FAR AUSTRALIA FIELD DAY

INCREASING PRODUCTIVITY & PROFITABILITY

Thursday 20th November 2025

SOWING THE SEED FOR A BRIGHTER FUTURE

Thanks to our host farmers: Botanicals Resources Australia

VISITOR INFORMATION

We trust that you will enjoy your day with us at our Tasmanian irrigated HRZ Crop Technology Centre Field Day. Your health and safety are paramount, therefore whilst on the property we ask that you both read and follow this information notice.

HEALTH & SAFETY

- All visitors are requested to follow instructions from FAR Australia staff at all times.
- All visitors to the site are requested to stay within the public areas and not to cross into any roped off areas.
- All visitors are requested to report any hazards noted directly to a member of FAR Australia staff.

FARM BIOSECURITY

- Please be considerate of farm biosecurity. Please do not walk into farm crops without permission. Please consider whether footwear and/or clothing have previously been worn in crops suffering from soil borne or foliar diseases.

FIRST AID

- We have a number of First Aiders on site. Should you require any assistance, please ask a member of FAR Australia staff.

LITTER

- Litter bins are located around the site for your use; we ask that you dispose of all litter considerately.

VEHICLES

- Vehicles will not be permitted outside of the designated car parking areas. Please ensure that your vehicle is parked within the designated area(s).

SMOKING

- There is No Smoking permitted inside any farm shed, marquee or gazebo.

Thank you for your cooperation, enjoy your day.

INCREASING PRODUCTIVITY AND PROFITABILITY UNDER IRRIGATION AT THE TASMANIA CROP TECHNOLOGY CENTRE

FEATURING FAR Australia INDUSTRY INNOVATIONS

On behalf of myself and the FAR Australia team, I am delighted to welcome you to our 2025 Tasmanian Crop Technology Centre (HRZ) Field Day featuring both Industry Innovations and GRDC investments.

Industry Innovations (II) is a FAR Australia initiative which continues to engage with industry to provide innovative research solutions which are helping to create a more productive, profitable and sustainable future for the Australian grains industry. With our Crop Technology Centres (CTCs) operating nationally across the growing regions of Australia, we provide the perfect platform to showcase new industry innovations, whether it be new crops, cultivars, agrichemicals, fertilisers or Ag technologies or GRDC levy investments. More information on our Industry Innovations initiatives is available in the booklet.

Today will provide you with a unique ‘seeing is believing’ opportunity to experience the latest innovations in cereal germplasm, agronomy, crop physiology and agrichemical usage. You can witness first-hand the impact of innovative treatments and techniques on enhancing crop performance and profitability.

Event Highlights:

- Topics for this irrigated High Rainfall Zone (HRZ) site and other FAR Crop Technology Centres in the national network will be featured.
- An opportunity to engage with one of the US’s cereal experts on closing the yield gap Prof Romulo Lollato Kansas State University, along with Dr Kenton Porker one of the new emerging farming systems experts with CSIRO.
- How do irrigated spring sown barley and autumn sown wheat grain yields from the Centre compare over the last four years.
- Benchmarking agronomics and profitability in Tasmania – what can we take away from the first year of the GRDC Hyper Profitable Crop (HPC) results generated in 2024. Brett Davey, Darcy Warren and Nick Poole lead the discussion.
- Most of all we want to share your insights from growers to advisers and researchers.

To make the programme as diverse as possible, I would like to thank all our speakers who have helped to put today’s programme together; in particular our keynote speakers Prof Lollato and Dr Porker.

Putting together a quality Crop Technology Centre takes a fair amount of planning so a very big thanks to our host farmers here at BRA (in particular Lachie McFadzean, Steven Pearce and Don Badcock) for their tremendous practical support given to the FAR Australia team. We would also like to thank our sponsors Elders Western Junction and AGF Seeds for their support today. Without the support of our sponsors our events would be reduced in scope so please engage with their representatives

Finally, I would like to thank the industry for investing in our research programme this season, in particular GRDC, key agrichemical manufacturers and plant breeders under our Industry Innovations portfolio.

Should you require any assistance today, please don't hesitate to contact a FAR Australia staff member. We hope you find the day informative, and as a result, take away something new which can be implemented in your own farming business.

Nick Poole Managing Director
FAR Australia

TAS HRZ CROP TECHNOLOGY CENTRE FIELD DAY

MORNING TIMETABLE

THURSDAY 20th NOVEMBER 2025

TASMANIA CROP TECHNOLOGY CENTRE

FAR AUSTRALIA

In-field presentations at canola research site	11:30	11:50	12:30
Welcome and introductions ***Nick Poole - Managing Director, FAR Australia*** *Outline of the programme for the day.*	**Coffee and introductions**		Lunch and refreshments
Brett Davey, SFS, and Darcy Warren & Nick Poole, FAR Australia ***Pushing potential profit? Benchmarks for agronomy and profit*** *The first year results of our new GRDC Hyper Profitable Crops project are out. Brett, Darcy and Nick look at the analysis of agronomic and profitability benchmarking in the region.*		1	
Industry Innovations leading the way to a brighter grains industry			
In-field presentations	**11:30**	**11:50**	**12:30**

Event kindly sponsored by

AGF seeds

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GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Pushing potential profit?

Some benchmarks for wet and drier environments.

Ben Jones and Rebecca Murray, FAR Australia

Introduction

In a world of water, where do you turn to check if your crop management is working to the profitable potential? The Hyper Profitable Crops project has some answers. Input use, agronomy, yield and quality were monitored on 93 paddocks across the high rainfall zones of southern Australia in 2024. Common input and grain pricing, together with weather data, were used to set some initial benchmarks. Crop performance relative to benchmarks can be used to indicate where management (or simply the season) might have led to a poor outcome, and what might be changed to improve future results. Fifteen paddocks in northern Tasmania were part of the first season of the project.

Method

Paddocks in either wheat or barley were volunteered by farmer members of discussion groups run by each hub (hosted by Southern Farming Systems). Input data was recorded between harvest of the previous crop and harvest of the focus crop. The hub facilitator recorded inputs, took soil samples (mid-season), and visited paddocks regularly to track growth stage. Before harvest, quadrats of mature plants were harvested and processed to estimate total biomass, yield components, and also provide data for quality analysis. Weather data was taken from the nearest SILO grid cell location (https://www.longpaddock.qld.gov.au/silo/point-data/).

Water-limited potential yields were estimated according to 25 kg/ha/mm grain x (growing season rainfall + irrigation + 30 % of fallow rain – 60 mm evaporation). Growing season was estimated for each hub area as the weeks where average rainfall exceeded a third of evaporation (30 year, over 3 week contiguous periods). A water use cap of 480 mm was applied across all groups, but in future will be adapted to better reflect the growing season. Radiation/temperature limited yields were estimated according to relationships with the photothermal quotient: photosynthetically active radiation divided by average temperature in the four weeks before estimated flowering date.

An estimated gross margin was calculated using the whole paddock yield, with quality set by the sample grain and price according to publicly available grain prices in May 2025 (with adjustment for freight rates according to discussion group location). A common input price list was used across the project and adjusted where necessary to reflect changes in each hub area. Where inputs applied across multiple years (eg. lime, soil amelioration) the cost per year was estimated *pro rata*. Operation costs were estimated on a similar basis. Since releasing the 2024 season reports (and for this analysis), harvest cost has been updated to be in proportion to yield (assuming throughput effectively limits harvest rate for crop yields > 3 t/ha).

Benchmarks

The analysis breaks profit into several components:

Potential yield	whichever of water- and radiation/temperature-limited yield is lowest.
Per cent of potential	how much of potential yield was achieved

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Price achieved/tonne	depending on quality, port price and estimated freight for each group
Cost	total of inputs, operation cost

Profit and cost are both expressed in terms of potential yield, so that they are comparable across water- and radiation/temperature-limited paddocks.

Benchmarks were calculated for each paddock and averaged across discussion groups, to determine some initial benchmark levels against which all paddocks could be compared.

Results

Many discussion groups achieved an average per cent potential yield achieved around 80% or higher (Figure 1). This seems like a reasonable benchmark for production. Higher per cent potential yields were achieved in drier environments and probably reflect under-estimation of stored water in soils with high plant available water. Some of the SFS Tas paddocks had yield limited by the water use cap, when the radiation/temperature potential yield would more correctly apply. These groups would have lower average per cent potential achieved.

Differences in price achieved reflect port and freight differences (Figure 2), but also quality achieved. In some groups, more of the paddocks are sown to cultivars with a maximum feed grades.

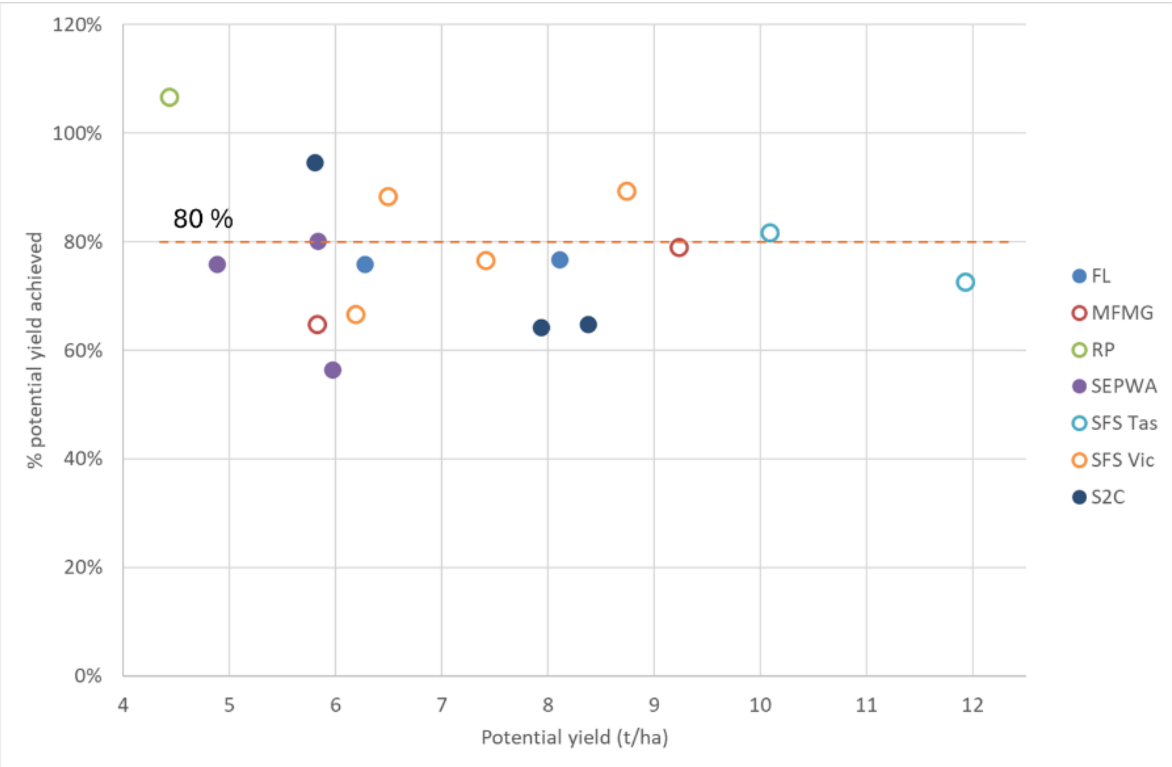

Figure 1. Potential yield benchmark: average per cent potential yield for each discussion group vs potential yield. Colours represent different hubs. The dashed line is a proposed potential yield benchmark of 80%.

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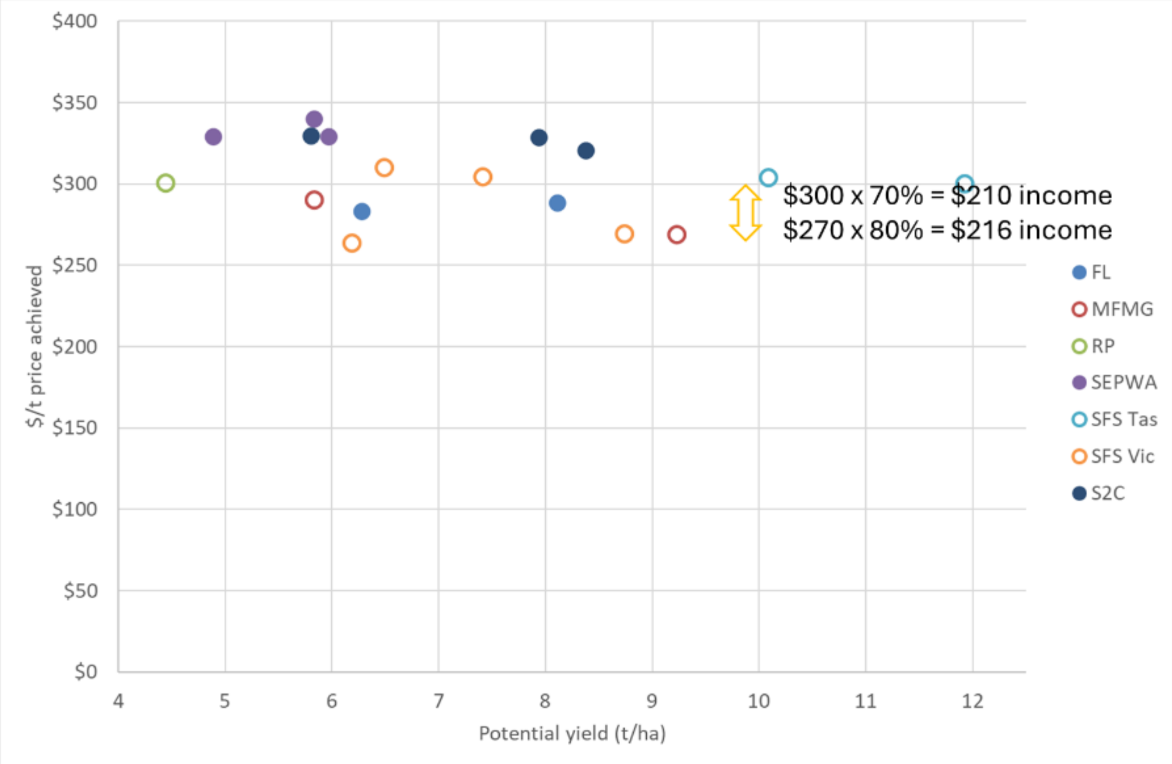

Figure 2. Price achieved benchmark: average grain price achieved in each discussion group vs potential yield. Colours represent different hubs.

