PERTH
WESTERN AUSTRALIA

MONDAY 22ND
TUESDAY 23RD
FEBRUARY 2021

GRAINS RESEARCH UPDATE, Perth

Program Book

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Proudly convened by:

GIWA
Grain Industry Association of Western Australia

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2021 GRAINS RESEARCH UPDATE, Perth

22nd and 23rd February 2021

Crown Perth, Burswood

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#GRDCUpdates

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

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#GRDCUpdates **Grains2021**

Welcome – GRDC Senior Regional Manager - West

I am proud to welcome you to the 2021 annual Grains Research and Development Corporation (GRDC) Grains Research Update, Perth – Western Australia's premier grains research forum.

This event plays an important role in enabling growers, advisers, researchers and industry service providers to connect and share knowledge to further the State's thriving export-focused grain industry, worth more than $6 billion per annum.

It is especially pleasing to be together here at this forum given the significant challenges posed by COVID-19 during the past year, which has impacted on many industry events.

However, it is important to guard against complacency and I remind everyone to adhere to the WA Department of Health guidelines and:

- Practise physical distancing
- Practise good personal hygiene (wash hands often with soap and water, or hand sanitiser and cover coughs and sneezes with a tissue or use your elbow)
- Stay home if feeling unwell and if you are experiencing flu-like symptoms get tested for COVID-19.

GRDC Senior Regional Manager – West, Peter Bird

While COVID-19 did have many consequences in the 12 months since the last Perth Update was held, from an overall production perspective WA growers were not greatly impacted and the State's grain harvest totalled 16.5 million tonnes – up more than 40 per cent on the 11.5mt produced in 2019.

Important grain industry events also proceeded, including the official opening of the $7.5 million Grains Research Precinct, comprising facilities at Murdoch and Curtin Universities.

This precinct was made possible by a GRDC Infrastructure grant and had significant co-investment from Murdoch University, Curtin University and the Department of Primary Industries and Regional Development (DPIRD).

It provides vital infrastructure for research in crop pathology, plant physiology and genetic improvement, and will benefit grain growers in WA and nationally, and support science capability development.

Grains Australia Ltd, that will combine a multitude of industry good functions under one organisation, was also announced. These functions are likely to include trade and market access, commodity variety classification, market information and education.

Grains Australia is an initiative of the GRDC, Grain Growers Ltd (GGL), Grain Producers Australia (GPA) and Grain Trade Australia (GTA) and its inaugural Chair is WA grain and livestock producer Terry Enright.

In 2020, the GRDC was also pleased to announce the appointment of international food and agriculture executive Anthony Williams as its new Managing Director and Chief Executive Officer.

This year's GRDC Grains Research Update, Perth, does not include international speakers and some presenters will join via video conference. However, I am firmly of the view the program remains as relevant as ever to growers, and I thank the Updates organising 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 50 concurrent sessions that will address important issues ranging from 'the big picture – market focus', crop protection and varieties, through to soils and nutrition, heat and drought tolerance, agronomy and farming systems.

'New researcher snapshots' will also form part of the concurrent sessions.

Extended focus sessions will cover 'strategies towards carbon neutral for the WA grains industry'; new chemicals and chemical use management strategies; and 'Grain Innovate – Innovation through disruption'.

In addition to the wealth of information delivered during these sessions, the GRDC Grains Research Update, Perth, is a great opportunity for networking and 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 and event coordinator the Grain Industry Association of WA 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

2021 Grains Research Update, Perth

Hosted by:

GRDC — Grains Research & Development Corporation

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Need Information?

Registration Desk

The Registration Desk will be manned 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 2021 Grains Research Update, Perth to enable you to select which presentations you wish to attend and provide key messages for each presentation.

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

A feature of Tuesday's program is the opportunity to attend one of three Focus Sessions. These 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 2021 GRDC Grains Research Update app, search and download Evise Events from the Apple App Store or Google Play Store on your device.
- Once downloaded, open Evise Events and click Tap to Start
- Enter the event code **GRDC**

Available on the App Store | GET IT ON Google play

List of Attendees

Included in the Event App is a List of Attendees and Event supporters for the 2021 Perth Update. This list will help you network and follow up on valuable contacts.

Wifi

Complimentary WiFi is available for all attendees.

- Select 'Crown Public Access'
- Access code: **GRAINS2021**

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Charging Station

Two mobile device Charge Stations are available — check the Crown Perth Floor Plan for locations.

Stay Hydrated

AGT

Water will be available throughout the Foyer in disposable COVID compliant water bottles. A take home water bottle proudly sponsored by AGT is in your satchel bag.

Fuel your body and mind — Catering breaks

The Exhibition Space is located in the Foyer where the catering breaks will be held.

Please note, if you have any dietary requirements you have already made us aware of, there will be a special dietary catering station – check the Crown Perth Floor Plan for the location.

Coffee Breaks

FMC An Agricultural Sciences Company | UPL OpenAg

Nothing beats a caffeine boost. There will be three Coffee Carts this year located throughout the Exhibition Space in the Foyer. Open all day with COVID compliant disposable cups.

The Coffee Carts are proudly sponsored by FMC and the take-home Coffee Cup in your satchel bag is proudly sponsored by UPL.

Networking Event – Day 1

CBH GROUP

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

Speakers and Sponsors Thank You – Day 2

Following the last Plenary Session on Day 2, join us for thank you refreshments from 4.20pm to 5.30pm to thank all the Research Updates speakers and sponsors. This will take place in the Crown Ballroom 3 Foyer.

Elbow bump instead

A few reminders to physical distance yourself while attending Research Updates. The GIWA Team have masks available if you would prefer to wear one. If you begin to feel unwell with cold or flu like symptoms, please advise GIWA staff, leave the event and get tested for COVID.

On arrival please check in to SafeWA either by the register or the App.

We value your Feedback

We aim to continually improve each Research Update event by listening to your thoughts. Help us by completing the Evaluation Form located in your satchel bag and on your Event App.

2021
GRAINS RESEARCH UPDATE, Perth

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Program
DAY 1 — Monday 22nd February 2021

Time	Program			
8.00 am	REGISTRATION & COFFEE			
9.00 am	PLENARY 1 – Grand Ballroom			

9.00 am **Welcome** — Darrin Lee, Chairman, GRDC Western Panel

GRDC INVESTMENT DIRECTIONS

9.05 am **Opening and future directions for GRDC investments in grains RD&E** — John Woods, Chairman GRDC

'Seed of Light' presentation — John Woods and Darrin Lee

CARBON NEUTRAL GRAIN FARMING IN WA BY 2050?

9.30 am **Climate change and agriculture** — Mark Howden, Director, Climate Change Institute, Australian National University

The market has spoken — Elizabeth O'Leary, Head of Agriculture, Macquarie Infrastructure and Real Assets

10.20 am **Panel discussion**

Time	SESSION 1 — The Big Picture – Market Focus	SESSION 2 — Varieties and Agronomy	SESSION 3 — Crop Protection – Disease	SESSION 4 — Soils and Nutrition
11.00 am	MORNING TEA			
11.40 am	**Barley 2030 opportunities – Vietnam and India** Mary Raynes, Australian Export Grains Innovation Centre	**Balancing the trade-offs in wheat variety choices to increase profit and reduce risk** Dion Nicol, Department of Primary Industries and Regional Development	**How does DMI fungicide resistance impact on spot type net blotch control in field, and can we do other things to help reduce disease pressure?** Geoff Thomas, Department of Primary Industries and Regional Development	**Potential from deep ripping heavy soils** Wayne Parker, Department of Primary Industries and Regional Development
12.10 pm	5 Min Moving			
12.15 pm	**Wheat 2030 Opportunities** Ross Kingwell, Australian Export Grains Innovation Centre **SE-Asian noodle market: value and opportunity for the Australian wheat Industry** Larisa Cato, Australian Export Grains Innovation Centre	**Patterns of crop water use in a long term rotation trial** Ken Flower, University of Western Australia	**Identifying when it is financially beneficial to alter fungicide dose when resistance is developing** Frank van den Bosch, Centre for Crop and Disease Management, Curtin University	**Deep ripping in 'Other' soil types: What are the options and are they effective?** Nathan Craig, West Midlands Group
12.45 pm	LUNCH			

This program may be subject to change.

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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Program DAY 1 — Monday 22nd February 2021 *(continued)*

1.45 pm	SESSION 5 — The Big Picture	SESSION 6 — Heat and Drought Tolerance	SESSION 7 — Crop Protection – Weeds	SESSION 8 — Soils and Nutrition
	Changing market chemical MRLs and impacts for growers Gerard McMullen, Chair, National Working Party on Crop Protection	**Increasing heat tolerance in wheat** Karine Chenu, Queensland Alliance for Agriculture and Food Innovation, University of Queensland	**Are seeding rate, seed size and row spacing important factors for the control of annual ryegrass in canola crops?** **Is annual ryegrass evolving in response to intensive weed control in Australian dryland cropping systems?** Mike Ashworth and Roberto Lujan-Rocha, Australian Herbicide Resistance Initiative, University of Western Australia	**Strategies and principles for liming acidic soils** Paul Damon, University of Western Australia **Liming – It's a no brainer…** Chad Reynolds, DPIRD
2.15 pm	5 Min Moving			
2.20 pm	**The road to real-time on-farm monitoring – connectivity, IoT sensors and data platforms** Kari-Lee Falconer, DPIRD	**How heat tolerant are our wheats?** Rebecca Thistlethwaite, University of Sydney **What solutions can we expect from plant breeding?** Dion Bennett, Australian Grain Technologies	**Weed ecology = weed management** Catherine Borger, DPIRD	**Tricks and tips in managing subsoil acidity towards doubling water use efficiency: recent lessons building on 25 years of research** Gaus Azam, DPIRD
2.50 pm	5 Min Moving			
2.55 pm	**Impact of land prices on purchase, lease and management decisions** Ashley Herbert, Agrarian Management	**Increased sowing opportunity offered by deeper sowing across the grain growing regions of Western Australia** Sarah Rich, CSIRO **Deep sowing of long coleoptile wheats increases grain yields and water productivity in the eastern WA wheatbelt** Greg Rebetzke, CSIRO	**TruFlex/Clearfield (XC) GM dual herbicide stacked canola for integrated management of annual ryegrass** Christopher Preston, University of Adelaide	**The health and nutrition of Western Australian soils** Andreas Neuhaus, CSBP
3.25 pm	AFTERNOON TEA			
4.00 pm	SESSION 9 — Farming Systems	SESSION 10 — Heat and Drought Tolerance	SESSION 11 — Crop Protection – Disease	SESSION 12 — Agronomy
	Monitoring every crop sequence across the entire Western Australian Wheatbelt – sometimes more is better Roger Lawes, CSIRO	**Pre-breeding canola for heat stress tolerance – a prototype facility for large-scale screening at flowering stage** Wallace Cowling and Sheng Chen, University of Western Australia	**Soil amelioration alters soil biology, soilborne disease and nematode pests of cereal crops – what are the implications?** Sarah Collins, DPIRD	**Bacterial ice nucleation activity in rainfall and on crop residues may be why rainfall prior to frost events and stubble retention increases frost damage in WA cropping systems** Ben Biddulph and Amanuel Bekuma, DPIRD
4.30 pm	5 Min Moving			
4.35 pm	**Profitable Rotation in Western Australia** Stacey Bell, Farmanco **Profitable break crops in the Low Rainfall Zone** Andrew Fletcher, CSIRO	**Mapping weather variability and recent changes in weather and crop growth drivers for the eastern and western grainbelt, and potential impacts on crop growth and yield** Meredith Guthrie, DPIRD	**First report of SDHI resistance in barley spot form net blotch in WA** Fran Lopez-Ruiz, Centre for Crop and Disease Management, Curtin University **Using a disease incident threshold based approach for Necrotrophic disease fungicide control with reference to net blotch on barley** Kith Jayasena, DPIRD	**Optimising the Gross Return value proposition when comparing Farmer Retained OP TT vs Hybrid CT and TT canola with varying seed sizes and plant population targets** David Tabah and Justin Kudnig, Pacific Seeds
5.05 pm	Networking Event (Sponsored by the CBH Group) — Exhibition Space Foyer			

This program may be subject to change.

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

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Program DAY 2 — Tuesday 23rd February 2021

8.40 am	**WELCOME COFFEE**			
9.10 am	**SESSION 13 — Varieties and Agronomy**	**SESSION 14 — Crop protection – Pests**	**SESSION 15 — Crop Protection – Weeds**	**SESSION 16 — Agronomy**
	Early decisions pay when growing chickpeas and faba beans Stacey Power, DPIRD	**Are our plant biosecurity measures up to the challenge (... are we 'COVID' ready)?** Sonya Broughton, DPIRD	**Feathertop Rhodes grass control** Mark Congreve, ICAN	**When to take advantage of early seeding opportunities for canola** Jackie Bucat, DPIRD
9.40 am	**5 Min Moving**			
9.45 am	**Legume break crops in 2021** Mark Seymour, DPIRD With a panel of: • Nathan Craig, West Midland Group • Geoff Fosbery, ConsultAg • Scott Wandell, grower, Esperance	**What's going on with Fall armyworm and Russian wheat aphid in WA?** Svet Micic and Dustin Severtson, DPIRD	**Glyphosate resistant ryegrass control comparison with new generation glyphosate wetter packages versus traditional formulations alone and combined with innovative double knock strategies** Michael Lamond, SLR	**Canola yield response to sowing date – from a few trials to many locations using simulation modelling** Imma Farre, DPIRD
10.15 am	**MORNING TEA**			
10.55 am	**SESSION 17 — Varieties and Agronomy**	**SESSION 18 — General**	**SESSION 19 — New Researcher Snapshots**	**SESSION 20 — Farming Systems**
	Barley varieties and agronomy tips for 2021 Blakely Paynter, DPIRD	**Pesky pests!** **Control Red legged earthmites using crash grazing** **Know what invertebrates are associated with weed seed control systems** **What to do if you see snails influx for the first time – snails management 101** Svet Micic, DPIRD	**Benchmarking soil amelioration outcomes using paddock yield and water use efficiency data** Jenni Clausen, DPIRD **Topsoil water repellence can benefit early growth and nutrition of furrow-sown wheat by increasing soil wetting depth** Simon Yeap, Murdoch University	**Profitable mixed farming systems in Western Australia** Stacey Bell, Farmanco
11.25 am	**5 Min Moving**			
11.30 am	**Oat crop varieties and agronomy tips for 2021** Georgie Troup, DPIRD	**Microbiome engineering as a tool to increase crop production in the 21st century** Falko Mathes, Bioscience Pty Ltd	**Cracking the code of group H cross-resistance in wild radish** Bowen Zhang, University of Western Australia **Minimising the impact of high temperature at flowering on spikelet fertility** Camilla Hill, Murdoch University	**The value of stubbles and chaff from grain crops as a source of summer feed for sheep** Dean Thomas, CSIRO
12.00 pm	**LUNCH**			

This program may be subject to change.

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

Program DAY 2 — Tuesday 23rd February 2021 *(continued)*

12.50 pm	FOCUS SESSIONS			
	Focus Session 1	Focus Session 2	Focus Session 3	New Research Snapshots
12.50 pm	**Strategies towards carbon neutral for the WA grains industry** **Convenor:** David Bowran, Yaruna Research David Bowran will lead a discussion with a panel of scientists and policy makers on how the Australian Government's Carbon Farming Initiative and Emissions Reduction Fund (ERF) can reward WA grain growers for adopting carbon farming.	**New and emerging crop protection products – What / where is the fit?** **Convenor:** Michael Lamond, SLR This focus session will review new herbicide products. Michael Lamond will lead a panel of independent agronomists and agricultural consultants to review new products. Panellists include: • Tim Boyes, Agvivo, Northam • Bill Moore, Elders Lead Agronomist, Perth • Luke Marquis, South East Agronomy Services, Esperance • Grant Thompson, Crop Circle Consulting, Geraldton Company Representatives will be in attendance to comment on technical aspects of each product.	**GrainInnovate – Innovation through disruption** **Convenor:** Fernando Felquer, GRDC Robert Williams, Artesian Investments and a series of presentations from recent startup initiatives with application to the grains industry. The $50 million GrainInnovate Fund was established as a partnership between the GRDC and Artesian Venture Partners. The fund invests in ag-tech start-ups developing innovative solutions to Australia's grain growers' constraints. This session will provide an opportunity to hear from the executive of GrainInnovate and leaders of six of the agri-tech start-ups in the fund's portfolio: • Laconik – (WA) • Datafarming – (QLD) • Telesense – (VIC) • Flurosat – (VIC) • Zetifi – (NSW) • Soil Carbon Co – (NSW)	**Unlocking the potential of ironstone gravels** Fran Brailsford, University of Western Australia **Optimum nutrition for ameliorated gravels** Jordy Medlen and Justine Tyson, ConsultAg **The role of polymers to improve water harvesting on sodic soils in the low rainfall zone of the WA wheatbelt** Rushna Munir, DPIRD **Weed management and control under different soil amelioration practices** Sultan Mia, DPIRD **New horizons in the detection of fungicide resistance – combining genetic testing with direct assessment of fungicide performance** Noel Knight, CCDM, Curtin University **Can you spot the difference?** Silke Jacques, CCDM, Curtin University **Putting the pulse back into chickpeas – how a 'wild approach' could revamp a one-time WA favourite** Toby Newman, CCDM, Curtin University **Effects of a native symbiotic fungus on crop growth and nutrition under controlled-environment conditions** Khalil Kariman, University of Western Australia
2.55 pm	**PLENARY 2**			
	PRECISION GRAIN FARMING • **Progress in the technologies and grower experiences with variable rate technology for fertilisers and chemicals** — Tim Neale, DataFarming — Mark Branson, Grower, Stockport, South Australia — Ben Cripps, Grower, Binnu Western Australia			
4.15 pm	**Close**			
4.20 – 5.30 pm	**Sponsors and speakers thank you refreshments — Crown Ballroom 3 Foyer**			

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

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GRAINS RESEARCH UPDATE, Perth

Day 1 – Contents

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

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Day 2 – Contents

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THE 2020-2022 GRDC WESTERN REGIONAL PANEL

January 2021

CHAIR - DARRIN LEE

Mingenew/Dongara, Western Australia

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

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DEPUTY CHAIR - JULES ALVARO

Merredin, Western Australia

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

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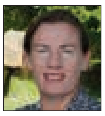
JULIET MCDONALD

Coorow, Western Australia



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

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ROHAN FORD

Binnu, Western Australia

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

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SUZANNE WOODS

Calingiri, Western Australia

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

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GARY LANG

Wickepin, Western Australia

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

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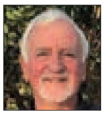
JOHN BLAKE

Albany, Western Australia



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

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NATASHA AYERS

Vasse, Western Australia

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

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RICHARD WILLIAMS

Perth, Western Australia

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

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DAN MULLAN

Perth, Western Australia

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

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DR PETER CARBERRY

Toowoomba, Queensland

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

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2021 GRAINS RESEARCH UPDATE
Perth – Floorplan

Climate Change and Agriculture

Mark Howden, Director, Climate Change Institute, Australian National University

The basic physics of how atmospheric concentrations of radiatively active gases (like carbon dioxide) affect climate has been known for over 160 years. Confidence in these relationships is supported by a huge range of other evidence including recent measurements and the palaeo record. So, it is unsurprising to see global temperatures rise as a result of the large GHG emissions arising from human activity which have increased atmospheric concentrations of CO^2 from 280ppm pre-industrial to 417ppm currently.

This has increased global temperatures by 1.1 degrees celcius since the pre-Industrial period, altered rainfall patterns and increased rainfall intensities, vapour pressure deficit, sea level rise and the risk from various climate extremes amongst other things. The rate of change is accelerating. These changes have already affected agricultural systems globally and in Australia, on average reducing yields, increasing yield variability and changing land-use between cropping and livestock grazing at some margins. Consequently, sustainable agriculture needs to be climate-adaptive agriculture.

These climate changes however, appear to be just the start of much larger changes given ongoing growth in emissions in spite of the 'Paris Agreement'. Current trajectories of emissions would lead to temperature increases in excess of 4 degrees celcius and the current Paris Agreement commitments around 3.2 degrees celcius. To achieve the Paris Agreement goal of 2 degrees celcius, emissions have to drop to net zero by about 2070 starting now. To reach 1.5 degrees celcius requires emissions to drop to net-zero by about 2050 and very substantially by 2030. There will hence be pressure for agricultural systems to contribute to the goal of lower GHG emissions, adding to the complexity of the challenges. These changes will happen in the context of increased challenges associated with biosecurity, land degradation and societal changes amongst many others.

