2023 GRAINS RESEARCH UPDATE, Perth

27 and 28 February 2023

Crown Perth, Burswood

@GRDCWest @theGRDC Grains2023

#GRDCUpdates

Update Papers: grdc.com.au/resources-and-publications/grdc-update-papers

grdc.com.au

Disclaimer

2023 GRDC Grains Research Updates – Program Committee

Peter Bird, GRDC, Program Committee Chair
Jo Wheeler, GRDC
Mike Ashworth, University of Western Australia
Dion Bennett, Australian Grain Technologies
Peter Bostock, GenTech Seeds
David Bowran, Grower/Researcher
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#GRDCUpdates

Welcome — GRDC Grains Research Update Perth proceedings

Welcome to the 2023 annual Grains Research and Development Corporation (GRDC) Grains Research Update, Perth – Western Australia's premier grains research forum.

The Grains Research Update provides attendees across the state access to the latest research, technology, market development and management innovations to improve grower productivity and profitability.

As a flagship GRDC event, the Update 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 $8.5 billion in 2022.

Off the back of a second record-breaking harvest, estimated by Grain Industry of Western Australia (GIWA) to be over 26 million tonnes, the grains industry is again 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 continue delivering returns to WA growers.

GRDC Senior Regional Manager – West, Peter Bird

In June, GRDC announced its continued investment into the Australian Export Grains Innovation Centre, committing $12 million over three years alongside the Department of Primary Industries and Regional Development (DPIRD).

We also announced a further $30 million investment into the Centre for Crop and Disease Management. Based at Curtin University, this national centre of excellence plays a crucial role in reducing the economic impact of wheat, barley, canola and pulse diseases to support grower profitability nationwide.

In July, and again with one of our key research partners in DPIRD, we announced a $20.4 million project that will give grain growers in low- and medium-rainfall zones new insights into farming systems practices that increase profit, manage risk and consider greenhouse gas emission options.

This year GRDC also committed to investing $10 million in the Western Australian Agricultural Research Collaboration, a joint initiative between the state's leading universities and research organisations.

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.

In addition to plenary sessions, the program comprises more than 40 concurrent sessions that will address important issues ranging from the market outlook for grains, crop protection and varieties, through to soils and nutrition, heat and drought tolerance, agronomy and farming systems.

Extended focus sessions will cover 'canola-on-canola – profit maker or system breaker?'; reducing grain farming emissions; and a plant breeding research workshop. 'New researcher snapshots' will also form part of the extended focus sessions.

In addition to the wealth of information delivered during these sessions, the GRDC Grains Research Update, Perth, is a great opportunity for networking and after a year where the event ran in virtual format, I hope you will enjoy catching up with other industry people as much as I do.

Also keep a look out for GRDC personnel, including staff and Western Region Panel members, so that you can chat to them and pass on feedback about industry issues impacting on grower profitability.

Lastly, but not least, I extend my sincere thanks to GRDC western region staff, event convenor the Grain Industry Association of WA and the presenters themselves for their hard work in delivering this flagship event on behalf of the GRDC.

I trust you will find the GRDC Grains Research Update, Perth, inspiring, informative and enjoyable.

Peter Bird

GRDC SENIOR REGIONAL MANAGER – WEST

2023 Grains Research Update, Perth

Hosted by:

GRDC would like to acknowledge all 2023 Grains Research Update, Perth Sponsors.

Industry Supporters:

Trade Sponsors:

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Need Information?

Registration Desk

The Registration Desk will be open during the entire two-day program. Please feel free to approach members of the GIWA team with any questions or assistance you may require.

Presentations and papers

This Program Book contains abstracts of presentations at the 2023 Grains Research Update, Perth to enable you to select which presentations you wish to attend.

Attendees are able to access all 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, unless not approved for online publication.

Focus Sessions / New Research

A feature of Tuesday's program is the opportunity to attend one of two Focus Sessions, a Plant breeding workshop or New Research Snapshots. The Focus Sessions are designed to enable a more in-depth discussion with experts in these fields than is possible during the concurrent sessions. Further details can be found towards the back of this Program Book.

Event App

Hopefully by now you would have checked out the Event App. If you are yet to do so, please follow the below.

- To access the 2023 GRDC Grains Research Update app, search and download the Whova Event App from the Apple App Store or Google Play Store on your device.
- Once downloaded, open Whova and enter your details.
- By entering in the email, you used to register for this event you will be automatically granted access.

Available on the App Store | GET IT ON Google play

Included in the Event App is a List of Attendees and Event supporters for the 2023 Perth Update. This list will help you network and meet some valuable contacts.

Wifi

Complimentary WiFi is available for all attendees.

- Select 'Crown Public Access'
- Access code: **GRAINS2023**

Keep in Touch

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grdc.com.au

Join the conversation: **#GRDCUpdates**

Charging Station

Two mobile device Charge Stations are available in the Exhibition Space.

Fuel your body and mind — Catering breaks

The Exhibition Space is located in Grand Ballroom 2 where the catering breaks will be held. Please note, if you have any dietary requirements you have already made us aware of, check with Crown staff and they will help you with your 'plate'.

Coffee Breaks

Nothing beats a caffeine boost. There will be Coffee Carts located within the Exhibition Space and in the Foyer. The Coffee Carts are proudly sponsored by AGT.

Networking Event – Day 1

The networking event on Monday evening is kindly sponsored by the CBH Group and will be held in the Exhibition Space. Enjoy the scrumptious canapes, drinks, and atmosphere. Take the time to chat with the exhibitors, old friends and make some new ones.

GIWA Breakfast – Day 2

The GIWA Breakfast is back! Join us on Tuesday, 28 February for breakfast at Crown sponsored by the Department of Primary Industries and Regional Development (DPIRD). Register to attend (separate registration) to hear from keynote speaker, Michael Whitehead, Director of Agribusiness Industry Insights for ANZ: **www.giwa.org.au/events/giwa-breakfast-2023/**.

Speakers and Sponsors Thank You – Day 2

Following the last Plenary Session on Day 2, join us for more networking, canapes and drinks in the Crown Ballroom 3 Foyer. This networking event is a thank you to speakers and sponsors and is proudly sponsored by CSBP.

Elbow bump instead

The GRU23 Team have masks available at the Registration Desk if you would prefer to wear one during the conference. If you begin to feel unwell with cold or flu like symptoms, please advise GIWA staff, leave the event and get tested for COVID-19.

We value your Feedback

We aim to continually improve each Research Update event by listening to your thoughts. Help us by completing the Feedback Form located on the Event App for the chance to win a $500 Crown voucher.

2023
GRAINS RESEARCH UPDATE, Perth

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Program DAY 1 — Monday 27 February 2023

8.00 am	REGISTRATION & COFFEE (Sponsored by AGT)			
8.45 am	PLENARY 1 – Grand Ballroom 1			
8.45 am	**Welcome** — Darrin Lee, GRDC Western Panel **Future directions for GRDC investments** — John Woods, Chair GRDC			
9.10 am	**The Grains Australia pathway to value** — Richard Simonaitis, Grains Australia			
9.25 am	**GRDC 'Seed of Light' Award presentation**			
9.45 am	**The market outlook for grains** — Michael Whitehead, ANZ			
10.15 am	**The sustainability of Australian grain farming systems** — Richard Heath, Australian Farm Institute			
11.00 am	MORNING TEA			
11.40 am	SESSION 1 — Agronomy	SESSION 2 — Markets	SESSION 3 — Crop Protection – Diseases	SESSION 4 Crop Protection – Weeds
	Selecting the right cereal variety for the conditions Felicity Harris, Charles Sturt University	**Grain export supply chain challenges** Ross Kingwell, AEGIC	**Australian Fungicide Resistance Extension Network update** Fran Lopez-Ruiz, CCDM	**The most expensive herbicide is the one that doesn't work: Hitting the target** Bill Campbell, Bill Campbell Consulting
12.10 pm	5 Min Moving			
12.15 pm	**Towards an understanding of crop residue effects on wheat yield** Michael Ashworth, AHRI	**Market requirements and how Australian wheats perform** Ken Quail, AEGIC	**The impact of new rust resistance genes** Melania Figueroa, CSIRO	**Glyphosate alternatives for summer and pre-seeding knockdown weed control** Harmohinder Dhammu, DPIRD
12.45 pm	LUNCH			
1.40 pm	SESSION 5 — Agronomy	SESSION 6 — Carbon and GHG	SESSION 7 — Nutrition	SESSION 8 Crop Protection – Weeds
	Optimal planting times for canola varieties Tamryn Davis, SLR Agriculture and Matthew Nelson, CSIRO	**Nitrous oxide emissions from cropping soils in the WA grainbelt: a 10-year perspective** Louise Barton, UWA	**What is driving yield response to phosphorus fertiliser in current cropping systems?** Craig Scanlan, DPIRD	**Strategic tillage: how does it impact weed management?** Catherine Borger, DPIRD
2.10 pm	5 Min Moving			
2.15 pm	**Grower experiences with Super High Oleic safflower in WA** Byron Milne, Spencer Beatty and Michael Lamond, SLR Agriculture	**Key learnings from benchmarking greenhouse gas emissions from WA growers** Stacey Bell-Crookes, Farmanco	**Optimising nutrition for high rainfall zone canola** Jeremy Curry, DPIRD	**Predicting profitability of summer weed control timing and impact on crop yield potential** Yvette Oliver, CSIRO
2.45 pm	5 Min Moving			
2.50 pm	**The fit of long coleoptile wheat for WA growers – opportunities and adaptations in shifting climates and landscapes** Michael Lamond and Kate Witham, SLR Agriculture	**Profitable low emission crop rotation?** Sud Kharel, DPIRD	**Carryover of nitrogen after crop failures** Darren Hughes, Laconik	**Herbicide resistance: a status update** Ken Flower, AHRI
3.20 pm	AFTERNOON TEA			

This program may be subject to change.

(Continued on following page...)

Grand Ballroom 1 | Crown Ballroom 1 | Crown Ballroom 2 | Crown Ballroom 3

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Program DAY 1 — Monday 27 February 2023 *(continued)*

4.00 pm	SESSION 9 — Nutrition	SESSION 10 – Soils	SESSION 11 — Plant Breeding	SESSION 12 — Markets and Post Harvest
	Potassium update – Panel discussion **Getting more efficiencies out of potassium (and nitrogen) fertilisers in a high price environment** James Easton, CSBP **Comparison of soil analytical methods for estimating plant-available potassium**	**Long-coleoptile wheats for improved establishment, weed competitiveness and productivity on ameliorated soils** Stephen Davies, DPIRD **Subsurface acidity management: long term grower case studies to direct future management** Alice Butler, DPIRD	**Targeted crop trait improvement through gene editing** Yong Han, DPIRD **Gene-editing and crop breeding: what can it deliver and what are the implications for international trade?** Michael Jones, Murdoch Uni	**Sustainability or Health? Grain-food product differentiation in key markets** Chris Carter, AEGIC
4.30 pm	Miaomiao Cheng, SoilsWest	**5 Min Moving**		**5 Min Moving**
4.35 pm	**K responses on loamy soils: an emerging issue for grain crops** Richard Bell, SoilsWest **Canola responses to potassium form, rate and placement in low and high rainfall environments** Richard Bell, SoilsWest	**Re-engineering soil to redefine the water-limited yield potential under changing climate** Gaus Azam, DPIRD	**50 years of wheat breeding impact in WA** Dion Bennett, AGT	**From stalk to store: opportunities for WA growers to improve harvesting and postharvest storage** Ben White, Kondinin Group
5.05 pm	**NETWORKING SUNDOWNER (Sponsored by CBH Group)**			

This program may be subject to change.

Grand Ballroom 1 — Crown Ballroom 1 — Crown Ballroom 2 — Crown Ballroom 3

2023
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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Program DAY 2 — Tuesday 28 February 2023

7.00 am	**GIWA BREAKFAST REGISTRATION (separate ticketing) – Crown Ballroom 3**
7.15 am	GIWA Breakfast commences – sponsored by the Department of Primary Industries and Regional Development
8.50 am	GIWA Breakfast concludes

8.30 am	**WELCOME COFFEE (Sponsored by AGT)**			
9.00 am	Welcome back			
9.10 am	**PLENARY 2 – Grand Ballroom 1**			
9.10 am	Plant protein production - value adding to Australian pulses — Phil McFarlane, Australian Plant Proteins			
9.55 am	**SESSION 13 — Soils**	**SESSION 14 — Canola**	**SESSION 15 — Crop Protection – Diseases**	**SESSION 16 — Crop Protection – Insects**
	Molecular level interpretation of Soil Water Repellency for the development of rapid assessment and novel amendments David Henry, Murdoch Uni	New genetics for improved canola establishment Matthew Nelson, CSIRO	Wheat powdery mildew Sam Trengove, Trengove Consulting	Using surveillance and social benchmarking to improve redlegged earth mite insecticide resistance management Lizzy Lowe, Cesar Australia
10.25 am	5 Min Moving			
10.30 am	Impact of timing of strategic deep tillage on crop productivity, profitability and agronomic opportunities George Mwenda, DPIRD	Manipulating canola canopies through agronomy and genetics in the high-rainfall zone Jens Berger, CSIRO	Insecticidal control of green peach aphid and turnip yellows virus: resistance threats, limitations and future alternatives Ben Congdon, DPIRD	Lessons learned from native budworm activity in wheat relative to traditional hosts lupins, pulses and canola Dusty Severtson, DPIRD
11.00 am	**MORNING TEA**			
11.35 am	**SESSION 17 — Soils**	**SESSION 18 — Digital Agriculture**	**SESSION 19 — Crop Protection – Diseases**	**SESSION 20 — Crop Protection – Insects and Weeds**
	Can we get gains in the paddock with different bio-amendment products and management strategies? Grace Williams, DPIRD Potential use of on-farm acidic sand and other ameliorants to detoxify subsoil boron while re-engineering the soil profile Kanch Wickramarachchi, DPIRD	Next generation digital technologies for the grains industry Ferdous Sohel, Murdoch Uni	How long do *sclerotinia* sclerotes survive in WA? Decision support tools to help with on-farm management of blackleg and *sclerotinia* in canola Jean Galloway, DPIRD	Russian wheat aphid thresholds in WA and using biological control for RLEM Svetlana Micic, DPIRD
12.05 pm	5 Min Moving			
12.10 pm	Options for managing sodic soils David Hall, DPIRD	Digital Agriculture: what does an information intensive agricultural system look like? Roger Lawes, CSIRO	Fungicide mixtures, rotations, timing and decisions for managing Net Form Net Blotch on barley in southern WA Kithsiri Jayasena, DPIRD Economical management of Spot Form Net Blotch in low rainfall environments Jason Bradley, DPIRD	Resistance status of wild radish, brome and barley grass Mechelle Owen, AHRI CoAXium® Barley: a new weed management tool Tristan Coram, AGT
12.40 pm	**LUNCH**			

This program may be subject to change.

(Continued on following page...)

Grand Ballroom 1 | Crown Ballroom 1 | Crown Ballroom 2 | Crown Ballroom 3

Program DAY 2 — Tuesday 28 February 2023 *(continued)*

1.30 pm	FOCUS SESSIONS			
	Focus Session 1	Focus Session 2	Focus Session 3	Focus Session 4
1.30 pm	**Canola on Canola: profit maker or system breaker?** **Convenor:** Juliet McDonald We have a range of speakers who can help understand critical components of whether or not to do canola on canola. • **Varieties and breeding objectives** – David Tabah • **Disease risks in canola** – Steve Marcroft • **Optimal nutrition** – Rohan Brill • **Insect problems in canola** – Dusty Severtson • **Weeds issues or solutions** – Harmonhinder Dhammu • **Grower experience with canola on canola** – Chad Eva	**Reducing grain farming emissions** **Convenor:** Ben White This focus session will look at how well WA grain farmers are meeting the grain farming emissions and what some of the constraints are to achieving further reductions. • **Findings of DPIRD/ CBH/ WOA work** – Jackie Bucat • **Lime/fertiliser use and emission trade-offs** – Chris Gazey • **Machinery efficiencies to reduce GHG** – Glen Reithmuller • **Experience of an on-farm audit** – Gary Lang • **Challenges for CBH and growers** – Royce Taylor • **Broad findings of farmers undergoing audits** – Stacey Bell-Crookes	**Plant breeding research workshop** **Untangling the 'Gordian Knot' of *septoria nodorum* blotch of wheat** Kar-Chun (KC) Tan, CCDM **Pangenomes as a technology to improve Australian Oats and barley industry** Penghao Wang, Murdoch Uni **Heat stress tolerance in a barley germplasm** Tefera Angessa, Murdoch Uni **Progress towards the discovery of genes for heat stress tolerance in a diverse canola population** Sheng Chen, UWA **In from the wild: improving chickpea chilling tolerance using the wild relatives** Jens Berger, CSIRO **Identification of aluminum-tolerant chickpea genotypes and their potential use in chickpea breeding** Yong Jia, Karthika Pradeep, Murdoch Uni **An effective strategy for pre-breeding investigations into soil constraints amidst climate change** Roopali Bhoite, DPIRD	**New researchers' snapshots** **Insect response to canola with modified sterol metabolism** Afroja Rahman, Murdoch Uni **A case of mistaken identity? – new knowledge of root lesion nematode pests of grains in south-west WA** Rhys Copeland, Murdoch Uni **Investigating herbicide tank mixes to control HPPD-resistant wild radish (*Raphanus raphanistrum*)** Rex Cao, AHRI/Nufarm **Investigating electric weed control in Australia** Miranda Slaven, DPIRD **Genome mining in fungi: uncovering a treasure trove of herbicidal molecules** Hera Nyugen, UWA **How are heat and drought stresses functionally linked to glyphosate resistance?** Arslan Peerzada, DPIRD **Effectiveness of chickpea rhizobia across Western Australian agro-ecological zones** Yvette Hill, Murdoch Uni **Wheat Blast what is our risk?** Zia Hoque, DPIRD **Revealing better metabolic adaptations in roots of bread wheat lines differing in salt tolerance mechanisms** Bhagya Dissanayake, UWA **Improving farming system profitability, management of greenhouse gas emissions and climate resilience in the low and medium rainfall zones of WA: Grower perspectives** Dayna Hutchison, DPIRD **Farm strategy and tactics matter** Michael Young, UWA
3.30 pm	15 Min Moving			
3.45 pm	PLENARY 3 – Grand Ballroom 1			
3.45 pm	**Grain crop residues to hydrogen and ammonia** — Louise Brown, Hydgene Renewables, and Greg Perkins, Wildfire Energy			
4.35 pm	**GRDC closing comments** — Peter Bird, GRDC			
4.45 pm	Sponsors and speakers' Sundowner (Sponsored by CSBP)			

This program may be subject to change.

Grand Ballroom 1 | Crown Ballroom 1 | Crown Ballroom 2 | Crown Ballroom 3

2023
GRAINS RESEARCH UPDATE, Perth

Day 1 – Contents

PLENARY 1 – *Grand Ballroom 1*

SESSION 1 – AGRONOMY – *Grand Ballroom 1*

SESSION 2 – Markets – *Crown Ballroom 1*

SESSION 3 – Crop Protection – Disease – *Crown Ballroom 2*

SESSION 4 – Crop Protection – Weeds – *Crown Ballroom 3*

SESSION 5 – Agronomy – *Grand Ballroom 1*

SESSION 6 – Carbon and GHG – *Crown Ballroom 1*

SESSION 7 – Nutrition – *Crown Ballroom 2*

SESSION 8 – Crop Protection – Weeds – *Crown Ballroom 3*

Day 1 – Contents *(continued)*

Day 2 – Contents

Day 2 – Contents *(continued)*

FOCUS SESSIONS

2022–2023 GRDC WESTERN REGIONAL PANEL

November 2022

DARRIN LEE, PANEL CHAIR

Mingenew, WA

Darrin was appointed to the Western Panel in 2014, becoming chair in 2018. He has been farming in WA's Northern Agricultural Region for more than 20 years. He has a keen interest in digital agriculture and 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.

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JULES ALVARO, DEPUTY CHAIR

Merredin, WA

Jules is a director of a broadacre, predominantly cropping business. She has also been involved in off-farm industry roles since 2015, including serving as a member of the GRDC Western Panel since 2015 and being a non-executive director on the boards of Partners in Grain (now Rural Edge) and Agricultural Women Wheatbelt East. She is on the Muresk Institute Advisory Committee.

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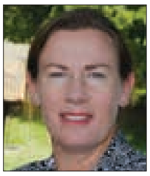

JULIET MCDONALD

Eganu, WA

Juliet is a Coorow grower and also works for Summit Fertilizers as an area manager. She has worked as a sales agronomist with Elders, area manager for GrainPool, marketing manager with Coorow Seeds and research agronomist and extension officer with the Department of Agriculture. She holds a Bachelor of Science in Agriculture from the University of WA and is qualified as a Fertcare® accredited adviser.

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SUZANNE WOODS

Calingiri, WA

Suzanne is an owner of Emdavale Farms, a 3400ha mixed-farming business. She is a founding shareholder in Hay Australia, a large export hay company. She is a director of the Australian Fodder Industry Association and Regional Early Education and Development Inc.

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GARY LANG

Wickepin, WA

Gary has been a grower for 37 years. He was a catalyst in initiating frost research confirming that high levels of stubble could increase frost damage to grain crops. He was a member of the GRDC National Frost Initiative steering committee from 2015 to 2019. He was president of the Facey Group.

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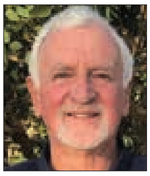

JOHN BLAKE

Albany, WA

John is a research and development consultant with Stirlings to Coast Farmers and an adviser with extensive experience in WA. He has had substantial overseas agricultural experience, particularly in North Africa. He 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.

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DR RICHARD WILLIAMS

Perth, WA

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 consultancy business groIQ published big data research findings internationally. He has recently returned to work for 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.

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DR DAN MULLAN

Perth, WA

Dan is a wheat breeder with InterGrain and is committed to delivering improved grain technology to growers by integrating a wide range of scientific disciplines, engaging with industry groups and addressing agricultural challenges. He spent his early career with CSIRO and the International Maize and Wheat Improvement Center, which provided him with excellent skills in high-level science and a global perspective on RD&E. He regularly engages with end markets for Australian grain to understand and extend information about the requirements of these markets. He maintains a close working relationship with researchers, breeders and management groups across Australia and the global plant breeding community.

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QUENTEN KNIGHT

Esperance, WA

Quenten is a consulting agronomist. He has broad agronomy experience with particular interest in soils, precision ag and hyper-yielding crops. He graduated from Muresk in 1991 with a Bachelor of Business (Agriculture) and has worked in a diverse range of regions across the WA wheatbelt. He has a long involvement with GRDC as an inaugural and long-serving RCSN member (now National Grower Network) and is a steering committee member for Soils West.

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CRAIG BROWN

Perth, WA

Craig holds a Bachelor of Business (Agriculture) from Curtin University. He is the sole director of Craig Brown Consulting and a director of Synergy Consulting, the largest independent agronomic consulting group in WA. Post-university, he was involved in herbicide resistance testing services, then was trials coordinator for a large reseller network before being based in Hyden as a company agronomist. From 2015–19, he was a member of the National Frost Initiative steering committee.

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DR NICOLE JENSEN

Queensland

Nicole is the GRDC general manager of the genetic and enabling technologies business group. She brings a wealth of experience in digital agriculture, plant breeding and genetics arising from roles she has held in Australia and internationally in the seed industry.

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2023 GRAINS RESEARCH UPDATE
Perth – Floorplan

Have your say

Help shape the future direction of the CBH Community Investment Fund

CBH Group and our members have a proud history of supporting regional communities through the Community Investment Fund.

This year marks a decade since the Fund was formally established and we want to ensure it is set up to continue supporting WA's grain growing communities for the next decade and beyond.