**FL = FarmLink (NSW), MFMG = Mackillop Farm Management Group (SA), RP = Riverine Plains (NSW), SEPWA = South East Premium Wheat Association (WA), SFS = Southern Farming systems, S2C = Stirlings to Coast (WA)*

Costs were quite consistent across the groups when expressed relative to potential yield, allowing for many of the groups not including fallow costs (Figure 3), and the highest SFS Tas group having a higher potential yield than indicated. Cost per tonne of potential yield was approximately $100/t above 8 t/ha, and an additional $10/t below it. These may be useful benchmarks.

Many of the groups achieved $130 profit per tonne potential yield (Figure 4) across the range of potential yields. This appears to be a useful upper benchmark. Medium and low benchmarks have been suggested at $100 and $60 profit per tonne potential yield.

Pushing potential profit?

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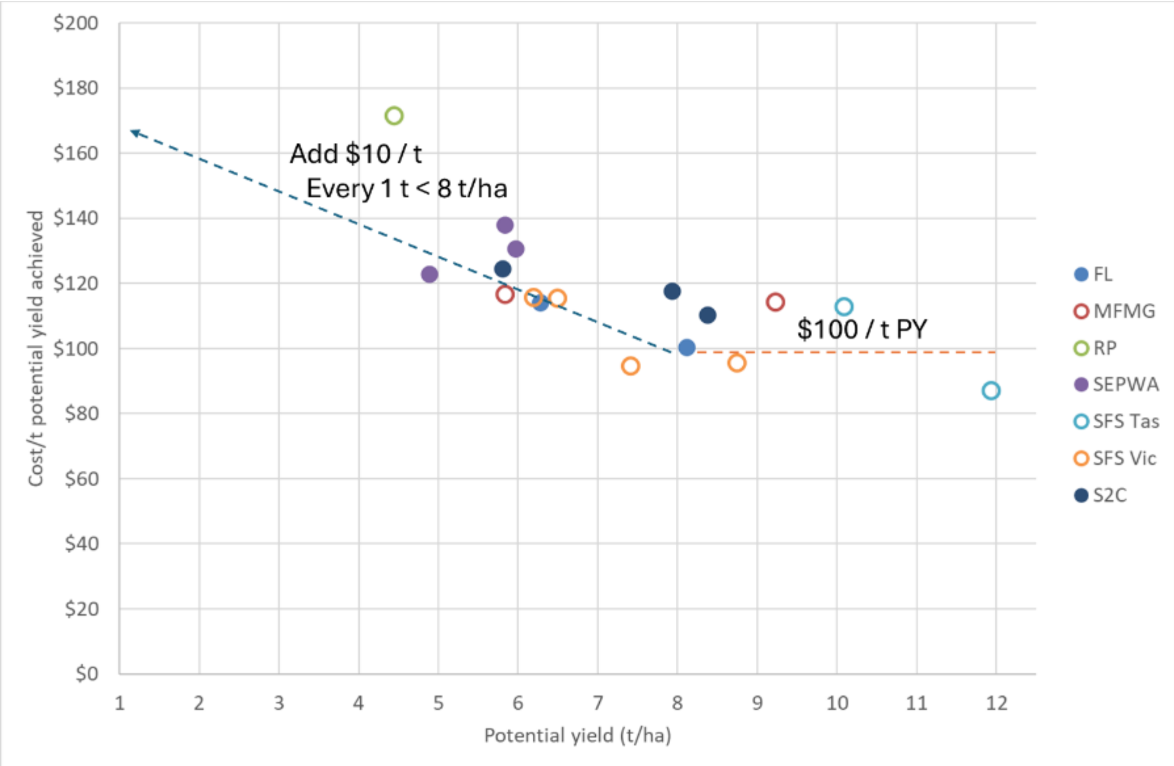

Figure 3. Cost benchmark: average cost per tonne potential yield in each discussion group vs potential yield. Colours represent different hubs. In hubs with open circles, costs were not measured before sowing. The dashed line is a proposed cost benchmark of $100/t potential yield, increasing $10/t for each t/ha below 8 t/ha.

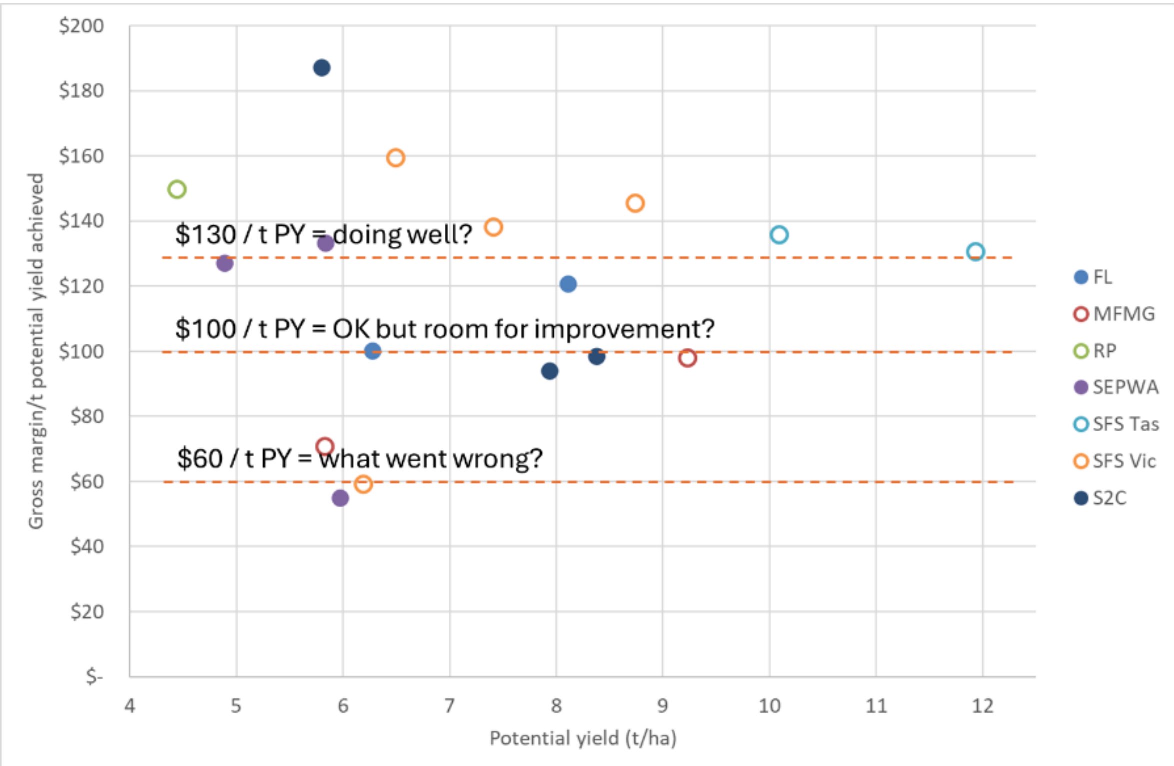

Figure 4. Profit benchmark: average profit per tonne potential yield in each discussion group vs potential yield. Colours represent different hubs. Dashed lines indicate proposed benchmarks.

Pushing potential profit?

Some benchmarks for wet and drier environments.

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Discussion/Conclusion

Application

The benchmarks are currently easiest applied by farmers who had a paddock in the project in 2024 and can calculate and compare their own benchmarks from the reports. Anyone who can estimate potential yield should be able to calculate what they should be achieving, and begin to target production, price or cost for further investigation if their profit benchmark appears low.

For example, if potential yield is around the 80% benchmark, the cause of a poor profit result rests either with price achieved, or cost.

The cost benchmark should also have application in-season, as a guideline on how much it would be reasonable to spend (or try to save) if the potential yield is likely to be different from planned. For example, at a potential yield of 6 t/ha, a cost benchmark of $120/ha/t potential yield should lead to a total $720/ha spend. If rain leads to a potential yield of 9 t/ha, the cost benchmark of $100/ha/t potential yield suggests a total of $900/ha spend, or no more than $280/ha more (including harvesting the additional yield).

The practical challenge in this application is how early any change in potential yield is known, vs. how much has been spent. In most areas of the project, little can be changed in the 12 weeks before harvest, and only about $20/ha/t potential yield is spent in the 8 weeks before that. The Tasmanian crops have more late-season flexibility (Figure 5; little changes in 10 weeks before harvest, and the last $20/ha/t is spent in the 6 weeks before that). This is partly a consequence of spring-sown crops included in the dataset, where warmer temperatures lead to quick development.

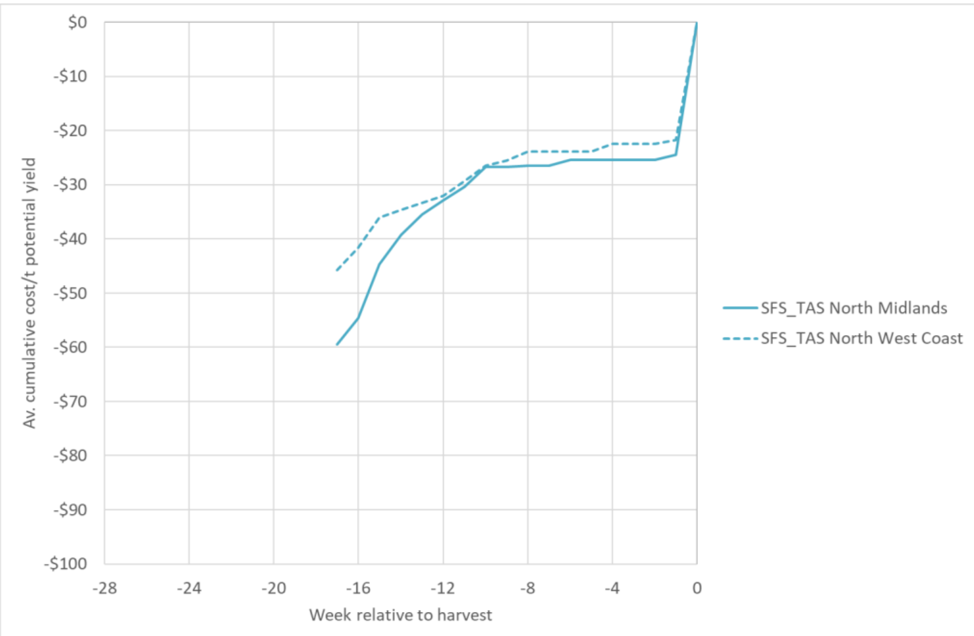

Figure 5. Cost remaining to be spent vs weeks before harvest, average for Tasmanian discussion group paddocks in 2024.

Pushing potential profit?

Some benchmarks for wet and drier environments.

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Future

Much effort this season has gone into establishing the system for transferring data from AgWorld and calculating this first round of benchmarks. The benchmarks, and the questions growers and advisers are asking, will in turn help to further refine the reports for the 2025 season paddocks.

There are some obvious refinements; for example, the profit benchmark should be related to potential price achieved. Assuming that costs will only vary slowly, the profit benchmark should be the main thing to change from year to year (with price).

Acknowledgements

The Hyper Profitable Crops project is funded by GRDC (FAR2403-002SAX).

Thank you to all the growers who contributed data, and to the many hub facilitators involved in setting up paddocks, collecting and editing data and reviewing reports. Thank you also to Paul Feely (Federation University CeRDI), the people of the AgWorld Helpdesk, and to members of the FAR Team involved in the project: Darcy Warren, Max Bloomfield, Aaron Vague and Nick Poole.

BIOLOGICAL BENCHMARKING- FIRST IN ITS FIELD

This initiative allows biological products to be evaluated under identical field conditions to synthetic standards, accelerating industry understanding and adoption of effective biological solutions.

Biological Benchmarking, developed by FAR Australia, is a brand-new initiative launching in 2025 to independently evaluate biological crop protection and productivity-enhancing products under Australian conditions. As interest in sustainable farming practices grows, so too does the demand for reliable data on the performance of these products. This initiative aims to provide side-by-side comparisons of new biological options against conventional synthetic controls to support confident decision-making by growers and advisers.

It is:

- **independent**
- **scientifically robust and replicated**
- **aligned with real-world agronomic practice**
- **focused on productivity, sustainability, and profitability**

- **With FAR Australia funded control treatments**

Collaborating Industry Stakeholders

This program is designed for biological product developers, distributors, agronomists, private consultants, and farming groups seeking to better understand the performance and positioning of biological products and demonstrate them to the wider industry.

With increased availability and global interest in biological inputs—from microbial inoculants to plant defense stimulants and biopesticides—there is a growing need for rigorous testing. The Biological Benchmarking series will provide that platform, offering clarity and confidence in a rapidly evolving product space.

Industry Innovations
leading the way to a brighter grains industry

BIOLOGICAL BENCHMARKING
an independent biological evaluation network

TAS HRZ CROP TECHNOLOGY CENTRE FIELD DAY

AFTERNOON TIMETABLE

THURSDAY 20th NOVEMBER 2025

In-field presentations at Cereal Research site	Station No.	1:30	2:00	2:30	3:00	3:30
Professor Romulo Lollato, Kansas State University, USA *- Prof Lollato looks at the lessons learnt in the US when attempting to close the yield gap (between potential and realised) over a run of different seasons. What are the key factors being taken into account?*	**1**	1				Closing address and refreshments
Nick Poole, FAR Australia ***FAR Australia research results from Tasmania.*** *Nick, chats about winter wheat variety performance compared to spring sown barley, the evolving ways we're using fungicides, the challenges we face in the eastern states of Australia compared to WA.*	**2**		1			
Darcy Warren, FAR Australia, Dr Kenton Porker CSIRO ***Barley resistance update and winter barley germplasm development -*** *Darcy discusses lessons learned in integrated management of Net form net blotch (NFNB) with triple mutant fungicide resistance threats. Kenton looks at the case for winter barley in light of new germplasm.*	**3**			1		
Nick Poole and Darcy Warren, FAR Australia ***Making better decisions on disease management practices in wheat and barley*** *Nick and Darcy look at a new GRDC project that seeks to use new technologies and decision support tools to make profitable and sustainable decisions with fungicides.*	**4**				1	
In-field presentations		**1:30**	**2:00**	**2:30**	**3:00**	**3:30**

Note we will only split into two groups if high numbers attend (otherwise we will run one group).	1
If we do split into groups we would ask that you stay in your allocated groups. Thank you for your cooperation.	

