early sowing is likely to be increasingly suited to WA due to alleviating climate change effects: reduced incidence of opening rains, reduced growing season rainfall, higher temperatures and hot spells that are becoming more frequent, longer and hotter. However early sowing has higher risks, including establishment, follow-up rain, frost, predation and disease.

Establishment was reduced with early sowing, even though sites were irrigated. Current research investigated the effect of temperature and moisture on early canola establishment. 2021 Research evaluated canola establishment in the laboratory, in hand sown plots at South Perth and in field plots near Greenough. Key results will be presented.

Reference

Canola establishment with early sowing

Jackie Bucat[1], Salzar Rahman[2] and Stephanie Boyce[3]
DPIRD South Perth[1], Northam[2], and Geraldton[3]

Matt Nelson, CSIRO

Matthew has had a varied and interesting career so far. His first taste of science research was during a summer job during 1993 at the world's oldest agricultural research institute (Rothamsted) in the United Kingdom, where he supported canola and linseed crop pathology projects. Matt had the opportunity to spend two months in Mongolia during 1996 where he assisted a local botanist to survey the impact of over-grazing by sheep and goat herds in the newly privatised stock industries that had previously mean managed by communes. Matt's first job after completing his PhD was as a molecular breeder with Seminis Vegetable seeds in Enkhuizen, the Netherlands during 2001. He then joined UWA in 2002 where he had a dual role as an academic pre-breeder and a commercial breeder with Canola Breeders WA Pty Ltd. During 2015, he moved to the UK to take up a position at the Royal Botanic Garden, Kew (UK) based at the Millennium Seedbank where he worked to harness the diversity available in crop wild relatives for crop improvement (mainly white lupin and carrots). Matt joined CSIRO during 2018 to lead a national program of canola improvement. His work focuses on the effective use of international canola varieties and wild relatives for improving the productivity and adaptation of Australian canola.

(Continued on following page...)

Summary

A nationwide survey (outlined below) of canola growers and agronomists identified marginal soil moisture and variable seeding depth as two key factors leading to poor canola establishment. The project identified several international varieties with enhanced vigour and/or longer hypocotyls, which emerged from 50mm sowing depth in the field better than all five current Australian canola variety controls. As a result, rapid and accurate screening methods have been developed for breeders to accelerate the development of canola varieties with improved establishment potential.

The aims of the *Genetic improvement of canola establishment* project were to understand the key genetic factors contributing to successful canola establishment, and to provide canola breeders with improved genetics from overseas varieties and selection tools to accelerate the breeding of varieties with better establishment potential.

A survey of 63 growers and agronomists provided insights from their experiences of canola establishment. This, along with a comprehensive review of the international scientific literature, pointed to two potential targets to breed canola varieties with improved establishment potential: longer hypocotyls and enhanced early vigour. Reducing the potential for secondary vigour was also considered a potential target. The team developed new lab-based methods to measure these traits in a panel of 100 international open-pollinated and 28 Australian (mostly hybrid) varieties. They identified international varieties that matched or exceeded the vigour and hypocotyl traits in current Australian hybrids. They also found low but detectable levels of secondary dormancy in some Australian varieties. The methods proved highly repeatable and are recommended for use in canola breeding programs. They tested the lab-based results in four field experiments in WA and NSW in 2021. A key finding was that international accessions identified in lab-based tests as being highly vigorous and/or with long hypocotyls emerged significantly better from deeper sowing (50mm depth) than the five current Australian varieties tested. These encouraging results will be tested again in field experiments in WA and NSW planned for 2022.

The results indicate that enhanced early vigour and longer hypocotyls are promising target traits for breeders to develop varieties with improved established at conventional sowing depths, and which can potentially be sown deeper than current varieties.

Reference

Genetic improvement of canola establishment

Matthew Nelson[1], Jose Barrero[2], Mark Cmiel[2], Andrew Fletcher[1], Ian Greaves[2], Trijntje Hughes[2], Andrew Toovey[1], Karen Treble[1], Alec Zwart[2], John Kirkegaard[2], and Greg Rebetzke[2]

[1]CSIRO Agriculture and Food, Floreat, Perth, Australia; [2]CSIRO Agriculture and Food, Black Mountain, Canberra, Australia

Oat varieties for 2022 and the new national oat breeding program

Dr Allan Rattey, InterGrain

Dr Allan Rattey is InterGrain's foundational oat breeder for grain oats and oaten hay targeting all regions of Australian. Before joining InterGrain during 2018, Allan was lead wheat breeder for Dow AgroSciences in Australia, where he was accountable for the company's national plant breeding structure and science.