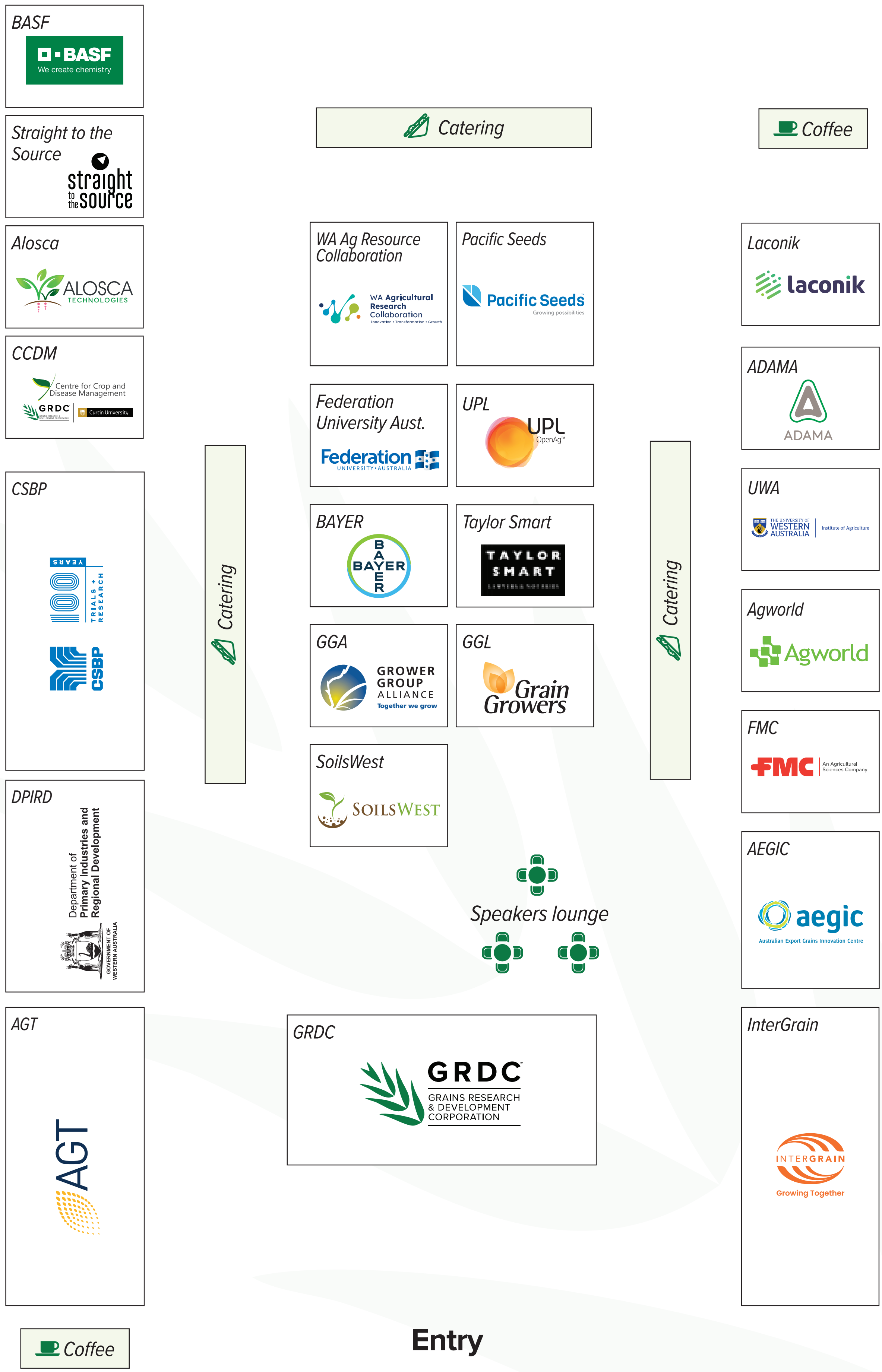
Growers and community members from grain growing regions are invited to share their thoughts and ideas on the Fund's future direction by completing the online survey and attending one of the regional workshops below:

Esperance Bay Yacht Club, Esperance	**7 March** 9.30am – 11.30am
Newdegate Hall, Newdegate	**8 March** 9.30am – 11.30am
Katanning Leisure Centre, Katanning	**9 March** 9.30am – 11.30am
Dalwallinu Recreation Centre, Dalwallinu	**13 March** 10.30am – 12.30pm
Port Denison Volunteer Sea Search & Rescue, Dongara	**14 March** 9.30am – 11.30am
Merredin Club, Merredin	**17 March** 11:00am – 1:00pm
Level 16, 240 St Georges Terrace, Perth	**27 March** 10:00am – 12:00pm

To participate, visit
cbh.com.au/CIFhaveyoursay
before 5 March 2023.

CBH GROUP

Exhibition Space (Grand Ballroom 2)



Day 1 – Monday 27 February

Plenary 1

The Grains Australia pathway to value

Richard Simonaitis, Grains Australia

Based in Perth, Western Australia, Richard Simonaitis brings a breadth and depth of industry experience to the role of Chief Executive Officer of Grains Australia. Most recently, Richard led the Australian Export Grains Innovation Centre (AEGIC) over the past six years to significant accomplishments including research to support the commercialisation of new oat rice and noodle products, developing soft and cookie wheat supply chains, and delivering valuable business insights into the future outlook for Australian grain. Richard has broad experience in export-focused commodities industries, having worked in logistics and product quality roles within the iron ore industry and in senior management roles within the grain industry across logistics, operations, marketing, and trading. He has a strong understanding of grain growers, the grains industry across Australia and the markets Australian grain is sold into. He also has internal experience developing several grain infrastructure projects in Indonesia.

Prior to becoming chief executive of AEGIC in February 2016, Richard was with the CBH Group where he led the national accumulations team for five years. He was chair of the Country High Schools Hostel Authority, an inaugural board member of the Australian Grain Institute capacity building project, a Fellow of the Australian Rural Leadership Foundation, a member of the Australian Institute of Company Directors, is on the Grain Trade Australia Trade and Market Access Committee and is part of the Grains Industry Market Access Forum.

Notes:

The market outlook for grains

Michael Whitehead, ANZ

Michael Whitehead is Director of Agribusiness Industry Insights for ANZ. In this role, Michael focuses on mapping industry-based trends and analysing the impact of these sectoral changes and dynamics on stakeholders across the agribusiness sector. Previously, Michael was the Product Specialist for Macquarie Agricultural Funds Management in New York, responsible for global marketing of major agricultural funds, focusing on grain and oilseeds opportunities in Australia and Brazil. Prior to this, Michael worked as Executive Director of Rabobank's Food & Agribusiness Advisory team in North America, providing industry research and corporate strategy. Michael has been featured widely in global media outlets, including CNBC, the Financial Times, and the Wall Street Journal. He has experience in agricultural production and consulting, particularly in Australia and China. Michael has a BA from La Trobe University, and MBA from the Melbourne Business School and the Rotterdam School of Management and has completed the Harvard Business School Advanced Agribusiness Course.

With the Australian grain sector experiencing its third successive strong year, many across the supply chain are evaluating where the industry is likely to head over the medium to longer term.

The grain market is increasingly impacted by a range of factors stretching well beyond the traditional factors of weather, supply, and demand.

This presentation will discuss the outlook for the wider grain market, taking into account drivers including geopolitics, investment flows, consumer behaviour, regulatory change, and economic developments.

Notes:

The sustainability of Australian grain farming systems

Richard Heath, Australian Farm Institute

Richard Heath is Executive Director of the Australian Farm Institute, an independent agricultural policy research organisation. Richard is a Nuffield Scholar and was a farmer at Gunnedah for 20 years until 2012. Previous to his current role Richard was Associate Professor of Agronomy and Farm Management at the University of Sydney. He is currently also a director of the Grains Research and Development Corporation and member of the CSIRO Agriculture and Food advisory committee.

Key messages

- The requirement to demonstrate positive sustainability outcomes is an unstoppable force in today's markets.
- True sustainability has a broad multi-capital context.
- The Australian Agriculture Sustainability Framework provides a whole of agriculture approach to sustainability.

Evidence of positive sustainability outcomes and progress towards ambitious sustainability goals are becoming a pre-requisite for market access. This is especially prevalent in premium markets, however even in less premium markets the mechanisms of trade, e.g., access to competitive finance, are requiring evidence of sustainability.

While some of the drivers for demonstration of sustainability are policy or regulation based, many are investment focused business drivers. A greater understanding of multi-capital mitigation of climate risk is leading to the setting of goals which encompass social and governance outcomes as well as environmental.

What does this mean for Australian grain farms? Evidence of sustainability will be required to be competitive in trade and business operating environments. The definition of sustainability will also continue to change and the opportunities to rewarded for a focus on sustainability will not remain constant.

In this environment the Australian Agriculture Sustainability Framework has been created to assist with alignment of existing and developing sustainability frameworks and to provide a forum through which a whole of Australian agriculture approach to sustainability can be developed and promoted.

Notes:

Selecting the right cereal variety for the conditions

Felicity Harris, Charles Sturt University

Summary

Phenology FUNdamentals: selecting the right cereal cultivar for the conditions.

- Optimal Flowering Periods provide a useful concept for growers to minimise risk of abiotic stresses.
- New Australian Cereal Phenology Classification Scale (ACPC) provides an improved understanding of phenology responses in wheat and barley.
- Integrating genetics and agronomy is key for climate adaptation.

Optimising phenology is critical to the adaptation of cereals to different growing environments across Australia. Research has highlighted the importance of an optimal flowering period, to ensure the critical period for yield development coincides with favourable seasonal conditions, whereby the risk of frost, heat and drought is minimised, and grain yield potential is optimised. Whilst this concept provides useful targets for growers to mitigate risk of abiotic stresses, they remain a major limitation to advancing cereal yields across Australia under a changing climate. Declining rainfall, seasonal variability and the increased likelihood of severe temperature events have increased the complexity associated with cultivar selection and sowing decisions. This presents a challenge for breeders, to release new cultivars which combine improved adaptation and stress tolerance, and for growers, to improve farming systems and agronomic practices to optimise genetic gains. This presentation will summarise recent research whereby integrating genotype × environment × management synergies have enabled growers to adapt to climate variability and maximise yield.

Notes:

Towards an understanding of crop residue effects on wheat yield

Michael Ashworth, Australian Herbicide Resistance Initiative (AHRI), School of Agriculture & Environment (M086), University of Western Australia (UWA)

ABSTRACT:

Towards an understanding of crop residue effects on wheat yield

Ken Flower, AHRI

Key messages

- Grain growers must place a greater emphasis on uniformly spreading crop residue.
- Residue can have positive or negative effects on the crop, and the response in any particular year is largely driven by the weather conditions.
- Increasing the amount of break crop residue in the cropping system, as opposed to cereal residue, would likely maintain the positive effects of residue and reduce any negative impacts.

Aims

Initial study looked at how long-term uneven residue spread in cereal (wheat-wheat-barley) and diverse (wheat-legume-canola) crop rotations influenced soil chemistry and crop establishment and yield.

Results

While it is important to retain crop residues on the soil surface to prevent erosion and conserve water, the effect of different amounts and types of residues on crop yield is complex. Residue can have positive or negative effects on the crop, and the response in any particular year is largely driven by the weather conditions. With frost occurring around flowering, increasing amounts of cereal residue has been seen to have a negative impact on wheat yield, whereas break crop residue does not. Increasing the amount of break crop residue in the cropping system, as opposed to cereal residue, would likely maintain the positive effects of residue and reduce any negative impacts. As residue spread behind harvesters is not always uniform, it is also important to understand the impact of uneven residue spread on crop performance.

Conclusion

Research by UWA found that uneven crop residue distribution influenced soil chemical composition in the long term, producing higher soil pH, organic carbon, and some nutrients directly behind the harvester.

It was found that problems are likely to increase as more farmers windrow and burn residues for weed control, and as harvesters become larger in controlled traffic systems, making it more difficult to spread residue across the full cutting width. To avoid the wavy effect in crops, greater emphasis is required on uniform spreading of residue.

Grain export supply chain challenges

Ross Kingwell, Australian Export Grains Innovation Centre (AEGIC), UWA and the Department of Primary Industries and Regional Development (DPIRD)

Key messages

- Bulk grain and containerised grain export supply chains are under duress.
- Investment and policy changes are needed urgently.

Aims

Aid discussions and decisions that ensure Australia's export grain supply chains are more effective and cost-efficient.

Results

Since 2020 the spread and management of COVID has disrupted supply chains, particularly containerised supply chains and the consequences of that disruption have been substantial and have extended into 2022. During 2020 into 2022, many importers and exporters have struggled with the consequences of a raft of supply-chain issues. Higher transport and handling costs, and unreliability and uncertainty in accessing containers and shipping opportunities have squeezed or devastated profit margins and placed upward pressure on end user prices (to the extent that the higher costs within supply chains have been able to be passed on).

During 2020 and extending into 2022 greater execution risk and supply chain costs associated with containerisation increased the per tonne costs of containerisation versus its bulk grain alternative, in many cases greatly reducing profits from grain containerisation. Problems and cost escalation in containerised supply chains during 2020 and 2021 spurred investigations into those supply chains by Kingwell et al. (2022), the Productivity Commission (2022) and the ACCC (2021 & 2022). Their investigations prompted several recommendations, outlined in the 'Conclusion' section below.

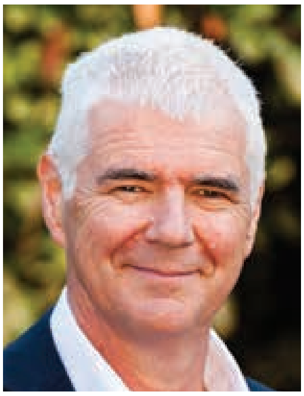
Conclusion

To lift the effectiveness and improve the cost-efficiency of Australian export grain supply chains (in container and bulk trade) remedial action by government and industry is needed. Beneficial actions are in four areas:

1. Improve market access to diversify and increase demand for Australian grain.
2. Undertake supply chain investments of enduring value.
3. Provide greater oversight and regulation to make supply chains more cost-efficient and transparent.
4. Specifically for the container trade, deliver grower education to raise growers' awareness of the processes and risks in exporting containerised grain.

Notes:

Market requirements and how Australian wheats perform



Ken Quail, AEGIC

Key messages

- Australia supplies wheat to a range of markets across Asia and the Middle East.
- Australian wheat ticks many boxes for our customers.

Aims

This paper will use examples from important Australian wheat markets to identify what we are doing well and where opportunities exist to increase value.

Results

Wheat use and flour applications are almost as diverse as the number of customers supplied. Engaging with and listening to these markets to understand their requirements has been key to the development of our classification system and grain trading standards.

Through technical exchange and cooperation in-market, AEGIC has been able to refine our understanding of functional requirements for flour millers, noodle manufactures and bakers. Australian wheat ticks many boxes for our customers.

Conclusion

We have significant functional benefits for our noodle markets in North Asia, China, and Southeast Asia. However, we have challenges in markets that represent significant value and growth.

Notes:

Australian Fungicide Resistance Extension Network update

Fran Lopez-Ruiz, Centre for Crop and Disease Management (CCDM)

One of the major challenges faced by the agricultural industry is the control of fungal crop diseases during the emergence of fungicide resistance. The presence of fungicide resistant pathogen populations in a crop, not only results in lower efficacy of chemical control methods but also, lower yields and quality due to increased disease pressure. In addition, unnecessary treatment with inefficacious products would represent an additional cost to the grower and contribute to adverse environmental effects. An optimal approach to combat this would be to determine what chemistries the populations are resistant to and use other, more efficacious chemicals instead.

The Australian Fungicide Resistance Extension Network (AFREN) is a GRDC funded project that aims at training the grains industry on fungicide resistance management tactics by bridging the knowledge gap existing between industry and researchers. To achieve this AFREN follows three key approaches: i) critical assessment of management-relevant fungicide resistance research, ii) development of industry-ready extension contents, and iii) delivery of extension targeting specific regional problems.

This presentation will discuss the key achievements of the former AFREN investment (2019-2022) and what can be expected for the new 2023-2026 investment.

Notes:

The impact of new rust resistance genes

Melania Figueroa, Commonwealth Scientific and Industrial Research Organisation (CSIRO)

ABSTRACT:

Rust's biggest secret tactic to kill a crop

Melania Figueroa[1], David Lewis[1], Eva Henningsen[1], Tim Hewitt[1], Kerensa McElroy[1], Shannon Dillon[1], Chris Webers[1], The Duong Nguyen[1], Rohit Mago[1], Eric Nazareno[2], Emmery Hartwig[2], Botma Visser[3], Zak Pretorius[3], Willem Boshoff[3], Danilo Pereira[4], Eva Stuckenbrock[4], Jibril Lubega[5], Kostya Kanyuka[5], Yun-Feng Huang[6], Lee Hickey[7], Andrew Milgate[8], Eric Stone[9], Brian J Steffenson[2], Shahryar F Kianian[10], Jana Sperschneider[1], Peter Dodds[1],

[1]CSIRO, Canberra, [2]University of Minnesota, USA, [3]University of the Free State, Department of Plant Sciences, South Africa, [4]ChristianAlbrechts University of Kiel and Max Planck Institute of Evolutionary Biology, Kiel and Ploen, Germany, [5]National Institute of Agricultural Botany, UK, [6]National Taiwan University, Taiwan, [7]University of Queensland, [8]Department of Primary Industries, New South Wales, [9]ANU-CSIRO Centre for Genomics, Metabolomics and Bioinformatics, [10]United States Department of Agriculture-Agricultural Research Service, USA

Key messages

- Widespread use of crop cultivars with race-specific resistance favours the evolution of virulence traits in rust fungi and subsequent epidemics.
- The release of new genes without in-depth characterisation of pathogen populations and crop cultivars jeopardises investments in breeding of new cultivars.
- New computational pipelines allow understanding of rust diversity at a haplotype level and provide opportunity to calculate risks when deploying new resistance genes.
- Nuclear exchanges play an important role in the emergence of new virulent races.
- Technological advances in artificial intelligence and genomics bring innovation for interventions to control rust diseases.

Aims

Generating knowledge of pathogen evolution and crop genetics to support decision making in breeding programs and safeguard Australia's cereal production.

Results

We developed computational pipelines and applications for chromatin contact data within chromosomes to separate the information from each of the two nuclear genomes present in rust isolates and define haplotypes.

We generated haplotype-resolved genome assemblies for multiple strains of three important rust species *Puccinia graminis* f. sp. *tritici* (wheat stem rust), *Puccinia tritici* (wheat leaf rust) and *Puccinia coronata* f. sp. *avenae* (oat crown rust).

By applying comparative and population genomics we gained new perspectives in the geographic distribution of rust fungi and genetic relationships at haplotype level.

We demonstrated the prevalence of nuclear exchange between isolates leading to the creation of new lineages causing significant disease outbreaks.

We show that virulence genomic association studies and prediction of rust secreted proteins at the haplotype level brings power to the characterisation of resistance genes and allows predictions of resistance durability.

Through the use machine learning algorithms and large genomic datasets from rust strains we developed 'PredictiPath', the first software tool to predict virulence to resistance genes from rust genome wide sequencing data.

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Conclusion

- Knowledge of host–pathogen co-evolution is essential to deliver durable resistance and decrease risks of virulence evolution in rust.
- New resources and tools have been developed to deepen our understanding of cereal rust and plant interactions.
- The use of these resources and tools will lead to improved decision-making processes in breeding programs and planting recommendations.

Notes:

Most expensive herbicide is the one that doesn't work: Hitting the target

Bill Campbell, Bill Campbell Consulting

ABSTRACT:

"The most expensive herbicide is the one that doesn't work: Hitting the target" – increasing the awareness and understanding of making good weed spraying decisions

Bill Campbell, Bill Campbell Consulting

Summary

- Always check that your sprayer is spraying 'as good as it can' using water sensitive paper. When setting up a sprayer, we use the basic application principles, calculations, and manufacturer's nozzle guides, but effective setup will still require quantifying, assessing and fine tuning.
- Different application situations (including summer weeds, pre-emergents, post emergent, fungicide and desiccation), depending on mode of action of the chemical being applied, have different water volumes and spray quality or droplet size requirements. The size, shape, and posture of the target, with consideration of false targets such as stubble and leaf area index of the crop, determines the water volume and spray quality.
- There are international guidelines for minimum water volumes and spray quality requirements for best efficacy. These will need to be adjusted depending on the different spray situations, conditions and any drift considerations.
- Maximising efficacy is multi-faceted. The spraying process and ultimate outcome is a balance between efficacy, efficiency, and risk of spray drift. There are many factors that are required to be balanced, all of which are capable of being compromised. The primary considerations are water volume- low volume vs high, spray quality- smaller droplets vs larger droplets, working speed- ideal vs fast, wind speed and meteorological conditions, time of the day, and operation of the sprayer for the application situation.
- It is difficult to evaluate the true losses and implications due to poor application, other than when requiring a complete respray. Poor droplet deposition and uniformity results in a sublethal dose with surviving moribund weeds remaining and less than ideal pre-emergent weed control. Whilst selecting for resistant weeds, weeds that have 'metabolic' type resistance will not be controlled.

Notes:

Glyphosate alternatives for summer and pre-seeding knockdown weed control

Harmonhinder Dhammu, DPIRD

ABSTRACT:

Glyphosate alternatives for summer and pre-seeding knockdown weed control

Harmohinder Dhammu[1], Alex Douglas[2], Dave Nicholson[1], and Catherine Borger[1]
DPIRD, [1]Northam and [2]Albany

Key messages

- A range of registered herbicides and herbicide mixtures provided excellent control of summer weeds, caltrop, Afghan melons, button grass, windmill grass and sow thistle, similar to or better than glyphosate.
- Commercially available organic herbicides Bioweed® and Slasher® applied at recommended rates using around 100L/ha spray volume had very poor weed control efficiency (0-69%) against the summer weeds mentioned above and are expensive options for broadacre farming.
- A range of registered herbicides and herbicide mixtures resulted in almost complete control of glyphosate resistant ryegrass, young capeweed, and mature sow thistle during early winter 2022.

Aims

To investigate a range of herbicides as alternatives to glyphosate that are currently registered for use in fallow and pre-crop establishment, for their potential to be used for the control of various summer weeds and in knockdown situations.

Results and conclusions

The herbicide treatments that provided 95-100% weed control efficiency (WCE) are presented below. WCE was calculated based on dry weight of weeds from a total of six field and screen house trials.

Note: For some herbicides, especially of the new ones, trade names are used here for ease of understanding and keeping it simple. For example, Alliance® = paraquat 125g + amitrole 250g/L, Dicamba M = dicamba 25g + MCPA 150g/L, Guerrilla® = paraquat 300g + amitrole 12g/L, Reflex® = fomesafen 240g/L, Terrain® = flumioxazin 500g/L, Terrad'or® = tiafenacil 700g/kg, and Voraxor® = saflufenacil 250g + trifludimoxazin 125g/L. We are not promoting any herbicide product and any similar products should be equally good.

Summer weed control (Trials with three replications conducted during summer 2021-22)

Caltrop (small vegetative to fruiting plants, field trial): Guerrilla® at 1.7L/ha, Alliance® at 4L/ha, glufosinate 200 at 3.75L/ha, paraquat 250 at 2.4L/ha, paraquat 250 at 2L + Voraxor® at 100mL/ha and 2,4-D amine 625 at 1.6L/ha recorded WCE of 96-100% like glyphosate 570 2L/ha (e.g., Roundup Ultra® max).

Afghan melons (2-8 leaf plants, field trial): Terrad'or® at 40g/ha, glufosinate 200 at 3.75L/ha in mixture with Reflex® at 750mL, saflufenacil 700 (e.g., Sharpen®) at 34g and Voraxor® at 100mL/ha provided 95% WCE and glufosinate in mixture with fluroxypyr 333 (e.g., Starane® Advanced) at 300mL/ha and 2,4-D amine 625 at 1.6L/ha alone recoded 100% WCE similar to glyphosate 570 2L/ha.

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Button and windmill grass (5-7 leaf tillering plants, screen house irrigated trial): a mixture of glufosinate 200 at 3.75L and paraquat 250 at 2.4L/ha, Alliance® at 4L/ha, Guerrilla® at 2L/ha, and haloxyfop 520 (e.g., Verdict®) at 150 mL/ha provided 100% WCE. However, glyphosate 570 2L/ha resulted in 57% WCE against button grass and 21% against windmill grass.

Sow thistle (2-8 leaf plants, screen house irrigated trial): Glufosinate 200 at 3.75L/ha, saflufenacil 700 at 34g/ha, paraquat 250 at 2L/ha, Guerrilla at 1.7L/ha and Glufosinate 200 at a lower rate of 2L/ha in a mixture with dicamba M at 3.2L, saflufenacil 700 at 1.5g, Terrain® at 10g, and Voraxor® at 100mL/ha provided 100% control of sow-thistle compared to 94% with glyphosate 570 2L/ha.

Summer weed control – Organic herbicides

Bioweed® (Pine oil 136g/L) at 7% of spray solution using 100L spay volume/ha recorded 15, 15 and 28% WCE against caltrop, button grass and sow thistle, respectively. However, it had no negative effect on growth and development of Afghan melons and windmill grass.

Slasher® (Nonanoic acid 525 g/L) at 20% of spray solution using 100L spray volume/ha had 50% WCE against button grass and 69% against sow thistle. For other summer weeds, its WCE was zero.

Pre-seeding weed control (Field trials with 3-4 replications conducted during mid-June 2022)

Glyphosate-resistant tillering ryegrass: Guerrilla® at 2L with 95% WCE was the best treatment followed by 87% WCE with Alliance® 1.5L/ha and 82% with glufosinate 200 2L + Terrad'or® 40g/ha. Ryegrass treated with glyphosate 570 at 2L/ha accumulated dry weight on par with the untreated control.

Capeweed (young plants): Glufosinate 200 at 2L/ha, Alliance® at 1.5L/ha and glyphosate 570 2L/ha provided 98-100% control of this weed.

Sow thistle (flowering plants): Glufosinate 200 at 3.75L/ha, saflufenacil 700 at 34g/ha, and Glufosinate 200 at lower rate of 2L/ha in mixture with saflufenacil 700 at 1.5g, Terrain® at 10g, and Voraxor® at 100mL/ha were as effective as glyphosate 570 at 2L/ha with WCE of 100%.

Notes:

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

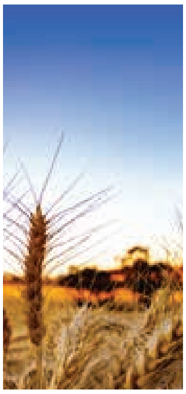
Rotating buys you time, mixing buys you shots.