Event kindly sponsored by

Wheat Performance under irrigation in Tasmania – FAR Australia Germplasm Evaluation Network GEN Trials – Nick Poole & Darcy Warren, FAR Australia

The Germplasm Evaluation Network (GEN) is a FAR Australia 'Industry Innovations' initiative that tests crop variety performance across FAR Australia's national network of Crop Technology Centres. GEN sites test variety performance with and without fungicide. FAR Australia provides the control varieties and breeders enter their chosen lines for evaluation.

2023 Season

Tas Wheat (FAR TAS II W23-12)

Sown: 26 April 2023
Harvested: 26 January 2024
Soil Type: Chromosol
Previous Crop: Poppies
Cultivar: Various
FAR Code: FAR TAS II W23-12
GSR (Apr-Nov): 562mm
Irrigation: 94mm

Key Points:

- *There was a significant yield interaction (<0.001) between variety and fungicide application with FAR SW1, RGT Waugh and Reflection, all giving less than 0.9t/ha response to fungicide in contrast to RGT Accroc which gave a 4.63t/ha yield response to fungicide.*
- *The highest yielding variety in the trial was FAR WW2 which was significantly superior to all other varieties tested, yielding just over 13.5t/ha.*
- *Severe stripe rust infection from early in the season reduced the yield of untreated Rockstar below 1t/ha, but was also uncontrollable under the full protection program based on three fungicides.*
- *Lower levels of Septoria tritici blotch (STB) were also present and tended to be more problematic where stripe rust infection was lower e.g. RGT Relay.*

Yield (t/ha), quality data (% protein, test weight) & Disease data

Table 1. Influence of fungicide on the grain yield (t/ha) of wheat cultivars plus and minus fungicide. *(Provisional moisture meter readings – until full analysis is available).*

	Management Level				
	Untreated		**Full protection**		**Mean**
Cultivar	**Yield t/ha**		**Yield t/ha**		**Yield t/ha**
Anapurna (w – red grained)	10.94	cd	10.35	de	**10.65**
Rockstar (s– white grained)	0.82	i	3.05	h	**1.93**
RGT Accroc (w – red grained)	3.62	h	8.25	fg	**5.93**
Reflection (w – red grained)	10.94	cd	11.60	bc	**11.27**
RGT Relay (w – red grained)	9.27	ef	10.78	cd	**10.02**
RGT Waugh (w – white grained**)**	11.48	bcd	12.29	b	**11.89**
FAR WW2 (w – red grained)	12.42	b	13.67	a	**13.05**
FAR SW1 (s – red grained)	7.12	g	7.38	g	**7.25**
Mean	**8.33**		**9.67**		**9.00**
LSD Cultivar p = 0.05	0.87		**P val**		<0.001
LSD Management p = 0.05	1.21		**P val**		0.038
LSD Cultivar x Man. p = 0.05	1.23		**P val**		<0.001

Note: w = Winter Wheat, s = Spring Wheat

Wheat Performance under irrigation in Tasmania – FAR Australia Germplasm Evaluation Network GEN Trials – Nick Poole & Darcy Warren, FAR Australia

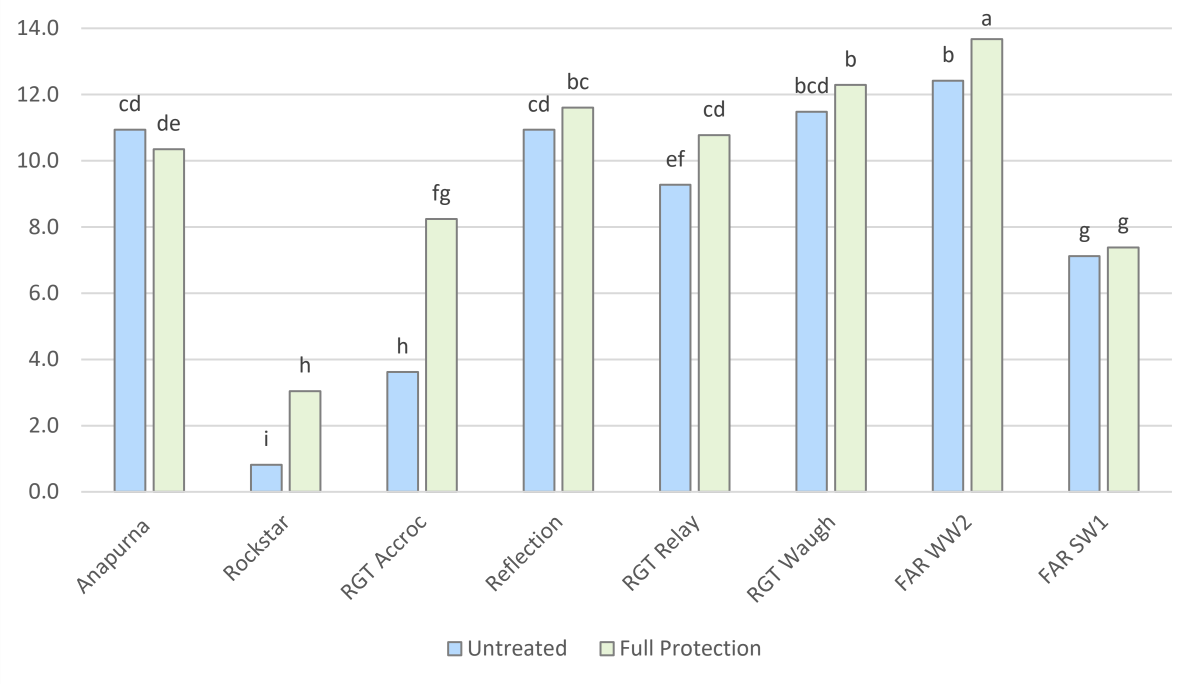

Figure 1. Influence of cultivar and fungicide on grain yield (t/ha), harvested on 26 January.

Table 2. Influence of fungicide and cultivar on the protein (%) and test weights (kg/hL) of wheat cultivars plus and minus fungicide – 26 January harvested.

	Management Level											
	Untreated		Full protection		Mean		Untreated		Full protection		Mean	
Cultivar	**Protein %**		**Protein %**		**Protein %**		**Test weight kg/hL**		**Test weight kg/hL**		**Test weight kg/hL**	
Anapurna	12.5	-	12.6	-	**12.6**	**c**	76.7	a	77.1	a	**76.9**	**a**
Rockstar	13.1	-	13.6	-	**13.3**	**b**	48.6	e	55.3	d	**51.9**	**e**
RGT Accroc	12.0	-	11.2	-	**11.6**	**d**	57.9	c	69.6	b	**63.8**	**d**
Reflection	10.7	-	11.2	-	**10.9**	**e**	74.9	a	74.9	a	**74.9**	**b**
RGT Relay	11.2	-	11.3	-	**11.2**	**de**	71.8	b	71.6	b	**71.7**	**c**
RGT Waugh	12.5	-	12.7	-	**12.6**	**c**	75.9	a	75.6	a	**75.7**	**ab**
FAR WW2	11.0	-	11.0	-	**11.0**	**e**	75.7	a	75.0	a	**75.3**	**ab**
FAR SW1	14.5	-	14.0	-	**14.3**	**a**	76.4	a	76.0	a	**76.2**	**ab**
Mean	**12.2**	**-**	**12.2**	**-**	**12.2**		**69.7**	**-**	**71.9**	**-**	**70.8**	
Cultivar	**LSD p = 0.05**		0.5	**P val**	<0.001		**LSD p = 0.05**		1.8	**P val**	<0.001	
Management	**LSD p = 0.05**		ns	**P val**	0.931		**LSD p = 0.05**		ns	**P val**	0.076	
Cultivar x Man.	**LSD p = 0.05**		ns	**P val**	0.078		**LSD p = 0.05**		2.5	**P val**	<0.001	

Wheat Performance under irrigation in Tasmania – FAR Australia Germplasm Evaluation Network GEN Trials – Nick Poole & Darcy Warren, FAR Australia

Disease Assessment data

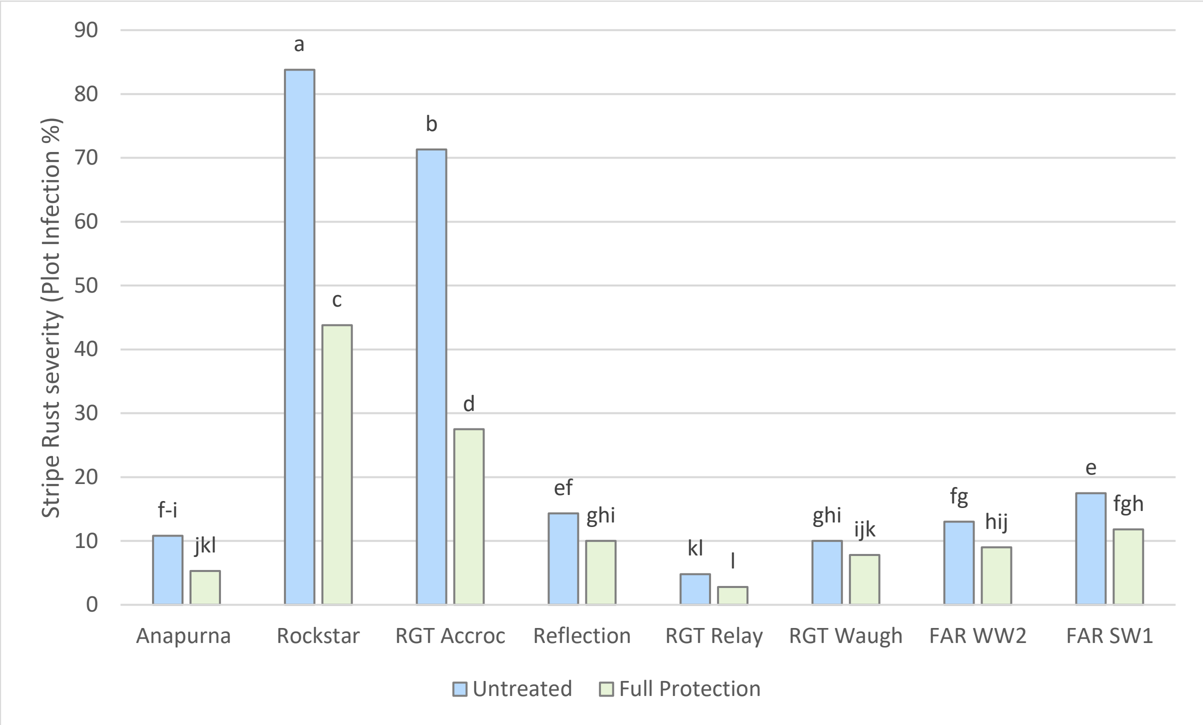

Figure 2. Influence of variety and fungicide management on Stripe Rust severity, assessed on 11 October 2023.

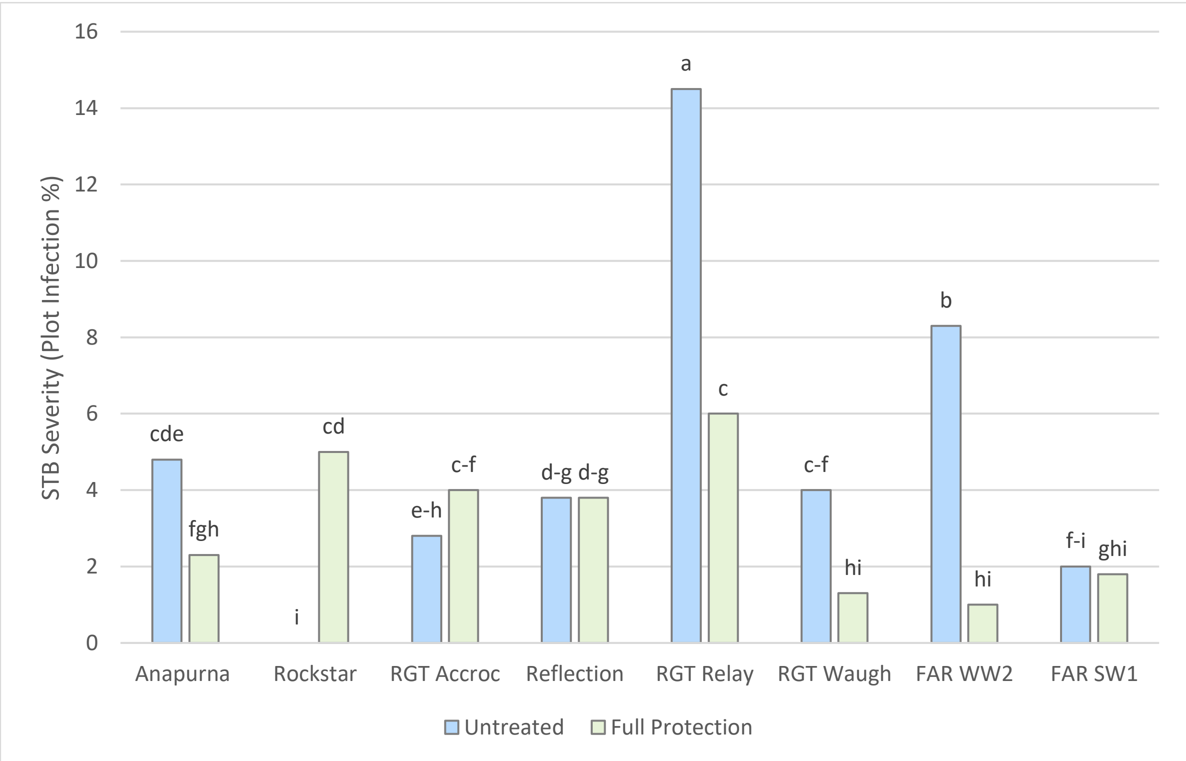

Figure 3. Influence of variety and fungicide management on Septoria tritici blotch (STB) severity, assessed on 11 October 2023.