As a plant breeder Allan has actively pursued his keen interest in leveraging technology applied in global crops, including corn and soybeans. He has successfully implemented synergistic strategies within Australian wheat breeding during career with CSIRO, Dow and InterGrain. Allan has also contributed significantly to local research, particularly with his involvement in sponsored genomic research at AVR.

Prior to joining Dow, Allan worked with CSIRO as the national gateway breeder and trait pre-breeder and as a sugarcane breeder with BSES in Northern Queensland.

Summary

Key points include:

- InterGrain have increased Oat breeding scale, efficiency and field-testing capacity whilst decreasing variety release times for faster industry adoption of improved genetics.
- InterGrain has applied high-end phenomics for biomass (r ~0.4-0.7) and hay colour prediction.
- InterGrain will invest and collaborate locally plus globally to build Oat genomic capacity.

The aim of the project was to transition national grain and hay oat breeding to InterGrain for increased rate of genetic gain per industry dollar invested.

During 2021, InterGrain doubled the size of National Oat breeding activities. Following industry collaboration, field testing environments used were targeted to great reflect industry practice and maximise genetic potential. For example, InterGrains' Stage4 trial at Holt Rock was sown 28th April and yielded 4.8t/ha, compared to the co-located NVT sown at 'normal time' which yielded 2.0t/ha.

InterGrain will deploy high through-put 'plant breeding machinery'; e.g., robot seed packer, high yielding summer nurseries, plus leverage existing company partnerships, e.g., scale with trial service providers, AVR genomics, Phenomic groups, to further increase scale and efficiency whilst reducing selection pipeline timelines. During 2022/23, we will release 3-5 new varieties with improved purity for various targets of the Australian Oat industry.

Oat variety choices for 2022 will also be discussed.

InterGrain will continue to engage with all aspects of the Australia oat industry and exporters to ensure breeding targets are relevant with clear value propositions. InterGrain will drive increased rates of genetic gain through state-of-the-art breeding platforms and breeding efficiencies.

Acknowledgments

InterGrain gratefully acknowledges the amazing industry support from SARDI, GRDC and AgriFutures to facilitate timely transition of data and seed for planting to ensure a successful 2021 season.

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the author would like to thank them for their continued support.

Reference

Oat varieties for 2022 and new national breeding program

Dr Allan Rattey, InterGrain Ply Ltd

GRDC Project Code Number: IGP2103-001AWX

Mice control

Steve Henry, CSIRO

The Rodent Management team at CSIRO is working on a portfolio of projects that encompasses the development of spatially explicit predictive models; the role of pastures as refuge habitat for mice; using genetic technology to understand mouse populations and disease profiles; and the development and implementation of the most effective control strategies to reduce the impact of mice.

Steve's research involves monitoring mouse populations to predict future mouse population outbreaks; investigating the efficacy of ZnP to enhance the success of control strategies; and understanding the ecology of mice in zero and no-till cropping systems to inform the development of more effective control strategies.

Steve believes that understanding farming systems is a critical component of developing better control strategies to reduce the impact of mice. All this work is focused on delivering more effective tools to reduce the impact of mice in cropping systems.

Summary

Favourable climatic conditions in WA during 2021 led to excellent crops, they also resulted in excellent conditions for mice. A large part of the WA cropping zone was seriously impacted by mice from sowing through to harvest. As is often the case in good seasons frost played a role in reducing yields for some growers and the climate contributed to a bountiful but logistically difficult harvest. The outcome of this is that growers are faced with managing stubbles that contain lots of food and shelter for mice.

This presentation will cover:

- The implications of high levels of residual food in stubbles.
- Establishing an environment in stubbles that is unfriendly to mice.
- The importance of monitoring mice to understand to magnitude of the mouse problem.
- Applying strategies to limit the impact that mice will have next sowing.

GRDC investments have enabled CSIRO to work on projects aimed at minimising the impact of mice in crops. Steve will provide a summary of the data from these projects and the implications of the results of this work for ongoing mouse control strategies.

Why bother with artificial intelligence in agriculture? Because it can improve fertiliser management

Jonathan Richetti, CSIRO

Jonathan's background is in agricultural engineering with honours. Jonathan was recognised as the third best undergraduate student. During his doctoral studies in 2015, he was a statistics lecturer at West Parana State University. During 2017, Jonathan was a Visitor Researcher Scholar at the University of Florida, working with soybean crop modelling and remote sensing applied with AI for regional yield estimates. This work was awarded the best graduate presentation at the 2017 Agronomy Society of America conference in the remote sensing section. After defending his thesis during 2019, Jonathan joined CSIRO as a postdoctoral fellow. At CSIRO, Jonathan is developing the next generation of sensor-based decision systems for agriculture.