Hence, the demand for effective, informed, sustainable and integrated climate change responses will likely increase substantially over the next decades. This presentation will frame the environment in which a set of rich climate adaptation and emission-reduction response strategies will help agriculture manage in a changing climate.

Notes:

The Market has Spoken

Elizabeth O'Leary, Head of Agriculture, Macquarie Infrastructure and Real Assets

Institutional capital and consumer markets are increasingly demanding the decarbonisation of all sectors, including agriculture, creating an imperative for farmland owners and operators to respond in a meaningful and measurable way. This presentation will examine the investor perspective and explore the opportunity for the Australian agriculture sector to take a leadership position in a decarbonising economy.

Notes:

Barley 2030 opportunities – Vietnam and India

Mary Raynes, Australian Export Grains Innovation Centre

ABSTRACT:

Australian barley market opportunities towards 2030

Mary Raynes, AEGIC

Key messages

- Over the next decade Australia will need to maintain and grow its presence in barley markets for malting and feed outside China.
- China will remain the largest malting barley importer globally towards 2030 with ongoing technical engagement important.
- Information packages that reinforce the quality, value, and fit of Australian barley to suit specific market segments and regions will support greater overseas use of Australian barley.

Aims

Examine a range of global barley markets and provide insights to the Australian barley industry on their current and future barley needs towards 2030.

Results

China will remain an important barley market for the Australian industry. Japan's demand for high quality food and feed barley will remain. Saudi Arabi's demand for feed barley is remains significant. Vietnam and India's growing beer consumption creates new opportunities for malting barley. Malting barley use and malting barley capacity will continue to grow across South America. Feed barley market opportunities exist in the South East Asia including Thailand, Philippines, Vietnam and Indonesia. Australia will have to be price competitive into the Middle East nations and Iran for feed. Small opportunities for malting and malt barley exist across the Sub-Saharan Africa region.

Conclusion

The Australian barley industry supported by government should conduct a comprehensive review of alternative market opportunities. The review should include detailed market analysis including the value and volume of opportunity, the suitability of Australian barley for key end uses and any market access constraints.

Develop a 'in-market' technical engagement strategy for identified countries including China with involvement from participants at multiple levels within the Australian industry.

Notes:


Hammer CL Plusϕ wheat
The highest yielding AH Clearfield® wheat.
Stingϕ wheat
Suited to low-medium rainfall areas, with quicker maturity.
Denisonϕ wheat
A very unique 'slow-very slow' spring maturity.
Catapultϕ wheat
A high yielding AH, suited to late April/early May sowing.
Illaboϕ winter wheat
Dual purpose winter wheat for early sowing.
Beastϕ barley
Quick maturing, very high yielding for low-medium rainfall areas.
Coyoteϕ lupin
Widely adapted with high and stable yields.
Looking for a new variety for 2021?
AGT
For further information
Alana Hartley, Marketing Manager WA
E alana.hartley@agtbreeding.com.au
M 0417 919 299
agtbreeding.com.au

Wheat 2030 Opportunities

Ross Kingwell, Australian Export Grains Innovation Centre

ABSTRACT:

Over the last 20 years Australian wheat export sales have pivoted away from Middle East markets towards a greater focus on South East Asian (SEA) markets.

Over the next 10 years wheat production in Western Australia (WA) increasingly will continue to focus on markets in SEA, and opportunistically on eastern Australia whenever persistent drought ravages this area. Limited growth in wheat production in eastern Australia is expected over the next decade, yet Australia's domestic demand, mostly in eastern Australia, will increase due to its growth in population and people's food preferences that increasingly draw on feed grains.

The implication is that WA will play an increasingly important wheat export role in Australian grain production. Bumper years in eastern and western Australia will ensure Australia remains a minor, yet still important, source of internationally traded wheat. However, severe drought in eastern Australia will see eastern Australia become an opportunistic market for WA grains, including wheat. However, in most years WA wheat will principally flow to international markets, especially growing SEA markets.

Notes:

SE-Asian noodle market: value and opportunity for the Australian wheat Industry

Larisa Cato, Australian Export Grains Innovation Centre

ABSTRACT:

Larisa Cato and Chris Carter, AEGIC

Australian wheat will become more competitive in key markets through action to better align the Australian industry to South East Asian wheat and flour quality requirements for various noodle products.

This research identified the key wheat and flour quality preferences and ideal target levels and attributes for major types of noodle products in South East Asian markets.

The information generated by this work is valuable to organisations across the Australian wheat value chain as it provides clarity around our customers' preferred quality requirements. It has moved the Australian wheat industry's understanding of these requirements from anecdotal to being based on quantitative measurement. This understanding creates opportunities for the Australian wheat industry to better match the supply of wheat to customers' quality requirements. Where purchasers are supplied with and recognise quality attributes, they are willing to pay for. This scenario is preferred to that where we compete purely on a price basis with low-cost origins such as the Black Sea and Argentina. This understanding is important in servicing and retaining export and domestic customers. A value proposition of Australian wheat that includes a combination of wheat quality improvement, alignment of grades and class classification targets and technical extensions (education and training) will return more value to wheat growers, than if Australian wheat competes purely on price with wheat from low-cost origins such as the Black Sea and Argentina.

Notes:

Balancing the trade-offs in wheat variety choices to increase profit and reduce risk

Dion Nicol, Department of Primary Industries and Regional Development

ABSTRACT:

Managing trade-offs in wheat variety decisions to maximise profitability

Dion Nicol, Jeremy Curry, Brenda Shackley, DPIRD

Flowering time is often the major determinant of wheat yield. It is impossible to perfectly match flowering time to every season given the large variation in environmental conditions that occur across seasons. Additional uncertainty arises given that germination can be uncertain prior to a significant break of the season, and that environmental conditions will cause variation in the rate of crop development (e.g. warmer weather driving faster development) year to year.

Given all of this uncertainty, variety choice and the best management of a wheat crop can be summarised into trade-offs between the relative risks of flowering too early or too late. In addition to the key principle of optimising development through variety and sowing time, other agronomic management may be influenced by the timing of sowing and development. Implications for plant density and nitrogen management with respect to earlier or later development and associated environmental conditions will be discussed. This presentation covers the 2020 NVT and DPIRD wheat agronomy results, exploring the risks and opportunities across Western Australia and outlining the principles of wheat variety choice and agronomic management that maximise overall profitability.

Notes:

Patterns of crop water use in a long-term rotation trial

Ken Flower, University of Western Australia

ABSTRACT:

Patterns of crop water use in a long-term rotation trial

Ken Flower[1,2], Phil Ward[3], Shayne Micin[3] and Neil Cordingley[2], [1]UWA, [2]WANTFA, [3]CSIRO

Key messages

- Pasture with late season weed growth tended to dry the soil out at depth more than a grain crop. Early spray-out would be required to conserve water for following crops.
- The root system of wheat and barley reached ~150–160 cm soil depth, although most activity was <110 cm.
- Wheat following fallow had a deeper root system than following a grain crop, utilising soil water from the full 160 cm of the measured profile.
- Canola had a deeper root system than wheat and barley and, in some seasons, dried the soil out more, particularly deeper in the profile (70–160 cm).
- Legumes had a similar rooting depth to wheat, although albus lupin used less water than wheat at ~70–90 cm depth and chickpea water used a greater proportion of available water/rainfall late in the season, perhaps reflecting slower maturity than wheat.
- Fallow had a marked benefit on following wheat yield after a dry summer/autumn and no effect after a wet summer.

Aims

To determine the effect of different rotations on crop yield and water use.

Results

There was less soil water remaining after pasture in some seasons compared with growing a crop, particularly deeper in the profile. This was probably due to late weed growth. Canola also appeared to dry the soil out more than wheat and barley between about 70–160 cm. The effect sometimes carried over to the next wheat crop, although that generally yielded more than wheat after a cereal crop. This suggests other benefits from canola such as reduced disease or increased nitrogen availability

The rooting depth of wheat and barley was similar at ~150–160 cm, with most activity above 110 cm. As expected, there was greater water extraction down to 160 cm in wheat following fallow, indicating deeper root activity. Canola had greater root activity than wheat for the full 160 cm (the deepest measurements). Chickpea and albus lupin had a similar rooting depth to wheat, although chickpea appeared to more of its water at the end of the season compared with wheat and albus lupin used less water at 70–110 cm.

In 2019, wheat yield after pasture (2.2 t ha-1) was similar to wheat after crops in the diverse rotation (~2 t ha^{-1}), which was higher than wheat grown in the cereal rotation (~1.7 t ha^{-1}) and monoculture (1.5 t ha^{-1}). Wheat after fallow was significantly higher than wheat after the other rotations/crops (3.4 t ha^{-1}), probably due to additional 126 mm of stored soil water.

Conclusion

Both pasture and canola dried the soil out more than wheat, barley or grain legumes, particularly deeper in the profile. The rooting depth of most crops was ~150–160 cm, with most activity above 110 cm. Canola and wheat after fallow had greater water extraction down to 160 cm, indicating deeper root activity. Albus lupin appeared use less water at 70–110 cm depth and chickpea used a larger proportion of water used at the end of the season compared with wheat. The beneficial effect of fallow on following wheat yield varied with the amount of summer/autumn rain.

Notes:

How does DMI fungicide resistance impact on spot type net blotch control in field, and can we do other things to help reduce disease pressure?

Geoff Thomas, Department of Primary Industries and Regional Development

ABSTRACT:

How does DMI fungicide resistance impact on spot form net blotch control in field?

Geoff Thomas[1], Jason Bradley[1], Kithsiri Jayasena[2], Andrea Hills[3], Ayalsew Zerihun[4], Fran Lopez-Ruiz[4] and Ting Tang[4],
DPIRD, [1]South Perth, [2]Albany, [3]Esperance, and [4]Centre for Crop and Disease Management, Curtin University

Key messages

- Genetic changes conferring reduced sensitivity or resistance to Group 3 (DMI) fungicides occur naturally in *Pyrenophora teres f.sp. maculata* (Ptm) populations (causal pathogen of spot form net blotch in barley) in Western Australia.
- In a field nursery trial at South Perth full label rates of some DMI fungicides (propiconazole, epoxiconazole, tebuconazole) gave poor control of SFNB caused by the resistant Ptm isolates compared to the sensitive (wild type) isolates.
- By contrast, SFNB control by fungicides containing prothioconazole was less affected by isolate resistance status.

Aims

To assess the dose-responses of DMI fungicide sensitive and resistant *Pyrenophora teres f.sp. maculata* isolates (causal agent of barley SFNB) to DMI fungicides under field conditions.

Results

A field trial established at DPIRD South Perth in 2020 evaluated and compared dose responses and efficacies of various foliar applied DMI fungicides between DMI sensitive and resistant Ptm isolates using the variety Oxford. Fungicide active ingredients tested in this trial were propiconazole, prothioconazole, tebuconazole, epoxiconazole and tebuconazole + prothioconazole applied at four rates, 2x, 1x, 0.5x and 0.25x maximum label rate, compared to untreated controls.

Disease assessments at two and four weeks after spraying showed that disease severity caused by the resistant isolates was greater than the susceptible isolates Previous glasshouse and small plot experiments have shown similar response when using the variety Oxford.

At two weeks after spraying, all fungicides reduced disease severity in plots infected with the DMI sensitive isolates, with the full label rate providing 50-70% reduction of disease severity on Flag-2 and Flag-3. However, in plots infected with the resistant isolates only sprays containing prothioconazole gave greater than 50% disease control at this rate.

At four weeks after spraying, differences in efficacy of fungicide actives were evident within and between isolates. Full label rate (1x) reduction of disease severity on Flag-2 and Flag-3 ranged from 20-30% (epoxiconazole and tebuconazole) to 45-57% (propiconazole, prothioconazole, Prosaro) in the sensitive isolate and from <10% (epoxiconazole, tebuconazole, propiconazole) to ~30% (prothioconazole, Prosaro) in the resistant isolate.

Conclusion

Resistance to Group 3 (DMI) fungicides has been identified in Ptm in Western Australia through molecular and laboratory testing. This experiment has demonstrated that field efficacy of DMI fungicides can be significantly lower against isolates exhibiting resistance in those tests and that individual fungicide ingredients can have different efficacies. In the presence of resistant isolates, some DMI fungicide actives will not provide adequate disease control and should be avoided. The relative efficacy of fungicide ingredients may vary dependent on the dominant resistant isolate. The results reported here underscore the importance of ongoing surveillance for fungicide resistance and field evaluation of fungicide efficacy to ensure growers are informed of products that provide effective disease control in the face of emerging resistance.

Notes:

Identifying when it is financially beneficial to alter fungicide dose when resistance is developing

Frank van den Bosch, Centre for Crop and Disease Management, Curtin University

ABSTRACT:

Identifying when it is financially beneficial to alter fungicide treatment program when resistance is developing. Azole resistance in spot form net blotch in WA

Frank van den Bosch[1], Ayalsew Zerihun[1]; Nick Poole[2]; Fran Lopez Ruiz[1]; Geoff Thomas[3], Mark Gibberd[1], Toto Olita[1], Ting Tang[1], Jason Bradley[3]; Joe Helps[4], Neil Paveley[5],

[1]School of Molecular and Life Sciences, CCDM, Curtin University, [2]Field Applied Research (FAR) Australia, [3]Department of Primary Industries and Regional Development, South Perth, [4]Rothamsted Research, Harpenden, UK, [5]ADAS High Mowthorpe, UK

Key messages

- The model suggests that when the resistant type dominates the spot form net blotch (SFNB) causal pathogen population, propiconazole does not give a positive economic return. The model also suggests that Prosaro does still give a positive economic return.
- With an increasing frequency of the resistant type, the model suggests that the economically optimal propiconazole dose decreases. The optimal dose of Prosaro, however, remains constant.
- According to the model outcomes, the moment to switch from propiconazole to Prosaro, depends on potential yield as well as other aspects of the fungicide treatment programme.

Aims

To answer the question 'what adjustments to the fungicide treatment programme should be made when azole resistance further develops in the pathogen population over the coming years?'

Results

The model outputs suggest that when no resistance developed yet, so the sensitive pathogen type dominates the population, in the lower yield areas (potential yield 1–2.5 t/ha) one application of propiconazole at full dose or Prosaro at 0.5-0.75 of a full dose minimises the cost to disease. For higher potential yield areas, two applications of propiconazole at full dose or two applications of Prosaro at 0.75 dose minimises the cost to disease.

The situation changes drastically when the resistant strain starts to dominate the population. In all treatment programmes we studied with the model, propiconazole does not give any positive economic return. This is due to the fact that propiconazole has very low efficacy on the resistant strain. Thus, according to the model output the economically optimal situation is not to use propiconazole. Prosaro does however still give a positive economic return because it controls the resistant strain moderately well.

The model was used to determine when growers should shift from using propiconazole to using Prosaro (or any other effective fungicide). The switch point depends on the potential yield in the area, whether a seed treatment active against SFNB is used, whether a mixing partner active against SFNB is used and whether a grower aims at maximising mean economic return or is risk averse.

Conclusion

Our findings suggest that azole fungicide treatment programmes may need to be adjusted when the recently emerged DMI resistance in SFNB increases in frequency and (possibly) eventually will dominate the population.
The key messages outline the actions to be taken.

Notes:

Potential from deep ripping heavy soils

Wayne Parker, Department of Primary Industries and Regional Development

ABSTRACT:

The potential of deep ripping heavy soil

Wayne Parker, DPIRD

Key messages

- Deep ripping and deep nutrient placement in sodic heavy soil can increase the number of crop roots deeper in the profile.
- Cloddiness from deep ripping heavy soil needs to be reduced to allow plant emergence to be equivalent to non-ripped soil.

Aims

To improve root exploration of a sodic clay soil with the addition of deep placed nutrients via deep ripping.

Results

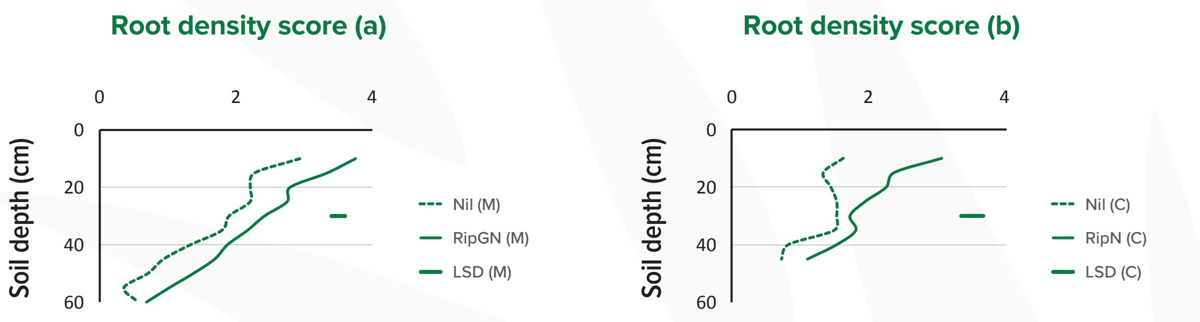

Figure 1. Representation of root density scores throughout the profile from soil pits dug at Mingenew (a) and Canna (b) trial sites. RipGN: ripping with gypsum and nitrogen burial. RipN: ripping with nitrogen burial

At Mingenew ripping with and without nutrients increased root density to 30 cm. Ripping with gypsum and nitrogen resulted in the greatest density of roots throughout the profile and to a depth comparable to rip plus nitrogen. Nitrogen, with and without ripping, increased root numbers to depth at Canna. There were additional roots in the top 20 cm when compared to the control. Ripping with nitrogen inclusion increased root density throughout the profile when compared to non-ripped treatments. Ripping alone increased root numbers to 25 cm when compared to the control at Canna.

Conclusion

In the first year of trials at Mingenew and Canna deep ripping and deep nutrient placement increased the density of roots to a greater depth in sodic soil when compared to no ripping, either with or without additional nutrient. However, it is not known if this improved root growth and depth will remain and/or improve yield of future crops.

Deep ripping heavy soil must leave a paddock compatible with dry sowing if it is to have a positive outcome. This may require ripping during a fallow phase to allow natural consolidation of the soil and clods. Also required will be an increase in the sowing rate to compensate for lower emergence numbers in the cloddy soil. There is a need to reduce cloddiness, which can be achieved with shallow leading tine rippers or heavy crumble rollers, without reducing surface cover and increasing the risk of erosion.

Notes:

Deep ripping in 'Other' soil types: What are the options and are they effective?

Nathan Craig, West Midlands Group

ABSTRACT:

Deep ripping in 'Other' soil types: What are the options and are they effective?

Nathan Craig, WMG

Key messages

- While nearly half of the soil amelioration strategies returned an economic benefit, few strategies gave a three-year net return of greater than $150/ha
- There were no consistent plant-based options for alleviating 'hard' soils with long season crop varieties potentially being able to increase the window for crop roots to penetrate hard soils when wet.

Aims

Two studies were completed in the 2018-2020 period to assess differing approaches to tackling soil compaction on 'other' soil types across the wheatbelt: The first project used twenty field sites to evaluate the benefit of soil amelioration across a wide range of soil types, while the second study was a literature review of plant-based options for the alleviating hard soils where deep ripping is not an option for growers.

Results

Field evaluation of deep ripping across a wide range of soil types across the WA Wheatbelt

Increases in grain yield were variable across treatments and there was no clear "best solution" across all sites. Instead, increases in grain yield was dependant on the amelioration treatment and the soil type. For example, sites that were loosely described as a sand generally responded to deep ripping, while gravel-based soils tended to respond to more aggressive tillage-based treatments. While the latter gave a good yield response in the first year following amelioration, this "tillage effect" benefit was short lived or variable in subsequent years. Approximately half of the soil amelioration treatments gave a positive economic benefit to soil amelioration, which included an initial approximate average cost of $80/ha for imposing soil amelioration treatments. There were few treatments that returned a net economic benefit of greater than $150/ha across the three years of trial data.

Literature review of plant-based options for alleviating 'hard' soils

There were no clear crop types that displayed the consistent ability to penetrate hard soils under a wide range of conditions in the WA Wheatbelt. A theme emerged in this review that the greatest chance of any crop species to penetrate hard soils was to increase the residence time of the break crop so that there is a longer period where the break crop is actively growing roots. This can be practically achieved using long-season crop varieties within the current suite of crop types that are available to grain growers in Western Australia.

Conclusion

Soil amelioration on 'other' soil types should be treated with caution by growers across the wheat belt before embarking on a large-scale amelioration program. The use of local knowledge, trials, and demonstrations of equipment are essential to find the method of amelioration that is most suited to local soil conditions.