Wheat Performance under irrigation in Tasmania – FAR Australia Germplasm Evaluation Network GEN Trials – Nick Poole & Darcy Warren, FAR Australia

2024 Season

Tas Irrigated Wheat (FAR TAS II W24-38)

Sown: 24 April 2024
Harvested: 31 January 2025
Soil Type: Chromosol
Previous Crop: 2024- Carrot seed

Cultivar: Various
FAR Code: FAR TAS II W24-38
GSR (Apr-Nov): 631mm
Irrigation: 45mm

Key Points

- *There was significant interaction in yield between variety and fungicide. The highest yielding treatment was AGFWHWW2 (previously tested as FAR WW2) under a two-spray fungicide program (12.57 t/ha). Reflection grown with fungicide was not statistically different from the top yielding variety, also achieving 12.35 t/ha. Both these treatments yielded significantly more than the equivalent plots grown without fungicide.*
- *Although yielding slightly less than the top variety, Longford, RGT Waugh and Anapurna still yielded strongly and gave no yield response to fungicide.*
- *Yields in excess of 11 t/ha were achieved by varieties with good stripe rust resistance and good standing power.*
- *The lowest yielding varieties on site were RGT Cesario, RGT Accroc and TA0109 and were all characterised by high (>70%) stripe rust (Yr) damage (both active infection and necrosis caused by Yr reaction), which was not fully controlled in this trial.*
- *There was no interaction between variety and fungicide for any grain quality parameters, with the differences only being produced by changes in variety.*
- *The only spring variety in the trial was KWS Expectum (previously tested as FAR SW1), a slow developing variety which has export quality status in Germany. It showed very favourable grain quality results with a mean protein of 13.3%, test weight of 79.2 kg/hL and screenings of 1.0%. It did however experience the most lodging in the trial with a lodging index score over 300 (out of a possible 500).*

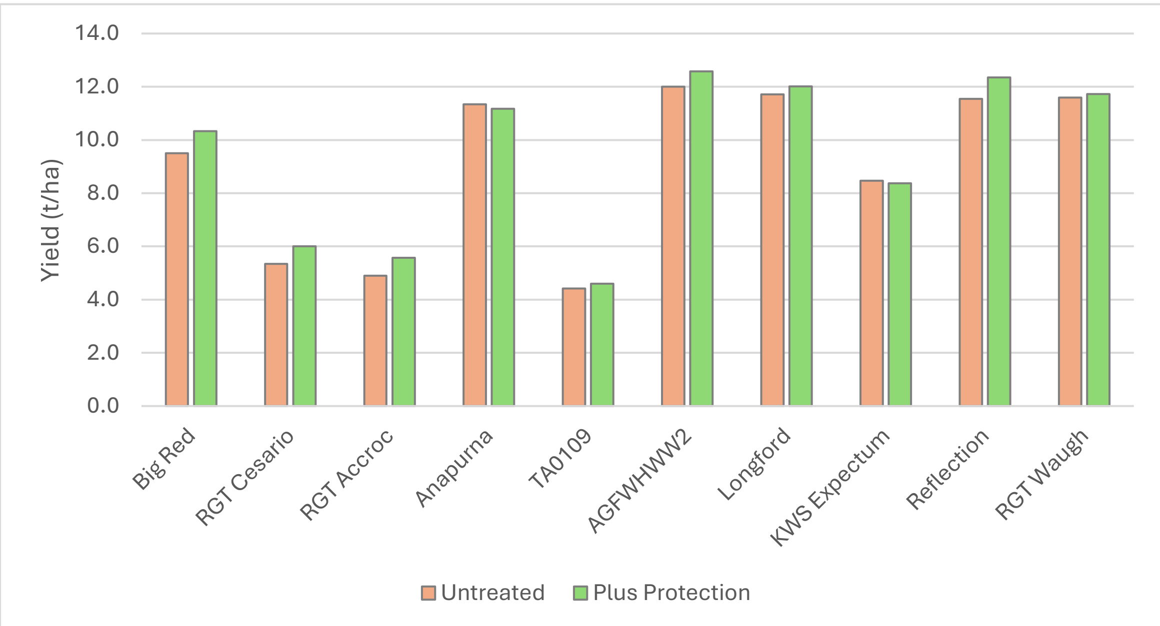

Figure 4. Influence of cultivar and fungicide on grain yield (t/ha), harvested on 28 January 2025.

Wheat Performance under irrigation in Tasmania – FAR Australia Germplasm Evaluation Network GEN Trials – Nick Poole & Darcy Warren, FAR Australia

Note: Stripe rust was not controlled by 'Plus fungicide' management with the two-spray program insufficient in terms of number of applications and poor timing.

Yield (t/ha) & disease data

Table 3. Influence of fungicide application on the grain yield (t/ha) of wheat varieties plus and minus fungicide.

Yield (t/ha)							
Variety		**Untreated**		**Plus fungicide**		**Mean**	
1.	BigRed *(w)*	9.51	g	10.33	f	**9.92**	**d**
2.	RGT Cesario *(w)*	5.34	jk	6.01	i	**5.68**	**f**
3.	RGT Accroc *(w)*	4.89	kl	5.57	ij	**5.23**	**g**
4.	Anapurna *(w)*	11.34	de	11.17	e	**11.25**	**c**
5.	TA0109 *(w)*	4.42	l	4.59	l	**4.51**	**h**
6.	AGFWHWW2 (FAR WW2) *(w)*	12.00	bc	12.57	a	**12.29**	**a**
7.	Longford *(w)*	11.71	cd	12.01	bc	**11.86**	**b**
8.	KWS Expectum (FAR SW1) *(s)*	8.47	h	8.37	h	**8.42**	**e**
9.	Reflection *(w)*	11.55	cde	12.35	ab	**11.95**	**ab**
10.	RGT Waugh *(w)*	11.60	cde	11.73	cd	**11.66**	**b**
	Mean	**9.08**	**b**	**9.47**	**a**	**9.28**	
	LSD Cultivar p = 0.05	0.35		**P value**		<0.001	
	LSD Management p = 0.05	0.15		**P value**		0.004	
	LSD Cultivar x Man. p = 0.05	0.49		**P value**		0.030	

Note: w = Winter Wheat, s = Spring Wheat

Disease Assessment data

Table 5. Influence of fungicide and cultivar on stripe rust damage (%) of wheat cultivars plus and minus fungicide – 30 October 2024 assessed.

Stripe Rust							
Variety		**Untreated**		**Plus fungicide**		**Mean**	
1.	BigRed	21.0	-	21.3	-	21.13	b
2.	RGT Cesario	70.0	-	72.5	-	71.25	a
3.	RGT Accroc	80.0	-	76.3	-	78.13	a
4.	Anapurna	16.5	-	18.0	-	17.25	b
5.	TA0109	66.3	-	85.0	-	75.63	a
6.	AGFWHWW2	1.8	-	4.8	-	3.25	c
7.	Longford	1.3	-	1.6	-	1.44	c
8.	KWS Expectum	4.8	-	7.0	-	5.89	c
9.	Reflection	0.0	-	1.8	-	0.88	c
10.	RGT Waugh	1.0	-	4.0	-	2.5	c
	Mean	26.25	-	29.22	-		
	LSD Cultivar p = 0.05	8.8		**P value**		<0.001	
	LSD Management p = 0.05	ns		**P value**		0.052	
	LSD Cultivar x Man. p = 0.05	ns		**P value**		0.528	

Note: Stripe rust was not controlled by 'Plus fungicide' management with the two-spray program insufficient in terms of number of applications and poor timing.
AGFWHWW2 in 2024 was FAR WW2 in 2023.

Wheat Performance under irrigation in Tasmania – FAR Australia Germplasm Evaluation Network GEN Trials – Nick Poole & Darcy Warren, FAR Australia

Summary

In the last two seasons stripe rust has been a very significant factor in grain yields under irrigation in the Tasmanian GEN trials. The disease has been more severe (in terms of early infection possibly because of more green bridge infection). Whilst our control of this disease was inadequate in 2024 it has revealed a clear split between high yielding disease resistant varieties and high yielding susceptible varieties. RGT Accroc and RGT Cesario are very high yielding varieties being in the top five yielding red feed wheats since 2021 at the FAR Australia Tasmanian Crop Technology Centre. The change of resistance status of RGT Cesario in 2022 from resistant to susceptible to stripe rust profoundly changed the management of this variety to be more intensive.

Over the last two years the standout variety under irrigation in our trials has been AGFWHWW2 (formerly FAR WW2) which has now been taken on commercially by AGF. In 2023 this variety was significantly better than all other varieties tested by FAR Australia (mean of treated and untreated with fungicide) and in 2023 significantly better than the other varieties when treated. The variety has exhibited good disease resistance and very high yield potential. RGT Waugh, a white grained long season wheat has also been very disease resistant with yields slightly lower than AGFWHWW2.

Comparison of highest yields – Spring sown barley vs autumn sown wheat under irrigation

The following yields have been taken from crops sown on the Crop Technology Centre at Hagley since 2021. The highest yielding plots have been compared in the following graph.

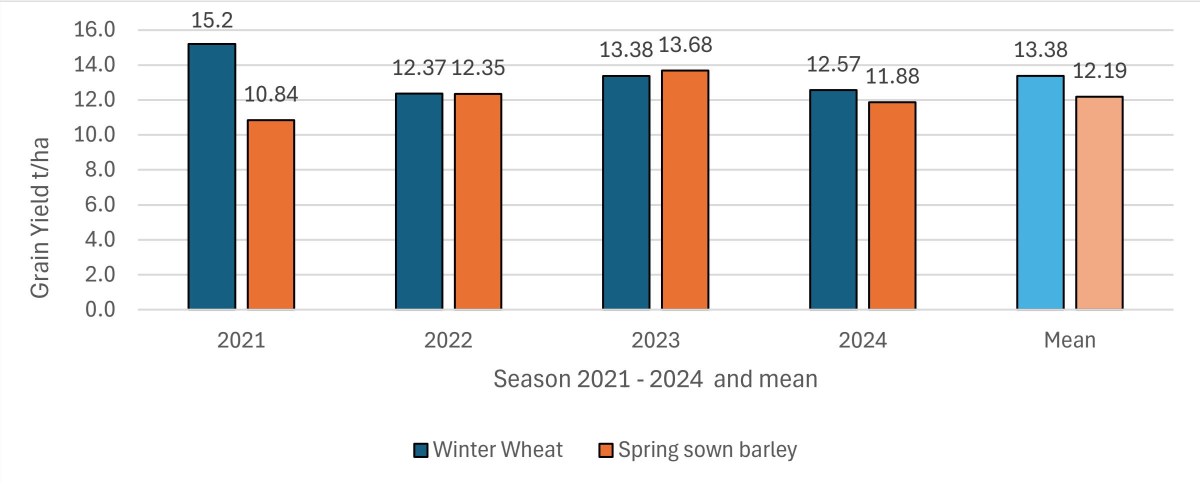

Figure 5. Comparison of highest grain yields (t/ha) of spring barley with autumn sown winter wheat – FAR Australia CTC Tasmania (based on 12m length plots)

Key Points

- *With savings in nitrogen inputs and fungicides spring sown barley has been a standout crop under irrigation established at the start of September, benefiting from longer days and higher solar radiation, provided summer temperatures are not excessive and irrigation is maintained.*
- *The comparison has shown the importance of photothermal quotient (PTQ) in generating yield potential in cereals, with a five-month crop duration competing favourably with a nine-month crop in Tasmania when irrigation is available.*

Integrated management of Net form net blotch (NFNB) with triple mutant fungicide resistance threats in south-west Victoria

Darcy Warren[1], Nick Poole[1], Aaron Vague[1], Max Bloomfield[1] & Rajdeep Sandhu[1]
[1] Field Applied Research (FAR) Australia

This paper brings together findings from the GRDC funded, QDPI lead project "Program 5 - Integrated management strategies for Net Form Net Blotch in low, medium, and high rainfall zones", looking specifically at lessons learned in the NFNB Stubble management × fungicide management trial in 2024 and early observations in 2025.

Key point summary

- NFNB severity reached high levels in untreated plots, with late-season infection exceeding 80% in low-input fungicide programs.
- Fungicide management significantly increased yield (mean response +1.21 t/ha) while stubble management alone did not provide a yield benefit.
- High-input fungicide programs delivered the best economic returns (ROI up to $3.78 per $1 spent), though disease was not completely controlled.
- Stubble management (burning or cultivation) did not significantly influence disease or yield in this trial, but remains an important tool where barley follows barley.
- The presence of triple fungicide resistance in *P. teres f. teres* in the region highlights the need for integrated disease management (IDM), combining fungicides with resistant varieties, crop rotation and paddock hygiene.

Background
Net form net blotch (NFNB), caused by *Pyrenophora teres f. teres*, remains one of the most significant foliar diseases of barley in southern Victoria. Its prevalence has increased alongside widespread cultivation of susceptible barley cultivars. In recent years, resistance and reduced sensitivity to all three major fungicide groups (DMI, QoI, and SDHI) has been confirmed in Australian NFNB populations. This triple resistance in the pathogen population presents a major challenge to disease control, requiring a shift away from reliance on fungicides alone.

The 2024 NFNB Stubble management trial was established as part of the GRDC funded, QDPI lead project "Program 5 - Integrated management strategies for Net Form Net Blotch in low, medium, and high rainfall zones" to investigate the interaction between fungicide input and stubble management, and to assess their impact on NFNB development, grain yield and economic return.

Trial 3. NFNB Stubble management × fungicide management multi-year trial

- **Location:** Lethbridge, Vic- medium grey clay soil
- **Previous crop:** Wheat (2023)
- **Sown:** 30 May 2024; harvested: 20 December 2024
- **Stubble treatments:** Standing, cultivated (2 May), burnt (2 May)
- **Fungicide strategies:**
    - *Low input*: Systiva (fluxapyroxad) seed treatment only
    - *High input*: Systiva, Opera (GS31), Aviator Xpro (GS39-49) & Opus (GS59)

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Grain yield:
Mean yield across the trial was 7.40 t/ha. The effect of fungicide management was highly significant ($p < 0.001$), increasing yield by an average of 1.21 t/ha. Stubble management had no significant effect on yield ($p = 0.678$).

Economic return:
High-input fungicide strategies produced strong positive margins (ROI up to $3.78), while low-input programs returned negative margins in all stubble treatments (Table 1).

Disease severity:
NFNB infections were low to moderate early in the season (GS31–39) likely due to a late May sowing however escalated rapidly by the grain fill stage (GS71–75). Untreated/low input plots recorded 80–83% infection compared with 50–59% in high-input plots. Stubble management did not significantly affect disease in the wheat-barley rotation.

Discussion
The results from this trial confirm that fungicides remain effective in reducing NFNB severity and protecting yield, however they also highlight the limitations of a fungicide-dependent approach. Despite four applications across multiple modes of action, NFNB was not fully controlled, with late-season infection still exceeding 50% in high-input treatments. As the presence of triple resistant mutants becomes more widespread in the NFNB pathogen population so the sustainability of such high input programs becomes more questionable.