- 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

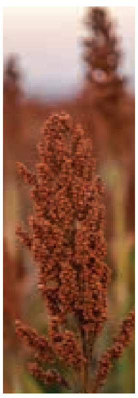
Preserve glyphosate and paraquat

- 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.

www.weedsmart.org.au

Optimal planting times for canola varieties

Tamryn Davis, SLR Agriculture, and
Matthew Nelson, CSIRO

ABSTRACT:

Optimal planting times for canola varieties

Tamryn Davis, SLR Agriculture; with contributing data from **Justin Kudnig** (Pacific Seeds) and **Andrew Heinrich** (Pacific Seeds), **Matthew Nelson** (CSIRO), with contributing data from **Jeremy Whish** (CSIRO)

Key messages

- Each canola variety has a unique thermal time target (number of day degrees) to reach flowering and degrees of vernalisation to modify this target based on environmental temperatures.
- Understanding this requirement will give growers more accurate information to base variety choice and planting decisions than is currently the situation with the broad categories such as a 'four or five series' maturity length classification.
- When planting canola in March or April there is the risk of plants 'running up' during warm dry spells after emergence if they lack 'vernalisation hold.' If a variety has too much vernalisation requirement the flowering date can be pushed out past the optimum flowering window for maximum grain yield potential.
- Work is being conducted to understanding the molecular basis of canola maturity drivers by CSIRO and privately funded work is being conducted by companies such as Pacific Seeds in quantifying canola phenology with detailed field experiments on vernal and thermal responses, that will lead to a much better understanding of individual canola variety maturity drivers.
- Better understanding of canola maturity drivers will assist growers in making variety choices in a much more sophisticated way than is currently the case. The end result for growers will be maximising water limited grain yield potential more often under a range of seasonal growing conditions.

Discussion

Whilst canola is recognised for its high profit potential and benefits within the farming system, it is still considered a risky crop based on the relatively higher input requirements. Biomass accumulation is an important determinant of final grain yield and forms a critical part of the Harvest Index equation. Where this is limited due to crops 'running up' too early during a warm dry spell at the start of the season, final grain yield may also be limited. Canola has an incredible ability to 're-set' its potential following a period of accelerated growth providing the growing conditions and fertiliser applications allow for such. If the growing conditions or fertiliser application are not optimal for the crop, maximum potential grain yield will not be met.

Previously, the industry has used a simple method of describing canola growing season length by grouping them into a series based on average time to flowering (i.e. five series) from recognised sowing windows. This has served the industry well to date, although broad maturity ranges and simple yield-based decisions from NVT trials do not account for subtleties in seasonal differences that influence the potential yield of different canola varieties particularly if sown early and outside recognised or recommended sowing windows.

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CSIRO are developing sophisticated models that can accurately predict flowering time of varieties for any given sowing date in any given Australian growing region. Initial models were based on the interaction between thermal time and vernalisation time properties of each variety. However, the process of determining the thermal and vernal time requirements of new varieties is lengthy and expensive. CSIRO have therefore turned to genomic prediction methods to simplify and accelerate the incorporation of new varieties into these flowering time prediction models. The aim is to be able to estimate canola maturity and development (physiology/phenology) under a range of growing conditions and sowing times. This information will assist growers with choosing suitable varieties for their environment and seasonal growing conditions.

Pacific Seeds have privately funded several years of in-field Winter and Spring type canola phenology trials across Australia that quantify variety development from different sowing dates. This work has identified some very clear differences in maturity drivers that provide stability under a range of growing conditions. This work will ultimately lead to an App that will assist growers with variety decision making.

The work that is being conducted by CSIRO and private breeding groups such as Pacific Seeds will lead to growers having more information on variety maturity drivers that will more often result in maximum grain yield potential.

Acknowledgements

Jeremy Whish (CSIRO), **Justin Kudnig** (Pacific Seeds), **Andrew Heinrich** (Pacific Seeds)

Notes:

Grower experiences with Super High Oleic safflower in WA

Byron Milne, Spencer Beatty, and **Michael Lamond,** SLR Agriculture



Key messages

- Importance of paddock selection, soil type and crop establishment practices from learnings to date based on grower experiences in 2022.
- Understanding the sowing windows for safflower and the impact on grain yield.
- Awareness of the herbicide options for weed control and safflower crop tolerance.
- Creating a nutrition plan based on findings from the 2021 and 2022 season.
- Water use, deep nutrient 'draw down' and possible implications to the rotation.
- Safflower disease summary from 2022.

Aims

- Compile grower observations from the 26 paddocks sown to safflower in 2022 across Western Australia, including final grain yield, time to flower, weed control and establishment.
- Compile two years of plot trial data from 2021 and 2022 on time of sowing, depth of sowing, variety evaluation, herbicide tolerance, herbicide weed systems trials and safflower plant back trials to cereals.
- Review the first year of nutrition trials conducted in 2022 and observations from 2021, including deep soil core results from 2022.

Results

1. **Site selection** – Soil type and position in the landscape appear to be critical to the success of safflower as it is a difficult crop to establish and finishes in the heat of summer during November and December if sown in April through to the end of May. The crop needs to access deep moisture to be able to fill grain in the heat of summer.
2. **Agronomy** – Grain yield can be impacted by the time of sowing, depth of sowing, nutrition, disease and weed control. Safflower is slow to emerge under ideal moisture and soil temperatures and even slower to emerge under low soil temperatures, therefore the balance of planting date, depth and soil moisture have a big impact on emergence percentage. The crop is also a poor competitor with weeds as it is slow to get going and bulk up. This makes weed control difficult, although findings from two years of herbicide tolerance and systems trials in WA indicate that some of the herbicides that can be used in lupins and wheat can be used in safflower. Preliminary data from nutrition trials carried out in WA suggest that safflower is very responsive to both P and N.

(Continued on following page...)

There was a complex of diseases that infected all trial sites in 2022, and many of the grower plantings to various degrees, this is currently being investigated in collaboration with the Centre of Crop Disease Management (CCDM) in Perth.

3. **Fit in the system** – Safflower is a broadleaf crop and a nematode break; it also remains green well into December if planted in May and finishes on sub-soil moisture under very high day temperatures. Safflower maturity is driven entirely by thermal time with approximately 2200 growing degree days to the start of flowering. The end product is high value and price is pegged against the world oleic market so grain yields of around 1.0t/ha should return a profit for growers once larger tonnages are grown. There appears to be a degree of flexibility in where SHO safflower may fit in the rotation either as a single or double break crop or as a short winter fallow crop. There is a sharp grain yield decline from mid-April to mid-June plantings, although Safflower sown in June can still yield over 1.0T/ha as can spring plantings growing entirely on sub-soil moisture.

Conclusion

Growers are in the very early stages of evaluating safflower as a break crop in Western Australia and the lessons learnt by growers from the 2022 season will help inform other growers on what to expect if trying SHO safflower for the first time. These findings will allow growers to better understand where SHO safflower is suited in the rotation and assist in limiting the risk of failures.

Notes:

The fit of long-coleoptile wheat for WA growers – opportunities and adaptions in shifting climates and landscapes

Michael Lamond and **Kate Witham,**
SLR Agriculture

Key messages

- Long-coleoptile wheat may allow for adaptation to climate change and seasonal variability, particularly with a forecasted shift from standard break of season to more sporadic summer rainfall events.
- Sowing deeper made possible through the coleoptile elongating *Rht-18* gene may allow subsoil moisture at depth to be chased. Plant establishment was significantly improved across six file trials in 2022, particularly for Mace-18. Such factors allow for greater control over key events such as sowing windows and flowering dates in increasingly unpredictable growing seasons.
- Unpredictable soil platforms following wind, rain or deep ripping can be combatted with long-coleoptile wheat's ability to emergence from depth. Emergence in high soil temperatures was found to be improved for *Rht-18* varieties.

Aims

- Investigate the fit of long-coleoptile wheat in Western Australia farming systems, particularly where changing climates and landscapes are concerned.
- Validate traits in long coleoptile wheat that lead to improved emergence and early vigour.

Results

Long coleoptile *Rht-18* wheat had significantly greater emergence rates and seedling vigour compared to conventional varieties when sown at 95-120 mm, particularly at high soil temperatures and uneven soil platforms. A relationship (correlation coefficient 0.7-0.91 across five sites) between coleoptile length and emergence was found, where long coleoptile Mace-18 had 30-40% greater emergence rates than Mace across five locations.

Seeding deeper utilising longer coleoptile wheat reduced the prevalence of *Rhizoctonia* and other fungal bodies typically found in the root zone proximal to the surface. Changing root zone depth also positively influenced crop safety for various pre- and post-herbicide chemistries at 35 mm and 100 mm, particularly for immobile herbicides such Trifluralin. Early vigour and increased plant numbers saw vigorous *Rht-18* varieties outcompete annual ryegrass.

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Conclusion

Long-coleoptile *Rht-18* wheat varieties have a direct fit for growers and various facets in WA broadacre cropping systems, particularly in the face of a shifting climate and rainfall variability. Benefits have been found around emergence through deep ripped soils and furrow fill, emergence at various soil temperatures, increased options around sowing depth and sowing windows, greater understanding around herbicide interactions and tolerance, and the potential to sow deep to reduce root exposure to soil pathogens such as *rhizoctonia*. Various agronomic characteristics have been assessed and exposed to growers over two years of trials in different environments to evaluate direct opportunities, benefits, and limitations of long coleoptile wheat to WA growers.

Notes:

Nitrous oxide emissions from cropping soils in the WA grainbelt: a 10-year perspective

Louise Barton, UWA

Key messages

- Ten years of field-based research has shown soil nitrous oxide (N_2O) emissions from fertiliser N application to Western Australian cropping soils are very small (< 0.12% of fertiliser N applied) in comparison to international standards (1.0% of fertiliser N applied).
- Greatest daily N_2O emissions occurred in response to summer rain rather than in response to fertiliser N applications.
- Liming soil may decrease soil N_2O emissions further in some instances, while increasing soil organic C may increase emissions to some extent. Including grain legumes in cropping rotations did not enhance soil N_2O emissions in the growing season or post-harvest.

Aims

- Quantify direct soil N_2O emissions from Western Australia cropping soils in response to fertiliser N application and the growth of grain legumes.
- Investigate strategies for lowering soil N_2O emissions from Western Australian cropping soils.

Results

Ten years of in situ measurements from various sites in the grainbelt found annual N_2O emissions were small (0.02–0.27 kg N/ha/yr) from Western Australian cropping soils and represent <0.12% of applied fertiliser N. Greatest daily N_2O emissions tended to occur in response to summer-autumn rain, and when the soil was fallow.

Liming decreased cumulative N_2O emissions from a wheat-wheat rotation at Wongan Hills by 30% by lowering the contribution of N_2O emissions following summer-autumn rain but had no effect but had no effect on N_2O emissions from a lupin-wheat rotation.

Increasing soil organic C at a long-term study site at Buntine enhanced soil N_2O emissions, but losses were still low (0.12% of applied fertiliser N) by international standards.

Including grain legumes in cropping rotations neither enhanced soil N_2O emissions during the growing season, or post-harvest, at Cunderdin and Wongan Hills.

Conclusion

Utilising soil N_2O data that is relevant to Western Australian cropping system is critical when calculating on-farm greenhouse gas emissions and will ensure that development of mitigation strategies for lowering these emissions are strategic.

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Key learnings from benchmarking greenhouse gas emissions from WA growers

Stacey Bell-Crookes, Farmanco

ABSTRACT:

Key learnings from analysing and benchmarking greenhouse gas emissions from 190 WA broadacre growers

Stacey Bell-Crookes, Farmanco

Key messages

- What aspect of the farming system is contributing the most to greenhouse gas (GHG) emissions. Does low GHG emission equate to low profitability?
- What are the drivers for on-farm change and how our growers are starting to reduce their footprint.
- What tools and information are required to navigate this complex carbon accounting environment in Australia agriculture.

Aims

There is a growing engagement from Australian agricultural businesses to measure current GHG emissions and modify their businesses to reduce and/or achieve net zero emissions. Farmanco has been collecting and analysing production, greenhouse gas emission and financial data from some of the best performing growers in WA. This presentation will outline the drivers for on-farm change, the GHG emissions of various farming systems and how changes are being made, plus the overall emissions picture in WA agriculture.

Conclusion

Utilising soil N_2O data that is relevant to Western Australian cropping system is critical when calculating on-farm greenhouse Farmanco has been collecting production and financial data from some of the best performing growers in WA for nearly a quarter of a century. Up to 70 different production measures are collected on an annual basis with greenhouse gas (GHG) emission parameters added in recent years. The GHG emission calculations and subsequent benchmarking is produced using the PICCC approved, Greenhouse Accounting Framework (GAF, University of Melbourne). This analysis has enabled Farmanco to examine current best practice management in relation to GHG emissions at a local scale, as well as track the improvements to the overall emissions picture in WA agriculture. At present, Farmanco has the largest dataset of WA farm businesses analysed for their GHG emission outputs.

Notes:

Profitable low-emission crop rotation?

Sud Kharel, DPIRD

ABSTRACT:

Profitable low emission crop rotation?

Sud Kharel[1,4], Christophe d'Abbadie[1], Amir Abadi[1], Ross Kingwell[1,2,3]
[1]DPIRD, [2]AEGIC, [3]UWA, [4]Meat Livestock Australia

Key messages

- Lower emissions do not always lead to lower profitability. Changes can be made to rotations without forgoing profits or increasing risks.
- On-farm emissions are not necessarily a reliable indicator of total emissions associated with agricultural activity.
- In some southern regions it is feasible to alter rotation selection yet maintain farm profitability and simultaneously reduce agricultural emissions.
- Research and innovation in low-emission fertilisers and anti-methanogenic feeds or pastures will further reduce agricultural emissions.

Aims

Analyse the relationships between crop rotation choice, profitability, and emissions.

Results

Results from the EVALUS (Economic Valuation of Alternative Land Use Sequence) model show the responsiveness of profitability (i.e., net margins) to changes in the proportion of pasture in rotations at many farm locations. For instance, at locations in the northern half of the WA agricultural region, net margins decline as the proportion of annual pasture in rotations increases, while in the southern half of the State's agricultural region, net margins increase as the proportion of annual pasture in rotations increases.

The responsiveness of emissions to changes in the pasture proportion also varies by location, with higher emissions in the southwest of the study region due to the more favourable climatic conditions for pasture-based, high stocking rate sheep farming. At several locations, the relationship between the percentage of pasture in rotations and the resulting net margins and emissions is curvilinear.

Conclusion

Emissions can be reduced, and net margins increased by altering crop/pasture rotation selection in the northern parts of the region towards more crop-dominant rotations, but at the expense of an increase in the volatility of returns. At all locations development of low-emission synthetic fertilisers and anti-methanogenic feeds or pastures will further reduce agricultural emissions.

What is driving yield response to phosphorus fertiliser in current cropping systems?

Craig Scanlan, DPIRD

ABSTRACT:

What is driving yield wheat response to phosphorus fertiliser in current cropping systems?

Craig Scanlan[1], Raj Malik[1], Gustavo Boitt[2], James Easton[3], Mark Gherardi[4], Zed Rengel[2]

[1]DPIRD, [2]UWA, [3]CSBP, [4]Summit

Key messages

- DGT-P can be used to identify P responsive soils where PBI > 50.
- The factors driving yield response to P on soils with PBI < 50 appear to have shifted from soil P level to those which affect the availability of stored soil P (rainfall before sowing and soil pH 0-10 cm).
- The factors above should be included with those currently used when making phosphorus fertiliser decisions.

Aims

- To build a data set of wheat yield response to phosphorus (P) fertiliser that is representative of current cropping systems in the grain-producing region of WA.
- To examine how soil properties and climate influence wheat yield response to P fertiliser in current cropping systems.

Results

Our investigation of the relationships between soil properties and yield response to P revealed that PBI 0-10 cm was an important factor. For sites where PBI 0-10 cm was > 50, a soil test calibration curve for DGT-P at 0-10 cm could be identified. For sites where PBI 0-10 cm was < 50, the soil test calibration curves for Colwell P and DGT-P were poor. The best calibration curve for Colwell P was found when the mean values for 0-30 cm were used, where PBI (0-30 cm) was less than 20.

Our analysis of rainfall revealed a systematic effect of rainfall before sowing on relative yield for sites where PBI < 50. A consistent pattern occurred for time-based windows that started 9 weeks before sowing and ended 1 or 2 weeks before sowing; the lowest relative yield was observed where no rain occurred during this period. The closest relationship between rainfall and relative yield was for the window from 5 to 2 weeks before sowing.

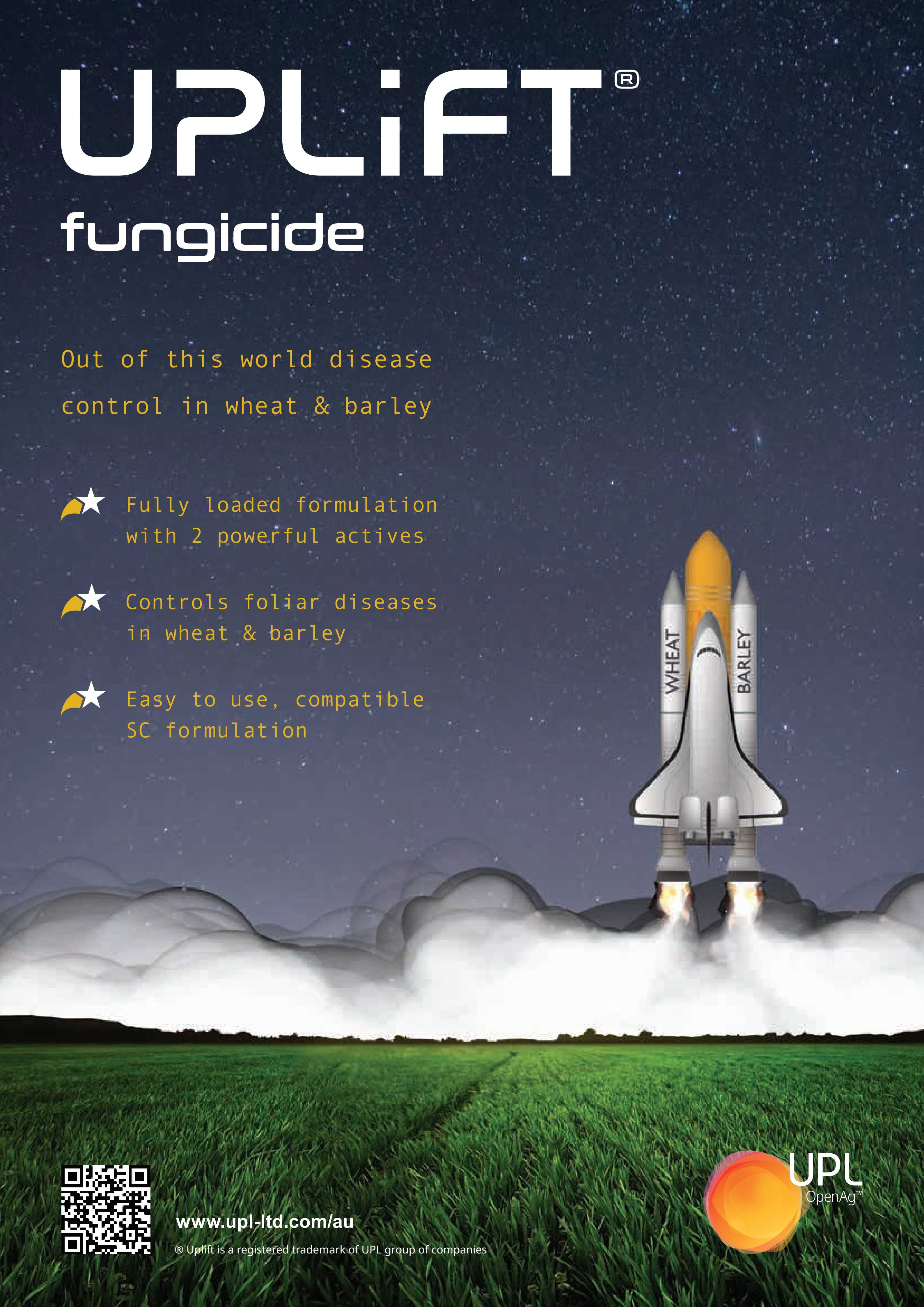
Further investigation of the relationship between rainfall in the window 5 to 2 weeks before sowing and soil properties on relative yield revealed an important interaction. The lowest values for relative yield were observed where rainfall was less than 8 mm (69%), but when rainfall was above this level, relative yield was influenced by soil pH 0-10 cm; it was 81% where soil pH was < 5.1 and 88% where soil pH was ≥ 5.1.

(Continued on following page...)

Conclusion

The results presented here suggest that there has been a shift in the factors driving yield response to P fertiliser in WA for soils with low PBI values (< 50). The influence of rainfall before sowing and soil pH that we detected suggests that factors that affect the availability of stored soil P are driving wheat response in current cropping systems, rather than just the level of soil P. For soils with PBI > 50, the data we have suggest that soils with DGT-P < 30 µg L-1 will be highly responsive to P fertiliser.

Notes: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Optimising nutrition for high rainfall zone canola

Jeremy Curry, DPIRD

ABSTRACT:

Optimising nutrition for high rainfall zone canola

Jeremy Curry, Mark Seymour, DPIRD Esperance

Background

Improvements in agronomic management and the farming system have resulted in canola yields of 3-5t/ha becoming increasingly common in the high rainfall zone of WA. With this increased yield potential, there remains uncertainty as to whether current nutrition strategies are adequate for sustainable production of these high potential crops. Although nitrogen rates are usually increased as required to match seasonal potential, the point at which ROI diminishes in high yielding canola in WA remains uncertain, particularly considering the historically high pricing in recent years. In addition to nitrogen, the need to adjust other macronutrient inputs (of which rates are generally more fixed across seasons) for higher yield potentials will be explored.

Aim

To compare macronutrient (nitrogen, phosphorus, potassium, sulfur) inputs in canola in the high rainfall zone of WA to determine the most profitable and productive strategies and how these align with current management recommendations.

Results

Four trials were established in the Esperance port zone across three seasons. Across these sites, yield in the absence of fertiliser ranged from 1.1-2.1 t/ha, while maximum yields under fertilisation ranged from 3.5-4.3 t/ha. Economic returns to nitrogen were generally significant up to 150kg N/ha, with returns above 150kg N/ha less assured and more dependent on grain and urea prices. While no site responded to potassium applications, yield responses to phosphorus and sulfur ranged from nil to over 1t/ha.

This presentation will provide a summary of the findings of this trial series and discuss the predictability of the nutrient responses seen across the sites (based upon soil testing and in-season monitoring) so as to inform nutrition management strategies for the 2023 season.

Optimising high rainfall zone cropping for profit in the Western and Southern Regions (DAW1903-008RMX) is a GRDC investment with the aim to address the gap between potential and realised yield in the high rainfall zone (450+ mm annual rainfall). The project is led by DPIRD in collaboration with project partners, CSIRO and FAR Australia.

Notes:

Carryover of nitrogen after crop failures

Darren Hughes, Laconik

Key messages

- Growers and agronomists should not budget on nitrogen (N) applied to crops that get frosted to carryover and deliver a grain yield or economic benefit to the following crop.
- When making fertiliser decisions for 2023 consider soil testing for N down to a depth of 60 cm. Based on samples tested in this project soils are N deficient.

Aims

To determine if N applied to crops that were frosted in 2021 carries over and has a grain yield and economic benefit to the 2022 crop.

Results

Soil samples were collected in March and July from each site at intervals of 0-10cm, 10-30cm and 30-60cm. Except for two sites, nitrate and ammonium levels were well below the desired range.

When comparing grain yields from the carryover N treatment to the 'Grower Standard' treatment there was a penalty of up to 1.46 t/ha in wheat and 0.19 t/ha in canola. This translates into an economic loss of $390/ha and $75/ha, respectively.

Conclusion

Soil tests show that prior to and early in the growing season soils were N deficient. The assumption made by growers and agronomists that N applied to crops that get frosted is stored in the soil and carries over to benefit the following crop is not supported by these results.

To maximise grain yield and economic returns in 2022 crops needed additional N fertiliser to be applied. Relying on N to carryover from 2021 was insufficient to meet crop demands.

Notes:

Strategic tillage: how does it impact weed management?

Catherine Borger, DPIRD

Key messages

- Seed burial varies widely between soil types, even when using the same soil tillage implements at a consistent speed. Therefore, check the depth of working to estimate weed seed burial.
- A full soil inversion (mouldboard) buries seed to approximately half the working depth.
- Seed burial by loosening (deep ripping) and mixing (rotary spading) is highly variable, depending on the soil type. However, there is no evidence that these amelioration techniques stimulate weed emergence in the following crop.
- How well a weed species recovers after burial depends on both burial depth and species. A species with a large seed like great brome can emerge from a greater depth than a species with small seeds like annual ryegrass.

Aims

This study identified three sites with contrasting soil types, which were exposed to full inversion, loosening and soil mixing. We examined weed seed burial by the different soil amelioration techniques and weed density in the three-year crop rotation after amelioration.

Results

The three sites at Yerecoin, Darkan and Williams had different soil types and the Williams site had very compact soil. As a result, while strategic tillage reached depths of over 30 cm at Yerecoin and Darkan, Williams had a maximum working depth of 18 cm.

Seed burial

Seed burial varied widely between sites. A full soil inversion buried most (about 90%) weed seeds at 10-20 cm at Yerecoin and Darkan. By comparison, at Williams the seeds were still at 0-10 cm. At all three sites, soil inversion placed most seeds at half the depth of working. Loosening via deep ripping was the only tillage technique that reliably put a proportion of seed at the maximum working depth, but percent of seed buried by loosening or soil mixing was highly variable between sites.

Weed growth

Annual ryegrass and great brome density were close to zero after the soil inversion in 2019. However, while annual ryegrass remained at low density, great brome recovered over the following three years. By comparison, loosening or soil mixing had very little impact on weed growth.

(Continued on following page...)

Conclusion

It is a general (international) rule-of-thumb that after a full soil inversion, most weed seeds are at roughly half the total depth of amelioration, and this result was confirmed at all three sites. The required burial depth to reduce emergence depends on the weed species. Annual ryegrass has a small seed, and emergence is substantially reduced at 5cm depth. Great brome will emerge from up to 15cm depth. The impact of loosening and soil mixing on seed burial and subsequent weed growth was highly variable between sites. It has generally been considered that these tillage techniques may stimulate weed growth (similar to the impact of an autumn tickle). However, our results indicated that these techniques do not reliably change weed emergence and density in subsequent years.