Notes:

Changing market chemical MRLs and impacts for growers

Gerard McMullen, National Working Party on Grain Protection

ABSTRACT:

Changing market chemical MRLs and impacts for growers

Gerard McMullen, NWPGP

Key messages

- It is a legal requirement to follow all label directions when applying any crop protection chemical.
- There are market access implications when using chemicals; applying a chemical according to label directions does not necessarily mean that grain will meet destination market requirements.
- Each destination country has their own chemical legislation based on their specific chemical usage and consumption patterns. Hence different MRLs for the same chemical and commodity can apply in different markets. Markets are continually changing their maximum residue limits (MRLs), with some key chemistry available in Australia being impacted soon.
- There is a need for advisers and growers to understand the risks of residues arising from chemical use and the impact on market acceptance. There is a range of information available to growers and their advisors to source to manage the impact of chemical use on market access. Before you intend to apply chemicals to a crop, if possible, talk to your marketer to seek their advice on market requirements.

Notes:

The road to real-time on-farm monitoring – connectivity, IoT sensors and data platforms

Kari-Lee Falconer, Department of Primary Industries and Regional Development

ABSTRACT:

The road to real-time remote on-farm monitoring

Kari-Lee Falconer, DPIRD

Key messages

- Solutions are available in the regions for creating connectivity and data transport networks across the farm.
- Installation of the IoT sensing and monitoring systems created a much greater awareness of the conditions and variability across the farm which has given confidence to decisions and changed work practices.

Aims

To accelerate farm businesses in overcoming challenges in on-farm connectivity and the use of real time on-farm digital IoT sensing systems.

The funding program follows the journey stories of the grower groups and agricultural colleges as they navigate choosing and installing high and low bandwidth on-farm connectivity solutions, real-time IoT sensors and devices, and data platforms to digitise data collection and transform their operations.

Results

A wide range of IoT enabled sensing systems for monitoring and gathering data on farm conditions were installed by the 15 projects with 63 host farms across the WA grainbelt. These ranged from single IoT devices on 3G/4G connectivity to multiple IoT devices on more complex WiFi connectivity systems on high bandwidth technologies. More specialised fit-for-purpose IoT data collection systems were also installed by projects using the low bandwidth Low Power Wide Area Network (LPWAN) technologies LoRaWAN, Sigfox and LTE-M/Cat M1.

Grower groups and agricultural colleges were able to use low bandwidth LoRaWAN and Sigfox connectivity technologies to create data networks transferring near real-time low-byte data across large properties with no or limited access to the main power grid or coverage from mobile phone towers. Catchment-wide data networks to collect and share both soil moisture and rainfall information were created using the higher bandwidth 3G/4G for connectivity. While WiFi technologies were able to achieve connectivity to blackspot areas on the farm, both high bandwidth technologies enabled cameras to be used on the IoT system.

There was a wide range of IoT sensors/devices installed across the 15 projects including soil moisture probes, rain gauges, weather stations, cameras, tank level sensors, frost sensors, soil pH, salinity sensors and more. The common finding across projects was their improved awareness of conditions across the properties and the variation found over short distances enabling them to make more timely decisions to improve efficiency and save costs.

Conclusion

Using IoT sensing systems improved growers' awareness of conditions across the property(s), the variability that can be found over short distances and the impact that can have on management decisions. Increased awareness through data can enable growers to make more timely decisions to improve efficiency and save costs. The key impact gathered from these projects were resource use efficiencies to be gained and the labour costs that could be redirected to other key business activities.

Notes:

Impact of land prices on purchase, lease and management decisions

Ashley Herbert, Agrarian Management

ABSTRACT:

Agricultural land price rises and their impact on farm profitability

Ashley Herbert, Agrarian Management

Key message

- Increased land price has added significant wealth to farm businesses.
- Land acquisition will bring a combination of financial and strategic value to a business.
- The value of land will vary between businesses.
- Determining value and affordability are key to making good decisions around buying land.
- Maintain the option to buy land – have a Plan B.

The recent and much publicised surge in land price across the state has been driven by a combination of factors. Amongst them are relatively strong earnings and low interest rates.

Obviously this presents as a double edged sword for a farm business. The increased prices have led to stronger balance sheets and greater wealth overall however, for those looking to expand it has presented somewhat of a quandary. Is it worth it?

Price and value aren't necessarily the same. For the most part, the price is what it is. The question is always about the value to the business, affordability and risks associated with a potential acquisition.

The key decisions revolve around determining the value of land to the business, how much can you pay, what are the risks and how can you mitigate them. Ultimately leading to the decision of "is it worth it?"

In parallel to the property market, lease values have also seen a considerable rise in recent times. This has clearly benefited landlords and made the decision to hold land as a passive investment quite attractive. Conversely, the tenant is having to pay more and potentially accept lower returns. While there are clear differences between buying and leasing land, the process of determining value and fit for a business are similar.

In my 27 years of consulting land has always seemed to be expensive at the time. But over the long term, buying land has generally been a good decision for a farm business in terms of maintaining operational scale and wealth creation.

Notes:

Increasing heat tolerance in wheat

Karine Chenu, Queensland Alliance for Agriculture and Food Innovation, University of Queensland

ABSTRACT:

Increasing heat tolerance in wheat in West Australia

Karine Chenu[1], Brian Collins[1], Najeeb Ullah[1], Troy Frederiks[2], Jack Christopher[1], [1]UQ/QAAFI Toowoomba, [2]DAF Toowoomba

Key message

- Tolerance for post-flowering more than pre-flowering heat is required to improve wheat productivity in a warmer climate.
- A field-based phenotyping method has been developed to reliably screen genotypes differing in flowering date.

Aims

- Provide a deeper understanding of what drives yield losses in wheat in a warming climate.
- Provide a robust phenotyping method to accelerate crop improvement for heat tolerance.

Results

The climate is changing with increasing temperatures and more extreme events. In a crop simulation study of how changes in climate since 1985 have impacted wheat yield in West Australia (WA), substantial changes related to increasing temperature were identified. Increasing average temperatures have caused large reductions in the duration of the wheat crop cycle, reducing yield potential. Heat shocks have caused on average a 14.5% yield loss (for standard agronomic practices), with a 1.5% loss in grain number due to pre-flowering heat events and a 13.4% loss in individual grain weight due to grain-filling heat shocks. In addition, the recorded trend in increasing temperatures has resulted in yield losses rising by 3.5% per decade since 1985 in WA.

To screen reliably for heat tolerance in the field, a novel method was developed. Heat tolerance trials are usually sown at different sowing dates to compare crops flowering at the recommended time of year with those flowering later which are typically exposed to greater heat stress. However, the genotypes tend to flower at different times from each other within each sowing. This means that some genotypes may escape exposure to heat at the most vulnerable developmental stage either partially or fully. In the new method, adding lights at the end of each row in the field induced a gradient of light intensity and a spread of flowering dates along rows of plants from each genotype. This allows the identification and comparison of plants at similar developmental stages which are experiencing comparable heat stress. With the new method, genotypes were ranked more reliably for heat tolerance than when comparing their performance between late and early sowings.

Conclusion

Heat stress occurring post-anthesis are impacting WA wheat crops more than pre-flowering heat stress. These stresses have been increasing over the last few decades. There is an urgency to breed for more heat tolerant wheat cultivars. A new field-based method was developed to screen for heat tolerance to accelerate the development of cultivars adapted to a warmer climate..

Notes:

Notes:

How heat tolerant are our wheats?

Rebecca Thistlethwaite, University of Sydney

ABSTRACT:

How heat tolerant are our current wheat varieties?

Rebecca Thistlethwaite[1], Anowarul Bokshi[1], Sang He[2], Reem Joukhadar[2], Daniel Tan[1] and Hans Daetwyler[2], Richard Trethowan[1], [1]The Plant Breeding Institute, The University of Sydney, [2]Agriculture Victoria, AgriBio, Bundoora

Key message

- Some Australian cultivars are significantly more heat tolerant than others when heat stress is applied at anthesis and grain filling growth stages. Materials identified and developed through this project provide new genetics for heat tolerance that can be used to improve the heat tolerance of current varieties.

Aims

This research compared the heat tolerance of current commercial wheat varieties under elevated day and night temperatures during anthesis (Zadok 60) and grain fill (Zadok 73) growth stages.

Results

Overall, in-field controlled environment chambers significantly impacted the yield and kernel weight of most lines evaluated when a heat shock was applied at anthesis and during grain fill. An average decrease in yield of 14% and kernel weight of 9.7% was observed between control and heated plots when a heat shock was applied during the day at anthesis. When minimum temperatures were increased at night during grain fill, yield and kernel weight were not as greatly impacted with decreases of 4.8% and 5.8% observed, respectively.

Recent Australian varieties performed well under anthesis heat treatment with the best performing varieties AGT Condo⦶, Coolah⦶, Sunprime⦶ and Cutlass⦶ combining yield potential and heat tolerance, closely followed by AGT Sunchaser⦶, LRPB Flanker⦶ and Intergrain Devil⦶. Varieties such as LRPB Dart⦶, RGT Zanzibar⦶ and AGT Scepter⦶ showed good yield potential and performed well under controlled conditions but were greatly affected by heat treatment. Intergrain Vixen seemed to be unaffected by heat treatment as the difference between control and treatment yield was negligible. CIMMYT breeding line (CMSA08Y00613S-050Y-050ZTM-050Y-59BMX-010Y-0B) significantly outperformed all current varieties for yield (56% better than AGT Suntop⦶) and kernel weight under control and heat treatments.

Conclusion

Current and emerging Australian cultivars have a good degree of heat tolerance, however there is still more that can be achieved. This research identified and developed new sources of heat tolerance that can be used by wheat breeders to improve yield in our increasingly variable climate.

Notes:

What solutions can we expect from plant breeding?

Dion Bennett, Australian Grain Technologies

Notes:

Increased sowing opportunity offered by deeper sowing across the grain growing regions of Western Australia

Sarah Rich, CSIRO

ABSTRACT:

Chasing water: Deep sowing can increase sowing opportunity across the grain growing regions of Western Australia

Sarah Rich, Yvette Oliver, Jonathan Richetti and Roger Lawes, CSIRO

Key messages

- Deeper soils can have higher soil moisture, so deeper sowing (50-200 mm) may offer increased sowing opportunities.
- When surface soils are dry, there may still be a sowing opportunity at depth, this is especially likely on lighter soils.
- In drier regions, where surface moisture is not guaranteed even late in the sowing window, deep sowing offers increased sowing opportunities across most of the autumn sowing window.

Aims

We aimed to understand how often, and under what conditions, a situation occurs where deep sowing would be beneficial, i.e. when surface moisture is sub-optimal for germination but where deep sowing (50-200 mm) could allow growers to access soils with sufficient moisture for germination and establishment, during the Autumn sowing window (late March to early June).

Results

Sowing deeper can offer a significant increase in sowing opportunity; location and soil type interact strongly with soil water so are closely related to how much and when sowing opportunity will increase.

Given that deep sowing can cause reduction in emergence and establishment, it is not a management option usually undertaken when the surface soils have adequate moisture. To understand the probability of these 'water chasing' deep sowing opportunities, we assessed the probability of moist soils over six days in a deep soil layer, when the topsoil was dry. On very heavy soils, deep sowing to chase moisture is likely to be of only sporadic benefit as small rainfall events are unlikely to penetrate beyond the surface layers. On sands however, significant increases in sowing opportunity exist. In higher rainfall areas, such as Dandaragan, the benefit of deep sowing to chase water is considerable early in the season but this advantage reduces as the sowing window progresses due to a high likelihood of significant rainfall events (and therefore moist surface soils). In dryer regions, such as Southern Cross, where large rainfall events can be sporadic even late in the sowing window, the advantage of deep sowing continues throughout May.

Conclusion

Sowing into deeper soil layers can access extra moisture not available in surface layers. Depending on soil type and location, deep sowing opportunities may be present even when surface layers are dry, this is most likely to occur on lighter soils. In higher rainfall areas these opportunities are most likely early in autumn while in lower rainfall areas, deep sowing can increase sowing prospects across the autumn sowing window.

Notes:

Deep sowing of long coleoptile wheats increases grain yields and water productivity in the eastern WA wheatbelt

Greg Rebetzke, CSIRO

ABSTRACT:

On-farm assessment of new long-coleoptile wheat genetics for improving seedling establishment from deep sowing

Greg Rebetzke[1], Andrew Fletcher[1], Shayne Micin[1] and Callum Wesley[2], [1]Charlesville Ag, Southern Cross WA, [2]CSIRO, Agriculture and Food

Key messages

- The trend has been for increasing summer rain and later autumn sowing breaks throughout the wheatbelt. Long coleoptiles will permit deep sowing into subsoil moisture stored from summer rains. This will allow earlier germination, and crop growth to occur under conditions optimal for maximising water productivity
- On-farm, deep-sowing studies at Southern Cross WA show benefits of new dwarfing genes in increasing coleoptile length and seedling emergence at sowing depths of up to 140 mm
- Australian breeders are using new dwarfing genetics to fast-track the delivery of new higher-yielding, long coleoptile wheat varieties.

Aims

1. To validate coleoptile lengths measured under controlled conditions in the field, and examine the potential for seedling emergence of long coleoptile wheats at sowing depths exceeding 120 mm; and
2. Assess the yield potential and water productivity with deep-sowing in a grower-led, on-farm field experiment.

Results

The long coleoptile Mace experimental line ('Mace18') containing a new Rht18 dwarfing gene established well at sowing depths of 120-140mm (up to 80% of 40mm control depth) when sown on 6 May 2020 at Southern Cross WA. Coleoptile lengths were measured at 120mm+ consistent with observations under controlled conditions. By contrast, the shorter coleoptile of commercially available Mace reduced establishment with deep sowing (30-40%). Grain yields were significantly ($P<0.01$) greater for deep-sown Mace18 (cf. 1.80 vs 1.25 t/ha for Mace18 and Mace, respectively), and water productivities of 19.8 and 13.8 kg/mm/ha for Mace18 and Mace, respectively. A near-doubling in head and grain number in the Mace18 breeding line lead to these greater yields. Similar benefits with deep sowing were also observed for long coleoptile selections in Magenta and to a lesser extent Yitpi genetic backgrounds.

Grain yields of Mace18 were similar for the deep- (1.80 t/ha) and shallow- (1.87 t/ha) sowings. The shallow sowing benefitted with earlier breaking rains contributing to a shorter 10-14 day delay in seedling emergence in this treatment. Together with the atypically cool conditions through grain-filling, the shallow sowing performed better than would normally be expected when sown dry, and particularly if sown mid- to late April.

Conclusion

The long coleoptile trait has allowed for sowing and good establishment with deep subsoil moisture retained from summer rains. Further studies are planned including use of earlier sowing dates and multiple sites in order to assess the potential for long coleoptiles as part of the broader farming system. Coinciding with this assessment is the pursuit by breeders in selection of the long coleoptile trait in delivering new wheat varieties to WA growers.

Notes:

Are seeding rate, seed size and row spacing important factors for the control of annual ryegrass in canola crops?

and

Is annual ryegrass evolving in response to intensive weed control in Australian dryland cropping systems?

Mike Ashworth and Roberto Lujan-Rocha, Australian Herbicide Resistance Initiative, University of Western Australia

ABSTRACT:

Manipulating canola agronomy for weed suppression: The compounding effect of seeding rate, row spacing and hybrid and open pollinated canola (*Brassica napus*) varieties on annual ryegrass (*Lolium rigidum*) growth and seed production

Mike Ashworth, Roberto Lujan Rocha, Zhanglong Cao, Suman Rakshit and Hugh Beckie, AHRI

Key messages

- Increasing canola seeding rate reduces annual ryegrass (ARG) seed production.
- The hybrid variety Trophy had reduced ARG seed production compared to the open pollinated (OP) variety Bonito.
- Reducing row spacing for OP canola resulted in lower ARG seed production, whereas reducing the row spacing of the hybrid variety did not significantly reduce ARG seed production.
- Hybrid and OP canola had higher yields when grown at the 50cm row spacing compared to the 25 cm row spacing, both with and without ARG competition.

Aims

This study explored combinations of canola crop row spacing, crop establishment density and cultivar (open pollinated or F1 Hybrid) in reducing annual ryegrass seed production whilst maximizing canola yield.

Results

Decreasing crop row spacing (from 50 to 25 cm) and increasing canola seeding rate (from 20 to 50 plants/m^2) was found to reduce ARG establishment in the absence of herbicides. No interaction between canola seeding rate and row spacing was identified (P=NS), it was found that the largest decline in ARG seed production occurred when the seeding rate was increased from 20 to 35 plants/m^2 at the 25 cm row spacing treatment, compared to an minimum of 50 canola plants/m^2 required to reduce ARG seed production when the row spacing was at 50 cm. Canola yield was increased in both hybrid variety treatments and when higher canola seeding rates were used (50 plants/m^2). Interestingly, canola seeded at the wider row spacing (50cm) consistently out yielded the corresponding variety and seeding rate combination at the narrower 25 cm row spacing.

Conclusion

Canola seeding rate is the main driver for achieving lower ARG seed production. However, interactions between the canola variety, row spacing and seeding rate show that a combination of some of these factors can also improve crop yields with and without ARG competition.

Notes:

Weed ecology = weed management

Catherine Borger, Department of Primary Industries and Regional Development

ABSTRACT:

Weed ecology: the key to weed control

Dr Catherine Borger and Dr Abul Hashem, DPIRD

Key messages

- All weed species have greatest seedling emergence in year 1, but species with a small seed have a higher proportion of seedlings emerge in year one compared to species with larger seeds. Species with large seeds have higher emergence in year 2 and 3.
- Burial of seeds extends the life of the seed bank in most weed species. Seed on the soil surface will germinate (and get sprayed) or degrade more rapidly than buried seeds.
- Weed-crop competition is related to weed emergence time.

Aims

A five-year national GRDC project entitled 'Seed bank ecology of emerging weeds' was completed in 2020. The project investigated the seed bank ecology, growth and competitive ability of ten different weed species. The comparison of these species within a single project has highlighted broad ecological trends that can be used to develop integrated weed management (IWM) strategies for different species.

Conclusion

A comparison of multiple weed species has allowed us to highlight some ecological 'rules of thumb'. For those species where research on biology and seed bank ecology has not yet been conducted, these rules of thumb give a starting point for developing an IWM program. These rules of thumb include:

1. Species with small seed will have greatest emergence in year one. Therefore, one year of seed set control will dramatically reduce the population. However, those species with small seeds often have broad scale dispersal, so it is also important to monitor neighbouring fields and check for new seed moving into the field.
2. Burial of seeds extends the life of the seed bank in most weed species. If seeds are left on the soil surface, they will germinate (and get sprayed) or degrade more rapidly than seeds at depth. A zero tillage system using disc seeding will bury 5% of seed at 0-5 cm and leave 95% of weed seed on the soil surface. By comparison, a no tillage system with knifepoint seeding buries 90% of seeds, with 10% of seed left on the soil surface. It is clear that IWM programs will require fewer years of intensive weed control in a zero tillage system.
3. Weed-crop competition is related to weed emergence time, with a greater competitive impact from those species that emerge at a similar time to the crop. Early weed control has the most benefit for protecting yield potential.

Notes:

TruFlex/Clearfield (XC) GM dual herbicide stacked canola for integrated management of annual ryegrass

Christopher Preston, University of Adelaide

ABSTRACT:

TruFlex/Clearfield (XC) GM dual herbicide stacked canola for integrated management of annual ryegrass

Christopher Preston[1], David Tabah[2] and Justin Kudnig[2], [1]University of Adelaide, [2]Pacific Seeds

Key messages

- Stacked tolerance in canola offers multiple options and timings to control annual ryegrass.
- Good early weed control is essential to reducing weed numbers in crop.
- Resistance to the imidazolinone herbicides is present in most annual ryegrass populations making strategies reliant on these herbicides ineffective.

Aims

This research examines the efficacy of different herbicide strategies in TruFlex/Clearfield canola compared to TruFlex, Clearfield, Clearfield/TT and TT to determine the best management practices for annual ryegrass control.

Results

Across three trials, annual ryegrass numbers were higher with strategies in canola that relied on imidazolinone or clethodim herbicides due to extensive resistance to these herbicides in annual ryegrass. There were no significant differences in annual ryegrass weed numbers between strategies using two or three applications of Roundup Ready Herbicide. Canola yield was lower for OP TT canola compared to hybrid canola and where early control of annual ryegrass was poor.