Stubble management and rotation
Although previous wheat stubble treatments did not influence final disease levels or grain yield in this trial, the preceding wheat crop meant inoculum carryover was relatively low. In continuous barley systems, stubble retention is a major driver of NFNB epidemics. Burning or cultivating barley stubbles remains an important strategy to reduce inoculum pressure, particularly where fungicide efficacy is compromised by resistance and reduced sensitivity. In 2025, trial plots have again been established, overlaying the 2024 trial, and therefore sown into barley stubble. Early season assessments at first node GS31 have shown significant reductions in disease severity in the lower canopy where stubble inoculum has been removed. Although severity levels recorded were relatively low (<10 % leaf area infected (LAI)), these results have been generated in a June sown crop of a MS variety cv Neo CL (more resistant than the 2024 trial) and would realistically be expected to have little to no infection under normal circumstances.

TAS HRZ CROP TECHNOLOGY CENTRE FIELD DAY

MORNING TIMETABLE

THURSDAY 20th NOVEMBER 2025

TASMANIA CROP TECHNOLOGY CENTRE

FAR AUSTRALIA

In-field presentations at canola research site	**11:30**	**11:50**	**12:30**
Welcome and introductions ***Nick Poole - Managing Director, FAR Australia*** *Outline of the programme for the day.*	**Coffee and introductions**		**Lunch and refreshments**
Brett Davey, SFS, and Darcy Warren & Nick Poole, FAR Australia ***Pushing potential profit? Benchmarks for agronomy and profit*** *The first year results of our new GRDC Hyper Profitable Crops project are out. Brett, Darcy and Nick look at the analysis of agronomic and profitability benchmarking in the region.*		1	
Industry Innovations leading the way to a brighter grains industry			
In-field presentations	**11:30**	**11:50**	**12:30**

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TAS HRZ CROP TECHNOLOGY CENTRE FIELD DAY

AFTERNOON TIMETABLE

THURSDAY 20th NOVEMBER 2025

TASMANIA CROP TECHNOLOGY CENTRE

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

FAR AUSTRALIA

In-field presentations at Cereal Research site	Station No.	1:30	2:00	2:30	3:00	3:30
Professor Romulo Lollato, Kansas State University, USA *- Prof Lollato looks at the lessons learnt in the US when attempting to close the yield gap (between potential and realised) over a run of different seasons. What are the key factors being taken into account?*	**1**	1				Closing address and refreshments
Nick Poole, FAR Australia ***FAR Australia research results from Tasmania.*** *Nick, chats about winter wheat variety performance compared to spring sown barley, the evolving ways we're using fungicides, the challenges we face in the eastern states of Australia compared to WA.*	**2**		1			
Darcy Warren, FAR Australia, Dr Kenton Porker CSIRO ***Barley resistance update and winter barley germplasm development -*** *Darcy discusses lessons learned in integrated management of Net form net blotch (NFNB) with triple mutant fungicide resistance threats. Kenton looks at the case for winter barley in light of new germplasm.*	**3**			1		
Nick Poole and Darcy Warren, FAR Australia ***Making better decisions on disease management practices in wheat and barley*** *Nick and Darcy look at a new GRDC project that seeks to use new technologies and decision support tools to make profitable and sustainable decisions with fungicides.*	**4**				1	
In-field presentations		**1:30**	**2:00**	**2:30**	**3:00**	**3:30**

Note we will only split into two groups if high numbers attend (otherwise we will run one group).	1
If we do split into groups we would ask that you stay in your allocated groups. Thank you for your cooperation.	

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leading the way to a brighter grains industry

Thank You to our long time supporters

We extend our heartfelt thanks to AGF Seeds for their generous sponsorship of the Hagley field day — your commitment to FAR Australia's field program is undeniable, your contribution plays a vital role in advancing agricultural research and innovation.

Integrated management of Net form net blotch (NFNB) with triple mutant fungicide resistance threats in south-west Victoria

Darcy Warren[1], Nick Poole[1], Aaron Vague[1], Max Bloomfield[1] & Rajdeep Sandhu[1]
[1] Field Applied Research (FAR) Australia

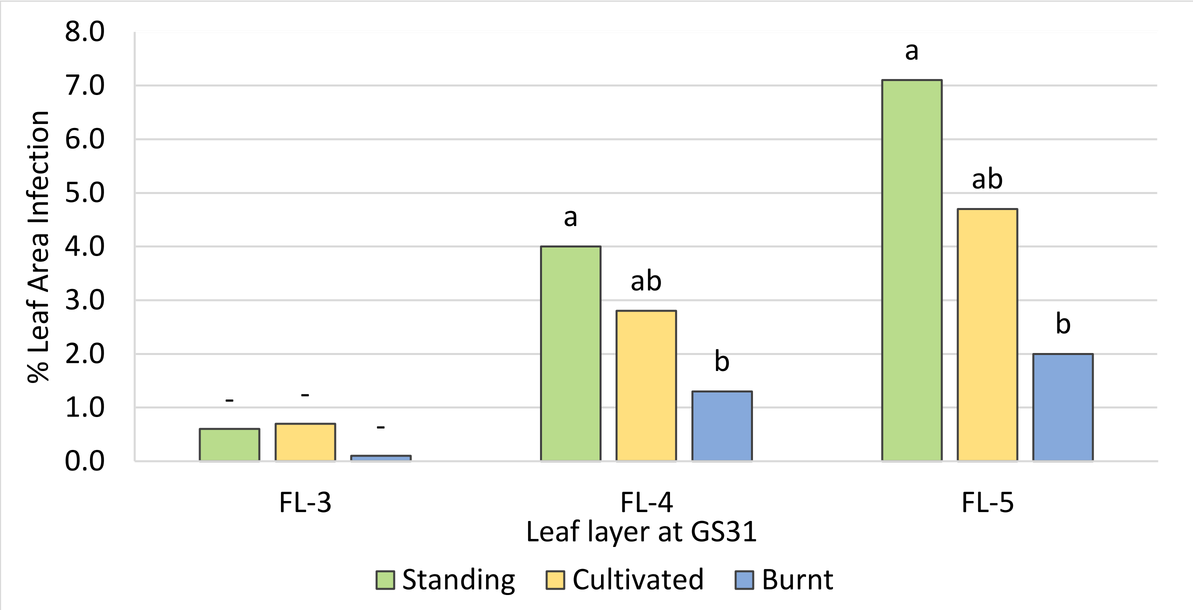

Figure 1. Influence of stubble management on early season Net form net blotch (NFNB) severity (%LAI), assessed 18 August 2025, cv Neo CL.

Resistant varieties

The trial highlights the vulnerability of susceptible varieties under high NFNB pressure. Fungicide input provided yield protection but was unable to deliver complete control. Resistant or moderately resistant cultivars provide the most sustainable protection and should form the foundation of integrated NFNB management. However, shifts in disease spectrum (e.g. increased scald and/or leaf rust) need to be monitored when varietal resistance is utilised.

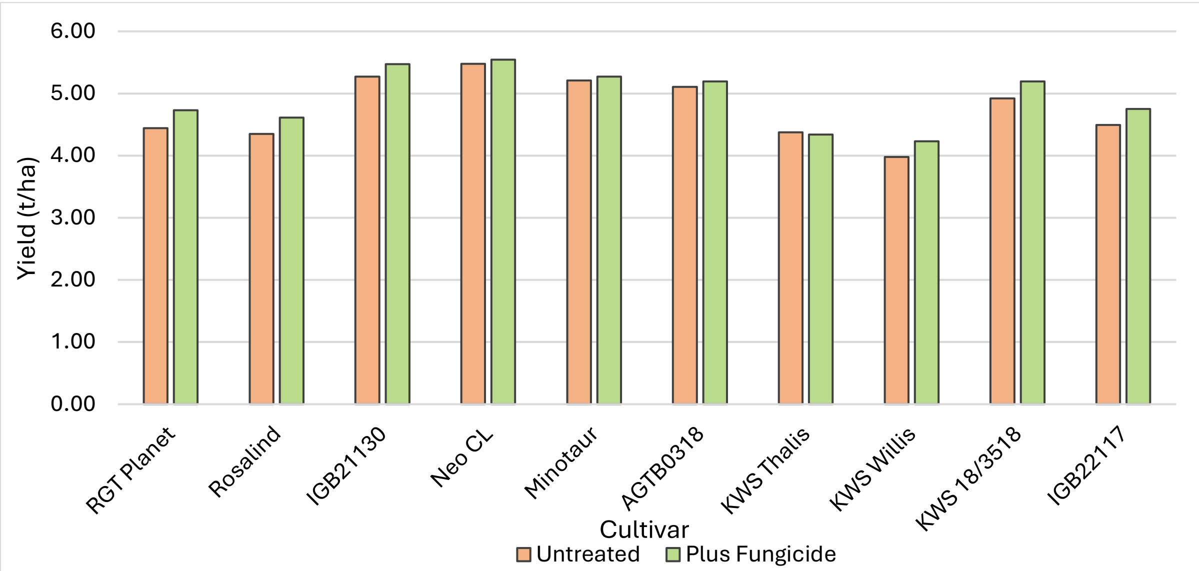

Figure 2. Results from FAR Australia's 2024 Barley Germplasm Evaluation Network (GEN) TOS 2 trial showing influence of barley variety and fungicide application on grain yield (t/ha) (P Value= <0.820, LSD= ns). These trials provide an insight into newly released barley varieties and promising breeder lines and their potential to provide more disease resistant, high yielding options.

FAR AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Integrated management of Net form net blotch (NFNB) with triple mutant fungicide resistance threats in south-west Victoria

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[1] Field Applied Research (FAR) Australia

Fungicide use

The economic data reinforces that low-input fungicide programs are not viable under high NFNB pressure, while high-input programs can still deliver ROI in the short term. However, in the presence of the triple resistant mutations, overuse of fungicides risk accelerating the loss of remaining efficacy. Strategic and targeted fungicide applications and integration of IDM tools is essential.

Table 1. Margin ($/ha) after fungicide, application and stubble management costs have been deducted from the value of additional yield at $345/t.

		Response to Fung. and Stubb. Man.	Cost of treatment	Extra income from fung.	Margin after input cost and app.	Return on Investment
Fung. Input	**Stubble Management**	**t/ha**	**$/ha**	**@$345/t**	**$/ha**	**$ back for every extra $1 spent**
Low	**Standing**	0.00	$36.00	$0.00	-$36.00	
Low	**Cultivated**	-0.06	$125.00	-$20.70	-$145.70	-$0.23
Low	**Burnt**	-0.24	$46.00	-$81.77	-$127.77	-$8.18
High	**Standing**	1.16	$141.85	$400.20	$258.35	$3.78
High	**Cultivated**	1.05	$230.85	$360.53	$129.68	$1.85
High	**Burnt**	1.11	$151.85	$383.99	$232.14	$3.31

Conclusion

This trial shows that fungicide programs continue to provide yield and economic benefit in susceptible barley varieties, but they cannot provide complete NFNB control. With triple fungicide resistance now present in the region, integrated disease management strategies are critical. Resistant cultivars, stubble management in barley-on-barley rotations, and diverse cropping sequences should all be combined with strategic fungicide use. These strategies will reduce pathogen inoculum, limit reliance on chemical control, and extend the life of existing fungicide options.

GERMPLASM evaluation network

your trusted research partner for germplasm evaluation

FAR AUSTRALIA

CALLING ALL BREEDERS! Would you like to expose your latest germplasm in GEN 2026?

Developing higher yielding crops through germplasm advances

Expanded Programme for 2025!

Now including milling oats plus and minus fungicide

An Industry Innovations (II) 2025 initiative

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leading the way to a brighter grains industry

SOWING THE SEED FOR A BRIGHTER FUTURE

GERMPLASM EVALUATION NETWORK (GEN) - BACKGROUND

Hagley, TAS

Wallendbeen, NSW

Esperance, WA

FAR Australia has been working with breeders to bring new products to the Australian Grains industry since its inception in 2012. It is a trusted development partner for many breeders, assisting with bringing in new germplasm to the marketplace, whilst ensuring the correct management to fulfil the genetic yield potential.

Industry Collaborations

FAR Australia is once again partnering with industry to independently showcase ***germplasm*** performance in a series of high productivity ***evaluation*** trials across the country as part of its Industry Innovations (II) initiative.

To develop independent research results on profitable germplasm developments in wheat, barley, milling oats and canola, using specific research strategies designed by FAR Australia for the High and Medium Rainfall Zones of Australia.

Should you wish to invest into FAR Australia's Germplasm Evaluation Network, please contact Darcy Warren 0455 022 044 darcy.warren@faraustralia.com.au

This independent initiative delivers a coordinated and independent network of high productivity trials in wheat, barley and canola. The trials will be managed 'plus and minus' fungicide with control varieties provided by FAR Australia.

Can we make better disease management decisions with the use of new technologies?

Nick Poole & FAR Australia team, Ag Victoria, Brill Ag and Trengove Consulting

Background

22 years ago, disease management in Australia changed because of an exotic (overseas) incursion of stripe rust that infected crops in WA in 2002. Rather unfairly it became known as the WA pathotype. It resulted in greater use of both in-furrow and foliar fungicides to control an infection that was to become widespread across the eastern states.

On the plus side it resulted in much greater understanding of how to use fungicides in modern Australian broadacre farming systems. As the use of fungicides increased so the market for fungicides increased, which in turn meant manufacturers had greater confidence in introducing newer fungicide actives and modes of action. ***It is arguable that Australia now has a fungicide armory that is as up to date and powerful as that available to growers in Europe.***

Key Points

- *It is now often the case that low-cost fungicides are included in disease management strategies with little evidence of disease or risk being identified.*
- *In a number of tillering cereal crops genetic yellowing, nutritional spotting and herbicide damage are misdiagnosed as disease resulting in an additional early fungicide application.*
- *Pathogen populations are incredibly adaptive and with more and more fungicides applied our pathogen populations change, becoming increasingly resistant to our modern fungicide armory through a process of selection (sensitive strains are destroyed more resistant strains survive).*
- *20 years later fungicide resistance and reduced sensitivity (partial resistance) is a real issue, particularly in the net blotch, Septoria, powdery mildew and blackleg pathogens.*
- *Whilst improved genetic resistance is a clear way to reduce our dependency on fungicide application, could we use new technologies and simple decision support tools to give us greater confidence to omit a fungicide application.*
- *One of the simplest ways of preserving the activity of our fungicides and reducing our resistance risk is to employ fewer fungicide applications during the course of a growing season.*

That is the objective of a new GRDC investment in wheat (GRDC FAR202503-001RTX) that is testing whether we can use decision support tools such as disease development apps, spore traps, simple wet weather rules of thumb and disease thresholds that would allow us to;

> ***Either – spray with greater certainty, omit a fungicide or delay fungicide to a later timing with the intention of using less fungicide***

Can we make better disease management decisions with the use of new technologies?