Notes:

Predicting profitability of summer weed control timing and impact on crop yield potential

Yvette Oliver, CSIRO

ABSTRACT:

Predicting profitability of summer weed control timing and impact on crop yield potential

Yvette Oliver[1], Rick Llewellyn[2], Therese McBeath[2], Andrew Ware[3], Michael Moodie[4]
[1]CSIRO Floreat WA, [2]CSIRO Waite SA, [3]EPAG, [4]Mallee Sustainable Farming

Key messages

- Summer weeds trials had 15-20 mm additional stored soil water and 10-30 kg/ha nitrogen retained in the soil from early weed spraying.
- Summer weed control in 2022 showed there was a trend of higher yields in the full weed control treatments compared to no control, but there was no statistical significance likely due weed variation.
- The $ummer Weed Tool may be a useful tool to determine the average yield benefits and likelihood of achieving a yield benefit for different spray timings.

Aims

The aim was to support the development of a tool which assists with summer weed spray decisions, as they usually take place under uncertainty of the coming summer and winter crop season conditions. To support development of the tool we have also conducted field trials to expand the relatively limited literature for summer weed control timing trials that have measured both the soil water and nitrogen impacts on the crop yield for validating simulations modelling.

Results

Trials were established in South Australia at Bute, Wharminda (two sites) and Mildura after significant rainfall events in Jan 2022 (127mm, 205mm, 88mm respectively). Four treatments of weed control were applied: 1. Full control with follow-up as required (sprays Feb, Mar), 2. Initial control with no follow-up (spray Feb), 3. Delayed control (spray Mar) and 4. No control. There was 15-20 mm of additional stored soil water and 10-30 kg/ha nitrogen retained in the soil from full weed control. There was a trend of higher yields (0.2-0.5t/ha) at the full weed control compared to the no weed control, however due to variability there was no significant differences. The APSIM modelling for 2022 season also predicted between 0 - 0.3 t/ha yield increases at the sites.

The $ummer Weed Tool determines the wheat yield gain and nitrogen saved from managing weeds Now (today) or Later (5-50 days) compared to not managing the weeds until mid-April. Using 100 years of historic climate the app can also show the probability of achieving 0.2 t/ha yield increase or 10 kg N saved. Using the app in February, at Minnipa (neighbouring town), with high weed density (50 weeds/m^2), if the weeds were sprayed now there was a 77% chance of gaining 0.2 t/ha of yield with an average yield gain of 0.64 t/ha, but if spray was delayed for 30 days there was only 53% chance of gaining 0.2 t/ha with an average yield increase of 0.32 t/ha.

(Continued on following page...)

Conclusion

Summer weeds can use a large amount of water, 20-50 mm and soil nitrogen 30-50 kg/ha N as indicated in these and literature trials (Hunt et al, 2013). However, the yield benefit is highly variable (0-1.5 t/ha Hunt et al. 2013) due to variability of summer rainfall after spraying and the growing season rainfall. The $ummer Weed Tool, uses historic growing season to give you this average yield benefits and likelihood of achieving a yield benefit for different spray timings. It can be used with other weed types, density and spray to estimate the water used by weeds and the subsequent effect on the yield. The $ummer Weed Tool can then be used to better understand whether it may be economic to spray now or delay for a particular site, weed and soil type combinations.

Notes:

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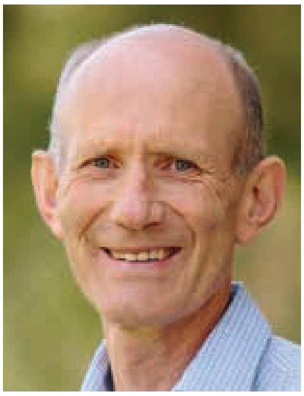
Herbicide resistance: a status update



Ken Flower, AHRI

It is well known that integrated weed management (IWM) is crucial for sustainable weed control. Much research has been focused on this area, with harvest weed seed control being a recent important development. Despite this, we are still heavily reliant on herbicides for weed control and weed resistance to herbicides is increasing. Also, there is the looming issue of loss of social licence to use key herbicides. Therefore, it is imperative that we reduce reliance on herbicides, even though they are likely to remain an important component of weed control.

This presentation will provide an overview of the status of herbicide resistance and highlight a potential new paradigm in weed control, based on recent developments in agricultural technology and data science. Already, advanced sprayers can detect individual weeds in fallow or in crops, so farmers can spot-spray with herbicide. However, to deliver effective weed control impact, a systems approach is required which combines the new technology with an understanding of the management and biology of both the crops and weeds. For example, if farmers could map and monitor all the weed patches in paddocks over time, they could develop a longer-term strategy to target the patches with different chemical or non-chemical control measures. A site-specific approach will require a re-think on how best to apply the weed control measures and also any implications for herbicide resistance. The efficacy of those measures could also be assessed through monitoring of patch sizes and locations. This could increase the effectiveness of both chemical and non-chemical control measures, to ultimately reduce dependency on herbicides.

Notes:

Potassium update

A PANEL DISCUSSION WITH: **James Easton,** CSBP, **Miaomiao Cheng and Richard Bell,** SoilsWest

Notes:

Getting more efficiencies out of potassium (and nitrogen) in a high price environment

James Easton, CSBP

Key messages

- Undiagnosed and untreated potassium (K) deficiencies can be expensive.
- Crops respond better to nitrogen (N) fertiliser if K is not limiting.
- Responses to banding K fertiliser can be up to double the responses to topdressing K.

Aims

- To investigate the effects of K supply on returns from N fertiliser.
- To determine the potential efficiency gains from banding K fertiliser on a loamy soil.

Results

Applying K increased responses to N fertiliser in two experiments near Beverley. At the more responsive site, grain yield responses to N were up to 50% greater with a nitrogen use efficiency (NUE) increase of 20%. At the second site, responses to N were increased by up to 20%.

In a third experiment, the yield response to banding 30kg K/ha was double that of the response to 30K topdressed. Banding 15kg K/ha produced 0.5t/ha more wheat than topdressing 30kg K/ha before seeding.

Conclusion

Potassium deficiency limited responses to N fertiliser and applying K fertiliser increased NUE.

Banding K on a loam produced double the yield response compared to topdressing K before seeding.

Notes:

Comparison of soil analytical methods of estimating plant available potassium

Miaomiao Cheng, SoilsWest

ABSTRACT:

Comparison of soil analytical methods of estimating plant available potassium

Miaomiao Cheng[1,2], Richard Bell[1,2], Qifu Ma[1,2], Craig Scanlan[1,2,3]
[1]Centre for Sustainable Farming System, Food Futures Institute, Murdoch University,
[2]SoilsWest, Murdoch University, [3]DPIRD

Key messages

- Both NH_4OAc-K and Colwell K were good indicators of K availability for a single growing season when soils had <400 mg/kg exchangeable K.
- The availabilities of nonexchangeable K for plant uptake varied in soils.

Aims

To determine if there is a better soil test to measure plant-available K over a wider range of soil types that occur in WA, especially on the loam and clay-textured soils.

Results

Quartz and K-feldspars were the dominant minerals in all soils, while limited white mica (1-2%) was identified in less than 10% of samples. The amount of K extracted by silver thiourea was only about 70% of the amounts extracted by $NaHCO_3$ (Colwell K) and NH4OAc. Soil non-exchangeable K extracted by nitric acid and sodium tetraphenyl borate (TBK) were from similar K pools, while aqua-regia K was 1-6 times higher than TBK and Nitric K.

Conclusion

There was no significant difference between NH_4OAc K and Colwell K in most of soils, and both of them were good indicators of total K uptake by wheat when soil exchangeable K was less than 400 mg/kg. The contribution of nonexchangeable K for short term plant uptake was low due to the relatively high amount of soil exchangeable K. In this diverse range of loam and clay-textured soils formed from weathered parent materials, the reliance on exchangeable K for plant K uptake suggests that plant-available K will be vulnerable to rundown due to negative K balances.

Notes:

K responses on loamy soils: an emerging issue for grain crops

Richard Bell, SoilsWest

ABSTRACT:

K responses on loamy soils: an emerging issue for grain crops

Richard Bell[1,2], Craig Scanlan[3], Qifu Ma[1,2], Tim Boyes[4]

[1]SoilsWest, [2]Murdoch University, [3]DPIRD Northam, [4]Agvivo

Key messages

- Yield responses now demonstrated on loamy soils due to run down in soil K levels.
- On loam soils, topdressed K rates of 100 kg K/ha gave maximum wheat grain yield.
- Soil test K levels required to avoid K deficiency on loamy soils appear to be higher than those used for sands and sandy duplex soils.
- Colwell K for 0-30 cm depth gave more reliable estimates of wheat response to K than 0-10 cm.

Aims

Negative K balances are causing rundown of K and deficiencies for crops are beginning to emerge on loamy soils which historically were adequate in K. In 2021 and 2022, eight K rate experiments were conducted between Northam and Beverley.

Results

Compared with nil-K supply, the treatments of 25/25 split, 100 and 200 kg K/ha significantly increased grain yield in 2021 at N York and E Beverley, but there was no yield response at E Greenhills and S Greenhills. In 2022, all K rates increased wheat grain yield at N York and S York, but not at the NW Quairading and E Beverley sites. At S York, on the sandy duplex soil, 25 kg K/ha, the lowest rate applied, was sufficient to achieve the maximum K response. By contrast on the red loamy earth soil at N York, maximum grain yield required 100 kg K/ha.

Soil test calibration curves were used to calculate critical ranges for Colwell K for the sites in this data set. For individual soil depths, the best calibration curve was for 20-30 cm (r=0.94, critical range = 35 to 46 mg/kg). Using the mean Colwell K values, 0-30 cm (r=0.83, critical range = 39 to 66 mg/kg) provided a better calibration than 0-10 cm (r=0.74, critical range = 47 to 102 mg/kg).

Conclusion

A series of field trials has confirmed that K deficiency is now occurring in loam and duplex soils in WA. Our analysis of trials completed so far indicates that testing below 10 cm is required; in this data set the mean Colwell K for 0-30 cm provided a reasonable calibration with relative yield.

Canola responses to potassium form, rate, and placement in low and high rainfall environments

Richard Bell, SoilsWest

ABSTRACT:

Canola responses to potassium form, rate, and placement in low and high rainfall environments

Richard Bell[1,2], Craig Scanlan[3], James Easton[4], Mark Gherardi[5], Qifu Ma[1,2]

[1]SoilsWest, [2]Murdoch University, [3]DPIRD Northam, [4]CSBP Kwinana, [5]Summit

Key messages

- Banding up to 45 kg K/ha of muriate of potash (MoP) and sulfate of potash (SoP) with seed had little effect on canola emergence.
- Canola showed similar responses to MoP and SoP in K uptake and seed yield at the rates of 15, 30, 45 kg K/ha.
- For both K forms, banding increased plant K uptake compared with topdressing.

Aims

Previous research on effects of form, rate and placement of potassium fertilisers were mostly completed with wheat. Here we examine effects of MoP and SoP rates and placement (topdressed, banded with or below seed) on canola at four sites with varied in-season rainfall.

Results

Field experiments were completed at Muntadgin and Piawanning (low rainfall) and Brookton (medium-high rainfall) in 2020 (below average rainfall) and at Brookton in 2021 (above average rainfall). Experimental treatments were K form (MoP, SoP), rate and placement (top-dress, band with or below seed) in 2020 and 2021. In both years, banding up to 45 kg K/ha of MoP and SoP with seed had little effect on plant emergence.

Conclusion

Canola responded to K rate and placement better in dry season than wet season as K plays a crucial role in promoting root growth and regulating plant water relations.

Acknowledgements

All field experiments were supported and managed by CSBP and Summit Fertilizers and were part of the potassium subprogram of the GRDC project 'Increasing profit from N, P and K fertiliser inputs into the evolving cropping sequences in the Western Region' (UWA1801-002RTX).

Notes:

Long-coleoptile wheats for improved establishment, weed competitiveness and productivity on ameliorated soils

Stephen Davies, DPIRD

ABSTRACT:

Long-coleoptile wheats for improved establishment, weed competitiveness and productivity on ameliorated soils

Stephen Davies[1], Andrew Blake[1], Melanie Kupsch[1], Ranny Wilkins[1], Greg Rebetzke[2]

[1]DPIRD, [2]CSIRO

Key messages

- The long-coleoptile trait ensured successful wheat establishment with deep sowing on yellow sandplain for both no-till control and ameliorated by ripping and rotary spading.
- Successful crop establishment on ameliorated soils ensures more rapid groundcover and soil stabilisation, maximises yield potential and increases crop competitiveness with weeds.
- Amelioration of deep yellow sand results in large yield increases even in a good season with a soft finish. These benefits are optimised with effective establishment of well-adapted varieties.

Aims

Assess the role of the long-coleoptile trait in wheat to improve crop establishment, vigour and yield and mitigate the risk of poor establishment from sowing too deep soils ameliorated using strategic deep tillage.

Results

Establishment of deep sown short-coleoptile Mace was reduced by 55% (-46 plants/m^2) compared to a 22% (-23 plants/m^2) reduction for long-coleoptile Mace-18. At the standard sowing depth Mace-18 had 25% higher establishment than Mace but at the deep seeding depth Mace-18 had 119% higher establishment, highlighting the benefit of the long coleoptile trait. Scepter establishment was reduced by 44% (-38 plants/m^2) and Calibre by 49% (-46 plants/m^2) with deep sowing. The Scepter seed used was large and this aided establishment despite having a short coleoptile. Seeding rate interacted with seeding depth to impact crop establishment, independent of variety. At the standard seeding depth the higher seeding rate increased plant establishment by 33% while for deep sowing, higher seeding rate increased establishment by 22%. Deeper sowing resulted in higher grass weed density scores for most varieties, but the increase was least for long coleoptile Mace-18.

Wheat grain yield from deep sowing was excellent for Mace-18, Scepter and Calibre such that there was no yield penalty compared to standard depth sowing. For short-coleoptile Mace deep sowing reduced grain yield by 0.6 t/ha (-13%) compared to sowing at the standard depth. Soil amelioration increased grain yield regardless of sowing depth. For Mace-18, Scepter and Calibre grain yield increased by 1.0-1.1 t/ha (+25-26%) due to amelioration whereas for Mace the yield increase was less at 0.6 t/ha (+15%).

(Continued on following page...)

Conclusion

Long-coleoptile wheat can ensure good crop establishment and productivity if seed ends up deep sown on ameliorated sandplain soils. Effective establishment leads to more rapid groundcover and soil stabilisation reducing the risk of soil loss from wind erosion and improves weed competitiveness.

Notes:

Subsurface acidity management: long-term grower case studies to direct future management

Alice Butler, DPIRD

ABSTRACT:

Subsurface acidity management – long-term grower case studies to direct future management

DWER – On-farm Soil Acidity and Nutrient Management
Alice Butler, DPIRD

Soil sampling to depth indicates that the proportion of paddocks with surface and subsurface soil pH below minimum targets of 5.5CaCl (surface) and 4.8CaCl (subsurface) has reduced from 70% and 50% respectively in 2005–2012 to 46% and 22–27% in 2020–2022.

Using grower's records and agronomist knowledge, the iLime app was able to reproduce changes in pHCaCl of sampled paddocks.

Modelling of past lime application and future management options assisted growers to estimate the value of past applications and likely best-bet options for the future.

Notes:

Re-engineering soil to redefine the water-limited yield potential under changing climate

Gaus Azam, DPIRD

ABSTRACT:

Soil reengineering redefines water-limited yield potential in Western Australia

Gaus Azam[1], Wayne Parker[2], Glenn McDonald[3], David Hall[4], Kanch Wickramarachchi[1], Chad Reynolds[2], Meredith Guthrie[5], Ross Gazey[6], Stephen Davies[2]

[1]DPIRD Northam, [2]DPIRD Geraldton, [3]DPIRD Albany, [4]DPIRD Esperance, [5]DPIRD Perth, [6]Ross Gazey Photography Perth

Key messages

- Soil reengineering has developed 'ideal soil profiles' by completely removing multiple interacting soil constraints from various soil types.
- Soil reengineering increased grain yield by up to four-fold depending on the type of crop, soil, and season.
- Soil reengineering more than doubled the water use efficiency (WUE) and often exceeded estimated water-limited yield potential (WLYP).

Aims

Address multiple interacting soil constraints to develop ideal soil profiles so crops can access the subsoil water and nutrients to maximise water and nutrient use efficiencies.

Results

Data from 11 reengineering sites demonstrate that soil reengineering has (i) completely removed soil water repellence, acidity, compaction, sodicity, aluminium and boron toxicities, and (ii) significantly improved cation exchange capacity, water infiltration and holding, almost immediately (within weeks), from the top 80 cm soil. Canola, wheat, and barley root grew to the depth of reengineering compared to the restricted (25-30 cm) root growth in the controls. Crops in the reengineered plots have taken up water and nutrients from the subsoil. As a result, grain yield increased by 2-4 folds, in the first two years, depending on the type of crop, soil and season. Canola grain yield increased by up to 1.7 t/ha while wheat and barley yields increased by 2.3 t/ha and 2.7 t/ha, respectively. Wheat and barley crop exceeded the WLYP while canola crops didn't.

(Continued on following page...)

Conclusion

This study demonstrates that a wide range of soils can be reengineered to remove multiple interacting soil constraints quickly allowing crop roots to explore the subsoil water and nutrients which otherwise remained unused in the untreated paddock. Despite 2021 and 2022 being above-average rainfall seasons, soil reengineering has increased the grain yield to a record level that was never been achieved by other innovations in the history of broadacre cropping. WUE increased by several folds. Cereal crops exceeded the WLYP. Despite a large improvement in yield, the canola crop didn't achieve the WLYP in the first two seasons. DPIRD Reengineering Soils Team will continue to investigate the longevity of the effect of soil reengineering on overall soil health and crop yield in the next few years.

Further information

The great dig to re-engineer soils.
https://groundcover.grdc.com.au/agronomy/soil-and-nutrition/the-great-dig-to-re-engineer-soils

Grains trials to overcome soil constraints break new research ground.
https://www.agric.wa.gov.au/news/media-releases/grains-trials-overcome-soil-constraints-break-new-research-ground

Soil re-engineering doubles productivity in WA trial plots.
https://www.abc.net.au/news/rural/2022-09-13/soil-re-engineering-doubles-productivity-in-wa-trial-plots/101414612

Notes:

Gene-editing and crop breeding: what can it deliver and what are the implications for international trade?

Michael Jones, Murdoch University

ABSTRACT:

Gene-editing and crop breeding: what can it deliver and what are the implications for international trade?

Michael Jones, Muhammad Adeel, John Fosu-Nyarko, Sadia Iqbal
Murdoch University

Key messages

- Gene-editing technology provides an exciting new set of tools for crop improvement.
- Knowledge of national and international regulations is needed for Australian growers to exploit the technology.
- The current status of the gene-editing regulatory landscape in countries which import Australian grains is presented, together with future perspectives on consumer acceptance of gene-edited grains.

Aims

The aim of this project is to enable Australian grain growers to gain first-mover advantage in using new breeding technologies, specifically gene-editing, to improve grain crops. This requires an understanding of the policies and regulations in importing countries, and active participation in aligning their regulations with those in Australia.

Results

Gene-editing (GEd) presents great opportunities to generate genetic advances and crop improvement, and there is now an air of excitement around potential applications of GEd for grain crops. For the benefits of GEd technologies to be realised, the international policy and regulatory environments must be clarified, to avoid non-tariff trade barriers.

Following a series of local, national and international webinars and workshops, we have mapped the policies and regulations on GEd technology in the major grain importing countries in the Asia-Pacific region. We have also trained scientists and regulators in the region to help ensure that their developing regulations are evidence-based.

Conclusion

The regulatory landscape is changing rapidly in favour of acceptance of GEd produce. In some countries the regulations are clear, in others they are developing, and some countries have yet to develop appropriate policies. There is clearly a need for harmonisation/alignment of GEd regulations in the region: this will enable the path-to-market for GEd products and enable the benefits of GEd technologies to be captured by growers and accepted by consumers.

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Review publication

Jones, M.G.K. et al (2022). Enabling Trade in Gene-Edited Produce in Asia and Australasia: The Developing Regulatory Landscape and Future Perspectives. Plants 2022,11, 2538 https://doi.org/10.3390/ plants11192538; DAWR/DAFF Building Capacity for Small Exporters to Exploit 'new breeding technologies' - Grant number 4-FA4N7WL

Notes:

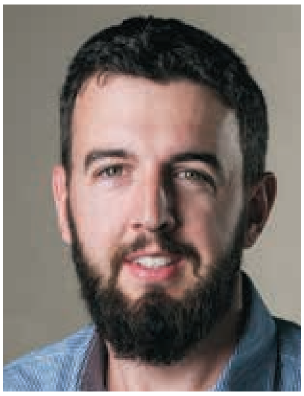
Targeted crop trait improvement through gene editing

Yong Han, DPIRD

CRISPR gene editing can precisely modify the target gene(s) in current crop varieties, and thus improve agronomic traits with reduced breeding time. In the countries such as Australia, America, Brazil, Argentina, UK and Japan, organisms modified using site-directed nuclease-1 (SDN-1) are not GMO. This novel technology has been successfully applied to major cereal crops such as rice, barley, and wheat. Recently, we have generated a barley mutant collection using CRISPR/Cas9 and the advanced materials have increased yield potential, nitrogen use efficiency, or altered plant stature, phenology, and coleoptile length. I will introduce the mutant's phenotypic changes in the key traits that result from targeted gene mutations and discuss the potential of such materials for future variety breeding and commercialisation.

Notes:

50 years of wheat breeding impact in WA



Dion Bennett, Australian Grain Technologies (AGT)

Key messages

- Wheat breeding delivers incremental but significant gains in on farm productivity in WA.
- Genetic gain for grain yield has been complimented by development or improvement of disease resistance, reduced risk of poor physical grain quality and other agronomic improvements.

Aims

To investigate the rate of genetic gain for economically important traits in bread and udon wheat production in Western Australia since the 1960s.

Results

- Long-term genetic gain has resulted in improvement in yield, as well as provided improvements in physical grain quality and disease resistance for WA growers.
- No sign of the genetic gain for grain yield slowing, in fact has increased over past 20 years.
- Yield gains shown in Udon and Clearfield too.

Conclusion

Wheat breeding will continue to deliver genetic gain for economically important traits for WA growers into the future, as it has in the past. The process to develop new varieties is slow but will meet current and future challenges for wheat production and marketing, as we have shown it has in the past.

Notes:

Sustainability or Health? Grain-food product differentiation in key markets

Chris Carter, AEGIC

Key messages

- Sustainability attributes are developing as a driver of consumer demand in SEA markets, though this driver is not yet as influential as in Australia or Europe.
- Food manufacturing companies are responding to sustainability-based shareholder pressure, capital requirements, and increasingly, sustainability covenants adopted in trade agreements.
- The entry point for promoting grain-based food with differentiating attributes is the snack/cereal/biscuit sectors, which will pull through to the staple food sectors (noodles/bread).

Aims

- To identify trends in the types of claims made on labelling used to differentiate grain food products for consumers in Southeast Asian markets.
- To compare trends across markets and identify how the industry could best act to take advantage of opportunities presented by changing consumer preferences, and limit exposure to the risks.

Results

In wealthy markets such as Australia and the EU there are upwards trends in labelling claims, especially for those regarding sustainability and health. In developing markets where consumers are concerned with satiety the use of labelling claims does not yet display a strong upwards trend. While some products in key developing markets use novel labelling, they are generally small components of the total grain demand, and more likely to occur in the snack food, biscuits and cereal subcategories than staple grain-based products (noodle/bread).

Labelling claims are a less effective indicator of actionable opportunities for the Australian grain industry than the ESG reporting produced by food manufacturing companies. There is a high and increasing level of sophistication of ESG reporting amongst the major food manufacturers in Southeast Asia.

Conclusion

Wealthier economies and segments within less wealthy markets are utilising claims which promote sustainability and health attributes to appeal to consumers' values. In time this will spill over to broader market segments.

From stalk to store: opportunities for WA growers to improve harvesting and postharvest storage

Ben White, Kondinin Group

Key messages

- Growers should measure losses at harvest (those measuring losses have significantly lower loss levels over those that don't).
- Front losses can be particularly high and while we have traditionally looked to reduce machine losses, surprisingly, front losses can be significantly higher than machine losses in some crops.
- WA growers have an opportunity to reduce the $300 million worth of grain being left in the paddock and can also take some simple steps to maintain the quality of any seed or grain in storage.
- The GRDC investment in grain storage is not only yielding an increase in grower awareness but is also delivering novel research on grain bag fumigation, grain aeration backpressure for Australian grains and independently evaluating adherence to the Australian Standard for gas-tight sealing.

Aims

This presentation will address the 'how' and 'why' we should measure harvester losses; outlining the value of lost grain and opportunities to address this.

Taking the passage of harvested grain, a step further through to storage, we also explore the opportunities to maintain the quality of grain in storage.

Results

Field measures of harvester machine and front losses on 78 properties during 2021 comprising 200 evaluations of losses in all major WA crops across a range of geographic regions.

Results of more than 100 silo pressure tests conducted nationally in 2022 – which silos pass AS2628-2010 which is essential for effective fumigation. 16 makes of cone base silos were tested (including four from Western Australia) of these, almost half (7) did not pass AS2628-2010 testing. Of the eight flat-bottom silos tested, four failed an independentAS2628-2010 test.