Conclusion

TruFlex (XX) and XC canola provide opportunities to control annual ryegrass with resistance to imidazolinone and clethodim herbicides. XC canola will also allow management of imidazolinone soil residues, even if imidazolinone herbicides are not used in crop.

Notes:

Strategies and principles for liming acidic soils

Paul Damon, University of Western Australia

ABSTRACT:

Principles and strategies for managing soil acidity

Paul Damon[1,2], Gaus Azam[1,3], Chris Gazey[1,3], Craig Scanlan[1,2,3], Zed Rengel[1,2], [1]Soils West; [2]UWA Agriculture and Environment, Crawley; [3]DPIRD, Northam

Key messages

- Dissolution of lime and increase in pH of an acidic soil is enhanced in soil layers with high soil water content.
- Very fine lime (0.05 mm) reacts rapidly in soil, even where water content is low.
- When deep slotting lime, the proximity of wheat rows to a limed slot is the major factor influencing greater wheat growth.

Results

Lime particle size and soil moisture effects

Very fine lime particles (0.05 mm) dissolved rapidly within soil, resulting in large increases in soil pH (1.6 pH units) within 7 days, regardless of the soil water content. The dissolution of medium (0.2 mm) and coarse (0.5 mm) lime particles occurred more slowly, as did their effects on soil pH. However, after 252 days, the effect of very fine, medium, or coarse lime particles on soil pH was similar.

The dissolution of medium (0.2 mm) and coarse (0.5 mm) lime particles was strongly influenced by soil water content, being approximately 20-fold greater at 80% of water holding capacity (WHC) compared to 20% of WHC.

Proximity of crop rows to limed slots is the major factor influencing growth response

The growth response of wheat rows to lime slotting was strongly influenced by their proximity to a limed slot. A tracer method demonstrated that a distance of 4, 9 or 11 cm between the wheat row and the limed slot delayed root activity within the limed slot by 2, 3 or 4 weeks, respectively.

The width of limed slots was not a critical factor, with similar wheat growth recorded in treatments with 4 cm wide or 8 cm wide limed slots. However, the depth of limed slots was important with greater growth of wheat rows positioned above 40 cm deep limed slots that traversed the acidic horizon, but not 10 cm deep ones.

Conclusion

Efficient management of soil pH is critical to the ongoing profitability of cropping enterprises on soils that are prone to acidification, such as sandy soils with low buffering capacity in the WA grainbelt. Lime incorporation into acidic soil increases soil pH, leading to greater proliferation of roots and greater uptake of nutrients and water from soil. However, lime effects are localised, and strategic tillage to incorporate lime into the subsoil is warranted.

Very fine (0.05 mm) lime particles rapidly neutralise soil pH; however, the purchase cost and handling constraints associated with fine lime materials should be considered. The dissolution of medium (0.2 mm) and coarse (0.5 mm) lime particles proceeds at a slower rate but can be significantly accelerated by incorporating into soil layers with higher water content. Evidence from field trials suggests that the slower dissolution rate of larger lime particles can also be compensated for in the short term by higher rates of application.

If lime slotting is used to rapidly ameliorate acidic subsoil, yield responses will be maximised where crop rows are positioned above the limed slots, which could be achieved if the spacing for tillage and seeding equipment are aligned.

The profitability of cropping enterprises on acidic soils will be maximised where efficient management of soil pH is complemented with the use of crops and varieties tolerant to acid soils.

Notes:

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Liming – It's a no brainer...

Chad Reynolds, Department of Primary Industries and Regional Development

ABSTRACT:

Liming – It's a no brainer...

Chad Reynolds, Gaus Azam, Stephen Davies, Chris Gazey, Wayne Parker and Joanne Walker, DPIRD

Key messages

- Dissolution of lime and increase in pH of an acidic soil is enhanced in soil layers with high soil water content.
- Very fine lime (0.05 mm) reacts rapidly in soil, even where water content is low.
- When deep slotting lime, the proximity of wheat rows to a limed slot is the major factor influencing greater wheat growth.

Aims

To assess the benefits of lime application and incorporation in the low rainfall zone of the north east wheatbelt, to improve crop productivity, profitability and soil pH.

Results

Yield increase through lime application became significant after two years and hence economic profit was gained. The cumulative economic profit achieved from the original lime application is up to $1100/ha after seven wheat yields over eight years.

Incorporation of lime has been successful in significantly increasing subsoil pH to the depth of incorporation but this hasn't significantly increased yields in this large scale experiment.

Conclusion

Results from seven crops grown over eight seasons at Tardun have shown that applying lime to the surface of an acid soil increased crop yield and hence cumulative profitability by up to $1100/ha in this low rainfall environment. Incorporating lime with tillage treatments did not further increase production and profitability at this location and soil type, despite a reduction in subsoil acidity.

The greatest yield benefit from lime application occurred in the lower growing season rainfall years, especially where there was stored subsoil moisture from either a large summer rainfall or following a fallow year (2019 season). This suggests that the wheat was able to get better root establishment on the soil with better soil pH profile and was able to access more of the moisture and nutrients at depth, thereby improving the yield.

This large scale experiment clearly shows the benefits of lime application on crop yield where soil acidity is a constraint. The wheat yield benefits received over a number of seasons resulted in a significant cumulative benefit. This demonstrates that sufficient lime application to acidic soil results in a positive economic outcome and shows that yield potential will not be gained if soil acidity is not addressed.

Notes:

Tricks and tips in managing subsoil acidity towards doubling water use efficiency: recent lessons building on 25 years of research

Gaus Azam, Department of Primary Industries and Regional Development

ABSTRACT:

Principles and strategies for managing soil acidity

Gaus Azam[1], Chris Gazey[1], Chad Reynolds[1], Stephen Davies[1], Craig Scanlan[1], Paul Damon[2] and Bob Nixon[3],

[1]DPIRD, [2]University of Western Australia, [3]R.Nixon & Co

Key messages

- In several trials, surface application of 2 t/ha lime increased yield and net economic benefit within 1–7 years of application, however, higher lime rates might increase yield further plus improve subsoil pH.
- Where the subsoil is acidic and compacted, incorporation of lime using strategic deep tillage is warranted.
- Soil pH and extractable aluminium values are strongly correlated, so it is recommended to use the most readily available and cheapest test as a diagnostic of subsoil acidity.

Aims

To evaluate the effectiveness, speed and extent of soil amelioration from different approaches to managing subsoil acidity and to evaluate the economic breakeven point for different liming strategies.

Results

Lime application increased yield and net profit significantly within 1–7 years depending on the soil type and methods of application. In most trials surface application of at least 2 t/ha of lime increased the yield, however, greater than 2 t/ha resulted in higher subsoil pH and lower extractable aluminium. Deep tillage (>30 cm) alone improved yield, but deep incorporation of lime ameliorated multiple soil constraints and increased grain yield to a greater extent than tillage alone or surface application. Incorporation of lime using shallow tillage (<20 cm deep) did not improve crop yield compared to surface application.

Soil pH and extractable aluminium values for a particular soil are strongly correlated, however, the level of extractable aluminium at a given soil pH varies between soil types. Plant root growth in acidic sand was strongly correlated to both soil pH and aluminium.

Conclusion

Results from several trials suggest that a significant increase in yield and net economic benefit from lime applied to the soil surface may be immediate if the topsoil is strongly acidic (e.g. pH 4.5 or below) while it can take longer if the pH of the topsoil is less acidic. A minimum of 2 t/ha of lime, applied to the surface, can increase grain yield in the short to medium term, but higher rates of lime would maintain and slowly improve subsoil pH over the longer-term. For compacted soil with subsoil acidity, incorporation of lime using strategic deep tillage can significantly increase yield and net economic benefit by alleviating multiple soil constraints. Soil pH and extractable aluminium values are strongly correlated and measuring one soil parameter will suffice as a diagnostic of subsoil acidity.

Notes:

The health and nutrition of Western Australian soils

Andreas Neuhaus, CSBP

ABSTRACT:

The health and nutrition of Western Australian soils

Andreas Neuhaus[1] and Alisa Bryce[2], [1]CSBP Limited, Kwinana, [2]Alluvio Pty Ltd

Key messages

- Soil fertility is declining in the lowest rainfall Agzones of WA (Agzone 1 and 4).
- The challenge for the agricultural industry is to reverse the decline in soil fertility. This implies regular monitoring of soil properties to depth and adjusting farm inputs.
- More research into building up organic matter, under a drying climate, in a practical and cost effective way is needed.
- More research into defining nutrient standards for subsoils is desirable.

Aims

(a) To update long-term trends and statuses of regional soil properties in Western Australia to detect emerging yield-limiting factors or nutrient overloads.

(b) To highlight possible soil health and nutritional research gaps.

Results

Soil test data show slightly declining and below 1% median organic carbon (OC) levels for Agzones 1 and 4. Low OC contributes to suboptimal soil stability scores and when below 1%, low average topsoil nitrogen (N), phosphorus (P) and sulfur (S) levels. As OC increases above 1%, average N and P linearly increase to 40 and 60mg/kg respectively. Average S levels, although more variable, plateau at 10-15mg/kg. pH is improving in Agzone 1, more than in any other Agzone.

Topsoil P, after being built up from 1998 to 2013 in all Agzones, is now trending downwards, especially in Agzone 1. This could be costing yield in cereal and canola paddocks. Agzones 3 and the Very High Rainfall (VHR) zone have the median highest P values (about 42mg/kg). However, some of these soils have a higher PBI and therefore higher critical P values. Median subsoil P (5-13mg/kg) is especially low in Agzone 3 on high PBI soils (median 95-133). All median subsoil P levels decline with depth across all Agzones.

Potassium (K) has rapidly declined in the last 7-10 years to approximately 40mg/kg in Agzone 1, which is considered yield limiting for cereals and canola, and to 90mg/kg in Agzone 4. A decrease in topsoil K to about 75mg/kg has also been observed for the pasture dominated VHR zone, which limits subclover pasture growth. Median subsoil K values are declining with depth in all Agzone soils. Texture contrast soils in Agzone 5 and shallow water table soils in the VHR zone indicated high exchangeable sodium percentages. Other nutrients (trace elements like copper, zinc and the macronutrient magnesium) are of minor concern in all Agzones of Western Australia, but plant tissue testing is recommended.

Conclusion

The identified decline in soil fertility should be monitored and considered by agronomists and growers when soil (and plant) testing for constraints in the area and when giving advice.

Notes:

Monitoring every crop sequence across the entire Western Australian Wheatbelt – sometimes more is better

Roger Lawes, CSIRO

ABSTRACT:

Monitoring every crop sequence across the Western Australian Low Rainfall Zone

Roger Lawes, Gonzalo Mata, Chris Herrmann, Jonathan Richetti and Andrew Fletcher, CSIRO

Key messages

- Consultants can monitor the productivity of paddock scale crop rotations across many farms with crop modelling and satellites.
- Over four years, rotations in the Low Rainfall Zone of WA included wheat after cereal (41% of the area), cereal after oilseed (7.2%), cereal after pulse or legume (5.7%), cereal after pasture (37%) and cereal after fallow (8.4%).
- Compared to continuous cereal, legume crops improved the following wheat crop yield by ~150 kg/ha. Wheat yields following canola and fallow were 180 and 170 kg/ha higher than wheat following a cereal.
- The analysis identified the paddocks, farms, and regions with lower or higher break crop effects than their neighbours.
- Big data analytics can analyse crop rotations across WA, with information about every farm and paddock in the Wheatbelt.

Aims

We use remote sensing and modern analytics to determine if farmers achieve similar 'break crop effects' in cereals to those reported by researchers.

Results

On average, wheat after canola, fallow, and legume crops yielded 180,170 and 150 kg/ha more, respectively, than wheat after a cereal. Wheat after a pasture on average yielded just 60 kg/ha more than wheat after cereal. These rotation effects describe the average benefit that farmers obtain in the low rainfall zone. They are much lower than experimental break crop benefits, often around 600 kg/ha. Break crop benefits did vary between paddocks and farms, and the analytical platform can help consultants identify how productive a particular field is relative to neighbouring areas. Notably, most wheat crops were grown after another cereal. Pastures were the next most dominant land use before wheat, followed by fallow, oilseeds, and grain legumes.

Conclusion

Consultants can monitor the paddock response to a management activity with satellites and big data analysis. They can also compare the production of neighbouring paddocks to determine if productivity can improve.

Notes:

Profitable rotation in Western Australia

Stacey Bell, Farmanco

Key messages

- Many factors need to be taken into account when considering what comprises a profitable rotation. Long term profitability also includes seasons where minimising a loss will play a key role in the success of a cropping rotation.
- The focus on enhancing profit should not come at the cost of your paddocks health or the quality of your production, long term agronomy decisions need to be a factor when making rotational decisions.

Aims

To equip growers with the tools to improve profitability through identifying and executing a cropping rotation that is best suited for their environment.

This project identified the factors that maximised the profitability of a cropping enterprise that included a legume crop, while taking into consideration the agronomic constraints of the season and area. This presentation will deliver clear guidance as to how best integrate a legume crop to maintain or enhance the profitability of a cropping enterprise.

Results

While wheat is still considered the key profit driver of the majority of cropping and mixed farming enterprises, having a variety of crops within a rotation is recommended in order to reduce disease risk, minimise weed burden and spread seasonal risk due to climatic and market conditions. Paddock break options include other cereal crops (barley, oats), legumes (lupins, field peas, chick peas), oil seeds and livestock. However, each of these options includes its own set of considerations.

There are many factors taken into consideration by producers and advisors that influence growers to undertake a specific cropping rotation. The stage of life (both individual and business), financial position, access to markets, attitude to risks, preferences, prices, climate, soil and access to agronomy technology all play a part in the decision making process that producers undertake. In order to reach the maximum profitability of a rotation, each of these factors must be considered and need to be addressed to achieve the synergy required.

- Human
- Profit
- Agronomy
- Capital

Taking these factors into account when planning a cropping rotation will improve the profitability of the rotation outcome.

Conclusion

Crop modelling systems have been developed over time in order to determine what the most likely outcome would be from a cropping rotation, the impact on the business and the profitability. An analysis of the economic value of rotational management takes into account interactions between different farm enterprises and the carry over effects of these decisions into the following seasons. When considering a cropping rotation, producers need to know what they're dealing with, have a clear strategy for each enterprise, consider the impact of each decision on farm profit and assess changes which are made. Tactical management decisions can improve profitability compared to following a uniform management strategy. Tactical management will depend on a range of factors, including the type of adjustments being made, location, climate, economic environment, and the quality of the information on which the tactical decisions are based. Each proposed tactical management scheme will need to be assessed in an environment as close as possible to the one in which it will be applied.

Notes:

Profitable break crops in the Low Rainfall Zone

Andrew Fletcher, CSIRO

ABSTRACT:

Break crops can form part of a profitable cropping system in the LRZ of WA The potential role of companion and intercropping in Australian grain farming systems. Should we be considering them?

Andrew Fletcher[1], James Lydon[2], Sarah Rich1, Chao Chen[1], Roger Lawes[1], [1]CSIRO Agriculture and Food, Floreat; [2]Nutrien Ag Solutions, Merredin

Key messages

- Break crops such as canola and pulses can be part of a profitable crop rotation in the LRZ.
- When analysed at the level of a single paddock at a single year then wheat is the most profitable and least risky crop to grow in the LRZ.
- However, when analysed at the whole farm level over multiple rotations including break crops is as profitable and less risky than continuous wheat.
- Farmers need to identify which break crops fit their soils, climate and farming systems.

Aims

1. Test whether high value break crops can be grown profitability in the LRZ; and
2. conduct and economic analysis to see how break crops contribute to the overall profitability and risk of cropping in the LRZ.

Results

We report the results of three years of experiments comparing the yield and profitability of six grain legume break crops. Lupin was consistently the highest yielding, but chickpea was consistently the most profitable.

Our analysis of economics of rotations showed that when compared at the level of individual crops wheat was the most profitable and least risky crop to grow. However, when compared at the whole farm level over multiple seasons, rotations that included break crops were more profitable and less risky than continuous wheat. This was due to the additional yield in wheat crops following break crops and due to the income diversification from break crops.

Conclusion

Farmers need to consider both the rotational benefits and the diversification benefits when considering new break crops.

Notes:

Pre-breeding canola for heat stress tolerance – a prototype facility for large-scale screening at flowering stage

Wallace Cowling and Sheng Chen, University of Western Australia

ABSTRACT:

Pre-breeding canola for heat stress tolerance – a prototype facility for large-scale screening at flowering stage

Sheng Chen, Katia Stefanova, Kadambot H. M. Siddique and Wallace A. Cowling, The UWA Institute of Agriculture, UWA

Key messages

- **Timing of heat stress:** The critical period for heat stress in canola begins one week before first flower and continues during the flowering period. Flowers subject to heat stress produce fewer pods and seeds.
- **Intensity and duration of heat stress:** A heat wave of three days with a maximum temperature of 32°C from midday for four hours, and an overnight minimum temperature of 22°C, is sufficient to reduce canola yield.
- **Genotypic variation in heat tolerance:** Genotypes vary in heat stress tolerance, based on their ability to set seed after heat stress during flowering.
- We are developing breeder-friendly methods for genetic improvement of heat tolerance in canola.

Aims

This research is developing methodology to facilitate large-scale screening of heat stress tolerance in canola at flowering stage, and will identify heat tolerant germplasm for Australian plant breeders. The new methods and heat tolerant germplasm will be transferred to canola breeders, which will accelerate the future commercial release of heat tolerant varieties. Our aim is to help Australian growers to maintain canola productivity as temperatures rise in response to climate change.

Results

Heat stress, in the absence of moisture stress, reduced seed yield significantly after 3d, 5d and 7d of heat treatment from one week before first flower and during the flowering period. A heat wave of three days with a maximum temperature of 32°C from midday for four hours, and an overnight minimum temperature of 22°C, was sufficient to reduce canola yield.

Heat treatments reduced seed yield (SYM) and pod number (PNM) on the main stem or lateral branches, depending on when heat stress was applied. Heat stress sensitivity began one week before first open flower on the main stem.

We screened 257 canola lines for heat tolerance for two years under field conditions followed by one year in a controlled environment room and found significant genetic variation for heat stress tolerance.

Conclusion

Significant genetic variation exists among canola varieties for tolerance to heat stress. Our research provides promising germplasm and breeder-friendly procedures to accelerate the future commercial release of heat tolerant varieties. We are developing a prototype pre-breeding facility for heat stress tolerance that could be incorporated into commercial canola breeding programs. In our experience, simulated heat waves of 32°C daily maximum and 22°C minimum are suitable for large-scale screening for heat tolerance in canola. We recommend assessing canola heat tolerance by measuring pod and seed formation on the main stem.

Notes:

Mapping weather variability and recent changes in weather and crop growth drivers for the eastern and western grainbelt, and potential impacts on crop growth and yield

Meredith Guthrie, Department of Primary Industries and Regional Development

ABSTRACT:

Recent changes in weather and crop growth drivers for the Western Australian grain-belt, and potential impacts on crop growth

Meredith Guthrie[1] and David Bowran[2], [1]DPIRD, [2]Yaruna Research

Key messages

- For ten locations in the Western Australian grain-belt we found a decline in winter (June to August) rainfall and an increase in out of season rainfall (November to March), in the last two decades compared to the previous two decades, and a trend in more negative values of a drought index in some locations.
- The number of days to complete full leaf emergence after June 1 (measured as ninety Growing Degree Days) is up to a day sooner, leading to faster crop growth and the potential to move grain filling into a cooler window.
- The number of rain days is fewer and number of days between rain events in winter is longer. All these elements means that crop production in the grain-belt is more challenging and will require continued innovation to maintain yields.

Aims

To examine current and potential rainfall and temperature patterns in the grain-belt and some of the implications for plant growth.

Results

Winter rainfall throughout the SWLD has generally declined in the last twenty years with a 15 to 45 mm reduction across much of the central and northern grain-belt. Out of season (November to March) rainfall has increased in the last twenty years with an increase of 15 to 45 mm in average rainfall across much of the grain-belt.

Since 2000, a drought index measuring drought in November to March, has been trending more negative, but trending more positive in locations along the south coast. The drought index measured in winter decreased in all locations, with locations along the southern grain-belt closer to the coast have values closer to zero.

Since 2000, the number of rain days per month has decreased by up to two days in May to July, one day in August and September and increased by one day in January in some locations. Since 2000, all locations have seen an increase in the average number of days between rain events in June. The trend continues for most months but is less extreme for August.

A cumulative ninety growing degree days (90 GDD) from 1 June is equivalent to approximately one leaf emergence in cereal plants once seedling emergence occurs. Since 2000, the average number of days for the 90 GDD to be met is now sooner than prior to 2000.