Nick Poole & FAR Australia team, Ag Victoria, Brill Ag and Trengove Consulting

The new project that is in its first year has four protocols covering the three year research programme. A selection of trials from these protocols (which are outlined below) are being conducted across four states in SE Australia at nine research sites, three in Victoria, three in SA, two in NSW and one on Tasmania.

Protocol 1. The economic value of germplasm, cultural control and at sowing inputs in foliar disease management strategies.

Objective: This will investigate the value of cultural control associated with rotation position, genetic resistance and at sowing fungicide inputs on the need for foliar fungicide inputs in the spring.

Protocol 2. Strategies based on decision support tools and new technologies.

Objective: To validate foliar fungicide treatments derived from spore trap results, simple environmental trigger points, % threshold infection levels on specific leaf layers and model-based decision support apps covering stripe rust & Septoria.

Protocol 3. Adjustment in foliar fungicide rates, timings and active ingredients based on more resistant germplasm.

Objective: To validate foliar fungicide strategies that reduce the number of fungicide applications and rate of fungicide whilst adhering to AFREN principles (Australian Fungicide Resistance Extension Network) to reduce resistance risk.

Protocol 4. Long term effects of stubble management, green bridge control and resistant germplasm on foliar disease levels in continuous wheat.

Objective: Based at two sites (Horsham & Gnarwarre), a two-year trial using larger block plots would seek to assess the cumulative impact of adopting Integrated Disease Management (IDM) measures aimed at reducing the disease risk in the following crop.

What is happening internationally?

As part of the project FAR Australia looked at how decisions on fungicides and disease management more generally are made in other parts of the world hooking up with international contacts in New Zealand, Canada and the UK. Although new technologies were being tested most management decisions were based on disease presence or risk combined with knowledge of the development stage. In most cases fungicides were applied within the principal stem elongation development period of GS30 – 59. Although many countries had specific threshold levels for particularly diseases it was unclear whether the thresholds were being used on farms, with time taken to arrive at threshold levels and logistics of large farm enterprises often cited as a reason for just spraying at particular development stage with less attention being addressed to the level of disease present.

Today we will look at the trials to explore how we have fared with our spray decisions this season. The project must own its decisions, good and bad since fungicide decisions are primarily decisions based on our attitude to risk, therefore where we don't take out insurance it needs to be based on sound rational and scientific evidence.

Protecting and feeding faba beans during the critical period

Aaron Vague[1], Nick Poole[1], Darcy Warren[1]
[1] Field Applied Research (FAR) Australia

Key point summary

- From 2015-2024, the FAR Australia faba bean research program has produced a fungicide response in only 50% of the years.
- In the responsive years disease control is pivotal in the period just after the start of flowering (1-3 weeks), when seed number and yield formation is being determined.
- In a low-moderate chocolate spot severity season SW Victoria (2024) there was adequate control and a yield benefit from a two-spray conventional strategy.
- Although the dry season in 2024 made additional phosphorus uneconomic, there were alterations in plant architecture with an additional 50 kg/ha P showing a trend of increased branching, plant height, and podding; and statistically significant effects on 100 seed weight, dry matter, and grain yield

Background

FAR Australia collaborates in two Grains Research & Development Corporation (GRDC) funded projects; "Development and extension to close the economic yield gap and maximise farming systems benefits from grain legume production" investment (DJP2105-006RTX) and "Epidemiology, economic thresholds and management of Ascochyta blight and Botrytis diseases in lentil and faba bean" (DJP2304-004RTX). As part of these GRDC Southern region grain legume projects we are targeting 6-8t/ha dryland yields in Gnarwarre with an objective of greater understanding the physiological and pathological constraints of integrated disease management of faba beans.

Over the last decade the most prevalent disease has been Chocolate spot caused by the pathogen *Botrytis fabae*. This disease is particularly prevalent after crop canopy closure, in line with an increase in humidity (commonly quoted as >70%). The disease has a temperature range of approximately 15 – 28°C with a more rapid spread with warmer temperature within this range. Infection can occur on many parts of the plant including flowers, leaves, stems and pods. Without a truly resistant germplasm there needs to be a disease control strategy in high-risk scenarios; for example, proximity to badly infected stubbles from the season before.

How do we make fungicide decision when we only achieve a yield response in 50% of years?

From 2015-2024 the FAR Australia faba bean research program has produced a fungicide response in only 50% of the years (Figure 1). Considering the enduring label of faba beans as "failure beans" is often closely associated with their propensity to have high yield losses associated with disease, it is somewhat unfounded in the data. Yet fear of a bad disease year perpetuates into every season and often chemical inputs are applied regardless of the amount of disease present. The reality is that a dry spring can act as a very good fungicide.

Protecting and feeding faba beans during the critical period

Aaron Vague[1], Nick Poole[1], Darcy Warren[1]
[1] Field Applied Research (FAR) Australia

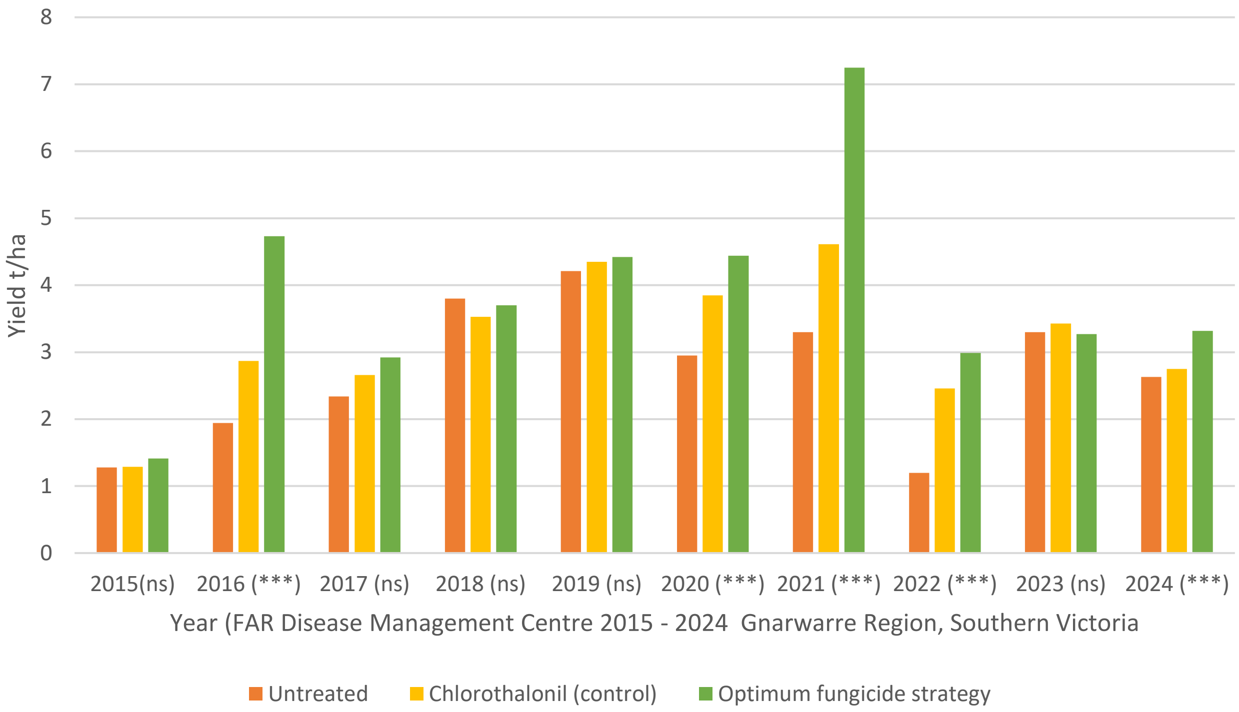

Figure 1. Yield response (t/ha) to fungicide (chlorothalonil control & best treatment in trial each applied as 2 spray approach) in faba beans 2015 – 2024 – Gnarwarre, Southern Victoria HRZ. *** - Statically significant yield response

When should we apply fungicides in the canopy to offer the greatest return on yield? Whilst we know a reasonable amount about the disease and the conditions for infection, we probably know less about exactly which parts of the plant are most important to protect from disease in comparison to wheat and barley. The "critical period" for faba bean development when seed number and yield formation is being determined is the period just after flowering (1-3 weeks) (Fakir 1997; Biswas et al. 2005; Mondal 2007).

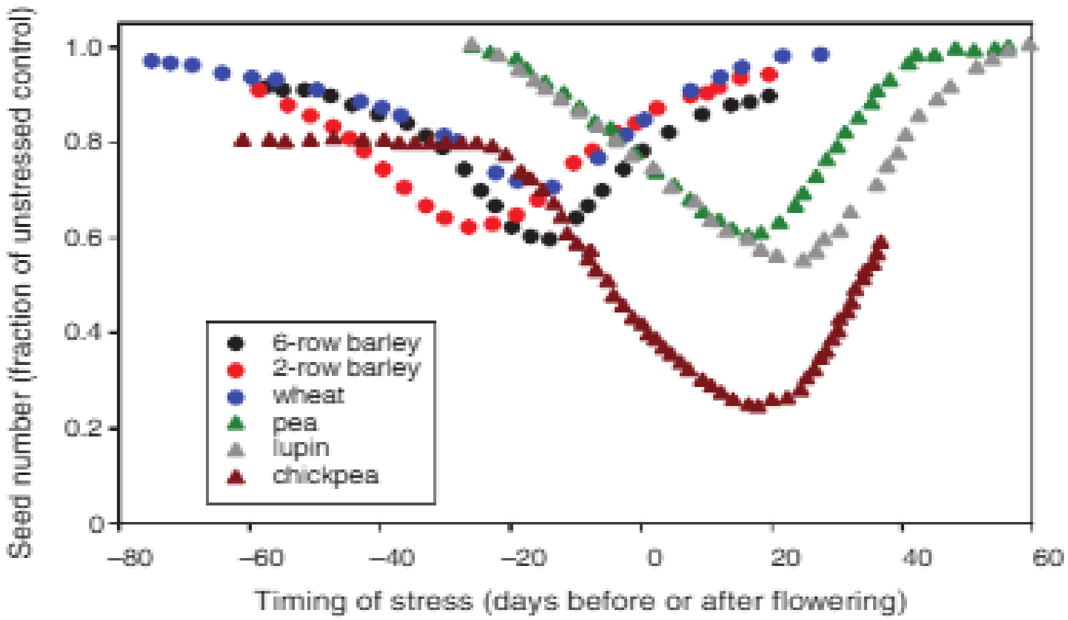

Figure 2. Critical period of seed number determination of winter cereals and pulses. V. Sadras and M. F. Dreccer (2015) Crop & Pasture Science 66(11):1137-1150

Protecting and feeding faba beans during the critical period

Aaron Vague[1], Nick Poole[1], Darcy Warren[1]
[1] Field Applied Research (FAR) Australia

Regarding applying a fungicide at a particular phenology stage, the evidence suggests that in a moderate disease year mid flowering (14 days after first flower) /early pod set are the most important fungicide timings (Table 1), with additional timings before and after dependent either on the season or specific pathogen issues. The importance of these key timings has been shown in trials where two spray approaches targeting these phenology stages have produced some of the best yields (average for both varieties).

Table 1. Influence of faba bean cultivar and disease management on grain yield (t/ha) at Gnarwarre 2024.

					Grain Yield (t/ha)					
Trt	4th node	**1st flower**	**1st flower +14 days**	**1st flower +28 days**	**PBA Amberly (MR)**		**PBA Bendoc (S)**		**Mean**	
1	---	---	---	---	3.24	-	2.83	-	3.03	**c**
2	---	---	---	Chlorothalonil +Carbendazim	3.33	-	3.07	-	3.20	**bc**
3	---	---	Chlorothalonil +Carbendazim	Chlorothalonil +Carbendazim	3.54	-	3.45	-	3.50	**a**
4	---	Mancozeb +Procymidone	Chlorothalonil +Carbendazim	Chlorothalonil +Carbendazim	3.43	-	3.34	-	3.38	**ab**
5	Tebuconazole	Mancozeb +Procymidone	Chlorothalonil +Carbendazim	Chlorothalonil +Carbendazim	3.41	-	2.95	-	3.18	**bc**
6	---	---	Miravis Star	---	3.26	-	3.35	-	3.30	**abc**
7	---	---	Miravis Star	Veritas	3.29	-	3.12	-	3.21	**bc**
8	Tebuconazole	Mancozeb	Miravis Star	Chlorothalonil +Carbendazim	3.35	-	2.88	-	3.11	**bc**
Mean					**3.35**	**-**	**3.12**	**-**		
Cultivar LSD p=0.05					0.27		**P val**		<0.001	
Fungicide Strategy LSD p=0.05					0.96		**P val**		ns	
Cultivar x Fungicide LSD p=0.05					0.38		**P val**		ns	

Tebuconazole applied at 145ml/ha, Mancozeb 750 at 2.00kg/ha, Procymidone 240g/ha, Chlorothalonil at 2.30L/ha, Carbendazim at 0.50L/ha, Miravis Star at 1/ha and Veritas at 0.75L/ha.

Thinking critically about the critical period with nutrition application.

Fact sheets describing the requirements for phosphorus in faba beans often vaguely suggest a figure such as "6kg/ha of phosphorus for every tonne of grain expected to be harvested". But like all management decisions with faba beans, realising these yield expectations with the challenges of the seasons can make upfront commitments difficult and costly. It is often overlooked how the timing and choice of applied nutrition effects the plant components that contribute to yield, that is to say – **how can we strategically apply nutrition to target and support the plant components that contribute to yield?**

Experiments in a below average rainfall year in 2024 demonstrate how additional phosphorus applied at sowing can set the plant up to target higher yield. Although the dry season in 2024 made the additional phosphorus uneconomic, there was an alteration in plant architecture with an additional 50 kg/ha P showing a trend of increased branching, plant height, and pods; and statistically significant effects on 100 seed weight, dry matter, and grain yield (table 2).