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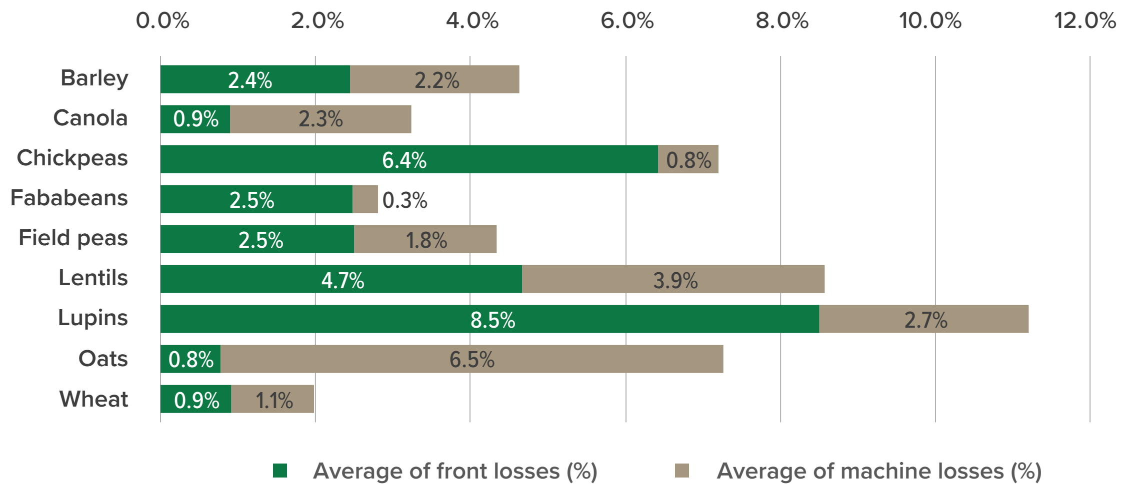

FIGURE 1. Losses by front and machine losses by crop type

Conclusion

The Harvester Loss project via a GRDC investment with GGA found there are significant opportunities to minimise grain storage losses when harvesting. In 2021 as much as $300m in grain was left in the paddock. Continuation of this work in 2022 will help to target harvester losses without impacting capacity.

The importance of growers carefully selecting grain storage options that are fit for purpose will ensure the quality of grain stored in on farm storages nationally will be maintained and low-cost fumigation options remain viable.

GRDC Project codes GGA2110-001SAX / PRB2011-001SAX

Notes:

Day 2 – Tuesday 28 February

Plenary 2

Plant protein production – value adding to Australian pulses

Phil McFarlane, Co-Founder and Executive Director – Australian Plant Proteins (APP)

Born and raised in the Victorian Wimmera-Mallee wheat belt region, Phil has an unwavering passion to make a significant contribution to the future of the Australian agriculture industry.

After an extensive career in the corporate world namely in the financial services sector, Phil became a co-founder of EAT Group, an agriculture investment management company that aims to develop Australian vertically integrated agriculture businesses (farm gate to plate) for both domestic and export market purposes.

From this, APP was founded in 2016 to capture the significant opportunity for Australia to play a key role in the supply of high-quality plant protein ingredients to meet increasing global demand.

APP produces protein isolates from Australian only pulses (i.e., faba beans, pea, lentils, chickpeas, mung beans) using their proprietary process which creates highly functional, 'clean', great tasting proteins suitable for a range of food and beverage applications.

Phil is responsible for APP's R&D, business operations, and developing its future manufacturing assets to meet the company's expansion strategy.

He has a Batchelor of Business (Accounting) and is a Certified Practicing Accountant (CPA).

Overview

APP is Australia's first and only plant-based isolate powder extraction, packaging and distribution business based in central Victoria. The protein powder is produced exclusively from Australian grown pulses.

Key topics to be covered are:

Why Protein?

- Consumer choice.
- Sustainability.
- Environmental.

What do we do?

- Our end-to-end business model.
- Varieties of Australian pulses.
- Continual Research & Development.
- Protein ingredient product range and food applications.
- By-Products – Value adding Starch from pulses.

(Continued on following page...)

What is the future?

- Global growth.
- International partners.
- Manufacturing investment in Australia – Victoria & South Australia.
- Australian pulse industry opportunity…wish list.

Key themes and messages

- Emerging global industry…key role for Australian farmers.
- Growing Australian pulses sustainably for value-add purposes and returns.
- Continuation of Federal & State funding.
- Let's not break what is not broken at farm gate…Australian pulses are already elite!

Notes:

Molecular level interpretation of soil water repellency for the development of rapid assessment and novel amendments

David Henry, Murdoch University

ABSTRACT:

Molecular level interpretation of soil water repellency (SWR) for the development of rapid assessment and novel amendments

David Henry[1,4], Richard Harper[2,4], Nicholas Daniel[1,4], Owen Horoch[1,4], Mijan Uddin [2,3], Mai Dao[2,3], Maria Then[2,4]

[1]Centre for Sustainable Farming Systems, [2]Centre for Crop and Food Innovation, [3]Institute of Forestry and Environmental Sciences, [4]Murdoch University, [5]University of Chittagong, Bangladesh

Key messages

- Soil mineral chemistry is equally important as particle size in determining SWR susceptibility.
- Rapid SWR screening techniques will aid in deployment of amendments.
- A small change in soil organic matter content can have a big impact on SWR.
- Soil organic matter composition also strongly affects SWR.

Aims

- To develop improved methods for the rapid detection of compounds that induce soil water repellency (SWR).
- Identify the molecular mechanisms that lead to SWR and use this information to develop novel amendments for long-term / sustainable amelioration.

Results

Improved assessment of soil organic matter in sandy soils was achieved with Accelerated Solvent Extraction coupled with Gas-Chromatography Mass-Spectrometry. This approach facilitated increased sample throughput for isolation and detection of compounds that induce SWR. Visible-Near Infrared (Vis-NIR) spectroscopy techniques have been reported for rapid assessment of SWR but require local calibration due to soil matrix effects. We are building spectral libraries to address this issue. Coupling of Vis-NIR with other techniques is expected to improve in-field assessment of SWR to facilitate targeted application of amendments.

Experimental studies identified a number of naturally occurring compounds that are responsible for inducing SWR. Adding these compounds to acid washed sand replicated results obtained in the field. Complementary computer simulations provided molecular level information about the interactions and arrangement of the organic compounds on soil particle surfaces. H-bonding interactions of fatty acids and fatty alcohols drive the orientation of the molecules into layers that induce SWR. Heat is also an important factor in dispersing compounds from plant matter into the soil. Amendments that disrupt the H-bonding of the acid and alcohol molecules with the soil particles lower SWR. We are developing novel soil additives that target these layers formed by the organic molecules.

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Conclusion

Accelerated Solvent Extraction coupled with GC-MS gives faster assessment of organic matter in field samples. Coupling of Vis-NIR spectroscopy with other spectroscopic techniques can provide rapid assessment of SWR in the field. Amendments that disrupt the interactions and organisation of specific types of organic compounds with soil particles will lead to reduced SWR. These amendments can be produced from sustainable sources.

Notes:

Impact of timing of strategic deep tillage on crop productivity, profitability, and agronomic opportunities

George Mwenda, DPIRD

ABSTRACT:

Impact of timing of strategic deep tillage on crop productivity, profitability, and agronomic opportunities

George Mwenda, Andrew Blake, Sud Kharel, Stephen Davies, DPIRD

Key messages

- The grain yields from ameliorated treatments were similar for a given time of sowing (May or June), irrespective of the timing of amelioration (September-June). However, wind erosion risk can vary from year to year and with soil type and site exposure and should be carefully considered with early amelioration timing.
- Late soil amelioration and sowing (June), which can reduce the risk of wind erosion, had lower grain yield compared to earlier amelioration timings (March-May) sown in mid-May due to the later sowing date. However, short-season and well adapted short-mid season varieties can improve the performance of late amelioration timings, thereby reducing the yield loss associated with later sowing.

Aims

- To determine the effect of timing of strategic deep tillage on grain yield.
- To determine if the wheat yield from either early (April) or late (June) timing of amelioration can be optimised by better matching crop season length and agronomy to early and late sowing times.

Results

In 2020 at Mingnew, plots ameliorated in March, April, and May and sown to canola and wheat in May outyielded the unameliorated control plots by 90%-120% (canola) and 29%-36 % (wheat). There were no yield differences due to the timing of amelioration. Grain yield response to late amelioration and late sowing in June had similar trends but yielded less than earlier amelioration timings sown in May due to the reduced yield potential with late sowing (yields of 0.7 vs 2.1 t/ha for canola; 1.7 vs 2.1 t/ha for wheat). A second set of experiments in 2022 at Cunderdin and Ogilvie, matching wheat variety season lengths with timing of amelioration and sowing showed potential for the use of shorter-season varieties to further improve the performance of later timings of amelioration.

A second longer term site in Corrigin investigating timing of amelioration was not responsive to soil amelioration in 2021 due to prolonged wet conditions. In the follow-up 2022 season, plots that had been ameliorated in May and June 2021 and sown in the third week of June 2021 had 30% higher yields than plots that had been ameliorated in March-May 2021 and sown in May 2021. The higher yield in 2022 following crops sown in late June 2021 is most likely due to residual nutrients and water remaining from a lower yielding crop in 2021. This requires further investigation but indicates the following: 1. there is potential to recover yield losses from a late amelioration and seeding in the subsequent season; 2. care needs to be taken after a high yielding crop, including those on ameliorated soils, to provide sufficient nutrition to meet the demands of the subsequent crop.

(Continued on following page...)

Conclusion

The crop productivity was not significantly impacted by the timing of amelioration, but later times of sowing negatively impacted yields, particularly for canola. For later amelioration timings (accompanied by late sowing) the use of well adapted short- and mid-short season wheat showed the potential to improve productivity and reduce yield penalties.
Late amelioration can often occur when the soil is wet, erosion risk is reduced and provides ample opportunity for knockdown sprays for weed control.

Notes:

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Primary Industries and Regional Development
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A002-23 FEB 2023

New genetics for improved canola establishment

Matthew Nelson, CSIRO

ABSTRACT:

New genetics for improved 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], Greg Rebetzke[2]

[1]CSIRO Agriculture and Food, Floreat, [2]CSIRO Agriculture and Food, Canberra

Key messages

- We identified overseas varieties with longer hypocotyls and/or enhanced vigour, which we predicted would have better establishment potential than current Australian varieties.
- This was confirmed in field experiments in WA and NSW in 2021 and 2022, where the best field establishment when sowing at 50mm depth was achieved by overseas varieties with long hypocotyls and/or high seedling vigour.
- The next step will be to transfer the long hypocotyl and high vigour traits into Australian-adapted canola to improve its establishment potential and suitability for deep sowing.

Aims

- To understand the key genetic traits contributing to successful canola establishment.
- To provide canola breeders with improved genetics from overseas varieties and selection tools to accelerate the breeding of varieties with better establishment potential.

Results

A grower survey and a comprehensive review of the international scientific literature highlighted two potential targets for improving the genetic potential of canola for effective establishment: longer hypocotyls and enhanced early vigour. We developed efficient lab-based methods to measure these traits, which we then used to screen an international panel of 255 open-pollinated (OP) varieties. We identified overseas OP varieties (both spring and winter maturity types) that matched or exceeded the hypocotyl length and vigour in the best Australian hybrids. We rigorously controlled for the influence of seed size or maternal seed source effects. We ground-truthed these lab-based results in field experiments in WA and NSW in 2021 and 2022. The key finding was that overseas varieties identified from lab-based tests as having long hypocotyls and/or high vigour emerged significantly better from deeper sowing (50mm depth) than any of the five current Australian varieties tested in field experiments. Importantly, the best overseas varieties came from a diverse range of countries, genetic backgrounds, and maturity types. Therefore, we believe there is ample scope for enhancing the establishment potential of Australian canola introducing overseas genetic diversity. It should be noted that intensive pre-breeding will be required to transfer the new genetics into Australian-adapted background with appropriate phenology and agronomic adaptation.

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Conclusion

Our results indicate that the establishment potential of Australian canola – and its suitability to be sown deeply – can be improved by introducing longer hypocotyls and enhanced vigour from overseas varieties. We are developing breeding tools and the necessary underpinning biological understanding to efficiently transfer these establishment-related traits into Australian-adapted canola over the coming years.

Notes:

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Manipulating canola canopies through agronomy and genetics in the high-rainfall zone

Jens Berger, CSIRO

Canola production is becoming increasingly important in the high rainfall zone, where yield is determined primarily by biomass, trading off harvest index (HI). However, input management for high biomass production carries greater financial risk, particularly if the growing season rainfall is poor. Moreover, high biomass production can have negative consequences for growers, including harvesting difficulties associated with tall crops, high stubble loads and in-season water use, and increased *Sclerotinia* risk.

To understand grower capacity to influence the canola yield/harvest index trade-off we used a factorial range of agronomic and genetic levers to manipulate canopy size and yield potential in on-farm trials near Kojonup, WA from 2020-22:

- Cultivar vigour: high (RR) versus low (TT)
- Plant density
- Inputs: (high vs low N or N x S), manure vs mineral N
- Early season grazing
- Plant growth regulators

These agronomic levers (plant density, grazing, plant growth regulators, input levels/source) had a huge impact on canopy size (yield, biomass, crop height), but only a minor effect on harvest index. Harvest index is important: high yielding treatment combinations were always associated with high harvest index. Harvest index is largely under genetic control, set by seed to pod dry matter ratios, thus there is a limited capacity to manipulate this through agronomy. While high harvest index cultivars exist, there are few high HI/high biomass options. To make this happen will require genetic intervention: pre-breeders making a compelling case for breeding companies to focus on this combination.

By understanding biomass partitioning in canola, we aim to de-risk production for growers giving them the tools to manage the canopy they require. A high HI/high biomass canola cultivar combined with flexible agronomic packages for different growing season rainfalls would provide a win-win scenario that growers can manage according to their risk-reward preferences.

Notes:

Wheat powdery mildew

Sam Trengrove, Trengrove Consulting

Wheat powdery mildew (WPM) was widespread across south-eastern Australia in the 2022 season, occurring in most wheat growing regions, expanding its area of incidence compared with historical occurrence. There are a range of interacting factors that have caused this, including the predominance of SVS varieties grown in most regions over a long period of time, early crop establishment in many regions in 2022, conducive environmental conditions for developing large crop canopies and for disease development and inoculum source carrying over from previous seasons. Difficulty achieving high levels of disease control with what were considered robust and well-timed fungicides were reported in many regions. Increasing prevalence of resistance and reduced sensitivity to group 11 QoI and group 3 DMI fungicides has been implicated in these control failures. Following recent SAGIT project (TC120) findings, investment by GRDC (TRE2204-001RTX) is seeking to quantify the extent of resistance development across the regions and identify management strategies for WPM given resistance development. This presentation will provide an update on the management and testing in this project.

Notes:

Insecticidal control of green peach aphid and turnip yellows virus: resistance threats, limitations, and future alternatives

Ben Congdon, DPIRD

Insecticidal pest control in food crops worldwide is becoming increasingly challenging as reductions in the registration rate of new modes of action are coupled with widespread insecticide resistance in target pests and legislation preventing their use in certain jurisdictions e.g., neonicotinoid bans in the European Union.

In Australian grain crops, insecticidal control is the cornerstone of management of many pests. One such pest is green peach aphid, which imparts its greatest damage to canola crops by vectoring turnip yellows virus (TuYV). Neonicotinoid seed treatments have been crucial to managing this threat for decades, but foliar insecticide applications are also seen as a potentially effective tool.

In this presentation and paper, we discuss recent research investigating how a widespread metabolic neonicotinoid resistance mechanism in the green peach aphid might be impacting seed treatment effectiveness. Furthermore, we discuss field trial results testing the use of pre-emptive foliar insecticide applications to manage green peach aphid and TuYV. In these trials, we also compare insecticidal efficacy with the use of a virus resistant variety to reduce TuYV infection. Lastly, we discuss where future investment should be directed to address the looming issues facing our industries current reliance on insecticidal control of green peach aphid.

Notes:

Using surveillance and social benchmarking to improve redlegged earth mite insecticide resistance management

Lizzy Lowe, Cesar Australia

ABSTRACT:

Using resistance surveillance, IPM demonstrations and social benchmarking to improve redlegged earth mite management

Adriana Arturi[1], Luis Mata[1], Aston Arthur[1], Paul Umina[1], James Maino[1], Svetlana Micic[1], Alan Lord[2], Lizzy Lowe[1]

[1]Cesar Australia, Victoria, [2]DPIRD

Key messages

- Due to evolving resistance in the redlegged earth mite (RLEM), there is a need to reduce reliance on current insecticides and rethink management options.
- RLEM populations resistant to synthetic pyrethroids (SPs) and organophosphates (OPs) continue to increase with the known range expanding, particularly in eastern Australia.
- Growers can keep RLEM under economic thresholds with minimum insecticides and preserve higher densities of beneficials.
- Social benchmarking has identified current knowledge, motives, and attitudes towards insecticide resistance to improve how redlegged earth mite is managed in the future.

Aims

To minimise the risk of further resistance in the RLEM, resistance surveillance and the development of up-to-date management recommendations help maintain the effectiveness of current chemical control options. Integrated pest management (IPM) strategies provide alternatives to insecticide use, and demonstration sites can showcase these results. Social research develops our understanding of current knowledge and attitudes regarding insecticide resistance management. These insights are used to ensure that management recommendations are applicable and achievable.

Results

Field surveys and resistance testing

Resistant RLEM populations have been found across Western Australia, South Australia, and Victoria. Within WA, the current distribution of SP and OP resistance is widespread. In South Australia, resistance is increasing, particularly in the southeast region. In Victoria, OP resistance has been detected in several areas. There has been no SP resistance detected within Victoria to date.

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IPM demonstration sites

On-farm trials were established to demonstrate IPM approaches and novel control strategies i.e., reduced insecticide applications. We found that can keep RLEM under economic thresholds with minimum insecticides and preserve higher densities of beneficials.

Social benchmarking

We investigated the current knowledge, practices, and attitudes of growers and advisors relating to RLEM insecticide resistance management. The main findings gave insight into to frequency of insecticide applications for RLEM control, how often growers and advisors employ an IPM mindset, and the common risk factors growers and advisors consider in their practices.

Conclusion

The ongoing surveillance of RLEM provides growers with insight into the resistance status in their region, which can inform management decisions. The social research enables us to better understand motives and identify knowledge gaps, which will be used to produce regionally relevant management recommendations and extension materials to help increase the adoption of IPM practice.

Notes:

Lessons learned from native budworm to activity in wheat relative to traditional hosts lupins, pulses and canola

Dusty Severtson, DPIRD

ABSTRACT:

Lessons learned from native budworm to activity in wheat relative to traditional hosts lupins, pulses and canola

Dusty Severtson[1], Amber Balfour-Cunningham[1], Saleh Adnan[2], Christiaan Valentine[1]

[1]DPIRD Northam, [2]NSW DPI

Key messages

- Budworm moths frequently fly into wheat crops, but they are deterred from laying eggs on wheat plants.
- Budworm moths prefer to lay eggs on wild radish and (volunteer) lupins in wheat crops so weed control is a critical part of preventing damage to wheat.
- Larvae either starve to death or have reduced performance and smaller pupae when forced to feed on wheat.
- Thresholds for budworm larvae in wheat are likely to be higher than 50 per 10 sweeps.

Aims

To understand the behaviour of native budworm in wheat crops, a non-traditional host, and estimated yield losses.

Results

Results from field surveillance of moths and larvae showed that budworm moths were frequently flying into wheat crops in the Geraldton port zone in numbers sometimes higher than in nearby traditional hosts lupins and/or canola. However, glasshouse trials confirmed that budworm moths are deterred from laying eggs on wheat plants, and larvae either starve to death or have reduced performance and smaller pupae when forced to feed on wheat.

Budworm prefer to lay eggs on wild radish and (volunteer) lupins in wheat crops so weed control is a critical part of preventing budworm moths laying eggs in crops and larvae transferring onto and feeding on wheat plants in spring.

Based on a field cage trial at Geraldton, we estimated economic losses of $1.71 per ha given five larvae per square metre (approx. 50 larvae per 10 sweeps) and $2.75 per ha loss given 10 larvae per square metre (approx. 100 larvae per 10 sweeps). This is based on $360 per tonne wheat price and 2 tonnes per ha anticipated yield.

Conclusion

In some years, native budworm moth migrations commence early and in very high numbers in the Geraldton port zone. This high moth pressure increases the chances of budworm damage to wheat crops, but spraying is likely to be not economically worthwhile even though some visual head damage may seem concerning.

BY CROWN

Can we get gains in the paddock with different bio-amendment products and management strategies?

Grace Williams, DPIRD

ABSTRACT:

Can we get gains in the paddock with different bio-amendment products and management strategies?

Grace Williams, Ravjit Khangura, Caroline Peek, Vanessa Stewart, DPIRD

Key messages

- Differences between treatments during the growing season and in the final grain yield were driven by nutrition strategy rather than the use of a bio-amendment product.
- The compost extract treatment provided more improvement to crop growth and yield than the commercial biostimulant which may be a result of the nutrient content of the product, however investigation into the individual components of the treatment is necessary.
- Bio amendment research is complex and given the range of outcomes products may be looking to achieve, research questions may need to be more targeted to understand the effect of different products.

Aims

To investigate the effect of two bio-amendment products on crop growth, grain quality and yield in a wheat crop when applied with or without commercial fertiliser, in comparison to crops treated with commercial fertiliser only.

Results

Results indicated that fertiliser had a much greater influence on wheat growth parameters than the bio-amendments. Significant differences were seen between treatments that included fertiliser compared to those that did not, regardless of whether these treatments also included a bio-amendment. An improvement of 0.09 to 0.18 in NDVI readings, 0.95 t/ha to 1.54 t/ha increase in biomass at anthesis and 170 kg/ha to 360 kg/ha increase in grain yield was observed in treatments including fertiliser compared to a standalone biostimulant treatment. In addition, there were minimal differences between standalone fertiliser treatments and fertiliser plus biostimulant treatments.

In several assessments, particularly leaf nutrient tests and grain yield, trends were observed where the compost extract treatment (compost extract plus powdered kelp and fish, humate granules and VAM seed dressing) with reduced fertiliser performed similarly or better to the full rate district practice fertiliser treatment. Similar trends were not observed with the commercial biostimulant. It is assumed this is due to additional nutrients present in the compost extract however investigation into the individual components in the treatment is necessary to understand how each component contributed to the improvement in crop growth.

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Conclusion

Fertiliser had a far greater effect than bio-amendment on wheat growth, nutrient contents, and yield, with large differences seen between treatments including fertiliser compared to those without, and minimal observable differences between standalone fertiliser and fertiliser plus biostimulant treatments.

The compost extract package seemed to have some improvement to crop growth compared to the commercial biostimulant, however due to several components making up the package it is difficult to determine what is contributing to the improved growth.

Notes:

TOP 10 TIPS FOR REDUCING SPRAY DRIFT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

01 **Choose all products in the tank mix carefully**, which includes the choice of active ingredient, the formulation type and the adjuvant used.

02 **Understand** how product uptake and translocation may impact on coverage requirements for the target. Read the label and technical literature for guidance on spray quality, buffer (no-spray) zones and wind speed requirements.

03 **Select the coarsest** spray quality that will provide an acceptable level of control. Be prepared to increase application volumes when coarser spray qualities are used, or when the delta T value approaches 10 to 12. Use water-sensitive paper and the Snapcard app to assess the impact of coarser spray qualities on coverage at the target.

04 **Always expect** that surface temperature inversions will form later in the day, as sunset approaches, and that they are likely to persist overnight and beyond sunrise on many occasions. If the spray operator cannot determine that an inversion is not present, spraying should NOT occur.

05 **Use weather forecasting** information to plan the application. BoM meteograms and forecasting websites can provide information on likely wind speed and direction for 5 to 7 days in advance of the intended day of spraying. Indications of the likely presence of a hazardous surface inversion include: variation between maximum and minimum daily temperatures are greater than 5°C, delta T values are below 2 and low overnight wind speeds (less than 11km/h).

06 **Only start spraying** after the sun has risen more than 20 degrees above the horizon and the wind speed has been above 4 to 5km/h for more than 20 to 30 minutes, with a clear direction that is away from adjacent sensitive areas.

07 **Higher booms increase drift**. Set the boom height to achieve double overlap of the spray pattern, with a 110-degree nozzle using a 50cm nozzle spacing (this is 50cm above the top of the stubble or crop canopy). Boom height and stability are critical. Use height control systems for wider booms or reduce the spraying speed to maintain boom height. An increase in boom height from 50 to 70cm above the target can increase drift fourfold.

08 **Avoid high spraying speeds**, particularly when ground cover is minimal. Spraying speeds more than 16 to 18km/h with trailing rigs and more than 20 to 22km/h with self-propelled sprayers greatly increase losses due to effects at the nozzle and the aerodynamics of the machine.

09 **Be prepared** to leave unsprayed buffers when the label requires, or when the wind direction is towards sensitive areas. Always refer to the spray drift restraints on the product label.

10 **Continually monitor** the conditions at the site of application. Where wind direction is a concern move operations to another paddock. Always stop spraying if the weather conditions become unfavourable. Always record the date, start and finish times, wind direction and speed, temperature and relative humidity, product(s) and rate(s), nozzle details and spray system pressure for every tank load. Plus any additional record keeping requirements according to the label.

Potential use of on-farm acidic sand and other ameliorants to detoxify subsoil boron while re-engineering the soil profile

Hasin Rahman, DPIRD

ABSTRACT:

Potential use of on-farm acidic sand and other ameliorants to detoxify subsoil boron while re-engineering the soil profile

Hasin Rahman and Gaus Azam, DPIRD

Key messages

Incorporation of acidic and neutral sands with calcareous sodic-saline-alkaline heavy soils from different parts of Western Australian:

- Decreased soil pH and electrical conductivity (EC).
- Boron (B) concentration.
- Increased plant available water (PAW).