Conclusion

While localised drought and heat events seem to have become more frequent in the last two decades, water use efficiencies have not necessarily declined and for some locations water use efficiencies of 20 mm/kg/ha were reported in 2020 with a decile 3 growing season rainfall. While furrow sowing has allowed for better water harvesting of the smaller events post seeding and along with stubble retention is helping conserve water deeper in the profile, even this may have limits. The warmer winters accelerate crop growth which may result in flowering and grain filling occurring under cooler temperatures and help to offset lower soil moisture accumulation in winter.

Notes:

Soil amelioration alters soil biology, soilborne disease and nematode pests of cereal crops – what are the implications?

Sarah Collins, Department of Primary Industries and Regional Development

ABSTRACT:

Soil amelioration alters soil biology, soilborne disease and nematode pests of cereal crops. What are the implications?

Sarah Collins[1], George Mwenda[1], Carla Wilkinson[1], Daniel Hüberli[1], Sean Kelly[1], Chad Reynolds[1], Melanie Kupsch[1], Kanchana Wickramarachchi[1], Helen Hunter[1], Christine Zaicou-Kunesch[1], Andrew van Burgel[1], Katherine Linsell[2] and Stephen Davies[1],
[1]DPIRD, [2]South Australian Research and Development Institute

Key messages

- Soil biology, soilborne pathogen (*Rhizoctonia solani* (AG8)) and nematodes pests (*Pratylenchus neglectus*, *P. quasitereoides* (RLN), and *Heterodera avenae* (CCN)) populations behaved differently after different amelioration options were applied at Yerecoin (yellow sand) and Darkan (duplex sandy gravel).
- Soil inversion and soil mixing treatments reduced *R. solani* inoculum in the topsoil; this effect persisted over both seasons. *R. solani* in the topsoil commonly impacts crops early in the season.
- Amelioration treatments stimulated soil biological activity and increased pathogen levels and nematodes pests at 10-40cm depth where these nematodes and pathogensare not usually found in non-ameliorated soils in WA.
- Soil inversion consistently out-yielded the control, deep ripping and soil mixing treatments. Soil inversion increased grain yield by > 0.57 t/ha (>17%) over the control at Yerecoin and Darkan in 2019 and 2020.

Aims

- Compare prevalence and distribution of soil biological communities, soilborne pathogen and nematode pests after three mechanical amelioration treatments to a non-ameliorated control.
- Determine if the addition of lime after mechanical amelioration influences the distribution and levels of soilborne pathogen inoculum and nematode pest levels.

Comments

Mechanical soil amelioration had a significant impact on the presence and distribution of nematode pests and soilborne pathogen in soils. Initial results suggest that the soil biological community was reduced in the topsoil by soil inversion but was stimulated by all amelioration treatments at other depths, particularly between 10-20 cm. Generally, amelioration decreased *R. solani* levels in the topsoil but increased them deeper in the profile. The soilborne pathogen and nematode pests we focused on in this study survived and persisted at depth for over two years. The disease implications of their continued presence and multiplication at depth is unclear and needs investigation.

Notes:

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First report of SDHI resistance in barley spot form net blotch in WA

Fran Lopez-Ruiz, Centre for Crop and Disease Management, Curtin University

ABSTRACT:

First report of SDHI resistance in barley spot form net blotch in WA

Wesley Mair[1], Fran Lopez-Ruiz[1], Noel Knight[1], Kul Chandra[1] and Dan Taylor[2], [1]CCDM, Curtin University and [2]DKT Rural Agencies

Key messages

- SDHI resistance has been reported in spot form net blotch (SFNB) for the first time.
- High frequencies of reduced sensitivity to SDHI fungicides were found in the surveyed region.
- Current management practices play a central role in the selection of SDHI resistance, especially in low-medium rainfall zones.

Aims

To assess the sensitivity of *Pyrenophora teres* f. *maculata* (Ptm; SFNB causal agent) to succinate dehydrogenase inhibitor (SDHI) and demethylase inhibitor (DMI) fungicides.

Results

A spot form net blotch-infected barley sample was received in June 2020 from a field in Cunderdin with indication of field failure of Systiva (fluxapyroxad). A fungicide sensitivity test incorporating SDHI (Group 7) fluxapyroxad was conducted to screen for the presence of fungicide resistance in this sample. This test confirmed different levels of SDHI resistance among the resulting *Ptm*, with fungal growth at 2, 5 and 10 µg/mL fluxapyroxad. DNA obtained from monoconidial cultures was analysed with species-specific primers to confirm the isolates as *Ptm*. Sequencing of the SDHI target gene subunits in twelve *Ptm* isolates revealed two mutations in subunit C, N75S and H134R, and one mutation in subunit D, D145G. These mutations have previously been associated with reductions in sensitivity to SDHIs in European populations of *P. teres* (Rehfus *et al.*, 2016). Isolates were subsequently analysed for EC_{50} values to the SDHI compounds fluxapyroxad, bixafen, penthiopyrad, isopyrazam and boscalid.

In July 2020, a field survey was conducted at the original site as well as four other locations within a ~10km radius. For each field, three transects were performed with a sample of 10 leaves collected at each 10m interval; a total of 122 samples were collected from which 262 disease lesions were obtained and processed in the laboratory for fungicide sensitivity. Species analysis confirmed 248 of these lesions as *Ptm* and 14 as *P. teres* f. *teres* (*Ptt*; net form net blotch causal agent). For fluxapyroxad, 46% of the *Ptm* lesions were classified as sensitive, 48% as reduced sensitive (growth at 2 or 5 µg/mL), and 6% as resistant (growth at 10 µg/mL). In order to determine whether resistance to DMI (Group 3) was present in these samples, DMI fungicide tebuconazole was also included in the test. The DMI sensitivity analysis showed 90% of *Ptm* as sensitive to tebuconazole, 7% as reduced sensitive (growth at 15 µg/mL), and 3% as resistant (growth at 50 µg/mL).

In September 2020, another field survey was conducted at the original site as above; analysis of these samples is ongoing.

Conclusion

The emergence of SDHI resistance in WA is a direct consequence of the selection pressure applied in the field due to the continuous use of this group of fungicides. Certain cultural and management practices can exacerbate this problem so rapid detection of fungicide resistance is critical for the deployment of optimal management decisions.

The results presented here confirm the emergence of SDHI resistance in the Cunderdin region of WA. Although the current resistance levels are low (6%), the frequency of the reduced sensitive population (related to small reductions in product performance) was almost 50%, which suggests that current SFNB management practices in the region are contributing to the selection of less sensitive fungi (see https://afren.com.au/understanding/#grower-advice for fungicide resistance terminology).

Rehfus A, Miessner S, Achenbach J, Strobel D, Bryson R, Stammler G. 2016. Emergence of succinate dehydrogenase inhibitor resistance of *Pyrenophora teres* in Europe. *Pest Management Science* 72(10): 1977-1988.

Notes:

Using a disease incident threshold based approach for Necrotrophic disease fungicide control with reference to net blotch on barley

Kith Jayasena, Department of Primary Industries and Regional Development

ABSTRACT:

Using disease incidence thresholds to guide barley net blotch control with fungicides

Kithsiri Jayasena[1], Laurie Wahlsten[1] and Geoff Thomas[2], DPIRD; [1]Albany, [2]Perth

Key messages

- When comparing Farmer Practice (FP) with Threshold Base Spraying (TBS) under lower net blotch (spot type) disease pressure than usually occurs in the Albany region, a 2nd spray could sometimes be avoided without compromising the grain yield and quality in addition to minimising input costs.
- Reducing the use of foliar fungicides will help prevent or delay the build-up of resistant isolates in the dominant net blotch pathogen population.

Aims

- To investigate the effects of threshold base spraying (TBS) of foliar fungicides on net blotch control and grain quality of barley.
- To determine if a TBS programme can reduce fungicide use?
- To compare the TBS with current Farmer Practice (FP) on net blotch control.

Results

STNB disease levels were lower than expected due to drier than normal conditions that prevailed in the southern part of the Albany Port Zone (APZ) during the two-year period (2019 and 2020) when the trials were conducted. However, six out of seven trials had a yield increase between 13% to 60% with foliar fungicide applications. This suggests that in the APZ foliar fungicides play a pivotal role in reducing the disease severity and increase yield even under lower disease severity. In one trial, FP yielded more than 60% than the TBS program. In the other five trials there were some visual yield differences between FP and TBS programs but none of these were significant (p=0.5). There was an increase in net profit $13/ha to $47/ha between the programs depending on the products used and number of foliar spray applications.

Conclusion

The TBS system uses regular monitoring of disease progress on a paddock scale to take decisions on whether to spray or not to spray as opposed to relying solely on a growth stage or calendar approach to fungicide application. As a result, TBS can result in fewer applications or delayed application of fungicides.

In the majority of trials reported in this paper, both FP and TBS had ranging from 15% to 60% increased yield above untreated. Three out of four trials the FP was slightly more profitable than TBS. But this needs to be balanced against the reduced number of fungicide applications and potential reduction in the development of fungicide resistance which could have a large impact on future profitability.

Notes:

Bacterial ice nucleation activity in rainfall and on crop residues may be why rainfall prior to frost events and stubble retention increases frost damage in WA cropping systems

Ben Biddulph and Amanuel Bekuma, Department of Primary Industries and Regional Development

ABSTRACT:

Bacterial ice nucleation activity in rainfall and on crop residues may be why rainfall prior to frost events and stubble retention increases frost damage in WA cropping systems

Ben Biddulph[1] Amanuel Bekuma[1], Sarah Jackson[1], Chaiyya Cooper[2] and Rebecca Swift[2], DPIRD, [1]South Perth; [2]Curtin Uninversity

COGGO Project Code: COGGO#2: The role of ice nucleating bacteria in frost sensitivity of cereals in Western Australia 2019

Key messages

- Infield thermography after head emergence indicates canopies freeze from the ground up. Ice nucleation starts first on the stubble in the interow, before moving to the older senesced leaves and up the plant leaf sheath, stems and reproductive tissue.
- Older leaves of wheat are the primary sites of ice nucleation (-4.7 to -6.3°C) followed by stubble (-5.7 to -6.7°C) and increase the risk of frost damage during heading and flowering,
- Stubble removal doesn't guarantee frost protection but might delay the increase in ice nucleation activity and hence decrease frost risk at flowering,
- Increasing concentrations of ice nucleating protein applied prior to frost events increased frost damage in a dose response manner, but a wet canopy by itself did not increase frost damage.
- Spring rainfall has biological ice nucleation activity but this varied with site and event.

Aims

To better understand the mechanism by which stubble retention and rainfall prior to frost events increase frost damage and to identify the main source of ice nucleation activity (INA).

Results

Infield thermography during frost events indicates canopies freeze from the ground up. Ice nucleation started first on the stubble in the interow before moving to the older senesced leaves and up the plant leaf sheath, stems and reproductive tissue. Our lab results confirm this and indicate that ***older leaves are the primary sites of ice nucleation (-4.7°C) followed by stubble (-5.7°C) which increase the risk of frost damage during the most susceptible stages. The higher INA on the stubble and older leaves is likely to be caused by ice-nucleating bacteria (INB), known to cause frost damage at -5°C***. An ice nucleating protein applied to wheat just prior to frost events significantly increased frost damage while sterile water alone did not suggesting an ice nucleator must be present in rain water as just wetting the canopy doesn't increase frost damage. Assessment of spring rainfall events from sites across the Great confirm rainfall can have ice-nucleating activity but the activity is variable with site and rainfall.

Conclusion

Rainfall prior to frost events and retained stubble appear to increase frost damage due to greater ice nucleation activity causing freezing damage to occur earlier in the night resulting in more terminal damage. Currently, the evidence is mounting to implicate the role of INB behind the increased INA, and our increased understanding may offer new management options that reduces INA on stubble and older leaves. In the meantime growers should continue to manage frost in the same way with frost zoning, enterprise, crop type, variety maturity and sowing date to minimise frost exposure and continue to manage stubble loads to manage frost risk.

Notes:

Optimising the Gross Return value proposition when comparing Farmer Retained OP TT vs Hybrid CT and TT canola with varying seed sizes and plant population targets

David Tabah and Justin Kudnig, Pacific Seeds

ABSTRACT:

Optimising the Gross Return value proposition when comparing Farmer Retained OP TT vs Hybrid CT® and TT canola with varying seed sizes and plant population targets

Justin Kudnig, Pacific Seeds

Key messages

- Grading OP TT canola seed to >2mm provides increased plant establishment, grain yield and gross returns.
- Higher yielding CT and TT hybrids provide consistent higher grain yields and gross returns than OP TT varieties.
- CT® and TT hybrids with seed sizes of =2mm or >2mm established at lower plant populations can provide higher grain yields and gross returns than OP TT varieties graded to >2mm at higher plant populations.

Aims

This research examines the differences in plant establishment (p/m²), harvested grain yield (t/ha) production for five different hybrids versus three open pollinated (OP) TT varieties (farmer retained source) with various seed sizes to determine the best gross return ($/ha) value propositions for growers.

Results

This research demonstrates that site environmental conditions and variety genetics had the largest effects on final established % of plant numbers rather than (TSW) seed size and target plant populations.

The MET analyses for yield showed two distinct yield clusters broadly described as Cluster 1 being higher rainfall, higher yielding and Cluster 2 as drier, lower rainfall environments. Yields across both clusters showed CT® or TT hybrids with more widely adapted genetics, seed size =2mm or >2mm, providing the highest yields at 25 and 40 plants per m² targets compared to any of the OP TT varieties, regardless of plant population target or seed size.

Gross return ($/ha) value proposition calculations showed some CT® and TT Hybrids between =2mm to >2mm seed size at the 25 or 40 plants per m² targets compared to OP TT varieties with larger >2mm seed showed average gross return increases ranging between $84/ha to $321/ha in the higher rainfall environments and $36/ha to $196/ha in the medium rainfall environments.

Conclusion

This study highlights that G X E X M interactions are very complex and dynamic. Genetics (G) is the biggest controllable factor, i.e. varietal choice; Environment (E) is the most significant factor by far. Management (M) will influence to a small degree in some environments, but for every environment where M has a significant effect, there are many environments where it does not. From a profitability perspective, the main consideration is Genetics by Multi-Environment relationships.

In relation to addressing canola growers industry requests for further research on validation of grading OP TT seed to >2mm, this research showed the >2mm seed across three OP TT 'farmer sourced' varieties, increased plant establishment of up to 35 percent, provided statistically significant yield increases of up to 433 kg per hectare and effectively lifted gross returns by up to $255 per hectare compared to the <2mm seed size.

Whether the trial locations received a medium or high growing seasonal rainfall total, several CT® or TT hybrids, even with lower plant population targets provided higher gross returns in $ per hectare than the three commonly grown OP TT varieties with the >2mm seed size in conjunction with the highest target population.

This research effectively validates that CT® or TT hybrids can provide a strong positive value proposition in $ per hectare for canola growers with higher yielding genetic backgrounds by consistently delivering higher returns than graded larger seed of farmer retained OP TT canola seed.

Notes:

Early decisions pay when growing chickpeas and faba beans

Stacey Power, Department of Primary Industries and Regional Development

ABSTRACT:

Early decisions pay when growing chickpeas and faba beans

Stacey Power, Mark Seymour, Andrew Blake, Harmohinder Dhammu, Geoff Thomas, DPIRD, Northam

Key messages

- Active management of chickpea ascochyta is essential, including seed dressing and 4 to 6 week foliar fungicide, even if the risk of ascochyta is considered low in your area.
- Chickpea growers should consider newly released variety CBA Captain⍭ for improved harvestability.
- PBA Amberley⍭ is a good choice for growers who have high yield and disease potential.

Aims

Provide pulse growers and their consultants with updated information on products, varieties and strategic agronomy practices to ensure information is not limiting adoption and performance of pulses in Western Australia (WA).

Results

Chickpea

- New, WA suitable variety CBA Captain⍭ has improved harvestability due to greater height to lowest pod, and it again produced equal highest yields in National Variety Trials in 2020
- Yields increased by 500 kg/ha when ascochyta was adequately supressed in the moderately susceptible variety Neelam at Mingenew in a decile 3 season.

Faba bean

- Low disease levels meant the better resistance rating of PBA Amberley⍭ was more important than fungicide timing in the control of chocolate spot in faba beans at Frankland River in 2020.
- In crop temperature and humidity sensors with real-time alerts could give faba bean growers the confidence to leave crops unsprayed with fungicide.

Conclusion

There are now attractive new variety options in both chickpeas and faba beans for growers across WA. Combined with robust disease and weed management packages, these should go a long way to improving grower confidence when introducing a grain legume option into their rotation.

Notes:

Legume break crops in 2021

Mark Seymour, Department of Primary Industries and Regional Development

ABSTRACT:

Legume break crops in 2021s

Mark Seymour[1], Scott Wandel[2], Geoff Fosbery[3] and Dr Nathan Craig[4], [1]DPIRD, [2]Mt Ridley Farmer, [3]ConsultAg, [4]West Midlands Group

Key messages

- Scott will discuss - growing lentil, field pea and vetch in the South-East.
- Geoff will discuss – farmer success and failure growing chickpea in the central region.
- Nathan will discuss – on-farm pulse trials.

Aims

Panel session to discuss opportunities and issues in choosing and growing a legume crop in 2021.

Results and conclusion

Some WA farmers have been growing pulses for over 30 years, many farmers grew them 30 years ago and never again, and for many growers their interest has waxed and waned over the years.

It appears many growers are once again looking for that elusive legume crop on their farms to fit in with their cereal dominant rotation.

This panel session will highlight some recent experiences from a farmer, consultant, grower group and researcher perspective - and hopefully highlight some ‘secrets’ to success.

Notes:

Are our plant biosecurity measures up to the challenge (... are we 'COVID' ready)?

Sonya Broughton, Department of Primary Industries and Regional Development

ABSTRACT:

Australia is free of many plant pests and diseases, with 42 exotic pests and diseases making up the national top priority pest list. Of these, 13 currently listed in the top 42 have been detected in Australia in the last 10 years, of which two are considered to be a threat to the grains industry. Of the 14, eradication was attempted against nine species, whilst three were deemed to be too well established to be eradicated, or could not be eradicated owing to the biology or ecology of the pest or disease. Like the Covid response, early detection is key to successful eradication. In this presentation I discuss current grains surveillance programs in Western Australia, the methods (general, specific), locations (urban, regional), and surveillance type (public, industry, high-risk site surveillance, pest-specific trapping), and lessons learned from recent eradication programs which together, ensure that government, producers and industry are up to the challenge of protecting WA's plant biosecurity status.

Notes:

What's going on with Fall armyworm and Russian wheat aphid in WA?

Svet Micic and Dustin Severtson, Department of Primary Industries and Regional Development

ABSTRACT:

What's going on with Fall armyworm and Russian wheat aphid in WA?

Dustin Severtson and Svet Micic, DPIRD

Key messages

- Fall armyworm was detected for the first time in Australia in early 2020 which migrated from northern Queensland to Kunnunurra, Broom, Carnarvon, Geraldton and Gingin.
- Russian wheat aphid was detected in WA for the first time in August 2020 in the Esperance region.
- Protection from these two new pests of grain crops need to be considered within grain production programs in WA.

Aims

To investigate the geographical range of two pests new to Western Australia (Fall armyworm and Russian wheat aphid) and provide management solutions to grain growers.

Results

Fall armyworm surveillance

Although fall armyworm moths were detected at Geraldton and Gingin, no moths or larvae were detected at the more than 70 grainbelt sites or from public reports of caterpillars via samples or images. At present Carnarvon is the most southern point where fall armyworm caterpillars have been confirmed.

Russian wheat aphid surveillance

A total of 121 sites were surveyed throughout the grain belt in 2020, however RWA was found in 24 sites in the Esperance port zone only. Sites with RWA were located in low, medium and high rainfall areas. RWA was found on early and late sown barley and wheat crops. Surveys found notably fewer RWA in crops which had an insecticide seed dressing. RWA was present at levels of less than 1% of tillers with RWA, which is well below control thresholds.

Conclusion

Fall armyworm and Russian wheat aphids are new pests of grain, pasture and horticulture crops in Western Australia. Proper identification, surveillance and an integrated pest management approach will be key in managing these pests going forward.

Notes:

GRDC GROWNOTES

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Feathertop Rhodes grass control

Mark Congreve, Independent Consultants Australia Network

ABSTRACT:

Understanding feathertop Rhodes grass – What can we learn from the east coast?