Furthermore, where additional nitrogen was applied without the extra P, there was either no or a negative effect on grain yield. But when applied with the additional P at sowing, 100 kg/ha N spread at the end of flowering yield higher than without any extra N.

Table 2. Influence of applied nutrition plant components and grain yield at harvest at Gnarwarre 2024.

	Treatment	Branches (m2)		Plant height (cm)		Pods (m2)		100SW (g)		DM (t/ha)		YIELD t/ha	
1	Untreated	50.3	-	67.3	-	117.2	-	72.8	c	7.9	bc	3.58	de
2	100kg/ha N (sowing)	52.8	-	68.3	-	125.6	-	78.1	a	9.5	ab	3.53	e
3	100kg/ha N (start flower)	52.5	-	68.9	-	113.3	-	77.0	ab	7.0	c	3.76	cd
4	100kg/ha N (end of flower)	62.0	-	69.9	-	121.1	-	76.4	ab	9.5	ab	3.44	e
5	50kg/ha P (sowing)	50.8	-	71.7	-	121.1	-	78.0	a	8.4	bc	3.86	bc
6	50P (sowing) + 100N (sowing)	58.8	-	72.6	-	121.1	-	78.3	a	9.5	ab	4.02	ab
7	50P (sowing) + 100N (flower)	66.0	-	73.4	-	118.9	-	77.4	ab	10.6	a	4.01	ab
8	50P (sowing)+ 100N (end flower)	62.0	-	75.7	-	151.1	-	74.5	bc	9.8	ab	4.17	a
Grand Mean		56.9		71.0		123.7		3.3		9.0		3.80	
LSD P=.05		12.5		5.9		22.8		3.0		2.1		0.22	
Treatment Prob(F)		0.099		0.096		0.071		0.026		0.045		<0.001	
CV												3.92	

22 kg/ha P (100 kg MAP) applied in furrow under all treatments before addition nutrition was added as per treatment list.

Acknowledgements

FAR Australia gratefully acknowledges the investment support of the GRDC in order to generate this research, project partners and the host farmers Duncan Campbell, Travis Everett, and Ewen Peel in SW Vic.

Contact details:

Aaron Vague, FAR Australia
Business Address: Shed 2/63 Holder Road Bannockburn VIC 3331
Ph: 0409 573 704
Email: aaron.vague@faraustralia.com.au

Fusarium crown rot in central and southern cropping systems: it's all a numbers game

Steven Simpfendorfer[1]

[1] NSW DPI Tamworth

Keywords

yield loss, crop rotation, canola, pulse, summer crop, double-break

GRDC codes

DPI2207-004RTX: Integrated management of Fusarium crown rot in Northern and Southern Regions

DPI2207-002RTX: Disease surveillance and related diagnostics for the Australian grains industry

Take home message

- Yield loss from Fusarium crown rot (FCR) is a function of the percentage of plants which get infected within a paddock
- The increased frequency of winter cereal crops within a rotation sequence elevated the probability of having much higher levels of FCR infection
- Rotation to non-host break crops such as canola and pulses does not fully eliminate FCR in all paddocks but considerably reduces the probability of having high levels of infection
- A two-year break may be required in paddocks with high FCR inoculum levels
- Rotation history remains a good indicator of likely FCR risk within individual paddocks but there is still some variability in actual levels of infection
- PreDicta®B or cereal stubble testing are useful tools to further refine crop rotation and other integrated disease management decisions to limit losses from FCR
- An integrated approach is required to reduce losses from FCR. There is no 'magic bullet'.

Background

Fusarium crown rot (FCR), caused predominantly by the fungus *Fusarium pseudograminearum* (*Fp*), remains a major constraint to winter cereal production across the central and northern NSW grain production region. FCR is also present in southern NSW but often goes unrecognised or can be misdiagnosed. The causal fungus is stubble-borne with inoculum surviving between seasons as mycelium (cottony-growth) inside retained winter cereal stubble and/or grass weed residues. Crop rotation to non-host break crops such as canola and pulses (e.g. chickpea, lupin or faba bean) remains a key management strategy for FCR. However, the process revolves around decomposition of *Fp* infected cereal stubble during these break crop and fallow phases which is in turn dependent on moisture availability and time. Consequently, the season in which a break crop is grown influences its effectiveness at facilitating decomposition of cereal stubble and reducing FCR inoculum levels. Conversely, recent research has highlighted when relative humidity is >92.5% that *Fp* can colonise vertically up retained standing cereal stubble in a process termed 'saprotrophic growth'. At 100% relative humidity this saprotrophic growth can occur at a maximum rate of 1 cm per day (Petronaitis *et al.,* 2020). The FCR fungus can therefore saprotrophically grow to the cut height of the cereal stubble under prolonged or accumulated periods of rainfall, effectively increasing inoculum loads. This can then result in FCR infected cereal stubble being spread out the back of the header during the harvest of lower stature break crops such as chickpeas, increasing FCR risk for the next cereal crop (Petronaitis *et al.,* 2022).

This dynamic between cereal stubble decomposition and saprotrophic growth appears to complicate the management of FCR within farming systems but what are paddocks across the region telling us?

What did we do?

Under a co-investment with GRDC, NSWDPI has been providing a free cereal stubble testing service to growers and advisors over the past two seasons. These samples were collected either during late grain filling or post-harvest from individual paddocks across central NSW, northern NSW and southern Qld, along with background information including the previous two crops within the rotation. Winter cereal stubble samples (bread wheat, durum, barley or oats) were trimmed and plated on laboratory media to determine the incidence of FCR based on distinctive growth of *Fp* in culture. Infection levels were then categorised as being either low (≤10% FCR), medium (11–25% FCR), high (26–50% FCR) or very high (≥51% FCR). This data provides an unbiased snapshot of FCR infection levels in winter cereal crops across the region under varying crop rotations over the last two seasons. But why is the level of FCR infection so important? It is simple, yield loss only occurs in cereal plants infected with FCR, with the actual extent of yield loss strongly dependent on the extent of moisture and temperature stress during grain filling. Growers may not have much influence over seasonal conditions and stress during this critical period, but they can influence the percentage of plants infected with FCR. Reduce FCR infection levels and you reduce the risk of yield loss by that same level. As a rough rule of thumb, 100% FCR infection can result in 80% yield loss in durum wheat, 60% in bread wheat and 40% in barley, if prolonged hot and dry conditions occur during grain filling. Granted that these are worst case scenario values from replicated and inoculated field trials across seasons, but even halving FCR infection levels to 50% reduces potential yield loss to 40% in durum, 30% in bread wheat and 20% in barley, if the spring conditions turn hot and dry.

What did we find?

Seasonal effects

In total, 718 winter cereal stubble samples were processed from the 2022 and 2023 harvest which consisted of 598 bread wheat, 62 barley and 58 durum wheat crops (data not shown). There were 249 cereal crops sampled in 2022 and 469 in 2023 (Figure 1). The levels of FCR infection have risen from 2022 to 2023, with the proportion of paddocks with very high levels (≥51% FCR) rising from 18% to 30%. Over the same period the proportion of paddocks with high levels of infection (26–50% FCR) have also risen from 20% in 2022 up to 30% in 2023 (Figure 1).

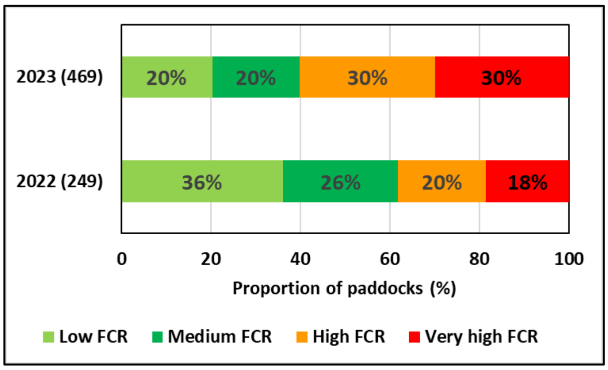

Figure 1. Proportion of winter cereal paddocks with varying levels of Fusarium crown rot (FCR) infection in 2022 and 2023.

Number in brackets (Y-axis) is the number of paddocks sampled in each year.
Low FCR = ≤10%, Medium FCR = 11–25%, High FCR = 26–50%, Very high FCR = ≥51%

FCR inoculum levels are a function of the percentage of plants infected and the quantity of stubble produced within a season. FCR infection is favoured by wet conditions which also generally increase biomass (i.e. stubble) production and yield of cereal crops. Consequently, larger inputs of FCR inoculum occur in wetter seasons such as 2021 and 2022 even though these conditions may not favour expression of FCR as whiteheads and yield loss from this disease. This data supports random crop disease surveys, conducted by NSWDPI with co-investment from GRDC, which have been showing a progressive build-up of FCR inoculum levels in this region from 2020 onwards. Milder temperatures and frequent rainfall during grain filling in 2021 and 2022 reduced FCR expression in these seasons. This was not the situation in 2023, with a return to warmer and drier conditions during spring which unfortunately also coincided with elevated FCR infection levels within central and northern cropping systems (Figure 1).

Sub-region levels of FCR

In total, 14 samples were from South Australia (SA), 14 from Victoria (Vic), 30 from south-west NSW (SWNSW), 43 from south-east NSW (SENSW), 131 from central-west NSW (CWNSW), 57 from central-east NSW (CENSW), 163 from north-west NSW (NWNSW), 173 from north-east NSW (NENSW) and 93 from southern Qld (SQld). FCR infection levels in the last two cereal crops have been highest in SQld, NWNSW and NENSW with the proportion of paddocks with very high levels (≥51% FCR) at 38%, 33% and 32%, respectively (Figure 2). The proportion of paddocks in this highest category of FCR infection level was lower at 23% in SWNSW, 18% in CWNSW and 14% in CENSW. A lower proportion of paddocks with FCR in this highest category were measured at 7% in SA, 5% in SENSW and 0% in Vic. However, all regions had relatively high FCR levels (≥26% FCR in high or very high categories) ranging from 14% of paddocks in SA up to 62% in NENSW (Figure 2).

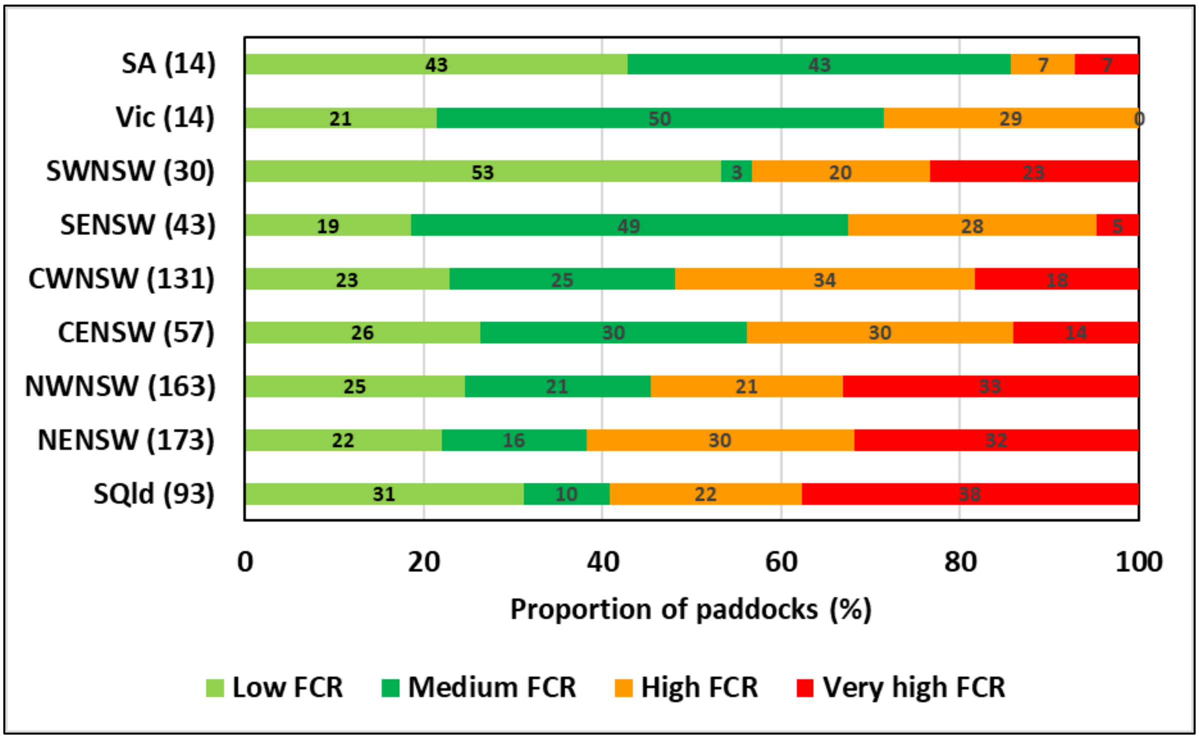

Figure 2. Proportion of winter cereal paddocks in 2022 and 2023 with varying levels of Fusarium crown rot (FCR) infection across sub-regions.

Number in brackets (Y-axis) is the number of paddocks sampled from each sub-region.
Low FCR = ≤10%, Medium FCR = 11–25%, High FCR = 26–50%, Very high FCR = ≥51%

Influence of a single break – what do the numbers say?

Adopt a cereal-cereal-cereal 'rotation' and there is a 27% chance of having high (26 to 50%) and 50% chance of having very high (≥51%) FCR infection (Figure 3). If the preceding crop was a summer break crop, then cotton (22% high FCR and 39% very high FCR in 18 paddocks) was potentially slightly better than sorghum (40% high FCR and 34% very high FCR in 35 paddocks). Fallowing the paddock rather than growing a crop did not reduce FCR levels in the subsequent 32 winter cereal crops tested with 35% having high and 41% very high FCR infection. If the preceding crop was a winter pulse or canola break crop then this risk of very high FCR in the 2022 or 2023 cereal crop was reduced further to 14% (average of pulse species) and 12%, respectively (Figure 3). In terms of pulse break crops, faba bean (14% high FCR and 7% very high FCR in 29 paddocks) was more effective than chickpea (22% high FCR and 20% very high FCR in 51 paddocks) and lupin (50% high FCR and 0% very high FCR in 17 paddocks; Figure 3).