Summary

Key points include:

- Artificial intelligence algorithms can improve nitrogen decision making over current methods. The current limitation is the availability of data.
- An effort is needed to integrate data sources and farm data to aid farming decision making. Building such a database is one of the main challenges for the community.

This work aims to clarify the possible uses of Artificial intelligence (AI) in farm management, particularly the use of machine learning to improve N fertilisation management in wheat.

The most important variable was the ratio between farmer and rich strips of normalised difference vegetation index (NDVI). Other important variables included the ratio between farmer and rich strips of normalised difference red-edge vegetation index (NDRE), the available mid-season N in the soil, and the ratio between farmer and low strip with NDRE. On average, the AI model generated an additional $9/ha profit over and above the farmers' management. However, similarly to precision agriculture, if there is no yield variation in the paddock, you might not need AI! A caveat is that the data used to train the AI model had comparatively few observations compared to the research studies. AI's main ability is to capture patterns in the data. Farmers and consultants often have much more than a couple of seasons of experience. Expanding the AI algorithm to different seasons and places will improve the algorithm's ability. In time, AI decision support systems will improve.

Vegetation indices are not enough to make an N decision. They are only useful when coupled with on-farm experimentation. Other variables, such as soil N, are also important to a certain extent. Secondly, and most importantly, AI methods with enough data (many observations of key variables) can improve mid-season N management by reducing the errors and biases if there is enough yield variability and, therefore, increasing the profitability of the decision. Finally, AI can be deployed into any farm and enhance the N decision making prowess of the entire industry.

Reference

Why bother with Artificial Intelligence in Agriculture? Because it can improve fertilisation management

Jonathan Richetti, CSIRO

Papers submitted and not presented for the Perth Update

For the 2022 Grains Research Updates events, not all papers could be accommodated to present at the Perth Update. All papers provided will be uploaded to the GRDC website at https://grdc.com.au/resources-and-publications/grdc-update-papers when they are supplied and approved for public access.

Sessions are being recorded and will be made available on the GRDC website following the event. You will receive a link by email to access these.

KEY CONTACTS

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

WESTERN REGION

PERTH
Suite 5, 2a
Brodie Hall Drive,
Bentley WA 6102

P: + 61 8 9230 4600
E: western@grdc.com.au

OPERATIONS

SENIOR REGIONAL MANAGER
Peter Bird
Peter.Bird@grdc.com.au
M: +61 4 3668 1822

BUSINESS SUPPORT TEAM LEADER
Stephanie Meikle
Stephanie.Meikle@grdc.com.au
P: +61 8 9230 4601

CONTRACT ADMINISTRATOR
Jenny Trang
Jenny.Trang@grdc.com.au
P: +61 8 9230 4608

CONTRACT ADMINISTRATOR AND PANEL SUPPORT
Laura Baugh
Laura.Baugh@grdc.com.au
P: +61 8 9230 4605

CONTRACT ADMINISTRATOR
Isabelle Roocke
Isabelle.Roocke@grdc.com.au
P: + 61 8 9230 4607

APPLIED RESEARCH DEVELOPMENT AND EXTENSION

MANAGER AGRONOMY, SOILS, NUTRITION AND FARMING SYSTEMS
Rowan Maddern
Rowan.Maddern@grdc.com.au
M: +61 4 7770 7225

MANAGER AGRONOMY, SOILS, NUTRITION AND FARMING SYSTEMS
Uys Lourens
Uys.Lourens@grdc.com.au
M: +61 4 5560 7464

CROP PROTECTION MANAGER
Georgia Megirian
Georgia.Megirian@grdc.com.au
M: +61 4 3957 5900

GROWER RELATIONS MANAGER
Jo Wheeler
Jo.Wheeler@grdc.com.au
M: +61 4 3829 2167

GROWER RELATIONS MANAGER
Lizzie Von Perger
Elizabeth.vonPerger@grdc.com.au
M: +61 4 3666 5362

GROWER RELATIONS MANAGER
Rachel Asquith
Rachel.Asquith@grdc.com.au
M: +61 4 3666 5361

GENETIC AND ENABLING TECHNOLOGIES

MANAGER NATIONAL VARIETY TRIALS
Andrew Heinrich
Andrew.Heinrich@grdc.com.au
M: +61 4 2960 7357

COMMUNICATIONS

COMMUNICATIONS MANAGER
Danielle Gault
Danielle.Gault@grdc.com.au
P: + 61 8 9230 4600

STRATEGY AND BUSINESS DEVELOPMENT

MANAGER COMMERCIALISATION
Roop Judge
Roopwant.Judge@grdc.com.au
M: +61 4 2804 8732