Mark Congreve, ICAN

Key messages

- Feathertop Rhodes grass is a prolific seeder.
- FTR will be the first to colonise bare ground.
- Expect glyphosate to be poor.
- Expensive to remove once established in cropping paddocks.
- Prevention is the best policy. This requires excellent farm hygiene, including individual remove of ALL individual plants from cropping paddocks.

Aims

Feathertop Rhodes grass is an emerging problem weed of cropping. Queensland has been dealing with the issue for >15 years so it is possible to learn from their experiences.

Comments

Feathertop Rhodes grass (FTR) is thought to have been introduced into central Queensland with the importation of buffel grass pasture seed from north America. In the past ~15 years it has been spreading widely, firstly throughout southern Queensland, and more recently to other mainland states. There is strong evidence to suggest that it is being spread by vehicles along major roadways throughout the country, especially where roadside managers preference glyphosate for roadside weed control.

FTR is often the first species to emerge on bare soil (e.g. sprayed roadsides, fallow paddocks) and is largely tolerant of glyphosate. Where FTR encroaches on no-till fallow farming paddocks it can rapidly take over, especially in wet summers.

The most successful strategies for managing FTR is to keep it out of cropping paddocks via meticulous attention to farm hygiene and removal of any individual plants prior to flowering.

Once established in cropping paddocks, populations can be reduced relatively quickly, as the seedbank persistence is short. However, this requires at least 2 years of 100% prevention of any further seed set, which is both costly and difficult to achieve on large areas; especially as there is likely to be multiple germinations per year.

Notes:

Glyphosate resistant ryegrass control comparison with new generation glyphosate wetter packages versus traditional formulations alone and combined with innovative double knock strategies

Michael Lamond, SLR

ABSTRACT:

Michael Lamond, SLR

Key messages

- Glyphosate resistant ryegrass is an emerging threat to growers in WA. Whilst 6 to 8 per cent of sampled populations in the recent AHRI Survey (2020) showed some level of Glyphosate resistance ryegrass, history tells us that these surveys are a good early indicator of what to expect in the future. Agronomist observation suggests that the areas most at risk are the low rainfall regions of WA where there is less ability to pay for the extra costs of increased rates of knockdown herbicides.
- Ryegrass in this trial at the early stages of developing resistance to Glyphosate required at least double the rate of a commonly used Glyphosate 450gai formulation than the equivalent rate of Glyphosate with a new generation wetter incorporated into the formulation to gain equivalent control of ryegrass.
- There is little difference in efficacy on ryegrass with the different Glyphosate salt formulations. Wetter type and rate have a greater impact.
- The wetter package becomes more critical when ryegrass is at the early stages of developing resistance than when fully susceptible and simply adding generic 'off the shelf' wetters to traditional Glyphosate 450gai formulations does not necessarily result in expected ryegrass control at rates where adequate control has been previously achieved. Moisture stress at application adds to the problem.
- Where ryegrass is developing resistance to Glyphosate, final control with a double knock of Paraquat generally results in poorer ryegrass control than expected. Replacing Paraquat with Glufosinate results in improved final ryegrass control in a double knock strategy.
- In paddocks where growers are finding ryegrass more difficult to control with Glyphosate, it is harder to estimate the rate increase that is required to gain satisfactory control when using traditional 450gai Glyphosates than Glyphosates with the newer generation wetters, as traditional 450gai Glyphosates vary in the type and percentage of wetter incorporated in the formulation.

Aims

- To determine the difference in rate of Glyphosate 450 required to gain equivalent ryegrass control when compared to a Glyphosate formulation with a new generation wetter package.
- To compare the difference in final ryegrass control between Paraquat and Glufosinate following an application of Glyphosate.
- To provide some 'rules of thumb' for growers to follow when deciding on the type and rate of Glyphosate to use to control ryegrass that they suspect is becoming more difficult to control.

Results

Glyphosate 450 achieved 65.7% final ryegrass control and Ultra Max 570 achieved 98.7% final ryegrass control with equivalent rates of grams active ingredient at 3L/ha of Glyphosate 450.

Glyphosate 450 applied at 3L/ha followed by Glufosinate 2L/ha + ammonium sulphate 5% achieved 100% final ryegrass control whilst Glyphosate 450 applied at 3L/ha followed by Paraquat 2L/ha plus 0.1% BS1000 wetter achieved 92.7% final ryegrass control.

Comments

The rate of Glyphosate 450 required to control ryegrass that is developing resistance to glyphosate not only has an impact on the level of ryegrass control, but also on the ability of a double knock with Paraquat to give commercially acceptable ryegrass control..

Notes:

When to take advantage of early seeding opportunities for canola

Jackie Bucat, Department of Primary Industries and Regional Development

ABSTRACT:

When to take advantage of early seeding opportunities for canola

Jackie Bucat[1], Martin Harries[2], Stacey Power[3], Andrew Blake[2], Imma Farre[1], Helen Cooper[4], Salzar Rahman[2] and Stephanie Boyce[1], DPIRD [1]South Perth, [2]Geraldton, [3]Northam and [4]Esperance

Key message

- Profitable canola crops can be grown as early as mid-March, although establishment is difficult and risky to rely on follow-up rains.
- Taking advantage of canola sowing opportunities is recommended from early April, into good soil moisture.
- Longer season varieties have highest yields with early sowing. Choose varieties based on yield performance and suitable maturity.

Aims

- Discover how early a profitable canola crop can be sown, with particular attention to phenology and development.
- Compare yield, quality and profitability of different sowing times to provide growers with information when considering early sowing times to match sowing opportunities.
- Prove if it is better to sow longer season varieties with early sowing and shorter season varieties with late sowing
- APSIM validation (addressed in the presentation by Imma Farre)

Results

Many WA growers are considering or planting canola earlier and earlier to take advantage of increasingly rare sowing opportunities and to fit in with farm logistics. How early is too early? It is important to know the earliest seeding time for a profitable canola crop and of risk factors and likelihood of success in the different agricultural regions/conditions.

Eight large field trials with 4-5 of sowing times, beginning 19th March, were established over the WA Agricultural region (Mullewa, Wongan Hills, Dale and Grass Patch) over two seasons (2019-2020). Eight TT varieties were used, covering the early to mid-late range of maturity and both OP and hybrid types. Trials were irrigated to simulate early sowing opportunities, so emergence occurred directly after sowing. Phenology was monitored on a weekly basis.

Sowing on March 19 resulted in profitable canola plots, with similar yields to sowing on April 10. Yields generally declined after April 10 sowing.

Phenology and the effects of different variety maturity will be presented and compared with site conditions.

Conclusion

When an early seeding opportunity occurs, seeding in April is a robust strategy. Seeding in March can be successful but is a higher risk strategy and growers could consider spreading risk by sowing only part of the canola program, using wetters and increasing the sowing rate of OP canola.

There will also be a brief presentation of NVT trials.

Notes:

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- Our focus is crop science and grain production, soil science and crop nutrition, disease, pest and weed management, and genetic improvement.

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Canola yield response to sowing date – from a few trials to many locations using simulation modelling

Imma Farre, Department of Primary Industries and Regional Development

ABSTRACT:

Canola yield response to sowing date. From a few trials to many locations using crop simulation modelling

Imma Farre, Martin Harries, Jackie Bucat, Stacey Power, Andrew Blake, Salzar Rahman, Stephanie Boyce and Helen Cooper, DPIRD

Key messages

- Crop simulation can help agronomists and growers make informed decisions about crop management to maximise profitability.
- For dry-sowing canola early, once the break of season occurs, assess the chances of achieving target yields and adjust the inputs accordingly, to maximise profitability.
- If sowing canola at the break of season, assess the risk of achieving certain yield, depending on the date of the break, and adjust inputs or consider alternative crop to maximise profitability.

Aims

Two aims:

1. For very early sowings and current cultivars, to validate the APSIM-Canola model; and
2. To provide better advice to agronomists and growers about yield expectations depending on location, break of season date and season type.

Results

APSIM-Canola model satisfactorily simulated the flowering dates for three generic cultivars (early, mid and late season length types), five times of sowing and four locations. The error in the yield simulations was greater for early sowings, but overall, the slope of the yield to sowing time relationship was satisfactorily simulated.

The canola yield response to sowing date in 2019 and 2020 trials was well simulated by the APSIM-Canola model, with peak yields for mid-April wet sowing.

Simulations showed a large year to year variability in yields. The simulation study demonstrated the importance of playing the season and adjusting management and inputs according to yield expectations in order to maximise profitability.

Conclusion

APSIM-Canola model can satisfactorily simulate flowering dates and grain yield for current cultivars across locations and sowing dates in WA.

In the field trials, it was possible to obtain economic yields with very early sowings with supplementary irrigation, but in field conditions it might be difficult establishing canola in very hot conditions in March.

As a rule of thumb, in WA, in low and medium rainfall locations, the optimum sowing period (wet sowing) to maximise grain yield for a medium maturity cultivar is April; and in the high rainfall locations the optimum sowing window is from early-April to mid or late-May, if frost is not an issue.

Notes:

Barley varieties and agronomy tips for 2021

Blakely Paynter, Department of Primary Industries and Regional Development

ABSTRACT:

Barley varieties and agronomy tips for 2021

Blakely Paynter, DPIRD Northam

Key message

- The barley industry is being well served by Australian and international breeding companies with the release of a suite of new, higher-yielding varieties. While all aim to be known as a malt barley, they can still be grown as alternatives to the feed-only varieties Fathom and Rosalind.
- No variety is perfect, so recognising each variety's strengths and weaknesses can help in the decision to adopt or not adopt and how to manage it to minimise the downsides.
- Spartacus CL and RGT Planet currently dominate Western Australia's barley production but will likely be challenged by Beast, Commodus CL, Leabrook, Laperouse, and Maximus CL in coming years.
- Getting the agronomic package right is the key to maximising profit, as there are subtle differences in how you set up a crop with a malt potential in mind and how you set up a crop to grow grain.
- Changes like drilling more seed, ensuring that barley is not restricted to the worst paddocks, timely sowing, and upping nitrogen rates are all hallmarks of a yield-focused program in conjunction with timely and appropriate fungicide management.

Aims and background

The area sown to barley has grown significantly in the last ten years. Between 2010-2014, barley occupied 15% of the total cropped area in the south-west of Western Australia. The popularity of barley rose in the next three-year period (2015-2017) to 17% of the total cropped area and has again increased since 2017 to 21%. An increase of over 0.5 million ha since the beginning of the decade. Why, a suite of new varieties, supportive and relevant research, appropriate development and extension, an open and constructive supply chain, and competitive pricing when combined have resulted in healthy margins. Despite the recent change in grain flow associated with the introduction of a tariff on Australian barley to China, the prospects for barley are still very bullish in Western Australia.

My presentation at the 2021 GRDC Research Updates will bring together the available information on five new barley varieties of greatest interest to the Western Australian barley industry – Beast⁽ᴾ⁾ (AGT), Commodus CL⁽ᴾ⁾ (InterGrain), Leabrook⁽ᴾ⁾ (SeedNet), Laperouse⁽ᴾ⁾ (SECOBRA Recherches), and Maximus CL⁽ᴾ⁾ (InterGrain).

Additionally, my presentation will cover management tips that can assist with yield maximisation including sowing date, nitrogen management and target plant density.

Notes:

Oat crop varieties and agronomy tips for 2021

Georgie Troup, Department of Primary Industries and Regional Development

ABSTRACT:

Oat Update 2021

Georgie Troup, DPIRD

This presentation will focus on;

- Variety performance, including evaluation of new varieties over multiple growing seasons and environments when grown for grain (data sourced from NVT and DPIRD/GRDC trials) and export fodder (data sourced from DPIRD/ AgriFutures Australia trials).
- The value of early April sowing for oat grain production, its impacts on yield and quality when compared to May sowing. In 2020, early April sowing at Wongan Hills and Muresk produced ~600 kg/ha yield advantage over May sown crop, but the quality improvements are the most critical factors for growers of milling oats.
- Optimising yield and quality in export fodder systems through variety selection and agronomy. Early May sown crop yielded 7.80 t/ha, while early June sown crop yielded 4.84 t/ha at Muresk in 2020. Brusher, Koorabup, Vasse, Yallara and Carrolup were the highest yielding varieties when sown in early May. However, when sowing was delayed until early June, Durack was significantly higher yielding than all other varieties – similar to 2019.

Aims

To evaluate oat varieties, and variety specific agronomy requirements to maximise profitability for oat growers – of hay and grain.

Notes:

Pesky Pests! Control red legged earthmites using crash grazing

Know what invertebrates are associated with weed seed control systems

What to do if you see snails influx for the first time – snails management 101

Svet Micic, Department of Primary Industries and Regional Development

ABSTRACT:

Control Redlegged earth mites using crash grazing

Know what invertebrates are associated with weed seed control systems

What to do if you see snails influx for the first time – snails management 101

Svet Micic, DPIRD

Key messages

Control redlegged earth mites using crash grazing

- Research conducted in the 1990's has shown that intensively grazing pastures throughout spring controls RLEM as effectively as insecticides. Yet the tactic has not been adopted by producers as impractical numbers of sheep are required. Given that in the absence of chemical control options resistant RLEM's could reduce crop yields by up to 30% at a loss of around $74/ha a spring grazing package could recover a substantial proportion of these losses. Even with chemical control RLEM's still cause losses of $4.95/ha or 3.6 million dollars in just canola crops in the Western GRDC region. Intensive spring grazing for four weeks and in some cases even two weeks could reduce these losses.

Know what invertebrates are associated with weed seed control systems

- A survey to understand how harvest weed seed control (HWSC) systems influence invertebrate populations in paddocks was conducted over all five port zones. With more growers opting for rotting down chaff from HWSC systems rather than burning, knowing what species are harbouring under the different chaff systems can assist with planning control measures. The survey highlighted that paddocks located in the Albany, Esperance and Kwinana West port zones were more likely to have pests such as European earwigs, slaters and snails. And in these locations, paddocks with chaff dumps were more likely to have European earwigs, slaters and snails, than paddocks with chaff lines or tram-lines. However, more pests were found under the chaff before sowing than were found after crop germination, indicating that these pests have moved out from the chaff into the paddock. Knowing what's in the chaff before sowing is critical to prevent crop damage.

What to do if you see snails influx for the first time – snails management 101

- Developing improved management tactics for snails remains a priority to improve growers' profitability and reduce market access risks caused by snail contamination of the grain harvest. Recent research from a three year national snail project will be presented. The extensive datasets highlight that baiting programs should be focused during March to June. It is possible to bait earlier as all snail species move in response to increases in relative humidity at ground level from late summer through autumn.

Notes:

Microbiome engineering as a tool to increase crop production in the 21st century

Falko Mathes, Bioscience Pty Ltd

ABSTRACT:

Microbiome engineering as a tool to increase crop production in the 21st century

Falko Mathes[1,2], Daniel Murphy[2] and Peter Keating[1], [1]Bioscience Pty Ltd, [2]UWA School of Agriculture and Environment

Key message

- Microbiome engineering is a novel approach that recognises the complexity of the soil and plant-associated microbial communities, and seeks to increase crop production by enhancing plant-beneficial microorganisms and functions.
- Two products with different modes of action (i.e. super-absorbent polymers and Bioprime®) increased the abundance of known, beneficial rhizobacteria and predicted plant-growth promoting functions in pot and field trials.
- Wheat yields increased between 2.4% and 26.6% for polymers, and between 3.4% and 10.4% for Bioprime across a number of field trials and different sites equating to increased net farm income of up to $129.79 per hectare for polymers and up to $104.58 per hectare for Bioprime.

Aims

To improve wheat yields by engineering the existing indigenous soil and plant-associated microbiomes using novel, commercially available amendments rather than microbial inocula.

Results

Polymer microbiome analysis and effects on wheat yields

The wheat rhizosphere and the polymers recruited similar rhizobacterial taxa from the soil microbiome, with some of them being enriched in the polymers. A number of predicted plant-growth promoting traits were significantly higher in the polymers than in the rhizosphere. Yield responses were largely positive (between 2.4% and 26.6%), except for one water-repellent soil (-3.5%).

Effect of Bioprime on wheat rhizosphere microbiome, plant growth and yield

Bioprime seed treatment significantly increased wheat shoot biomass by 27% in a pot trial and elevated abundances of known rhizobacterial taxa. This was associated with increases in a number of predicted plant-growth promoting functions. In field trials, Bioprime increased yields between 3.4% and 10.4% across different modes of application, trial locations and growing seasons.

Conclusion

The product examples given in this paper represent early efforts at microbiome engineering and have shown promising yield responses while utilising two very different modes of action (microbial adhesion for polymers and signalling chemistry for Bioprime). Growers can look forward to future developments in this area of research that ultimately could improve crop production and farm business success.

Notes:

TOP 10 TIPS

FOR REDUCING SPRAY DRIFT

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.

Benchmarking soil amelioration outcomes using paddock yield and water use efficiency data

Jenni Clausen, Department of Primary Industries and Regional Development

ABSTRACT:

Benchmarking soil amelioration outcomes using paddock yield and water use efficiency data

Jenni Clausen[1], Bindi Isbister[1], John Bruce[1], Steve Davies[1], Tony Murfit[2], [1]DPIRD [2]Warakirri Cropping, Mawarra

Key messages

- Whole paddock averages of yield, percent of yield potential achieved and gross margins can benchmark the effect of amelioration on paddock productivity.
- Utilising spatial data layers to map yield, yield potential and gross margins can assist in identifying areas least and most responsive to amelioration. This allows targeted assessment of other constraints if a low response or indicate which soils on the farm to ameliorate if more responsive.
- Standard yield potential estimations under-predicted achieved yields after amelioration in some soil types more than others, therefore other methods of estimating yield potential and water use efficiency after amelioration will be explored.

Aims

To assess the use of different benchmarking techniques to measure/monitor the spatial and temporal effect of soil amelioration (lime, deep ripping and one-way ploughing) on crop production from a paddock in Burracoppin, located in the low rainfall zone of the WA eastern wheatbelt. Soil types in the paddock vary including sandy loam, sand over gravel, loamy clay, and medium-heavy clay.

Results

Transforming yield data to an estimate of yield potential provided a way to standardise the yield across seasons and crop types to assess the relative changes in production across the paddock after amelioration. When viewed as average performance before and after amelioration, overall paddock yield averages improved, but viewing the yield data spatially became more interesting as key soils types were highlighted with various levels of responsiveness and water use efficiency. The deep sandy earth soils without a severe subsoil acidity constraint achieved the highest improvement in percent of yield potential, whereas the sands with a more acidic subsoil remained a poorer performing soil type of the paddock.

Conclusion

The methods explored provide a way to spatially benchmark paddock and soil type performance after amelioration. These approaches identify key soils to target for future amelioration across the farm and those that do not have a return on investment with the amelioration approaches applied.

Notes:

Topsoil water repellence can benefit early growth and nutrition of furrow-sown wheat by increasing soil wetting depth

Simon Yeap, Murdoch University

ABSTRACT:

Topsoil water repellence can benefit early growth and nutrition of furrow-sown wheat by increasing soil wetting depth

Simon Yeap[1], Richard Bell[1], Craig Scanlan[2], Richard Harper[1] and Stephen Davies[2], [1]Murdoch University, [2]Department of Primary Industries and Regional Development

Key messages

- Deep ripping to the depth of the hardpan in yellow sand, sand over gravel duplex soils and gritty grey clay provided positive yield responses for up to four years when paddocks were managed under a controlled traffic farming system.
- There was no benefit to deep ripping a calcareous loamy earth.
- Deep ripping in controlled traffic farming had a return on investment of $1 to $29/ha over four years depending on depth or the addition of topsoil slotting plates.

Aims

To assess the efficacy of water-repellent topsoil for water harvesting and for early crop growth and nutrition under limited water supply.

Results

Results from three controlled glasshouse experiments growing wheat (cv. Mace) in 27 L pots showed that severely water-repellent topsoil treatments with a wettable furrow averaged 112% more shoot dry matter than completely wettable topsoil treatments during early growth (40-51 days after sowing; $P<0.05$). Total uptake of N, P, and K was also significantly ($P<0.05$) greater in repellent treatments than in completely wettable treatments by 125%, 196%, and 144%, respectively, on average across all glasshouse experiments. Even after a 40% reduction in plant density, repellent treatments with the lowest plant density (75 plants/m^2) still produced 62% ($P<0.05$) more shoot dry matter and 88% greater total nutrient uptake (averaged from N, P, and K), relative to completely wettable treatments with the highest plant density (125 plants/m^2). Soil volumetric water contents in the furrow at 5 and 15cm and in the inter-row at 15cm were also relatively greater in repellent treatments than in wettable treatments, with faster wetting rates in repellent treatments.