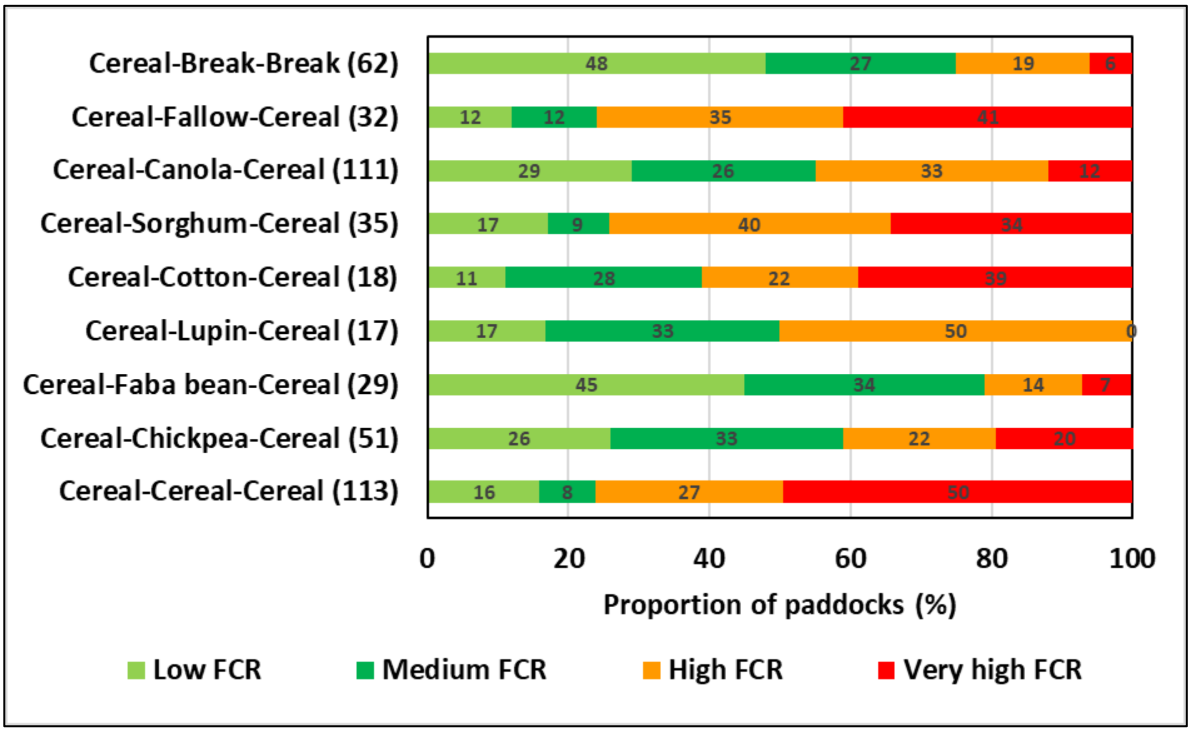

Figure 3. Proportion of winter cereal paddocks in 2022 and 2023 with varying levels of Fusarium crown rot (FCR) infection under different crop rotations.
Number in brackets (Y-axis) is the number of paddocks sampled from each rotation sequence.
Low FCR = ≤10%, Medium FCR = 11–25%, High FCR = 26–50%, Very high FCR = ≥51%

There are a number of potential variables such as FCR infection levels in cereal crops two years ago, stubble management (e.g. burning or cultivation), seed source (e.g. Fusarium grain infection from 2022 FHB epidemic), grass weed management, inter-row sowing, and harvest height which could also underly this data and introduce variability. Clearly non-host crop or fallow periods reduce the probability of higher FCR infection levels and consequently yield loss from this disease so playing the rotation numbers works. However, a one-year break may not be sufficient under higher FCR infection levels. A two-year break further reduced the probability of high and very high FCR infection levels in 2022 or 2023 cereal crops which dropped to 19% and 6%, respectively (Figure 3).

What is the effect of one break crop in three years?

Alright, let's try presenting differently and having a 'glass half full' approach. Assume low and medium FCR infection levels result in <25% whiteheads in a season conducive to disease expression, so does not trigger the 'I told you not to sow another cereal crop in that paddock' argument with your agronomist. In a three-year consecutive cereal situation (cereal-cereal-cereal), there is a 24% probability of this happening. This increased to 33% if the paddock was in fallow two years ago and 28% if it was a pulse crop two years ago. However, the likelihood of this outcome reduced to 23% if it was canola and 20% if it was a summer crop two years ago (Figure 4). Some may like these probabilities and continue to roll the dice whilst others may be swayed more by the probabilities around the second wheat crop having high or very high FCR infection levels (Figure 4).

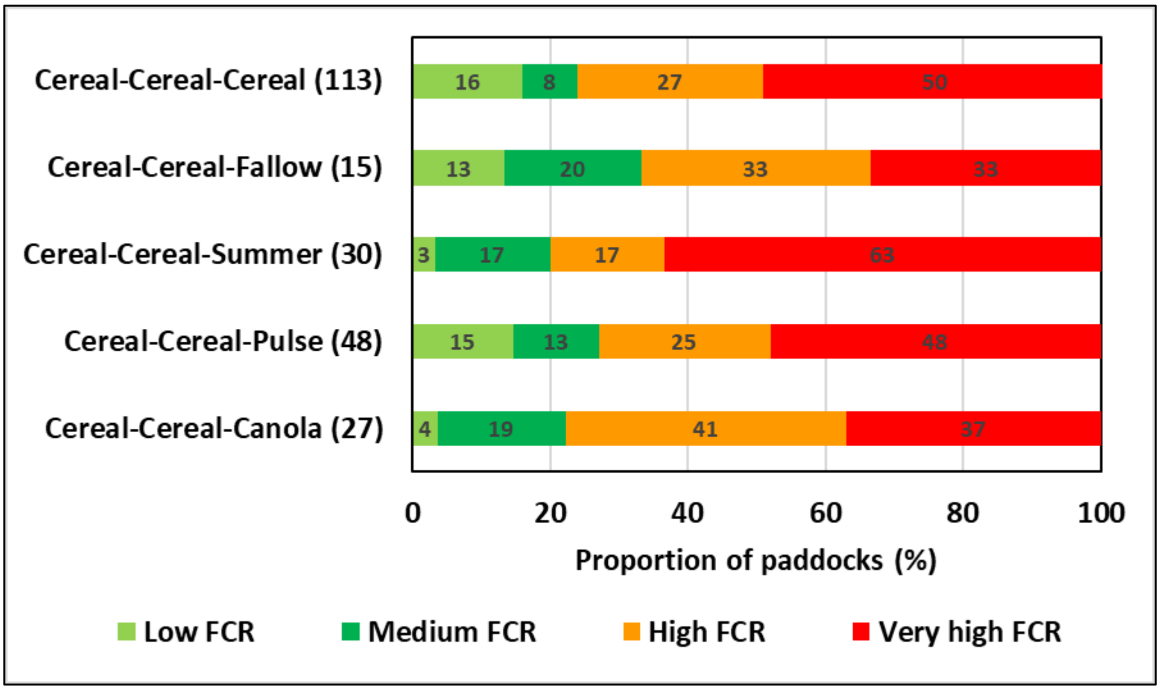

Figure 4. Proportion of winter cereal paddocks in 2022/23 with varying levels of Fusarium crown rot (FCR) infection under different crop rotations.
Number in brackets (Y-axis) is the number of paddocks sampled from each rotation sequence.
Low FCR = ≤10%, Medium FCR = 11–25%, High FCR = 26–50%, Very high FCR = ≥51%

Conclusions

Recent crop history within individual paddocks is a useful guide to the likely risk of FCR infection. However, not all paddocks and underlying crop management are the same so there is variability in the actual numbers, but the rotation sequence clearly drives the probability of having higher or lower levels of FCR infection. This further highlights the value of testing to establish actual FCR infection levels within a paddock using PreDicta®B or cereal stubble plating to further guide crop rotation and other integrated disease management decisions within individual paddocks.

Integrated management of FCR

To manage the risk of yield losses in cereals, firstly identify the risk of Fusarium crown rot in each paddock. High-risk paddocks generally include durum, bread wheat or barley crops being sown into a paddock with a history of stubble retention and tight cereal rotations (including oats). Other considerations include:

- Use effective weed management to reduce grass weed hosts in crop and fallow situations which serve as alternate hosts for the FCR fungus.

- Remember the larger the grass weed when controlled the longer that residue serves as a potential inoculum source
- Given the recent Fusarium head blight epidemic in 2022, ensure that you are sowing seed free of Fusarium infection as infected seed introduces FCR infection into paddocks.

All other management options are implemented prior to sowing so knowing the risk level within paddocks is important. This can be quantified through PreDicta® B testing (SARDI) or stubble testing (NSW DPI).

If medium to high FCR risk, then:

- Sow a non-host break crop (e.g., lentil, field pea, faba bean, chickpea, canola). A two-year break may be required if FCR inoculum levels are very high.

If still considering sowing a winter cereal:

- Consider stubble management options in terms of both impacts on FCR inoculum but also fallow soil moisture storage.

  a. ***Cultivation*** accelerates stubble decomposition which can decrease FCR risk (as the causal pathogen is stubble-borne) BUT it takes moisture and time. Cultivation also increases the spread of Fusarium crown rot inoculum across a paddock in the short term and increases exposure of below ground infection points (coleoptile, crown and sub-crown internode) in cereal plants to contact stubble fragments infected with the FCR fungus. Cultivation close to sowing therefore increases the incidence of plants which get infected with FCR. Cultivation can also significantly reduce soil moisture storage during fallow periods.

  b. ***Stubble baling*** removes a proportion of the above ground inoculum from a paddock potentially reducing FCR risk. The pathogen will then be concentrated in the shorter stubble butts and below ground in the previous rows. Hence, baling in combination with inter-row sowing is more likely to reduce FCR risk. Reduced ground cover after baling and removal of cereal straw can reduce fallow efficiency.

  c. ***Stubble burning*** destroys above ground inoculum but depends on the completeness of the burn. Burning has no effect on the survival of the FCR fungus below ground in crown tissue even with a hotter summer burn. Hence the pathogen will be concentrated below ground in the previous rows with survival between seasons dependent on the extent of summer rainfall. Burning of cereal stubble can considerably reduce fallow soil moisture storage so a ‘late Autumn’ burn is preferable to an ‘early Summer’ burn. Stubble burning in combination with inter-row sowing is more likely to reduce FCR risk.

  d. ***Reducing cereal stubble height*** limits the length of stubble which the FCR fungus can vertically grow up during wet fallow periods restricting the overall inoculum load within a paddock. Consequently, harvesting and leaving retained cereal stubble longer (e.g. stripper fronts) leaves a greater length of stubble for subsequent potential saprotrophic growth of the FCR fungus. This is not a major issue in terms of FCR risk if the retained infected cereal stubble is left standing and kept intact. However, if the infected stubble is disturbed and redistributed across a paddock through grazing, mulching, cultivation or the subsequent sowing process then this can increase the incidence of FCR infection. Recent research in NSW has also demonstrated that increased cereal harvest height allowed saprotrophic growth of the FCR fungus above the harvest height of a following chickpea crop. This resulted in FCR infected cereal stubble being spread out the back of the header during the chickpea harvest process increasing FCR risk for the next cereal crop (Petronaitis *et al.* 2022). Consider matching cereal stubble height at or after harvest in paddocks planned for a following shorter status break crop such as chickpea or lentils to prevent redistribution of retained FCR infected cereal stubble during the break crop harvest process.

- Select a cereal type and variety that has more tolerance to FCR ***and*** that is best suited to your region (see above results). Yield loss from FCR is generally durum>bread wheat>barley>oats. Recent research has shown that cereal type and varietal resistance has no impact on saprotrophic growth of the FCR fungus after harvest. Hence, cereal crop and variety choice does not have subsequent benefits for FCR risk with a paddock.
- Consider sowing a variety earlier within its recommended sowing window for your area. This will bring the grain filling period forward slightly and can reduce water and heat stress which exacerbates FCR expression and yield loss. However, this needs to be weighed against the risk of frost damage. Research across locations and seasons in NSW has shown that sowing at the start versus the end of a three-week recommended planting window can roughly halve the yield loss from FCR.
- If previous cereal rows are intact – consider inter-row sowing to increase the distance between the new and old plants, as most inoculum is in the stem bases of the previous cereal crop. Physical contact between an infected piece of stubble and the coleoptile, crown or sub-crown internode of the new cereal plants is required to initiate FCR infection. Research across locations and seasons in NSW (30–35 cm row spacings in stubble retained systems) has shown that inter-row sowing can roughly halve the number of wheat plants that become infected with FCR. Precision row placement can also provide greater benefits for FCR management when used in combination with rotation to non-host crops.
- Ensure nutrition is appropriate for the season. Excessive nitrogen will produce bulky crops that hastens moisture stress and makes the expression of FCR more severe. Whitehead expression can also be made more severe by zinc deficiency.
- Consider a seed fungicide treatment to suppress FCR. Fungicide seed treatments are not a stand-alone treatment and must be used as part of an integrated management approach.

References and further resources

PreDicta®B procedure - Sampling_protocol_PreDicta_B_Northern_regions.pdf (pir.sa.gov.au)

Petronaitis LT, Forknall C, Simpfendorfer S, Backhouse D (2020) Stubble Olympics: the cereal pathogen 10cm sprint - GRDC. GRDC Update paper

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Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers and their advisers through their support of the GRDC. The author would also like to acknowledge the ongoing support for northern pathology capacity by NSW DPI. This research would also not have been possible without the support of growers and advisors through submission of cereal stubble samples for testing and provision of background rotation data.

Useful discussions with Glenn Shepherd (IMAG consulting) around data presentation are also appreciated.

Contact details

Steven Simpfendorfer
NSW DPI, 4 Marsden Park Rd, Tamworth, NSW 2340
Ph: 0439 581 672
Email: steven.simpfendorfer@dpi.nsw.gov.au
X (Twitter): @s_simpfendorfer or @NSWDPI_AGRONOMY

Date published

August 2024

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HEAD OFFICE: Shed 2/ 63 Holder Road
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VIC 3331
Ph: +61 3 5265 1290

12/95-103 Melbourne Street
Mulwala
NSW 2647
Ph: 03 5744 0516

9 Currong Street
Esperance
WA 6450
Ph: 0437 712 011

Email: comms@faraustralia.com.au
Web: www.faraustralia.com.au