Aims

The key to successful soil reengineering is to ameliorate multiple interacting soil constraints including elemental toxicity. An incubation study was conducted aiming to decrease soil pH, EC, and level of B toxicity and increase PAW in four calcareous-saline-alkaline heavy soils amended by the incorporation of acidic and neutral sands.

Results

Results indicate that the incorporation of increasing rates of acidic sand significantly decreased soil pH and B concentration for Carnamah, Bonnie Rock, and Holt Rock soils. The incorporation of neutral sand with Salmon Gums soils also significantly decreased B concentration but not soil pH. With a 50:50 subsoil clay to acid sand mixing ratio, B concentration was almost half for all soils; therefore, it become nearly non-toxic for Carnamah, Bonnie Rock and Holt Rock soils, but it remained at a toxic level (~30mg/kg) for the Salmon Gums soil. The incorporation of increasing rates of any sand significantly decreased soil EC for all soils. The incorporation of acid sand also significantly increased PAW by up to 53.3% for Carnamah soil.

Conclusion

Irrespective of soil types, the incorporation of acidic sand improved soil constraints such pH, EC and B toxicity and increased PAW. As increasing rates of incorporation of acid sand decreased soil pH and ameliorated B toxicity for Carnamah, Bonnie Rock and Holt Rock soils. The incorporation of acid sand could be an effective amendment to reengineer saline-sodic-alkaline soils by reducing alkalinity and B toxicity. The increase in PAW was significant for all soils where Carnamah soil had the largest improvement. This finding will improve our understanding of incorporating sand to sodic-saline-alkaline soil in several soil reengineering field trials across WA. Further work to understand the nutrient release, the longevity of this effect and practical ways of incorporating sand into deep sodic-saline-alkaline soil is needed.

Options for managing sodic soils

David Hall, DPIRD

ABSTRACT:

Options for managing sodic soils and sodic soil management: Opportunities for harvesting more rainfall using hydrophobic polymers

David Hall, Rushna Munir, Ed Barrett-Lennard, Wayne Parker, Glen Riethmuller
DPIRD (Esperance, Merredin, Perth, and Geraldton)

Key messages

- Gypsum remains the best tool for reducing dispersion and modifying the chemistry of dispersive soils. However, multiple applications over many years will be required to leach sodium and toxic elements from the root zone.
- Water harvesting using mounds and polymer 'hats' and reducing soil evaporation through mineral mulches have led to major yield increases on sodic and saline soils. The adoption of these novel treatments will depend on their longevity and cost.
- Deep tillage even with amendments has not led to increased crop yields in dispersive clay soils.

Aims

Sodic and dispersive clay soils accumulate salt and impede water infiltration, water storage, root growth and grain yield. They are found in a wide range of soils and rainfall zones throughout the wheatbelt of WA. Management options investigated include reducing dispersion through the application of gypsum (gypsum), harvesting more rainfall (mounds + hats), reducing soil evaporation (mulches), and improving root growth (tillage and amendments). This paper discusses each these options and results from a range of experiments that have been monitored over several years. The aim of this research is to investigate traditional and novel systems of soil management that can improve crop production and profitability on sodic/dispersive clay soils.

Results

The gypsum requirement (amount of gypsum required to reduce exchangeable sodium to acceptable levels) of many sodic soils often exceeds 20 t/ha. Multiple applications over time are therefore required to improve the long-term chemistry of sodic soils. While in-furrow gypsum has improved yields in dry seasons, results from annual in-furrow gypsum applications and broadcast applications did not show any significant differences in 2021 or 2022. We presume that in these wet years, crop growth was not limited by the presence of elevated salinity in the root-zone.

Water harvesting using mounds and polymer or plastic 'hats' has increased cereal yields by 0.6 t/ha when averaged over thirteen trials. Gravel mulches have increased cereal yields by 0.7 t/ha in eleven trials. Both treatments increase plant available water either by concentrating rainfall in the seeding furrows or by directly reducing soil evaporation.

Deep tillage with and without deep placed amendments in sodic clay soils has not resulted in yield increases across five trial years in the central and eastern wheatbelt.

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Conclusion

Reversing the dispersion of sodic soils requires the application of large amounts of gypsum (~20 t/ha). Our research shows that there may be several viable alternatives to this approach. All these alternatives are based on the improved hydration or increased leaching of salt from the soils. Aspects of this research are novel and will have a longer lead time to be market ready.

Acknowledgements

GRDC Project DAW1902-001 RTX

Notes:

Next generation digital technologies for the grains industry

Ferdous Sohel, Murdoch University

AI for frost detection in plant imagery

Key messages

- Frost detection in plants can be formulated as an image classification problem between adjacent temperature classes.
- Machine learning (ML) models can be trained to detect frost (ice nucleation and crystallising points in time and temperature) in wheat plants in real-time using infrared thermal imagery.
- ML models can determine the duration of the frost events.

Aims

To investigate if ML models can capture the thermodynamic patterns in plants' freezing from infrared thermal images.

Results

- ML models can capture the thermodynamic patters in real-time. They can detect the ice-nucleation and crystallising points up to a quarter of degree °C precision.
- On a sliding scale the system can keep track of time series data and record the duration of the frost related events.
- Our proposed technique takes 17ms time per image for testing and analysis.

Conclusion

This study presents an IRT and ML-based method, which can detect the ice nucleation and freezing points in plants in field-based conditions. Overall, this study provides important insights into a primary building block for the future development of automatic and real-time on-field plant frost monitoring systems.

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AI for real-time weed detection and classification from imagery

Key messages

- Weeds in crop detection and infestation mapping can be formulated as an ML-based object detection and classification problem from multimodal imagery.

Aims

To investigate ML models for species level weed map generation from imagery.

Results

- We develop a species level multi-class weed benchmark dataset.
- Then apply enhanced ML models to detect and classify weed instances in an image collected from various modalities e.g., integrated drone and ground imagery.
- Our proposed technique takes ~11ms time per image for testing and analysis.

Conclusion

ML can be used in integrated weed detection and mapping and hence for subsequent targeted control mechanisms.

AI for real-time pest detection and classification from imagery

Key messages

- ML models can be used for instance level pest detection and recognition as well as detection of the colonies of pests.

Aims

To investigate ML models for species level pest map generation from imagery (with and without canopy).

Results

- We develop a species level multi-class pest colony benchmark dataset.
- ML models achieves more than 95% accuracy to detect and classify pest instances and their colonies in an image. collected from various modalities e.g., integrated drone and ground imagery.
- Our proposed technique takes ~30ms time per image for testing and analysis.

Conclusion

ML can be used in integrated pest detection and mapping and hence for subsequent targeted control mechanisms.

Overall, AI technologies and novel techniques can be used in agricultural data analytics and applied in control mechanisms for weed, pest and frost detection in crops.

Notes:

Digital agriculture: what does an information intensive agricultural system look like?

Roger Lawes, CSIRO

Key messages

- Digital technologies, such as yield maps, crop models and satellite imagery have all been available for more than 20 years.
- Modern machinery and data platforms have advanced, rapidly. They are now able to utilise and link these data to plan cropping operations and improve decision making.
- Artificial Intelligence (AI) technology can be used to combine outputs from crop models, satellites, and drones to deliver improved decisions. This approach has been used to deliver reliable site-specific N management solutions. The next generation of technology will assist with site specific insecticide, herbicide, and fungicide management.
- These tools can potentially identify savings of $100/Ha or more.

Summary

Digital agriculture has long promised to help growers and advisors improve their decision making, and profitability across the farm. Many tools, such as Yield Prophet®, yield monitor maps, satellite imagery and drone imagery have been used sporadically by the industry to address specific issues. For example, poor performing zones in fields have been identified and targeted management has been applied.

The process of generating variable rate prescription fertiliser maps, using this advanced information, can be challenging. Furthermore, the net economic returns for variable rate fertiliser application are moderate, at best. However, there have been recent advancements in commercial machinery, where boom sprayers can apply variable rate, and green on green weed detection is possible. The digital platforms that major machinery manufacturers use are becoming more sophisticated, and easier to use. They are now capable of ingesting data from crop models, drones and satellites to inform variable rate decisions.

The implication is that sensor technology, and data handling technology are rapidly improving. Digital technology can already target sprays to lower overall herbicide use, help segregate protein levels of grain to maximise crop value and apply site specific targeted fertiliser to maximise efficiency. The technology can identify yield gaps, and help growers prioritise which paddocks to manage intensively. Here, we discuss the John Deere System, the Hardi System, and describe how these systems can be used with other tools to help make decisions on farm and improve profitability.

Notes:


STRONG FINISHES
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GROUP 14 HERBICIDE
Simpler, more comprehensive broadleaf weed control
Frequency® Herbicide
GROUP 27 HERBICIDE
Fine-tune tank-mixes to take control of tough weeds
Luximax® Herbicide
GROUP 30 HERBICIDE
A breakthrough in annual ryegrass control for wheat*
Versys® Insecticide
GROUP 9D INSECTICIDE
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Systiva® Seed Treatment Fungicide
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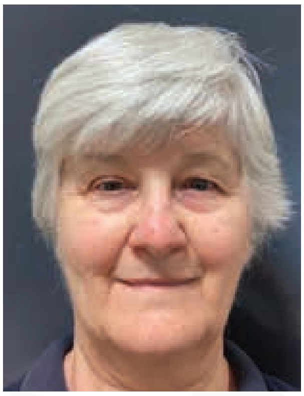
How long do *Sclerotinia* sclerotes survive in WA? Decision support tools to help with on-farm management of blackleg and sclerotinia in canola



Jean Galloway, DPIRD

ABSTRACT:

How long do *Sclerotinia* sclerotes survive in WA? Decision support tools to help with on-farm management of blackleg and *sclerotinia* in canola

Jean Galloway[1], Adam Sparks[2], Steve Marcroft[3], Ciara Beard[4], Kylie Chambers[1] Andrea Hills[5]
[1]DPIRD Northam, [2]DPIRD Nash Street, [3]Marcroft Grains Pathology Horsham, [4]DPIRD Geraldton, [5]DPIRD Esperance

Key messages

- *Sclerotinia sclerotiorum* sclerotia have survived on the soil surface at Northam for six seasons.
- DPIRD and GRDC have developed three tools to support on-farm management decisions for key diseases in canola. BlacklegCM for blackleg stem canker, UCI BlacklegCM for blackleg upper canopy infection (UCI) and SclerotiniaCM for sclerotinia stem rot (SSR) management.
- UCI BlacklegCM was released in mid-2022. Based on field monitoring of UCI in 2022 the decision support tool has been updated to take account of blackleg leaf lesions on canola varieties that are rated as resistant (R).

Aims

- To determine how long *Sclerotinia sclerotiorum* sclerotia remain viable on the soil surface.
- To test and update canola disease management decision support tools in WA.

Results

Sclerotia survival on the soil surface

Sclerotia formed in a 2016 canola crop have been weathered under natural conditions on the soil surface at Northam. Each year since 2017 the sclerotia have been monitored for apothecia production. In 2022, after six seasons on the soil surface, these sclerotia were still producing apothecia.

Testing canola disease management decision support tools

On-farm testing of the SclerotinaCM decision support tools has occurred in several seasons in the Geraldton and central wheatbelt areas of WA. These trials had varying levels of SSR.

In-crop monitoring of blackleg UCI in early sown canola crops at more than 20 locations in WA in 2022 found blackleg leaf lesions at first flowers in most varieties including lesions on some resistant (R) varieties. The tool was updated to take account of R varieties that develop blackleg leaf lesions.

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Conclusion

Sclerotinia sclerotiorum sclerotia can survive for at least six seasons on the soil surface in WA. Most paddocks in WA will by now have some level of *Sclerotinia* risk associated with them. SclerotiniaCM has been shown in on-farm trials to be useful in WA for predicting circumstances in which fungicide management of SSR may be beneficial.

The latest version of UCI BlacklegCM now has an additional function that asks the user to input information about the resistance rating of the cultivar being grown. This function will prevent the tool from predicting a positive return for fungicide application on R varieties that have leaf lesions at flowering.

Notes:

Fungicide mixtures, rotations, timing, and decisions for managing Net Form Net Blotch on barley in southern WA

Kithsiri Jayasena, DPIRD

ABSTRACT:

Impact of fungicide product, rotation, and timing on Net Form Net Blotch in Planet barley in southern WA

Kithsiri Jayasena[1], Andrew van Burgel[1], Jean Galloway[2], Laurie Wahlsten[1], and Mark Slattery[3]

[1]DPIRD Albany, [2]DPIRD Northam, [3]Grower, Kojaneerup South

Key messages

- Net Form Net Blotch (NFNB) was widely distributed across south coast WA in 2022.
- Greater virulence for Planet barley is apparent in NFNB.
- Foliar fungicide spraying on established crops reduced NFNB.
- The best impact on yield was seen when fungicide was applied early in epidemic development.
- Timely application of a foliar fungicide at growth stage Z31 increased yields by 13% as compared to the control.

Aims

To compare NFNB control from a range of foliar fungicide timing combinations including a threshold-based system (TBS) and standard one or two-spray approaches with a range of fungicide products.

Results

For the current study, two foliar fungicide management trials were conducted on adjacent 1 ha blocks of Planet barley, one sown with Uniform®-in-furrow and the other with Hombre® Ultra seed dressing. Planet is susceptible to the Oxford NFNB pathotype which has been dominant in this region. Comparisons were made to the untreated controls of one or more applications of fungicides containing actives Prothioconazole as Proviso®, Propiconazole with Benazovindiflupyr as Elatus® Ace, Prothiconazole with Bixafen as Aviator® Xpro®, Propiconazole with Azoxystrobin as Topnotch® and Tebuconazole with Prothioconazole as Prosaro®. Fungicides used and sequence of application in each block were selected to conform with fungicide resistance guidelines and avoid NFNB pathogen resistance issues. Foliar fungicides were applied at: Z31 only (Proviso®); at Z39 only (Proviso®); farmer practice (at Z31 (Prosaro®) and Z39 (Aviator® Xpro®); TBS (at Z39 (Proviso®) and Z59 (Topnotch® or Elatus® Ace) applied when the top three open leaves reached average 10% disease severity); standard practice (at Z31 (Proviso®) and Z39 (Proviso®); full control (at Z31 (Proviso®), Z39 (Topnotch® or Elatus® Ace), Z56 (Topnotch®).

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The Hombre® Ultra as seed dressings or Uniform® in-furrow fungicides used here were not sufficient to protect the crop up to Flag leaf emergence from NFNB. The block sown with Unform® in-furrow, registered for 90 days suppression of net blotches, had NFNB appear at stem extension (Z31) (disease severity less than 1%) whereas in the crop sown with Hombre® Ultra, no registration for net blotches, NFNB appeared at early tillering (Z25) and had average 1% disease severity on open top three leaves.

Across the south coastal production zone there has been a shift towards greater virulence of NFNB, which was reflected at this site. In the crop sown with Uniform® in-furrow, disease pressure and severity was extremely high, at Z83 (early dough stage) 82% leaf area on the top three leaves of untreated controls were affected by NFNB. If foliar fungicides were applied NFNB reduced to an average 69% ($p<0.001$). In crops sown with Hombre® Ultra, spray applications reduced NFNB at Z73 from 66% for the unsprayed control to an average of 53% for the fungicide sprayed treatments.

For both trials, spraying at Z31 only or spraying at Z31 and Z39 increased yield ($p<0.05$ or $p<0.1$) with yield between 5.2t/ha and 5.4t/ha compared to the unsprayed control with yield between 4.7t/ha and 4.8t/ha.

In these trials there was no difference in yield or disease levels between an early spray at Z31 and a two-spray strategy at Z31 and Z39 ($p>0.05$). Late application of foliar fungicides applied at Z39 and Z59 based on a threshold-based system and multiple applications of foliar fungicides at Z31, Z39 and Z56 reduced disease ($p<0.05$), however did not lead to an increase in yield when compared to the control ($p>0.05$).

Conclusion

Shifting virulence in the NFNB pathogen and an extremely favourable season resulted in very high disease pressure in Planet barley crops across the south coast in 2022.

Uniform® in-furrow delayed the onset of NFNB until stem extension, but foliar fungicides applied at and after stem extension reduced disease severity and improved yield.

Use of foliar fungicides at different timings as a single spray at different growth stages such as Z31 or Z39 or multiple spraying at Z31 and Z39 or Z39 and Z59 were able to reduce severity of NFNB.

Timely application of foliar fungicide at Z31 under high disease pressure (with or without an additional spray at Z39) reduced the disease and increased yield.

Under high disease pressure, using a threshold-based system (TBS) and monitoring the development of NFNB during the season to determine spray timing was not as effective as standard practice. The TBS allowed disease to reach uncontrollable levels before intervention, in this environment the threshold should be revised to be less than 10% disease severity. The success of the Z31 timing, which intervened at start of epidemic, suggests that a lower threshold would have been more appropriate.

In a year with a very susceptible (VS) host, a perfect environment, and huge amounts of stubble around, the use of an effective fungicide at the onset or early in the epidemic (Z31) was the key to best result. Allowing the disease to take-hold and further magnify the inoculum pressure was too much for the fungicides to bear.

Notes:

Economical management of Spot Form Net Blotch in low rainfall environments

Jason Bradley, DPIRD

ABSTRACT:

Economical management of spot form net blotch in low rainfall environments: using less susceptible varieties makes sense

Jason Bradley[1], Kylie Chambers[2], Andrea Hills[3], Geoff Thomas[1]
[1]DPIRD South Perth, [2]DPIRD Northam, [3]DPIRD Esperance

Key messages

- Spot Form Net Blotch (SFNB) is a major foliar disease of barley across Western Australia, promoted by the dominance of varieties rated as susceptible or worse as adult plants (94% of crop area sown to barley in 2021).
- This research found that fungicide management of SFNB in low rainfall zones does not always provide yield improvements in Maximus or Spartacus, although grain quality increases in less plump varieties such as Spartacus may result in an economic return.
- Growing varieties with even modest improvements in genetic resistance such as Maximus can reduce both inoculum carryover and in-crop disease severity of stubble borne diseases like SFNB and in most seasons reduces the need for in-season fungicide application.

Aims

To assess different SFNB control strategies including variety resistance and fungicide applications, for their impact on grain yield and quality and ultimately economic return from treatment.

Results

As part of GRDC funded project DAW2104-001RTX, four small plot field trials were conducted across the 2021 and 2022 seasons in the eastern wheatbelt (Muntadgin, Nungarin (2), and Merredin). The trials compared the most widely grown barley variety in the region Spartacus CL (SVS) and its most likely replacement Maximus CL (MSS).

Maximus and Spartacus have the same level of SFNB resistance (S) at seedling to tillering growth stages, however Maximus exhibits a degree of adult plant resistance (MSS) and consequently diseased leaf area in upper canopy is significantly lower than Spartacus. In Merredin replicate trials sown in 2022 over blocks of Maximus or Spartacus stubble showed that Spartacus stubble generated a higher disease pressure on seedlings for the following season.

In fungicide trials, whilst there were significant treatment effects in reduction of SFNB severity compared to the Untreated control during the season, significant yield effects were not evident. In all trials Maximus out-yielded Spartacus in Untreated and fungicide treated plots, ranging between 5-23% greater yield. The most evident benefit from the multiple spray fungicide treatments and greatest difference between the varieties in response to fungicide related to grain quality, with higher retention >2.5mm (Maximus +3.4%; Spartacus +8.5%) and improved grain weight. In two of the four trials Spartacus retentions were <80% (feed grade) in Untreated plots.

(Continued on following page...)

Conclusion

In low rainfall areas, where there is uncertainty of economic response to fungicide management of SFNB, growing varieties with improved genetic resistance reduces both the need for and uncertainty associated with fungicide intervention.

As well as Maximus, there are a number of newer barley varieties released with reduced susceptibility to SFNB (MSS-MRMS), giving growers more confidence to minimise fungicide usage. Between the 2021 and 2022 seasons there was already a considerable shift away from Spartacus CL, 51% down to 31% of barley area sown compared to an increase in Maximus CL 4% up to 33% (Paynter, 2022).

Notes:

Russian wheat aphid thresholds in WA and using biological control for RLEM

Sveltana Micic, DPIRD

ABSTRACT:

Russian wheat aphid thresholds in WA and using biological control for RLEM

Svetlana Micic, Rachel Golledge, DPIRD Albany

Key messages

- The Russian wheat aphid (RWA) action calculator accurately predicts if yield loss will occur under WA growing conditions. If thresholds are exceeded by 2%, RWA can cause approximately losses of $136 /ha.
- Previous trials have shown French Anystis mite (FAM), biological control of redlegged earth mite (RLEM), can reduce RLEM in spring by 80%. Uncontrolled, RLEM are estimated to cause $200m damage. For FAM to survive and spread, it requires refuges that are not cropped or sprayed.

Aims

- To test the Russian wheat aphid calculator under WA conditions.
- Determine the persistence of French Anystis Mite at 36 release sites in WA and two set -up nursery collection sites.

Results

Russian wheat aphid threshold calculator

Yield loss from RWA depends on the time of colonisation and the length of time RWA are present in the crop.

If seed treatments were not applied, RWA were 11 times more likely to be detected on tillers; thresholds for feeding damage by RWA were met by late tillering in all four trials. If seed dressings were applied, thresholds for feeding damage by RWA were not reached.

In all trials, RWA feeding damage was detected but on average 20% of tillers with feeding damage did not have a colony of RWA present.

The action threshold for RWA at 30 days before head emergence was 4% of tillers with RWA. In trials where the threshold was exceeded by 2% or more, the control on average had 16% more yield and 33% less screenings than treatments with RWA.

If the action threshold was just met, and RWA did not persist, no yield loss was detected.

The amount of yield loss predicted by the action calculator was conservative. The average yield loss was approximately three times greater than the action calculator estimate. On average if the threshold was exceeded by 2%, there was a 0.4 t/ha decrease in yield.

(Continued on following page...)

French Anystis mite, a biological control for RLEM

French Anystis mite (FAM), a biological control of redlegged earth mites (RLEM), can control up 70%- 80% of RLEM in spring. Between 1988-1991, 36 release sites for FAM were established from Coorow to Augusta.

Surveys in 2021/22 found FAM only at 10 release sites. Nine release sites were long-term pasture paddocks, of which only two had a history of in-frequent organophosphate insecticide applications. Only at one release site, which had been cropped for the first time in 2021, were FAM found in uncropped weedy refuges in the paddock.

At all release sites, FAM were found to have spread from the original release site only if directly adjacent to the release site was a pasture paddock or a weedy refuge. In release sites that were cropped FAM were not found in weeds along fence lines or laneways, only in refuges in the paddock that could not be sprayed such as drains.

Two nursery sites have been established to allow interested parties to collect FAM for release:

1. Manjimup Research Facility (MRF), even though FAM were not released here, FAM spread 1.4 km from the original release site onto MRF.
2. Boyup Brook release site had the highest abundance of FAM found to date, with on average 92 FAM per square metre.

Conclusion

Russian wheat aphid calculator under WA conditions does predict yield loss accurately. However, thresholds rely on accurately assessing RWA numbers and not using plant damage symptoms as a measure. The yield loss prediction by the calculator for WA is conservative.

FAM will persist in paddocks and will provide downward pressure on RLEM only if the paddock is not to be cropped. Alternatively, in cropped paddocks, FAM will persist in weedy refuges and can provide control of RLEM in the refuges only if refuges are not sprayed with herbicides or insecticides.

Notes:

Resistance status of wild radish brome and barley grass

Mechelle Owen, AHRI

ABSTRACT:

Resistance status of wild radish brome and barley grass

Mechelle Owen[1] and Ken Flower[2]
[1]AHRI, [2]UWA

Key messages

- Wild radish resistance is widespread for chlorsulfuron, intervix and 2,4-D.
- Resistance levels in brome grass and barley grass remain low for most herbicides but are increasing for sulfonylureas.
- Resistance levels vary across and within cropping regions for different species and herbicides.

Aims

To monitor the frequency and distribution of herbicide resistance in key weed species to commonly used herbicides in cropping paddocks.

Results

The GRDC-funded random surveys conducted in Australia during harvest 2020 reveal that herbicide resistant weeds species are common. However, the incidence of resistance varies significantly for weed species in cropping regions both within a cropping zone and across Australia. Wild radish is predominantly a major weed in WA and less significant in the Eastern States. In Western Australia, wild radish is a common weed in the northern agricultural region and is gradually spreading south. Ninety-four wild radish populations were collected from WA, with most (>80%) populations having resistance to commonly used herbicides such as chlorsulfuron and imazamox + imazapyr (group B/2), 2,4-D (group I/4) and diflufenican (group F/12). Herbicides such as atrazine (group C/5) and mixtures such as pyrasulfotole + bromoxynil (groups H/27 and C/6) had lower levels of resistance and remain effective for controlling wild radish, while no glyphosate resistant populations were detected.

In WA, 205 brome grass populations have been tested to five herbicides: quizalofop, clethodim (both group A/1), glyphosate (group M/9), imazamox + imazapyr and sulfosulfuron (group B/2). Resistance to quizalofop was detected in 1% of populations while resistance to the sulfonylurea herbicides was higher, with many fields (around 40%) containing resistant plants. A glyphosate resistant brome population was also detected. Group B/2 resistant barley grass populations were evident across Western Australia (13% of fields) while resistance to other herbicides used for this species was generally low, with 1-2 populations having resistance to paraquat (group L/22) or quizalofop. Generally, resistance levels have remained stable over the past five-year survey period for these weed species in Western Australia; however, sulfonylurea resistant brome and barley is becoming more widespread.