Conclusion

Under regular but limited water supply (≤5.4mm every two days) with no leaching, severely water-repellent topsoil with a wettable furrow significantly increased early shoot dry matter and nutrition (N, P, and K) of furrow-sown wheat relative to completely wettable topsoil. Such improvements in early growth and nutrition due to repellent topsoil treatments could be attributed to preferential flow below the wettable furrow which increased the rate of soil wetting and soil water availability at depth relative to wettable topsoil treatments which exhibited even but shallow wetting. Diverting water to the subsoil would also lessen evaporative water loss from the surface of repellent topsoil treatments and, as a result, allow more water for transpiration and shoot growth. Where soils have not been ameliorated, furrow sowing and banding wetting agents could be an effective strategy to promote water harvesting and improve crop productivity on water-repellent sandy soils in water-limited environments.

Notes:

Cracking the code of group H cross-resistance in wild radish

Bowen Zhang, University of Western Australian

ABSTRACT:

Field resistance to group H herbicides in wild radish

Bowen Zhang, Roberto Busi, Danica Goggin and Hugh Beckie, Australian Herbicide Resistance Initiative, UWA

Key message

- Two field populations were confirmed to be resistant to Velocity by dose – response studies at two different plant stages, with large (four-leaf) plants surviving 1000 mL Velocity ha^{-1}.
- Small (two-leaf) wild radish resistant plants were highly suppressed at the recommended label rate (670 mL ha^{-1}).
- The two field populations are also confirmed to be cross-resistant to mesotrione (Callisto) and topramezone. (Frequency).

Aims

Confirm and quantify the first case of field resistance to HPPD-inhibiting (group H) herbicides.

Results

Plant survival of 8.9% and 12.2% was observed in two field populations (1986-2020 and 1991-2020) of wild radish treated at the two-leaf stage with the recommended dose of Velocity (670 mL ha^{-1}). The calculated LD50 values were 112 mL ha^{-1} and 181 mL ha^{-1}, respectively. The susceptible population (WARR36) was fully controlled at the label rate and the resulting LD_{50} value was 17 mL ha^{-1}. The calculated resistance indices were seven and 11 for the two field populations, respectively. The assessment of plant biomass revealed plants highly suppressed by the action of Velocity with calculated resistance indices equal to one (no resistance).

Conversely, the control of larger wild radish plants (four-leaf stage) was much reduced. At the highest dose (1000 mL ha^{-1}) a much higher survival rate of 66% and 75% was recorded for populations 1986-2020 and 1991-2020, respectively, with estimated LD_{50} values higher than the maximum tested rate (i.e. >1,000 mL ha^{-1}). Conversely, WARR36 was fully controlled at the recommended label rate and the estimated LD_{50} value was 192 mL ha^{-1}. The calculated resistance indices were >5. Surviving resistant plants were greatly suppressed resulting in a 3-fold resistance index: GR_{50} values were estimated to be 263 and 372 mL ha^{-1} for 1986-2020 and 1991-2020, respectively and 101 mL ha^{-1} for the susceptible population WARR36.

We assessed cross-resistance by dose – response analysis of foliar post-emergence application of mesotrione, pyrasulfotole and topramezone to four-leaf wild radish plants. At the recommended rate (or 3.7-fold above for pyrasulfotole) of each stand-alone herbicide, we observed 78% and 50% survival to mesotrione (96 g ha^{-1}), 55% and 72% to pyrasulfotole (140 g ha^{-1}) and 64% and 61% to topramezone (12 g ha^{-1}), for 1986-2020 and 1991-2020, respectively Conversely, the survival of the susceptible control ranged from 0 – 4% at the same dosages. The calculated resistance indices indicate a 10- up to 20-fold resistance as response to stand-alone post-emergence applications of mesotrione, pyrasulfotole or topramezone

Conclusion

This is the first report of field resistance to HPPD-inhibiting herbicides. We observed that resistance was minimized (ie resistant plants highly suppressed) when Velocity was applied at the full rate and to small radish plants. Research is warranted to confirm the frequency of cross-resistance to HPPD herbicides in wild radish via random surveys and resistance testing of problematic wild radish populations. A collaborative research endeavour is currently on-going to study and characterize the mechanism(s) of resistance and cross-resistance to HPPD inhibitors.

Notes:

Minimising the impact of high temperature at flowering on spikelet fertility

Camilla Hill, Murdoch University

ABSTRACT:

Minimising the impact of high temperature at flowering on spikelet fertility

Camilla Hill[1], Sharon Westcott[2], Lee-Anne McFawn[2], Debbie Wong[3], Xiao-Qi Zhang[1], Kerrie Forrest[3], Matthew Hayden[3], Tefera Angessa[1], Chengdao Li[1,2], [1]Western Crop Genetics Alliance, Murdoch University; [2]DPIRD; [3]DJPR

Key messages

- Adapting crops to warmer environments is a priority to maintain or enhance yield.
- Heat stress resulted in 5-20% fertility reduction in Australian barley varieties.
- New germplasm with better tolerance was identified.
- Enhanced heat stress tolerance of reproductive organs using genetic approaches has the potential to overcome heat stress-induced yield losses in crops under current and future hotter climates.

Aims

- To uncover of the full range of genetic diversity present for spikelet fertility in current germplasm;
- To understand the relationship between fertility rate and grain plumpness under heat stress;
- To identify varieties with superior spikelet fertility compared to currently available germplasm;
- To deliver marker assays for tracking the inheritance of alleles in breeding material.

Results

Field trials of a worldwide barley panel of 500 varieties were conducted at Wongan Hills in 2019/2020. Heat escape and earlier flowering were successful strategies to mitigate heat damage, and resulted in higher grain fertility, grain yield and grain quality traits. Varieties that flowered during heat stress periods recorded on average 5–20% lower spikelet fertility compared to those that flowered outside the stress windows. We detected large differences of more than 80% regarding spike and spikelet fertility in Australian varieties. Based on decreases in spikelet fertility at high temperature, cultivars Flinders, Vlamingh and La Trobe were most tolerant (2–6% reduction), while cultivars Grimmett and Oxford were highly susceptible (17–30% reduction) and cultivars Sloop, Sloop Vic and Skiff and were moderately susceptible (8-13% reduction) to high temperature. Targeted re-sequencing of the entire barley panel identified over 7,000 genetic variants across 130 spikelet fertility and heat-tolerance related genes. This information will allow the identification of new markers to breed barley varieties with enhanced spikelet fertility under heat.

Conclusion

Annual economic losses to heat stress are at least AU$ 1.1 B. Spikelet fertility at high temperature is a valuable screening tool for heat tolerance during the reproductive phase. Early flowering consistently outperforms late flowering under heat stress for a range of agronomic traits. Based on decreased spikelet fertility, several research lines but only few cultivars maintain spikelet fertility after heat stress compared to control conditions. Genetic information of heat-tolerant and sensitive varieties screened in this project will be used to improve spikelet fertility of the next generation of barley cultivars.

Notes:

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Profitable mixed farming systems in Western Australia

Stacey Bell, Farmanco Management Consultants

ABSTRACT:

Profitable Mixed Farming Systems in Western Australia

Stacey Bell, Farmanco

Key messages

- Successful implementation of the key profit drivers for both cropping and livestock enterprises, in a manner which eliminates enterprise conflict, results in a suitably integrated and profitable mixed farming business.
- While potentially easy to understand and implement when focusing on an individual enterprise, the ability to integrate the two enterprises in a synergistic manner ultimately drives profitability in a mixed farming business.
- There are a range of potential tensions between the cropping enterprise and the livestock enterprise. If these tensions are managed well through careful consideration to effective integration between the enterprises, robust profit outcomes are within reach.

Aims

To equip growers with the tools to improve profitability through achieving a synergistic relationship between cropping and livestock enterprises. This project identified the characteristics shared by producers that are successfully integrating cropping and livestock enterprises. This report will deliver clear guidance to mixed enterprise farmers of how best to approach managing their enterprise mix.

Results

This project identified that there are three key principles to strive for at the whole of business level to ensure the profitable integration of cropping and livestock, they are as follows:

1. Generate a consistent operating return that is stronger than your cost of capital.
2. Know and implement the key profit drivers in both crop and livestock enterprises.
3. Integrate cropping and livestock enterprises in a manner in which eliminates enterprise conflict.

To assist with achieving these key principles, there were four key profit drivers identified that comprise the Profit Driver Framework that apply equally to both cropping and livestock enterprises. The four primary profit drivers are:

1. Gross margin optimisation
2. Low cost business model
3. People and management
4. Risk management.

A key message is that all four profit drivers need to be addressed, if any components of the profit driver framework are overlooked then whole of business performance will be compromised at some point.

A consistent message from the project is that there is a large gap in financial performance between the Top 20% businesses and the Other 80% business in each agro-ecological zone. There is abundant opportunity for many mixed enterprise producers to increase profit from the resource base that they currently have available to them.

Conclusion

The ability to integrate the two enterprises (sheep and cropping) in a synergistic manner ultimately drives profitability in a mixed farming business. The concept of cropping and livestock enterprises being synergistic often sounds straightforward from a theoretical perspective. The practical implementation around consistently achieving this goal is often much more difficult.

Whole of business profitability and performance is the best indicator of how successfully a mixed farming business is integrating cropping and livestock enterprises. The Top 20% producers have been selected based on Return on Equity (ROE) and we have also given consideration to Return on Assets Managed (ROAM) performance.

Effective integration is about optimising the Win-win outcomes and also ensuring, that if there is a win-lose scenario that cannot be avoided, that the whole of business compromise is minimised. Minimising any compromise requires favouring or protecting the choice that will preserve the most profit margin for the business as a whole.

Notes:

The value of stubbles and chaff from grain crops as a source of summer feed for sheep

Dean Thomas, CSIRO

ABSTRACT:

The value of stubbles and chaff from grain crops as a source of summer feed for sheep

Dean Thomas[1], Andrew Toovey[1], Gonzalo Mata[1], Anna Biddle[2] and Phil Vercoe[2], [1]CSIRO Agriculture and Food, [2]University of Western Australia

Key messages

- Sheep can consume a higher quality diet through selective grazing, but the overall low quality of stubble and chaff means that farmers need to ensure higher quality feeds are also available, e.g. spilled grains, green pick and providing supplementary feed to meet nutritional requirements.
- Wheat chaff alone provided less than half of the maintenance requirements of ewes. By comparison, barley chaff contained seven times the amount of grain, on average, and other barley chaff components were of higher feeding value.
- Offering a 200 g/day lupin supplement improved the ewe's energy intake additively, i.e. did not affect the amount of chaff eaten.

Aims

- To measure the nutritive value of components of chaff and standing stubble from winter crops
- To investigate the intake and component selection of wheat chaff by sheep.

Results

Winter crop stubbles offer a low quality, but valuable, source of feed during summer. On average sheep spend 20% of their time on stubbles during the year, green and dry pastures and supplementary feed make up the other main feedbase components. Approximately half of mixed enterprise farmers spread chaff, while slightly less than half aggregated chaff in either chaff piles (from chaff carts), chaff lines or windrows.

The quality of header chaff was consistently low (about 6 MJ metabolisable energy/kg DM), but varied significantly by site, crop type and plant component (e.g. main stem, fine stem and leaf). On average, barley chaff from lines and heaps contained 26.2 g/kg of grain, compared with only 3.9 g/kg in wheat chaff. The low quality of chaff for all crop species means that substantive amounts of spilled grains, green pick or supplementary feeds are needed to support livestock production when chaff is fed.

Young and mature ewes offered wheat chaffs ate a similar amount overall, but intake of each chaff ranged from 571 to 804 g DM/head/day. However, on a metabolic bodyweight basis the intake of young ewes was 36% higher than mature ewes. The estimated ME intake from chaff represented 48% and 35% of the maintenance requirements of the young and mature ewes, respectively.

Conclusion

Sheep on mixed farms in WA spend about 20% of their time grazing on stubbles during the year. Sheep preferentially select the higher quality components of chaff. However, even the higher quality chaff components are of relatively low feeding value and when offered ad libitum will only provide about one third to one half of the daily maintenance requirements of sheep. Therefore, farmers need to ensure that sheep have access to other high-quality feed such as spilled grains, supplements or green forage to maintain or grow sheep on wheat chaff or standing wheat stubbles. This may not be the case for barley chaff, where the proportion of grain was much higher. This study demonstrated that provision of a supplement is additive, that is both young and mature sheep offered a supplement did not reduce their intake of chaff. The factors responsible for variability in nutritive value seen among chaff samples remain unclear and understanding the G x E x M drivers of stubble quality would help farmers to predict livestock production outcomes more accurately when grazing stubbles.

Notes:

Strategies towards carbon neutral for the WA grains industry
Focus Session 1

Convenor: David Bowran, Yaruna Research

David Bowran will lead a discussion with a panel of scientists and policy makers on how the Australian Government's Carbon Farming Initiative and Emissions Reduction Fund (ERF) can reward WA grain growers for adopting carbon farming

This focus session will be aimed at the issues around the opportunities and costs grain production systems have in moving towards carbon neutrality. The topic has become more relevant in recent times with the moves at commonwealth level to encourage more carbon sequestration in agriculture.

You will be given the opportunity to hear from a range of speakers with global down to paddock level understanding of the issues, and to hear what the science, economics and farmer experience say is practical.

Dr David Bowran from Yaruna Research will lead an outstanding panel of academics, scientists and consultants:

- Prof. Mark Howden, Australian National University, Climate Change Institute
- Prof. Richard Harper, Murdoch University
- Assoc. Prof. Fran Hoyle, University of WA
- Prof. Ross Kingwell, University of WA
- Nicholas McKenna, Planfarm
- Fiona McCredie, Grain Growers

Topics open for discussion include:

- Global initiatives around reducing Green House Gases in agriculture
- Australian rules and policies around carbon farming
- Soil carbon in WA
- Agricultures carbon neutral challenge
- On farm grain production practices and the Carbon Farming Initiative
- Carbon and GHG calculators for on farm use

Come with your curly questions on what this topic means to you as a grower, consultant or scientist. A carbon neutral Australia by 2050 could have some big benefits or costs to grain production in this state, or maybe none at all!

Notes:

New and emerging crop protection products – What / where is the fit?

Focus Session 2

Convenor: Michael Lamond, SLR

This focus session will review new herbicide products - where they fit into various systems and regions, cost comparisons with existing products and stewardship in relation to herbicide resistance.

This will be the first opportunity for growers and the industry to be involved in 'head-to-head' comparisons of each of the new herbicide s available to growers in 2021.

Mike Lamond from SLR Research will lead an outstanding panel of independent agronomists and agricultural consultants to review the new products:

- Tim Boyes, Agvivo, Northam
- Bill Moore, Elders Lead Agronomist, Perth
- Luke Marquis, South East Agronomy Services, Esperance
- Grant Thompson, Crop Circle Consulting, Geraldton

Company representatives will be attending to comment on technical aspects of each product:

- Calisto (pre-emergent control of radish in wheat), Ben Parkin Syngenta
- Overwatch (pre-emergent for ryegrass control in wheat), Steve Pettenon FMC
- Luximax (pre-emergent for ryegrass control in wheat), David Peake, BASF
- Reflex (pre-emergent radish control in lupins), Ben Parkin, Syngenta
- Terrad'or (knockdown spike), Mark Slatter, Nufarm
- Ultro (pre-emergent grass control in Lupins), Bevan Addison, Adama
- Voraxor (pre-emergent and knockdown spike for radish/ryegrass control in wheat), David Peake, BASF

Roberto Busi, from the Australian Herbicide Resistance Institute will also attend to provide comments on management of herbicide resistance.

Notes:

GrainInnovate – Innovation through disruption
Focus Session 3

Convenor: Fernando Felquer, GRDC

Robert Williams, Artesian Investments and a series of presentations from recent startup initiatives with application to the grains industry.

The $50 million GrainInnovate Fund was established as a partnership between the GRDC and Artesian Venture Partners. The fund invests in ag-tech start-ups developing innovative solutions to Australia's grain growers' constraints.

This session will provide an opportunity to hear from the executive of GrainInnovate and leaders of six of the agri-tech start-ups in the fund's portfolio:

1. Laconik – (WA)

Wayne Pluske E: wayne.pluske@laconik.com.au P: 0418 726 121

Laconik is redefining fertiliser rate decisions to increase profits for farmers. Laconik was established in 2017 by Darren Hughes and Wayne Pluske. Like many farmers, they were frustrated at the snail's pace of improvement in fertiliser profitability. No one else appeared to have the incentive or interest to alter how rates have been determined for the last fifty years, so they decided to do it themselves. Darren and Wayne looked at how other industries and other parts of agriculture are using data to improve decisions. Laconik is now a pay-as-you-use web platform that uses farmer data and twenty-first century ways of analysing it to measure where fertiliser profitability is currently at with ways to continually improve it.

Wayne Pluske is an expert in soils and fertilisers and has spent twenty-five years trying to improve fertiliser efficacy in Australia's grains industry. He has developed and helped commercialise many of the tools still used to make fertiliser recommendations. An avid communicator, Wayne was awarded the 2020 western region Grains Research and Development Corporation (GRDC) Seed of Light award, presented to someone who makes a significant contribution to extending research outcomes.

The investment contributed to the development and in-paddock farmer use of:

- Laconik N (variable rate prescriptions for in-season nitrogen)
- Laconik Trial (test rates and measure return on investment on fertiliser recommendations)
- Laconik VR (quick and easy way to vary fertiliser rates)
- Laconik Combine (combines science with the farmer's data to gauge and continually improve fertiliser profitability)

After using Laconik, farmers are questioning their fertiliser advice. Proof in the paddock, from their own scientific trials, show that current fertiliser recommendations are leaving profit on the table. Growers now have the incentive and hassle-free ways to take control of their most expensive input cost.

Notes:

2. Datafarming – (QLD)

W: www.datafarming.com.au @data_farming, @timneale1 **E:** tim@datafarming.com.au **P:** 0409 634 006

DataFarming is an Australian ag-tech company that is developing integrated, easy to use, intelligent, precision technology solutions. DataFarming streamlines the process of capturing data, developing insights, and harvesting value in complex agricultural systems. Our solutions allow farmers, agronomists, and industry to access real-time spatial agriculture data, with the aim to reduce risk and improve production. Our solutions focus on removing the barriers to adoption of precision ag technologies and are now Australia's most popular Precision Ag software. We use spatial data analytics and artificial intelligence and provide end users with simple, real time intuitive cloud-based solutions. Most farmers and agronomists find accessing relevant and accurate PA data difficult, costly, and complex. On-ground application is suffering, where adoption rates are around 10% on Australian farms. And coupled with this, yield variability is more than 300% in almost every paddock. Lifting productivity of poor performing parts of paddocks can easily double grain production. Agronomists and farmers are overloaded with data and need better tools to manage and make sense of it.

Tim Neale, who was recently named Australian Rural Consultant of the year, has over 25 years' experience across Australia and internationally, 20 of which was spent running his own business. Tim's strong ag tech focus has been driven by an evolution from CTF (controlled traffic farming), sustainable farming systems, auto-steer guidance technology, elevation mapping and water drainage planning, yield mapping, variable rate, soil mapping, and satellite imagery. He has managed over 20 industry RD&E projects for a broad spectrum of clients in grains, horticulture, cotton, viticulture, sugarcane, turf, and tree crops. He has been on the CRCSI (program 4) board, Society for Precision Ag Australia (SPAA) committee, and the National Positioning Infrastructure (NPI) advisory board.

Notes:

3. Telesense – (VIC)

Marcus Kennedy E: marcus@telesense.com **P:** 0419 221 719

TeleSense provides industrial IoT monitoring solutions for post-harvest commodity storage and transport. It helps to manage risks in the world's perishable commodities supply chain by using machine learning algorithms. Whether assets are stationary or moving, TeleSense uses cloud-based technology to simplify monitoring. The solutions help eliminate human error, improve operational efficiency, and increase profitability. TeleSense is helping grain growers and managers protect and maximise the value of their stored agri-products. It helps early detection of risks such as moisture, concentrated heat, mould & insect infestation that would result in grain spoilage, reduction in quality and potential complete loss though an explosion or fire.

As Executive Chairman of TeleSense Aust., Marcus is active in the innovation ecosystem, as a mentor/coach, an investor in Agtech startups and as a business adviser. Marcus is passionate about supporting Australian innovation and fostering emerging leaders across the agri-food sector.

Prior to Telesense, Marcus was most recently Chief Development Officer at Graincorp and led the corporate strategy, business development, implementation and strategic governance across the listed agri-food group.

Notes:

4. Flurosat – (VIC)

Marie Marion, Digital Agronomist and Project Manager E: marie@flurosat.com P: 01413121609

FluroSat is an innovative agtech company, that delivers agronomic decision support tools globally. Founded in Sydney, Australia in 2016 we have offices in the US, Australia, and Europe. Over the last 4 years, we have grown to serve market leaders in crop consulting, retail and manufacturing of agricultural input, farm machinery and food processing.

Marie Marion is an agronomist and project manager at FluroSat. She works with agronomists, food processors and retailers across Australia to promote the adoption of Precision Ag. Passionate about technology and agriculture, she has a substantial background in the Agri-Tech industry. After studying agronomy and Smart Farming in France, she won first prize in the European 'Farming by Satellite' competition and worked for FarmStar, the French leader in Precision Ag, owned by Airbus and Arvali.

Notes:

5. Zetifi – (NSW)

John Lucas E: john@zetifi.com (cc dan@zetifi.com) P: 0428252210 (alt Dan Winson 0410 351 270)

Zetifi is a wireless networking startup from Wagga NSW building connectivity devices and solutions for people in rural and remote areas. Zetifi has completed successful trials with DPI NSW, DPIRD WA, DPIR NT and Birchip Cropping Group and is currently completing an Australia wide pilot with Case IH to bring high bandwidth connectivity to farms, farm machinery and farmers. Zetifi have developed new technology to solve connectivity problems in areas with little or no mobile coverage and are bringing fast and reliable connectivity to farmers that increases productivity, profitability, safety and quality of life.

John Lucas is Zetifi's Product Manager and is responsible for managing research, development and pilot programs for Zetifi's suite of connectivity solutions. John completed a Diploma in Applied Science (Agriculture) through Wagga Ag College and worked as a researcher at CSU in the school of Agriculture for eight years before starting Terrabyte Services, a precision ag and data processing consultancy with Jon Medway. John works closely with ag professionals through the Zetifi beta tester program to make sure the solutions we build meet their needs, and the needs of Australian farmers.

Notes:

6. Soil Carbon Co – (NSW)

Tegan Nock E: tegan@soilcarbon.co P: 0428 835 944

Soil Carbon Co. is developing new tools to allow growers to rapidly build and trade carbon offsets. The organisation is made up of researchers and practitioners working across microbiology, soil science and agronomy to deliver new pathways for carbon sequestration, paired with the avenues for growers to be rewarded for the carbon built within their soils. Soil Carbon Co. is based in Orange, NSW with teams across Australia and the US developing new microbial technology and carbon market mechanisms. Soil Carbon Co. is building out innovative ways for growers to capitalise on this opportunity by pairing agronomic tools with pathways for trading soil carbon. The technology that Soil Carbon Co. develops is scalable and economically accessible microbial technology, designed specifically for grain production systems.

Tegan Nock is Co-Founder and CPO at Soil Carbon Co. where she leads the research and development of new practical microbial technologies focused on carbon sequestration. Her team works across Soil Carbon Co.'s international microbial library to better understand the mechanisms of microbially mediated soil carbon sequestration and deliver new products for carbon sequestration and agronomic benefits in a range of farming systems.

Notes:

Unlocking the potential of ironstone gravels

Fran Brailsford, University of Western Australia

ABSTRACT:

Increasing knowledge and profitability of cropping on ironstone gravel soils

Francesca Brailsford[1], Daniel Murphy[1], Talitha Santini[1], Frances Hoyle[1], Peta Clode[2], Matthias Leopold[1], Martin Saunders[2], Davey Jones[1,3], Jeremy Shaw[2], Jeremy Bougoure[2], Grace Scullett-Dean[1], Emily Cooledge[3], Yoshi Sawada[1], [1]SoilsWest, School of Agriculture and Environment, UWA, [2]Centre for Microscopy, Characterisation and Analysis (CMCA), UWA, [3]Bangor University, UK

Key messages

- Ironstone gravel soils are an often underperforming soil type present in 25% of croplands in the southwest of WA.
- Our research takes a first detailed look at gravel composition, microbial colonisation and their role in water and nutrient movement in order to improve the management of these soils.

Aims

To provide new information on water and nutrient use efficiency of ironstone gravel soils to better inform their management.

Results

Elemental chemistry, mineralogical structure (Synchrotron/XRF), internal porosity (micro-CT tomography), water retention and nitrogen/phosphorus-binding capacity (stable and radioactive isotope tracing) were determined on gravels spanning the four main gravel types (iron (Fe), aluminium (Al) and silica (Si)-dominated plus equal Fe/Al/Si content). Despite gravel contributing <1 % of the total belowground surface area available for nutrient binding, 60 % of Colwell P and 84 % of total P was found to be associated with the gravel fraction rather than the soil (i.e. <2 mm particles). Iron content (particularly hematite) appeared to determine the amount of phosphorus bound up in ironstone gravels. Additionally, gravel external surface area is predictable from diameter across different gravel types, providing a metric to rapidly estimate surface area available for P/N binding.

Conclusion

Our research findings provide fundamental knowledge of gravel composition, mineralogical structure and interactions with water and nutrients (P/N) that has not previously been undertaken. Follow up studies (pot trials and field-scale studies) would build on the knowledge generated in this project to allow gravel-type specific management in the next few years.

Notes:

Christmas
BY CROWN

Optimum nutrition for ameliorated gravels

Jordy Medlen and Justine Tyson, ConsultAg

ABSTRACT:

Optimal Nutritional Package for Reefinated gravels to maximise return on investment

Justine Tyson, Jordanne Medlen, Ben Whisson and Garren Knell, ConsultAg

Key messages

- To maximise the return on investment following the renovation of lateritic gravels, standard P rates in environments of ≤3t/ha are the lowest risk option and should be used as the sites were shown not to be responsive to phosphate.
- No significant yield or grain quality improvements were measured with increasing applications of phosphorus on cemented lateritic gravel soils. Whilst unresponsive to additional phosphate, starter phosphate is essential due to the high phosphate binding nature of freshly reefinated gravels. Nill P treatments suffered a yield penalty.
- Soil samples aimed at characterising freshly renovated gravels showed that nutritionally nothing is limiting to plant growth. Due to the locations of the trials being in yield environments below 3t/ha, and all sites receiving below average rainfall, soil moisture was likely to be limiting production rather than phosphate.

Aims

- Characterise recently renovated gravels through extensive, comprehensive soil testing.
- Ground truth soil test results on gravel soils to optimise crop nutrition inputs.
- By 2023, 90% of growers renovating cemented lateritic soils will have the knowledge to apply nutrition to these soils that will maximise their return on investment.

Results

The soil test results across each of the sample sites were adequate with 14 out of the 15 sites requiring ≤9 units of phosphorus to achieve target yield. The tissue tests identified marginal P at the Harrismith site across each of the treatments. Small patches of transient Mn deficiency were observed at some of the trial sites. This, however, was not captured in the tissue test results.

In terms of infield measurements including plant numbers, head counts and biomass weights there was very little difference between treatments. At the Tarin Rock and Kukerin sites where the low treatment had no P applied, there was a greater variation in the response to the three treatments, showing a greater jump in yield between their low and recommended rate than between the recommended and high rate. There was very little difference in yield and grain quality within each trial site.

At three of the five trial sites, the increase in fertiliser did not offset the small yield gains, resulting in a lower net return.

Conclusion

The standard rates of phosphorus which are applied to most cereal crops (6-9 kg P/ha) in the Wheatbelt of Western Australia are adequate to maximise growers return on investment following reefinating. The small proportion of soil and the presence of shallow rock restrict the plants ability to access water hence no additional nutrition above what is applied to the rest of the paddock is required.

Notes:

The role of polymers to improve water harvesting on sodic soils in the low rainfall zone of the WA wheatbelt

Rushna Munir, Department of Primary Industries and Regional Development

ABSTRACT:

The role of polymers to improve water harvesting on sodic soils in the low rainfall zone of the WA wheatbelt

Rushna Munir[1], Edward G. Barrett-Lennard[2,3,4], Glen Riethmuller[1], David Hall[5] and Mohammed Ziaul Hoque[1], [1]DPIRD Merredin, [2]DPIRD South Perth, [3] Murdoch University, [4]The University of Western Australia, [5]DPIRD Esperance

Key messages

- Sodic soils are dispersive which can limit the entry of water into the soil profile.
- In sodic soil, benefits of water harvesting are evident in dry growing seasons with up to 50% more grain yield with micro-water harvesting compared to conventional tillage.
- Water harvesting occurs through combinations of enhanced soil mounding and the use of plastic 'hats' to direct rainwater from the mounds to the furrows. The use of plastic is not economic so we have been investigating polymer sprays to coat the soil.
- The hydrophobicity of sprayable biodegradable polymers differ depending on soil type.

Aims

To identify polymers and rates of application that can allow rainfall to be harvested more efficiently for crop use.

Results

This research tested five different sprayable polymers to determine water repellence on clay soil and sand, the longevity of this effect, required rates and the method of application in an 'open air' experiment to expose polymers to weathering and natural UV light. Best uniform application of the polymers was achieved using a spray cabinet. The setting of the hydrophobic polymer layer was limited in clay soil compared to sand. The 'shrink-swell' behaviour of the clay soil associated with soil wetting and drying opened up surface cracks, caused the hydrophobic polymer layer on top soil to fracture, and as a consequence the polymer lost water repellence. Sand and chaff mulching at the soil surface overcame cracking of the clay. The adverse effects of shrink/swell did not occur in sands. In addition, the hydrophobic polymer layer on sand showed a resistance to wind erosion.

Conclusion

Greater gains in water use efficiency might be achieved through micro-water harvesting by using hydrophobic chemicals which increase water runoff from mounds into the inter-row for crop use. Biodegradable polymers could be environmentally sustainable and suitable for a range of different soil types. Benefits for sands could occur without other amelioration, but on clays amelioration might require combinations of treatments.

Notes:

Weed management and control under different soil amelioration practices

Sultan Mia, Department of Primary Industries and Regional Development

ABSTRACT:

Soil amelioration has gained great interest in the grainbelt over the past decade to incorporate lime, bury repellent soils or disrupt compacted soil; however, relatively little is known about its impact on weeds or the weed seed bank. A series of field, screen house and glasshouse trials were designed to understand better how soil amelioration techniques alter weed dynamics. Results suggest that the impact of amelioration on weeds varies with the types of mechanical amelioration treatments, ploughing depth, per cent of topsoil mixing, and weed seed burial. This research will give us a good insight into how weeds respond to soil amelioration and formulate better weed management strategies following soil amelioration.

Notes:

New horizons in the detection of fungicide resistance – combining genetic testing with direct assessment of fungicide performance

Noel Knight, Centre for Crop and Disease Management, Curtin University

ABSTRACT:

New horizons in the detection of fungicide resistance – combining genetic testing with in vitro assessment of fungicide performance

Noel Knight, Wesley Mair, Kul Chandra and Fran Lopez-Ruiz, CCDM, School of Molecular and Life Sciences, Curtin University

Key messages

- Phenotypic testing for fungicide resistance has resulted in the detection of several genetic mutations associated with fungicide resistance in net blotch fungi.
- Genetic detection systems for assessing presence and frequency of fungicide resistance in field samples have been developed.

Aims

Develop improved and complementary phenotypic and genetic detection systems for fungicide resistance in net blotch fungi.

Results

A high-throughput workflow for isolating net blotch fungi from diseased leaf samples and assessing *in vitro* growth with fungicides was developed and used to assess samples from fields. This phenotypic assessment detected resistance and reduced sensitivity to demethylation inhibitor (DMI, Group 3) and succinate dehydrogenase inhibitor (SDHI, Group 7) fungicides in Western Australia. DNA sequencing revealed genetic mutations associated with these phenotypes. Using this information, a genetic detection workflow was designed for use in a highly sensitive detection system (quantitative PCR). This incorporates species identification of the net blotch fungi (*Pyrenophora teres* f. *teres* or *P. teres* f. *maculata*), followed by testing for 19 different genetic sequences associated with fungicide resistance. Combining tests (multiplexing) to reduce testing times has also been successful.

Conclusion

With the emergence of fungicide resistance in net blotch fungi across Western Australia, detection of resistance has become more critical to effective disease management. The development of improved phenotypic and genetic detection systems provides a robust process for investigating the presence and frequency of fungicide resistance in field samples.

Phenotypic assessment allows for detection of novel and known fungicide resistance mutations. And while the genetic detection system only detects known mutations, a benefit may be assessment of DNA directly from diseased leaves or plant tissues, without the requirement for initial phenotypic assessment. This is currently being investigated.

Notes:

Can you spot the difference?

Silke Jacques, Centre for Crop and Disease Management, Curtin University

ABSTRACT:

Can you spot the difference?

Silke Jacques, Johannes Debler, Evan John, Leon Lenzo, Kofi Stevens, Kar-Chun Tan, CCDM, Curtin University

Key messages

- Using molecular tools, we can now differentiate and quantify two major necrotrophic fungal pathogens that form a disease complex on wheat.
- The outcome of this research will allow us to identify wheat varieties that possess the best resistance to not just a single but two pathogens, thereby reducing the impact diseases caused by BOTH fungi.
- The development of our research pipeline to understand fungal disease complexes of cereals will contribute to minimising the impact of other economically important cereal disease complexes such as net- and spot-form of net blotch of barley.

Aims

To SPOT the difference between highly similar spot-like lesions caused by two different fungal pathogens that causes yellow spot (YS) and septoria nodorum blotch (SNB) of wheat, we aim to develop molecular tools to simultaneously monitor both pathogens during host infection and determine their level of competition. This will allow us to provide the breeders with specific knowledge on which varieties to select to reduce the impact of not just one but two pathogens.

Results

YS and SNB frequently co-exists on wheat in the field and therefore form a 'disease complex'. The symptoms caused by these different pathogens are very hard to distinguish visually, as they both form highly similar spot-like lesions. Therefore, we have developed YS and SNB fungal strains labelled with different fluorescent reporter proteins. This color-tagging methodology now allows us for the first time, to visually distinguish both pathogens during wheat infection and monitor the progression of a disease complex live and in real time. We are currently using molecular tools such as a digital PCR approach to determine the level of fungal 'biomass' during co-infection of wheat varieties with different disease resistant rating to SNB and YS as well as varieties with different effector sensitivity profiles. We want to understand the dynamics between these fungal pathogens on multiple wheat varieties with different resistance profiles and are working in close collaboration with breeders to collect in-field disease samples.

Conclusion

By developing tools, we can now SPOT the difference and focus on the wheat disease complex of YS and SNB as they are found in the field and understand their dynamics and infection profiles on different wheat varieties. This information will allow the breeders to improve resistance to both pathogens rather than focusing on a single pathogen.

Notes:

Putting the pulse back into chickpeas – how a 'wild approach' could revamp a one-time WA favourite

Toby Newman, Centre for Crop and Disease Management, Curtin University

ABSTRACT:

Putting the pulse back into chickpeas – how a 'wild approach' could revamp a one-time WA favourite

Toby E. Newman[1], Silke Jacques[1], Christy Grime[1], Fiona L. Kamphuis[1], Robert C. Lee[1], Jens Berger[2] and Lars G. Kamphuis[1],
[1]CCDM, [2]CSIRO

Key messages

- A collection of wild chickpea accessions have been exploited to expand the genetic diversity of chickpea and improve the yield of chickpea crops.
- We have dissected the genetic basis of various important agronomic traits and aim to provide breeders with genetic markers by June 2021.
- Wild chickpea relatives represent an important source of resistance to the damaging fungal disease ascochyta blight (AB) and several accessions with higher levels of resistance compared to current varieties have been identified.

Aims

- Expand the narrow genetic base of domesticated chickpea.
- Identify desirable traits in wild chickpea germplasm and provide new genetic markers associated with these traits to breeders.

Results

We developed 32 populations derived from wild chickpea accessions crossed with elite chickpea cultivars, which produced over 8,000 lines. These were genotyped and screened in field trials, which enabled us to identify loci associated with several important agronomic traits (growth habit, time to flowering and podset, seed size, colour and shape as well as yield). We also selected a subset of high-yielding individuals over two years at multiple Australian sites, which are being exploited further in the chickpea breeding program.

In addition, we identified wild chickpea relatives with resistance to multiple, highly aggressive Ascochyta rabiei isolates and mapped genomic loci underlying this resistance.

Conclusion

The exploitation of chickpea wild relatives has the potential to ultimately shape the breeding of new, higher-yielding chickpea varieties – the impact of which may not only strengthen the Australian chickpea industry but help reboot its popularity as a viable WA crop.

Notes:

Effects of a native symbiotic fungus on crop growth and nutrition under controlled-environment conditions

Khalil Kariman, University of Western Australia

ABSTRACT:

Effects of a native symbiotic fungus on crop growth and nutrition under controlled-environment conditions

Khalil Kariman[1], Craig Scanlan[1,2], Gustavo Boitt[1], and Zed Rengel[1], [1]SoilsWest, School of Agriculture and Environment, UWA,
[2]Department of Primary Industries and Regional Development

Key messages

- The native fungus improved growth and nutrition of wheat, barley as well as canola (a non-mycorrhizal crop)
- Growth and nutritional benefits were observed in soils with low and high phosphorus (P) levels
- The fungus functioned in both light (low PBI) and heavy (high PBI) soils.

Aims

Exploit the potential of a novel fungal biofertiliser for agricultural crops.

Results

All three grain crops (wheat, barley and canola) were shown to get growth and nutritional benefits from the native fungus (*Austroboletus occidentalis*). The fungal symbiont has a strong phosphate solubilisation capacity (mediated by exudation of organic acid anions) and converts the solubilised P into inorganic polyphosphates. Presence of the native fungus in soil did not affect root colonisation by indigenous arbuscular mycorrhizal fungi in wheat and barley, and no root colonisation was detected in canola. Crops were also shown to get benefits from the fungus in both light and heavy soils under low soil P level as well as high P level (in contrast to arbuscular mycorrhiza, which is suppressed under high P conditions).

Conclusion

The native fungus *A. occidentalis* has a promising potential as a novel biofertiliser for agricultural crops including canola. *A. occidentalis* is compatible with arbuscular mycorrhizal fungi, so crops can get benefits from both types of fungi, simultaneously. Growth benefits under high P conditions suggest that crops may also get non-nutritional benefits from the fungus when the soil P level is optimal, e.g. tolerance to drought, soil constraints.

Notes:


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FMC's Overwatch® Herbicide is about to revolutionise your pre-emergent treatment of annual ryegrass, as well as bifora, sowthistle, silver grass, wireweed and a wide range of others. With up to 12 weeks of control, crop safety and operational flexibility, FMC's Overwatch® Herbicide is set to change the way you see weeds in wheat, barley and canola.
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Progress in the technologies and grower experiences with variable rate technology for fertilisers and chemicals



Tim Neale, DataFarming

Mark Branson, grower, Stockport, South Australia

Ben Cripps, grower, Binnu Western Australia

ABSTRACT:

Our journey with Precision Ag started in 2012 with no yield data, computer software and patchy 3G coverage and a burnt header. We started by utilising EM and Radiometric scanning, This initial investment cost $50,000 or approx. $30/Ha with approx. 1600 ha scanned.

Precision Ag on our farm includes a CTF system based around 13.6m spacing on 3m centres, we have implemented a VRT program across our program and this includes most operations on the farm. We record our Yield Data at harvest and also utilise a Cropscan 3000H Infratec Protein Analyzer. The Chaser bin has scales, and we manipulate protein to load trucks bound for CBH. During Harvest we map weed species and density as well. We have used a chaff cart for HWSM until 2018 and have transitioned to chaff decks since the 2019 harvest. Post-harvest and fallow we use a 28m Weedit for spot spraying. All records are recorded by the machinery and recorded electronically in SMS Agleader. Other Key components to our system are Dropbox, Excel.

I will be talking about our Precision Ag Journey, how we started, what we have done, what we still do and where we think we will go with Precision Ag.

Notes:

Notes:

Papers submitted and not presented at the Perth Update

For the 2021 Grains Research Updates events, the Program Committee received over 100 Expressions of Interest (EOIs) to present at the Grain Research Update, Perth. All EOIs were carefully considered, and unfortunately due to time constraints, only half of these could be accommodated to present at the Perth Update.

All papers provided will be uploaded to the GRDC website at **https://grdc.com.au/resources-and-publications/grdc-update-papers** when they are supplied and approved for public access.

Notes:

Notes:

Notes:

KEY CONTACTS

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