(Continued on following page...)

Conclusion

Herbicide resistance is common in most agricultural fields although resistance levels vary across regions and between species. Despite brome and barley grass species being less abundant than annual ryegrass, resistance to the group A and B herbicides was identified. It is important to document the distribution and herbicide resistance frequency in these minor weeds, as herbicide control options for these species are limited. Continual monitoring of the distribution, incidence and frequency of herbicide resistance will aid management decisions by farmers and agronomists for sustainable weed control. The challenge is to use a wide range of integrated weed management options that help achieve herbicide sustainability and thus productivity of cropping systems.

Notes:

LOOK AROUND YOU.

1 in 5 people in rural Australia are currently experiencing mental health issues.

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

The GRDC supports the mental wellbeing of Australian grain growers and their communities. Are you ok? If you or someone you know is experiencing mental health issues call *beyondblue* or Lifeline for 24/7 crisis support.

beyondblue
1300 22 46 36
www.beyondblue.org.au

beyondblue
Depression. Anxiety.

Lifeline
13 11 14
www.lifeline.org.au

Lifeline
13 11 14

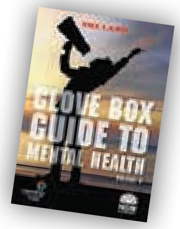
Looking for information on mental wellbeing? Information and support resources are available through:

www.ifarmwell.com.au An online toolkit specifically tailored to help growers cope with challenges, particularly things beyond their control (such as weather), and get the most out of every day.

www.blackdoginstitute.org.au The Black Dog Institute is a medical research institute that focuses on the identification, prevention and treatment of mental illness. Its website aims to lead you through the logical steps in seeking help for mood disorders, such as depression and bipolar disorder, and to provide you with information, resources and assessment tools.

www.crrmh.com.au The Centre for Rural & Remote Mental Health (CRRMH) provides leadership in rural and remote mental-health research, working closely with rural communities and partners to provide evidence-based service design, delivery and education.

Glove Box Guide to Mental Health
The *Glove Box Guide to Mental Health* includes stories, tips, and information about services to help connect rural communities and encourage conversations about mental health. Available online from CRRMH.



www.rrmh.com.au Rural & Remote Mental Health run workshops and training through its Rural Minds program, which is designed to raise mental health awareness and confidence, grow understanding and ensure information is embedded into agricultural and farming communities.

www.cores.org.au CORES™ (Community Response to Eliminating Suicide) is a community-based program that educates members of a local community on how to intervene when they encounter a person they believe may be suicidal.

www.headsup.org.au Heads Up is all about giving individuals and businesses tools to create more mentally healthy workplaces. Heads Up provides a wide range of resources, information and advice for individuals and organisations – designed to offer simple, practical and, importantly, achievable guidance. You can also create an action plan that is tailored for your business.

www.farmerhealth.org.au The National Centre for Farmer Health provides leadership to improve the health, wellbeing and safety of farm workers, their families and communities across Australia and serves to increase knowledge transfer between farmers, medical professionals, academics and students.

www.ruralhealth.org.au The National Rural Health Alliance produces a range of communication materials, including fact sheets and infographics, media releases and its flagship magazine *Partyline*.

ifarmwell growing farmers' wellbeing | Black Dog Institute | Centre for Rural & Remote Mental Health | CORES™
Rural & Remote Mental Health | Heads up Better mental health in the workplace | National Centre for Farmer Health | National Rural Health Alliance Ltd

P Level 4 | 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604 **T** +61 2 6166 4500 **F** +61 2 6166 4599 **E** grdc@grdc.com.au

CoAXium® Barley: a new weed management tool

Tristan Coram, AGT

Key messages

- CoAXium® Barley is an innovative technology that provides in-crop tolerance to Group 1 Quizalofop-P-Ethyl herbicide (Aggressor® herbicide).
- Extensive trials have demonstrated the safety of CoAXium® barley when treated with Aggressor® herbicide.
- The first CoAXium® Barley variety, Titan AX, is available to growers for the 2023 season.

Aims

Grass weeds including annual ryegrass, barley grass, brome grass and wild oats cause average annual losses in winter cereals of over AU$34M. Consequently, providing additional tools for the control of grass weeds in barley has significant benefit to Australian growers. Group 1 herbicides, inhibiting acetyl co-enzyme A carboxylase (ACC'ase inhibitors), are commonly applied in naturally insensitive broadleaf crops to control grass weeds but cannot be used in cereal crops due to their sensitivity. Here, we describe the development and characterisation of barley with a modified ACC'ase inhibitor that confers tolerance to Quizalofop-P-Ethyl (QPE) herbicide.

Results

The (non-GMO) mutation responsible for this tolerance occurred naturally in a grower's field and was initially characterised by the University of Adelaide. Australian Grain Technologies (AGT) introduced the mutation into the breeding programme and has assessed the tolerance of barley lines to Aggressor® QPE in field trials. Results from four years of field trials demonstrate that yields are maintained after application of Aggressor® herbicide at up to twice the recommended label rate. AGT has generated crop tolerance and residue data, and partnered with Sipcam Australia, to gain Australian Pesticides and Veterinary Medicines Authority (APVMA) label registration for Aggressor® herbicide. The technology has now been launched, along with along with stewardship guidelines at www.coaxium.com.au.

Conclusion

This new technology provides growers an additional tool for combating grass weeds in their barley crops, particularly where barley grass, brome grass and wild oats are an issue. The technology will also be valuable for cleaning up volunteer wheat from malt barley crops. Importantly, Aggressor® herbicide has a short degradation period in the soil, which eliminates any plant back issues for the following crop and does not result in any detectable grain residue that could impact market access.

Canola on Canola – profit maker or system breaker?

Focus Session 1

Convenor: Juliet McDonald, GRDC Western Panel

Canola on canola might seem like a good thing economically but changing rotations comes with risk. Disease in a crop like canola can be devastating and salvage options expensive. So are there places where it might work, and if so, what rules might we want to follow to make it successful.

Understanding the components of canola production would seem to be the best way to start and breaking the system down and looking at disease, insects, weeds, nutrition and variety choice will be a logical step. We have a range of speakers knowledgeable in each of the topics who can help understand critical components of whether or not to do canola on canola.

- **Varieties and breeding objectives** – David Tabah
- **Disease risks in canola** – Steve Marcroft
- **Optimal nutrition** – Rohan Brill
- **Insect problems in canola** – Dusty Severtson
- **Weeds issues or solutions**
- **Grower experience with canola on canola** – Chad Eva

This session provides an important opportunity to understand when or where tighter canola rotations might work, and importantly what failure might look like.

Notes:

Reducing grain farming emissions
Focus Session 2

Convenor: Ben White, Kondinin Group

Reducing greenhouse gas (GHG) emissions from farming continues to be a target for governments and consumers as the world seeks to limit global warming. This focus session will look at how well WA grain farmers are meeting this challenge, and what some of the constraints are to achieving further reductions.

The session will provide the audience with an opportunity to discuss with an expert panel a range of topics such as:

- What do we mean by reducing net GHG emissions? What comprises emissions?
- How do we calculate/measure net emissions?
- Emission calculators – do they agree and what are the main differences?
- How do I know if my farm is a good or poor performer for GHG emissions?
- Emission intensity vs net emissions – why the difference and what does it mean?
- Where are the main emission sources on WA farms, where can we sequester GHGs on farm?
- Why are we concerned with reducing GHG emissions?
- Financial gain through niche market? e.g., Boortmalt carbon neutral grain purchases. Or financial costs of doing nothing?
- Market access – now or in future?

A range of speakers with considerable experience in this area will present challenging points of view on the topic.

- **Findings of DPIRD/CBH/ WOA work** – Jackie Bucat
- **Lime/fertiliser use and emission trade-offs** – Chris Gazey
- **Machinery efficiencies to reduce GHG** – Glen Reithmuller
- **Experience of an on-farm audit** – Gary Lang
- **Challenges for CBH and growers** – Royce Taylor
- **Broad findings of farmers undergoing audits** – Stacey Bell-Crookes

This session provides an important opportunity to understand if farmers are able to further cut GHG emissions, and if not what the consequences might be.

Notes:

Plant breeding research workshop
Focus Session 3

Convenor: Camilla Hill, GRDC

Untangling the 'Gordian Knot' of *septoria nodorum* blotch of wheat

Kar-Chun Tan, CCDM

ABSTRACT:

Untangling the 'Gordian Knot' of *septoria nodorum* blotch of wheat

Kar-Chun Tan[1], Evan John[1], Silke Jacques[1], Huyen Phan[1], Lifang Liu[1], Danilo Pereira[2], Daniel Croll[3], Karam Singh[1,4], Richard Oliver[5]

[1]CCDM, Curtin University, [2]ETH Zurich, Switzerland, [3]University of Neuchatel, Switzerland, [4]CSIRO, [5]University of Nottingham, UK

Key messages

- The genetic complexity of *septoria nodorum* blotch of wheat caused by the fungus Parastagonospora nodorum can be likened to a Gordian Knot. This greatly impedes progress in breeding for SNB resistance in wheat.
- Snn1 and Snn8 (formerly Snn2A) genes are found in many commercial wheat varieties that confer susceptibility to SNB. Western Australia possessed a specialised SNB fungal population that relies on the production of specific effector molecules (or toxins) to exploit weaknesses found in Snn1 and Snn8 during infection.
- Prioritise the removal of Snn1 and Snn8 to further improve SNB resistance in Australian wheat varieties.

Aims

- Decipher the genetic basis of SNB resistance in wheat to WA P. nodorum populations.
- Provide breeders with priority genetic targets to improve SNB resistance in wheat.

(Continued on following page...)

Results

Our study (DOI: 10.1371/journal.ppat.1010149) identified a high proportion of *P. nodorum* isolates that are endemic to Western Australia produce a high level of a toxin-like molecule called Tox1 which causes tissue death in susceptible wheat. Elevated Tox1 production is caused by a genetic mutation in the Tox1 locus. Furthermore, we know that high Tox1 production masks the effect of other toxin-like molecules such as Tox8 (formerly Tox2A) in SNB. We have evidence to suggest that Tox8 can compensate for the reduction or loss of Tox1 production in P. nodorum through functional redundancies. Susceptibility to Tox1 and Tox8 in wheat is conferred by the Snn1 (chromosome 1B) and Snn8 (chromosome 2A) genes. Both genes are important for seedling and adult plant SNB of wheat in Western Australia and should be considered key breeding targets.

Conclusion

We recommend the removal of Snn1 and Snn8 dominant susceptibility genes in wheat to improve SNB resistance in future wheat varieties. Molecular tools for Snn1 and Snn8 genotyping such as biochemical screening kits and wheat genetic markers are available at the CCDM.

Notes:

Plant breeding research workshop
Focus Session 3 (cont.)

Pangenomes as a technology to improve Australian oats and barley industry

Penghao Wang, Western Crop Genetics Alliance, Murdoch University

ABSTRACT:

Machine learning to predict genotypes and genotype-environment interaction associated with complex traits for genomic selection

Penghao Wang[1], Tefera Tolera Angessa[1], Camilla Beate Hill[1], Xiao-Qi Zhang[1], Sharon Westcott[2], Meixue Zhou[3], Sergey Shabala[3], Tianhua He[1], Chengdao Li[1,2]
[1]Western Crop Genetics Alliance, Murdoch University, [2]DPIRD, South Perth, [3]TIA, University of Tasmania

Genomic selection (GS) provides the potential to accelerate crop breeding and increase selection efficiency. Challenges remain to accurately predict genomic estimated breeding values and practical application for complex traits. We developed a new method by integrating Bayesian GBLUP and Random Forest to model the gene-gene and gene-environment interactions for complex traits. The method can accurately predict the phenotypic performance of complex traits, identify haplotypes associated with desired phenotypes, and predict the ideal haplotype for optimal phenotypes in specific environments. We tested our approach with 855 barley lines and phenotypic data for grain yield and flowering time from multiple environments. With 30,543 SNPs, nine soil parameters and six daily environmental measurements, our method has achieved high accuracy in predicting phenotypes from their genotype profile with correlation coefficients of 0.93 and 0.82 for flowering time and grain yield, respectively. Our approach identified ten haplotype blocks associated with flowering time and thirteen with grain yield, accounting for > 90 % of the total genetic effects. We further predicted the effect of each haplotype and identified the varieties with the best haplotype for crossing design and selection. For any desired phenotypic performance in a specific environment, the untested combinations of environments and optimal genotypes could be predicted. We also developed a Web-based interface (https://penghaowang.shinyapps.io/shinygui/) to test the method, which can inform breeders of the optimal haplotypes and varieties carrying them, facilitating fast and haplotype-based breeding.

Notes:

Plant breeding research workshop
Focus Session 3 (cont.)

Heat stress tolerance in a barley germplasm

Tefera Tolera Angessa, Murdoch University

ABSTRACT:

Heat stress tolerance in a barley germplasm

Tefera Tolera Angessa[1], Hamid Shirdelmoghanloo[2], Kefei Chen[3], Sharon Westcott[4], Chengdao Li[1]
[1]Murdoch University, [2]DPIRD Northam, [3]Curtin University, [4]DPIRD South Perth

Aims

This study was undertaken to explore the potential of barley germplasm reported for heat stress tolerance measured by stay green characteristics under terminal heat stress and drought conditions.

Key messages/ Results

- Grain quality associated traits such as grain thickness was reduced by heat stress induced at first awn peep stage commonly called ZS49 (4.6%) and at grain-filling stage (6.5%), a reduction percentage higher than grain length and grain width, and thus increased grain screenings by 101.9%.
- Reduction in thousand kernel weight due to heat stress at ZS49 (10.0 %) and at grain filling stages (13.0%) highlights the degree of damage and thus the potential economic loss that heat stress can cause on paddock scale.
- Superior genotypes characterised by stay green/ NDVI trait for up to 122 days after sowing and high chlorophyll contents (>30 SPAD units) for up to 35 days after ZS49, thick grains, high grain yield potential can be used to develop improved commercial varieties for heat stress prone environments.

Conclusion

Heat stress reduces yield and grain quality traits. Heat stress impact on the industry can be reduced by integration of genotypes characterised by stay green/ NDVI, high chlorophyl content for longer period and thick grains when developing improved varieties with high grain plumpness for heat stress prone environments.

Notes:

Plant breeding research workshop
Focus Session 3 (cont.)

Progress towards the discovery of genes for heat stress tolerance in a diverse canola population

Sheng Chen, UWA Institute of Agriculture

ABSTRACT:

Progress towards the discovery of genes for heat stress tolerance in a diverse canola population

Sheng Chen[1], Aldrin Cantila[2,4], Suman Rakshit[3,5,6], John Quealy[1], Jacqueline Batley[1,2,4], Kadambot Siddique[1], Wallace Cowling[1]
[1]The UWA Institute of Agriculture, [2]School of Biological Sciences, [3]Statistics for the Australian Grains Industry, [4]UWA, 5School of Molecular and Life Sciences, [6]Curtin University

Key messages

- 323 genotypes from a genetically diverse *Brassica napus* population were screened for heat stress tolerance using a prototype heat screening facility at The University of Western Australia (UWA) over two years with early and late sowing.
- 90k SNP Brassica chips were applied for genotyping and 41,907 polymorphic SNPs were used for molecular genetic analysis.
- Genome wide association studies identified 34 QTLs, from which 334 candidate genes are potentially related to heat stress tolerance. These genes, once their functions are confirmed by a multi-omics approach, could be used in genomic selection for improving heat stress tolerance in canola breeding programs.

Aims

This research uses a coordinated multidisciplinary approach for improving canola heat tolerance. The aims are to provide promising heat-tolerant materials and breeder-friendly protocol/methodologies to accelerate the future commercial release of heat tolerant canola varieties in Australia.

Results

In the study, we evaluated 323 diverse genotypes for their heat tolerance using the heat screening facility at UWA in 2020 and 2021 with both early (in mid-April) and late (in early June) sowing. Eight traits under two treatments (Control vs Heat) and two environments (Early vs Late) over two years (2020 & 2021) were measured. Five traits are measured based on main stem: Seed yield on main stem, pod number on main stem, seed number on main stem, seed number per pod and 100 seed weight on main stem. Three traits are measured based on whole plant: seed yield on whole plant, above-ground biomass, and harvest index. Heat stress showed significant genetic variation for all five main stem traits i.e., seed yield, pod number, seed number, seed number per pod, and seed size (at <0.001) and on harvest index (at <0.01).

41,907 polymorphic SNPs among 323 genotypes were used for GWAS analysis. These SNPs identified 34 QTLs associated with heat tolerance as measured by stress tolerance index and percentage change of each of eight traits measured. 334 candidate genes were possibly related to heat stress tolerance, and they are zinc finger (19%), receptor kinase (19%), membrane protein (11%), cell division/chromosome partitioning (9%), F-box protein (7%), stress response (6%), RNA binding protein (5%), heat-shock protein chaperone (4%), heat-shock protein (4%), and ABC transporter (3%), respectively. These genes, once their functions are confirmed by multi-omics approach, could be used in genomic selection for improving heat stress tolerance in canola breeding programs.

Notes:

Plant breeding research workshop
Focus Session 3 (cont.)

In from the wild: improving chickpea chilling tolerance using the wild relatives

Jens Berger, CSIRO

Low genetic diversity constrains chickpea improvement by limiting variability for the trait of interest. This is particularly the case for reproductive chilling tolerance which delays pod set in chickpea, exposing the crop to terminal drought throughout Australia, reducing yield and yield stability. This reflects chickpea's unique evolutionary history whereby the crop escaped winter stress in both space and time, moving from West to South Asia (Indian subcontinent) in the Bronze Age and returning as a spring-sown crop. In contrast, its close wild relatives are true winter annuals that germinate with the autumn opening rains in low temperature habitats in SE Turkey and have > 100-fold greater genetic diversity than domesticated chickpea. While this combination suggests great potential for improving domestic chilling tolerance, until recently there were very few wild accessions to work with.

This changed with recent collection in SE Anatolia returning 100s of wild accessions that can be crossed with domestic chickpea. We screened the collection for low temperature flowering, podding and pod production rate in both Turkey and Australia and identified tolerant lines that have been crossed into PBA Captain. The data demonstrates that wild Cicer is more 'cold tolerant' than chickpea, with much more stable phenology, higher growth rates, earlier pod set and higher rates of low temperature pod production. Field evaluations of existing wild x domestic populations established to maximise genetic diversity rather than chilling tolerance demonstrate the feasibility of introgressing this adaptation into chickpea. At Mt. Barker in 2021, low temperature (<13.4°C) pod production rates were almost 3-fold greater in wild Cicer than domestic chickpea while the wild x domestic hybrids were intermediate between the two. Work is ongoing to better understand both the temperatures responsible for chilling stress and wild and domestic responses to these as well as their underlying genomic basis.

Notes:

Plant breeding research workshop
Focus Session 3 (cont.)

Identification of aluminium-tolerant chickpea genotypes and their potential use in chickpea breeding

Yong Jia, Karthika Pradeep, Murdoch University

ABSTRACT:

Identification of acid soil tolerant chickpea genotypes and their potential use in chickpea breeding

Yong Jia[1], Karthika Pradeep[1], Wendy Vance[1], Sharon Westcott[1], Lee-Anne Mcfawn[1], Jenifer Bussanich[2], Tefera Angessa[1], Richard Bell[1], Chengdao Li[1]
[1]Murdoch University, [2]DPIRD

Aluminum (Al) toxicity in acidic soil is a major limiting factor for chickpea yield improvement. Compared to cultivated chickpea Cicer arietinum L., wild Cicer lines display much higher genetic diversity in terms of Al tolerance, thus providing a valuable genetic pool for chickpea breeding. Using a hydroponics cultivation system, we assessed the Al tolerance of 303 wild Cicer lines and identified a significant quantitative trait locus (QTL) on chromosome 7 that is associated with Al tolerance. This QTL locus is positioned ~ 5Mb from our previously identified CaMATE2 organic acid transporter gene. We also identified a few Al tolerant genotypes of wild Cicer and extracted their specific genetic haplotypes. We further also verified the variation of Al tolerance between two cultivars (Hatrick, Slasher) and two wild Cicer lines (Gunas_062, CudiB_022C), the latter of which were clearly less inhibited by Al treatment. qRT-PCR analyses showed that both CaMATE2 and CaMATE4 were highly expressed in root tips and significantly up-regulated upon Al treatment (15 µM Al3+). In summary, our results provided new insights into the genetic basis of Al tolerance in chickpea and will facilitate the transfer of Al tolerant genotypes into commercial chickpea cultivars in the future.

Notes:

Jump into a scholarship to study WA oats

Two Nuffield Scholarships are available in 2024 aimed at advancing oat processing opportunities in Western Australia

NUFFIELD AUSTRALIA FARMING SCHOLARS

NUFFIELD SCHOLARSHIPS TO BENEFIT THE WESTERN AUSTRALIAN OAT INDUSTRY

Supported by the Processed Oat Partnership, the two scholarships will focus on research that benefits WA's milling oat industry.

This might include innovative solutions and opportunities in oat agronomy, processing, industry sustainability, breeding, marketing, oat food and beverage product development or oat processing waste.

MONDAY 6 MARCH
2024 scholar applications open

11 - 13 SEPTEMBER
2024 scholarships announced at the National Conference, Perth
nuffield.com.au/conference-2023

MORE INFORMATION
visit www.nuffield.com.au

THE PROCESSED OAT PARTNERSHIP

The Processed Oat Partnership is an industry-led program, supported by the State Government, providing a foundation for growth in the oat industry over the next 20 years.

The Grain Industry Association of WA (GIWA), through the GIWA Oat Council, is the lead program partner and advisor, providing a communications portal between stakeholders. The Department of Primary Industries and Regional Development is the lead State Government agency for the program.

GIWA Grain Industry Association of Western Australia

GOVERNMENT OF WESTERN AUSTRALIA Department of Primary Industries and Regional Development

WWW.GIWA.ORG.AU/POP

Plant breeding research workshop
Focus Session 3 (cont.)

An effective strategy for pre-breeding investigations into soil constraints amidst climate change

Roopali Bhoite, DPIRD, UWA Institute of Agriculture

ABSTRACT:

An effective strategy for pre-breeding investigations into soil constraints amidst climate change

Roopali Bhoite[1,2], Darshan Sharma[1,3], Karyn Reeves[1], Kerrie Forrest[4], Rosemary Smith[1], Mirza Dowla[1]
[1]DPIRD, [2]The UWA Institute of Agriculture, [3]Murdoch University, [4]Agriculture Victoria AgriBio

Key messages

- Soil sodicity is a predominant constraint to farm sustainability in Australia. Sodicity affects multiple traits and tolerance is required at all developmental stages to improve yield stability.
- Identifying and incorporating tolerant genes into popular varieties will improve yield stability.
- The rapid pre-breeding scheme designed for quantitative traits (presented in the paper) offers translation solution across crops and traits.

Aims

- Describe an effective pre-breeding scheme for enhancing tolerance to soil constraints in new varieties.
- Present outputs of the Genome-wide association studies (GWAS) for sodicity tolerance in wheat.

Results

GWAS identified 39 de novo SNPs, including 18 haplotypes on chromosome 1A, 1B, 1D, 2A, 2B, 2D, 3A, 3B, 5A, 5D, 6B, 7A, 7B, 7D for yield and yield-components tolerance. The unknown location of de novo SNPs on allelic sequence were identified (IWGSC RefSeqv1.0). Bioinformatic analysis of significant genomic regions associated with SNPs and haplotypes revealed candidate genes (Calcineurin B-like and dirigent protein, BHLH-, PHD- and HTH myb type -transcription factor) as a potential contributor to increased yield stability on sodic-dispersive soil. Genome-wide variant annotation identified functional SNPs, impacting gene expression and protein coding.

Conclusion

The integrated data arising from pre-breeding scheme for quantitative trait enhancement is widely applicable to any breeding programs. The functional SNPs/haplotypes, allele-specific markers, candidate genes and transcription factors could be used in molecular breeding, genomic selection and validated genes could be used in genome editing. The resulting varieties would contribute to ensuring grower profitability, farm sustainability and global food security.

New researchers' snapshots
Focus Session 4

Insect response to canola with modified sterol metabolism

Afroja Rahman, Murdoch University

In Australia, canola is the third largest crop and Western Australia is the major canola growing state producing about 40% of the nation's 2.7 million tonnes each year. With times, canola has been attacked by a wide range of insects and pests. Among them, green peach aphid (GPA), Myzus persicae and diamondback moth (DBM), Plutella xylostella are the most notorious one. Unfortunately, canola industries are currently facing a major challenge in developing long-term control strategies for insect pests. The widespread use of chemical insecticides and pesticides has a negative effect on non-target species, green eco-system, and it has resulted in increasingly growing resistance in the targeted species. To address the above issues, an innovative, more efficient, and environmentally friendly approach to control insect pests is needed, which will reduce human and environmental risks. One approach is to develop genetically modified (GMO) canola with modified sterol level in canola. Sterol especially phytosterol is an important component for harbivorous insects. Phytostrols are associated with insect life cycle, development, reproduction, and feeding preferences. It has been reported that insects' life cycle can be affected by modified sterol profile, but little attention has been paid to modified sterol profile in canola. GMO canola with modified sterol profile can be an alternative approach to control insect pests This project aimed to investigate insect (GPA and DBM) responses to canola with modified sterol profile. This study will improve our understanding of insect-plant interactions and help to develop a more sustainable and eco-friendly management practices.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

A case of mistaken identity? – new knowledge of root lesion nematode pests of grains in south-west WA

Rhys Copeland, Crop Biotechnology Research Group (CBRG), WA State Agricultural Biotechnology Centre (SABC), Murdoch University

ABSTRACT:

A case of mistaken identity? – new knowledge of root lesion nematode pests of grains in south-west WA

Rhys Copeland[1], John Fosu-Nyarko[1,2], Michael Jones[1,2], Sarah Collins[3]
[1]Crop Biotechnology Research Group, Murdoch University, [2]Food Futures Institute, Centre for Crop and Food Innovation, Murdoch University, [3]DPIRD

Key messages

- Four root lesion nematode species (*Pratylenchus* spp) were identified in six cereal paddocks in the south-west of WA.
- They included two recently identified and characterised species: *P. quasitereoides* and *P. curvicauda*, which have very similar characteristics and cannot be easily differentiated.
- *P. quasitereoides* and *P. curvicauda* were found in different paddocks and at different times in the same paddock, which may make it difficult, to ascertain if they are the same species.
- Molecular diagnostic tools are being developed to distinguish the two species so effective management strategies can be established.

Aims

To look for a diagnostic tool to delineate between the potentially misidentified root lesion nematodes *P. quasitereoides* and *P. curvicauda*.

Results

A survey and molecular characterisation of the ribosomal DNA sequences of Pratylenchus species collected from oat, barley and wheat paddocks in Cancanning, Darkan, Duranillin, Katanning, Kenmare, and Manjimup in WA's south-west were conducted in 2020. Four species of Pratylenchus: *P. curvicauda*, *P. neglectus*, *P. penetrans*, and *P. quasitereoides*, as well as one unidentified species, were found.

P. curvicauda and *P. quasitereoides* were identified in different paddocks, and the former was also identified exclusively from a paddock previously known to be predominantly infested with the latter. The two species have very similar morphometric and morphological features.

A thirty-base region with low intraspecific and high interspecific variability between the species was identified. A detailed assessment of the ribosomal DNA sequences is needed to develop a molecular diagnostic test to distinguish the two species.

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Conclusion

Work done so far strongly suggest *P. curvicauda* and *P. quasitereoides* are two separate species and are both present in the south-west of WA. Their identification, combined with the finding of unidentified species, indicates that more Pratylenchus species may be present in WA farms. Commercial barley (Hamelin and Stirling) and wheat (Mace and Wyalkatchem) varieties have previously been identified as susceptible to *P. curvicauda*, the most recently identified species in WA. Control strategies must be adjusted to include all existing species and avoid potentially hidden economic losses.

The successful development of a molecular diagnostic tool will aid a more accurate identification and the charge for better control strategies.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Investigating herbicide tank mixes to control HPPD-resistant wild radish (*Raphanus raphanistrum*)

Rex Cao, Nufarm Australia, UWA

ABSTRACT:

Investigating the cost-effective management of HPPD-resistant wild radish (*Raphanus raphanistrum*)

Rex Cao[1,2], Mark Slatter[2], Danica Goggin[1] and Roberto Busi[1]
[1]AHRI, UWA, [2]Nufarm Australia

Key messages

- Three field trials were conducted on two putative (42-2020 and 81-2021) and one previously reported (91-2020) Hydroxyphenyl pyruvate dioxygenase (HPPD)-resistant wild radish populations.
- The HPPD-inhibiting herbicide pyrasulfotole applied stand-alone did not effectively control field populations 81-2021 and 91-2020.
- Mesotrione was found to be much less effective on 81-2021 compared to population 91-2020 when applied as an off-label post-emergence treatment in the field.
- 81-2021 was cross resistant to diflufenican and pyrasulfotole, the tank mix of them only resulted in 48% mortality.
- A mix of picolinafen and pyrasulfotole restored mortality of population 81-2021 to 94%, suggesting picolinafen could be an effective way to manage HPPD and Phytoene desaturase (PDS) cross-resistant wild radish.
- Then, if combined with an additional mode of action, the mixture of diflufenican, bromoxynil, and pyrasulfotole with or without MCPA also effectively controlled HPPD-resistant wild radish.

Aims

- Investigate the optimal way to manage HPPD-resistant wild radish.
- Understand the mechanisms of HPPD resistance in wild radish populations.

Results

Field trials on three wild radish populations (42-2020, 81-2021, and 91-2020) revealed that the application of 50 g/ha pyrasulfotole (unregistered standalone use) resulted in 84, 35 and 58 % wild radish mortality, respectively, at 6 weeks after treatment. A mix of 50 g/ha pyrasulfotole + 250 g/ha bromoxynil resulted in 90, 81, and 84% mortality, respectively. Population 42-2020 was confirmed to be moderately resistant to pyrasulfotole in pot screening, but the field application of pyrasulfotle treatments were very effective. We observed reduced efficacy on 81-2021 and 91-2020 populations which was consistent to previous pot-screening and field results. Additionally, though both populations 81-2021 and 91-2020 showed similar level of reduced efficacy on pyrasulfotole treatments, 81-2021 was more resistant (56% mortality) to the post-emergence application of 96 g/ha mesotrione compared to 91-2020 (73% mortality), suggesting there are different mechanisms contributing to HPPD resistance in the two populations.

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Cross-resistance to the PDS-inhibiting herbicide diflufenican was also observed in 81-2021, where the combination of 25 g/ha diflufenican + 50 g/ha pyrasulfotole resulted in only 48% mortality. However, the picolinafen + pyrasulfotole tank mix improved the mortality to 94%. Furthermore, adding 250 g/ha bromoxynil in diflufenican and pyrasulfotole mix resulted in 100% mortality across both 81-2021 and 91-2020 populations. The four-way mix of diflufenican, bromoxynil, pyrasulfotole, and MCPA resulted in greater than 98% control across both HPPD-resistant populations, with no significant crop damage observed in later assessments. Mesotrione, however, resulted in significant crop damage when applied at post-emergence as it is an off-label application.

Conclusion

The field trials revealed that more than one HPPD resistant wild radish population is present in the WA wheatbelt. The two resistant populations responded differently to mesotrione, suggesting multiple mechanisms of resistance. The cross-resistance to HPPD and PDS herbicides in wild radish populations may result in the failure of a diflufenican + pyrasulfotole tank mix treatment. Yet, resistance could be mitigated by addition of bromoxynil to the mix. Field trials also suggested that picolinafen may reduce diflufenican resistance. This suggested that a picolinafen and pyrasufotole mix could be a cost-effective option for managing HPPD and PDS cross resistance. Three-way or four-way mixtures (diflufenican + bromoxynil + pyrasulfotole with or without MCPA) are also confirmed to deliver effective control of HPPD- and PDS- multi-resistant wild radish.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Investigating electric weed control in Australia

Miranda Slaven, DPIRD Northam

ABSTRACT:

Investigating the application of electric weed control in Australian fallow scenarios

Miranda Slaven, DPIRD Northam

Key messages

- Electric weed control utilises high-voltage current to burst the shoot and root cells of the weed, either killing the weed or suppressing growth.
- Results from field trials showed that electric weed control is highly effective in fallow scenarios, with results comparable to herbicide treatments.
- Electric weed control was generally found to be more effective in controlling broadleaf weeds, compared to grass species.

Aims

The aims of this study were to determine the applicability of electric weed control in fallow scenarios for eliminating natural and long-established weed populations, compare the effectiveness of single and double applications of electric weed control and herbicides as well as analyse the impact of application speed on the efficacy of electric weed control.

Results

Electric weed control was found to be effective at controlling established weed populations at two trial sites (Northam and Bassendean), based on NDVI (Normalised Difference Vegetation Index) and dry weed biomass data. The effectiveness of electric weed control at the Northam site was similar to that achieved by the applied herbicides. The completion of a second application of electric weed control at both trial sites increased the level of weed control achieved. This improvement was similar to that achieved by the double application of herbicides at the Northam site. While increasing the speed of application from 2 to 4 km-1 was expected to reduce control efficacy as it decreases the amount of energy transferred (comparable to reducing herbicide rate), no significant differences were determined. The control of broadleaf species was observed to be more successful than that of grass species, likely due to morphological differences.

Conclusion

The effectiveness of electric weed control applications in fallow scenarios was found to be high and equivalent to herbicide. However, it was observed that electric weed control was more successful in controlling broadleaf weeds than grass species. Additionally, increasing application speed did not impact the effectiveness of electric weed control. However, a greater variation in application speeds may reduce efficacy and a second application may become necessary to achieve optimal weed control. Overall, electric weed control was indicated to be a viable future option for use in Australian agricultural industries.

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New researchers' snapshots
Focus Session 4 (cont.)

Genome mining in fungi: uncovering a treasure trove of herbicidal molecules

Hera Nyugen, UWA

ABSTRACT:

Genome mining in fungi: uncovering a treasure trove of herbicidal molecules

Hera Nguyen[1], Zhou Shang[2], Joel Haywood[3], Yit-Heng Chooi[1]
[1]School of Molecular Sciences, UWA, [2]School of Pharmaceutical Sciences, Shandong University, [3]CCDM, Curtin University

Key messages

- Proof-of-concept of an emerging genome mining strategy providing an alternative approach to finding potential herbicidal molecules in fungi.
- Fungal plant pathogens are an excellent source of herbicidal molecules as they contain a plethora of phytotoxic natural products.
- My research uncovered a natural product that has HMG-CoA Reductase (HMGR) inhibitory activity, where HMGR is a novel herbicidal target.

Aims

To find a potential herbicidal natural product in fungal genomes with HMGR inhibitory activity using a resistance gene-directed genome mining approach.

Results

Using the emerging resistance gene-directed genome mining approach, I uncovered a biosynthetic gene cluster in the fungal plant pathogen *Cercospora beticola* that encodes for a natural product with HMG-CoA Reductase (HMGR) inhibitory activity. HMGR is a critical enzyme in the biosynthetic pathway of isoprenoids (e.g., cholesterol) and is a novel herbicide mode of action. The expression of the first genes in the *C. beticola* cluster's biosynthetic pathway resulted in an intermediate, pannorin, produced with reported HMGR inhibitory activity. Pannorin is structurally different from current HMGR inhibitors, with the potential of a novel HMGR inhibition scaffold making it a viable herbicide.

Conclusion

I present an emerging genome mining strategy that can assist in finding molecules in fungi with the desired herbicide modes of action. This strategy provides a viable and rational approach to unearthing many fungal natural products with inherent herbicidal bioactivity. Using this mining strategy, I found a natural product, pannorin, in a fungal plant pathogen with a novel HMGR inhibition scaffold, making it a plausible herbicide. During my PhD, I will conduct further work to assess pannorin's herbicidal activity and will continue to work on finding more natural products with novel herbicide modes of action.

New researchers' snapshots
Focus Session 4 (cont.)

How are heat and drought stresses functionally linked to glyphosate resistance?

Arslan Peerzada, DPIRD

ABSTRACT:
How are heat and drought stresses functionally linked to glyphosate efficacy and resistance development?

Arslan Masood Peerzada[1], Alwyn Williams[2], Chris O'Donnell[2], Steve Adkins[2], Catherine Borger[1]
[1]DPIRD, Northam, [2]University of Queensland, Gatton

Key messages

- Glyphosate at the recommended rate provided substantial control of susceptible biotypes of all the tested weed species when subjected to high temperature and drought stress individually.
- Drought stress exacerbated the adverse effect of high temperature on weed morpho-physiology, and the combined drought and heat stress had a more detrimental impact on weed's glyphosate susceptibility, especially in tolerant biotypes.
- Physiological and structural modifications, as a drought or heat stress avoidance strategy, could be associated with herbicide resistance mechanisms in weeds, especially non-target site.

Aims

- To investigate the impact of adverse climatic conditions on the growth and efficacy of glyphosate on summer fallow weed species, i.e., windmill grass (*Chloris truncata* R.Br.), common sowthistle (*Sonchus oleraceus L.*), and flaxleaf fleabane [*Conyza bonariensis* (L.) Cronq.].
- To determine if specific changes in weed morpho-physiological characteristics due to the adverse climatic conditions could explain the glyphosate ineffectiveness.

Results

Herbicide efficacy

Although glyphosate efficacy was reduced at below recommended field rates, complete control was recorded when it was applied at recommended rates for all the tested weed species. Windmill grass and flaxleaf fleabane showed more tolerance to glyphosate than common sowthistle under drought stress, unlike under high temperature. The combination of high temperature and drought stress greatly reduced glyphosate performance, particularly in tolerant windmill grass and flaxleaf fleabane biotypes.

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Weed biology

High temperature improved Windmill grass growth with higher leaf area and biomass accumulation, followed by reduced stomatal conductance; however, flaxleaf fleabane and common sowthistle produced fewer, smaller, and thicker leaves with higher chlorophyll content. Drought stress imposed structural changes on the leaves and affected their physiological performance; drought stress exerted a more pronounced impact on the physiology and growth of flaxleaf fleabane and common sowthistle than windmill grass. However, high temperature amplified the drought effect on weed growth and physiology, which was species- and biotype-specific.

Conclusion

Drought stress, either individually or combined with temperature, had a significant effect on weed morpho-physiology and species' glyphosate susceptibility. These changes in morpho-physiological characteristics under adverse climatic conditions could possibly influence the herbicide susceptibility by interfering with interception, retention, absorption, translocation, and metabolism. Using improved spraying techniques and herbicide technologies, as well as weather monitoring, will play crucial role in sustaining glyphosate performance under the changing climate.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Effectiveness of chickpea rhizobia across Western Australian agro-ecological zones

Yvette Hill, Murdoch University

ABSTRACT:

Diversity of chickpea nodulating rhizobia in Australian cropping systems

Yvette Hill[1], Jason Terpolilli[1], MacLean Kohlmeier[1], Alireza Agha Amiri[1], Ronald Yates[2], Graham O'Hara[1]
[1]Murdoch University, [2]DPIRD

Key messages

- Soil rhizobia that are distinct from CC1192 (Group N) are evolving to nodulate chickpea.
- There are diverse strains across the growing regions in WA.
- These 'new' rhizobia may provide a valuable resource for future inoculant development.

Aims

Conduct a survey for Chickpea nodulating Mesorhizobia across the agro-ecoloical zones of Western Australia.

Results

In this study 705 chickpea nodule isolates have been shown to carry the mobile symbiosis integrative conjugative element of CC1192 (ICEMcSym1192) and of these 28.47% have been identified as distinct from CC1192. The ratio between CC1192 and novel strains differs across the agro-ecological zones of Western Australia, including northern, eastern, central, sandplain areas and the Ord River irrigation scheme. These differences are most likely related to cropping history as well as farming practices. In the Ord River area alone, 13 different strain types were identified from 117 isolates. Of these, 92% were as effective as CC1192 in plant top dry weight which correlated to the plant top total % N for these treatments (R2=0.63). Preliminary data for the novel strains of the remaining areas seems consistent with that seen with the Ord River strains even though they represent very diverse Mesorhizobium groups. A subset of acid soil strains has been selected for assessment in nodulation and production values.

Conclusion

The newly nodulating strains of chickpea across WA are themselves diverse and distinct from CC1192 with a significant number as effective as the inoculant strain. These strains are a valuable resource for the study of possible implications posed with respect to the efficacy of these newly evolved strains or their competitive ability with CC1192 in chickpea cropping systems.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Wheat blast what is our risk?

Zia Hoque, DPIRD

ABSTRACT:

Wheat blast: emerging future disease threat of wheat in South Asia and Australia

Zia Hoque, Jean Galloway, Geoff Thomas, Jeff Russell, DPIRD

Key messages

- Wheat blast (WB) caused by a fungus named *Magnaporthe oryzae* Triticum (MoT) lineage (synonym *Pyricularia oryzae* Triticum) is one of the potential future disease threats of the wheat industry in Asia and Australia. This paper is trying to create awareness among growers, professionals, and researchers about wheat blast disease and its potential risk to wheat production systems Australia.

Aims

Present a brief overview of wheat blast disease globally, to give a clear understanding of its potential impact on the wheat industry and to provide information on identification of the disease.

Results

Wheat blast is a dreadful disease with limited control options that presents a global risk to wheat production. First detected in Brazil in 1985, it subsequently spread across major wheat producing areas of the country as well as several South American countries including Bolivia, Paraguay, and Argentina. In 2016, wheat blast was introduced to Bangladesh and Zambia via international wheat trade, threatening wheat production in South Asia and Southern Africa with the possibility of further spread across these continents. Wheat blast is a fast-acting, severe disease which predominantly affects wheat heads that become fully or partially bleached and result in poor quality, small, shrivelled grains with a reduced test weight. Yield losses are often significant and can lead to 100% crop loss when environmental conditions are conducive for disease epidemics. In 2009, wheat blast reduced Brazil's national wheat production by 30 per cent. Wheat blast is dependent on both seed and airborne spore spread. The disease poses risk for all wheat production regions but is of greatest threat to grain growing regions in warm, humid, and wet environments. Rainy and humid weather conditions during heading stage of wheat crop have been found to enhance the occurrence and development of wheat blast disease. Quarantine measures to restrict the spread of pathogen from infected region to disease-free areas and countries and to avoid potential outbreaks in new regions are the best way to manage risk of this disease. Within Australia (and Western Australia) surveillance for this disease to demonstrate disease absence is carried out regularly. Several management strategies for mitigating the effects of wheat blast exist, but a holistic and sustainable IDM approach is essential. The best option to tackle the wheat blast in infected regions is growing resistant varieties, but availability of resistant varieties is still limited.

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Conclusion

Presently, wheat blast is counted as a significantly damaging disease of wheat worldwide. From its origin in Brazil in 1985, it has spread to many South American countries and made intercontinental jumps to Bangladesh in South Asia and Zambia in Africa, infecting around three million hectares of wheat within a decade. Although most wheat-growing countries of the world are still free from this disease, it has a potential to spread on seed into other countries especially Asia and Australia where it could be very damaging as global warming is a significant issue. This is an alarming situation for future world food security. The WB pathogen is fast-evolving, highly aggressive, and potentially devastating in various agro-ecological zones; therefore, a globally intensive effort is required to prevent its damage and limit its introduction and spread. Strengthening biosecurity and quarantine, adequate routine surveillance, information sharing, awareness creation, pre-preparedness and proactive research planning is the best ways to tackle the invasion and manage wheat blast disease.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Revealing better metabolic adaptations in roots of bread wheat lines differing in salt tolerance mechanisms

Bhagya Dissanayake, UWA

ABSTRACT:

Revealing better metabolic adaptations in roots of bread wheat lines differing in salt tolerance mechanisms

Bhagya Dissanayake[1], Rana Munns[1], Christiana Staudinger[2], Nicolas Taylor[1], Harvey Millar[1]
[1]UWA Crawley, [2]The University of Natural Resources and Life Sciences, Vienna

Key messages

- Higher metabolic capacity towards root lignification improves root tolerance to salinity stress.
- Wheat varieties with higher Na+ exclusion capability induces energy metabolism within the roots under salinity.

Aims

- To examine the molecular mechanism underpinning root tolerance of wheat to salinity stress.
- To develop molecular markers associated with better root adaptations to salinity.

Results

Gladius showed the least tolerance to salt compared to Mocho de Espiga Branca (Mocho), Westonia Nax1 and Westonia Nax2. Results revealed a common metabolic bottleneck during salt exposure which exists around the end of glycolysis, and which defines the fate of downstream pyruvate metabolism. Tissue tolerant wheat variety Mocho de Espiga Branca and enhanced salt excluding Westonia Nax lines showed constitutively higher metabolic capacity towards lignification. Westonia Nax lines showed metabolic arrangements to induce energy production in order to fulfil energy demand within the roots. Less salt tolerant cultivar Gladius showed re-configuration of metabolism around pyruvate to facilitate the downstream metabolism. Putative protein biomarkers associated with root tolerance were developed.

Conclusion

Higher root lignification capacity is associated with root tolerance to salt. Putative biomarkers identified in this study could be utilised in future breeding programs to select wheat lines with better adaptations of roots to salinity stress.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Improving farming system profitability, management of greenhouse gas emissions and climate resilience in the low- and medium-rainfall zones of WA: grower perspectives

Dayna Hutchison, DPIRD

ABSTRACT:

Improving farming system profitability, management of greenhouse gas emissions and climate resilience in the low- and medium-rainfall zones of WA: grower perspectives

Dayna Hutchison, DPIRD

Key messages

- In 2022, The WA Farming Systems Project conducted a grower consultation process across the low and medium rainfall zones to identify key research priorities and knowledge gaps, with a focus on system break options for increased diversity and profitability, capturing early sowing opportunities, and greenhouse gas emissions management. Whilst there were regional differences in core farming system drivers, risks and management considerations, a number of highlighted themes consistent across regions were raised to form a set of research priorities as identified by growers.

Aims

Growers must continuously adapt to strategic risks to remain internationally competitive, sustainable, and profitable. Systems based research can identify strategies on how to best manage existing production system risks and prepare for potential future scenarios in ways that enhance grower profitability and climate resilience and sustainability outcomes. A grower consultation process was conducted to guide the systems-based research conducted by DPIRD in the upcoming years.

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Results

A stakeholder engagement process was conducted to identify key research themes aligned to three primary outputs: key decisions around early sowing opportunities; system break options for increased diversity, and current understanding of greenhouse gas emissions management. This process has shown that the themes that require prioritisation in upcoming research activities include:

- Identification of long-term risks associated with continuous cereal systems and quantification of diversity requirements for maintenance of productive and resilient farming systems.
- A profitable legume crop for improved nitrogen fixation, with further understanding of how often, when and where it is to be sown.
- Further understanding of emissions mitigation strategies, and what effect this will have on the farming system's viability economically.
- Nitrogen use efficiency and how rotation strategies can be used to reduce input of synthetic fertilisers.
- Integration of ag tech into decision making processes for enhanced efficiency.
- Opportunities for early sowing – how to maximise water use efficiency whilst minimising risk.

Notes:

New researchers' snapshots
Focus Session 4 (cont.)

Farm strategy and tactics matter

Michael Young, UWA

ABSTRACT:

Farm optimisation modelling to improve rotation choice on a mixed enterprise farm in a variable environment

Michael Young[1,3], John Young[1], Ross Kingwell[2,3,4], Phil Vercoe[3]
[1]Youngs Farm Analysis, [2]AEGIC, [3]UWA, [4]DPIRD

Key messages

- Selecting the 'best' suite of rotations to apply on a farm is complex. This analysis considers ~3500 different rotation phases.
- It is strategically optimal to run continuous pasture on sandy soils in the Great Southern region.
- Tactical adjustments to canola, by up to 63%, in response to unfolding weather conditions can increase farm profits.

Aims

Provide a deeper understanding of what drives broadacre farm profitability in WA through advanced farm modelling.

Results

Results indicate that tactically adjusting rotation choice in response to the unfolding weather conditions increases farm profit by 6% for the most profitable weather-year and 23% for the least profitable weather-year. It is optimal to adjust canola area by up to 63% depending on break of season timing and the presence/absence of follow up rains. The best paddocks to adjust depend on soil type and land use history.

Conclusion

A new whole farm optimisation model (AFO) is a powerful tool capable of performing a wide range of farm analyses. AFO was applied in this analysis to identify the optimal suite of rotations and tactical rotational adjustments on a typical Great Southern farm. Modelling results indicate that tactically adjusting rotation choice in response to unfolding weather conditions increases expected farm profit by $30,400.

Notes:

Plenary 3

Grain crop residues to hydrogen and ammonia

Louise Brown, Hydgene Renewables

Hydrogen, with a negative carbon footprint, can be generated from renewable biomass sources by means of a novel biocatalyst technology.

- Approximately 40% of the weight of straw is comprised of sugars that can be utilised to produce hydrogen.
- The hydrogen can be used for the production of renewable fertiliser, as well as for transport and power generation.

Critical to reaching net-zero global targets, and the success of Australia's agricultural industry and grain sector, is access to low-cost green hydrogen for renewable fertiliser production. HydGene Renewables, with the support from GRDC and CSIRO through the BRII grant program, has optimised the development of its biocatalyst solution for the efficient conversion of sugars from wheat and barley straw into hydrogen. Production can be done on-site, or locally, eliminating the need for complex and expensive storage and transportation infrastructure. The hydrogen producing biocatalyst solution is deployed in a modular cartridge and generates carbon-negative hydrogen of high purity. HydGene is now scaling its technology with a focus on supporting the decarbonisation of major hydrogen industries, including ammonia production; and is exploring ways where the hydrogen can be used on farms, such as for powering vehicles and machinery, and as a reliable energy source.

Notes:

Grain crop residues to hydrogen and ammonia using the MIHG process

Greg Perkins, Wildfire Energy Pty Ltd

Using the MIHG process technology developed by Wildfire Energy, hydrogen with a negative carbon footprint can be generated from renewable biomass such as grain crop residues. The MIHG technology uses gasification to break down all components of the biomass/waste at high temperatures into syngas (CO and H2) and biochar which can be used to sequester carbon. The syngas can be further purified into hydrogen for use as an energy carrier or for conversion to ammonia.

The novel feature of the MIHG process technology is that the gasification is performed in a simple low-cost reactor and conducted in batches with a moving injection point which produces syngas continuously enabling the biochar to be removed as a cold solid at the end of a batch.

Wildfire Energy, with the support from GRDC and CSIRO through the BRII grant program, has optimised the design of the MIHG waste to hydrogen technology which can process a wide range of feedstocks including grain crop residues, all types of other biomass and even residual domestic and commercial wastes and built a pilot plant to demonstrate the conversion of biomass/wastes into hydrogen. In parallel Wildfire has been progressing the design for initial commercial deployment.

In this presentation Wildfire summarise its MIHG process technology and show pictures and videos of its MIHG pilot plant in operation and present 3D models of what a commercial MIHG waste to hydrogen plant could look like.

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