VICTORIA CROP TECHNOLOGY CENTRE

FAR AUSTRALIA

Industry Innovations
leading the way to a brighter grains industry

FIELD DAY

INCREASING PRODUCTIVITY & PROFITABILITY IN THE VICTORIA HRZ

Thursday 10th October 2024

Thanks to the GRDC for investing in some of the research we will be discussing today

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Thanks to the following event sponsors:

AGF seeds

westernAG The Best in Agronomic Advice KNOWLEDGE INNOVATION RELIABILITY COMMITMENT

SOWING THE SEED FOR A BRIGHTER FUTURE

Thanks to our host farmers: the Peel family and Travis Everett

VISITOR INFORMATION

We trust that you will enjoy your day with us at our Victoria Crop Technology Centre Field Day. Your health and safety is 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 IN THE VICTORIA HRZ

FEATURING INDUSTRY INNOVATIONS

On behalf of myself and the FAR Australia team, I am delighted to welcome you to our 2024 Victoria Crop Technology Centre Field Day featuring Industry Innovations and canola, cereal and pulse agronomy.

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 more productive 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. 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, and agrichemical usage. You will witness first-hand the impact of innovative treatments and techniques on enhancing crop performance and profitability.

Event Highlights:

- Cereal Trials: Explore a range of trials featuring crops sown at different times, showcasing how timing can influence crop yields.
- Understanding the latest advances in disease management strategies for grain legumes and pulses.
- Expert Presentations: Hear from industry leaders, who will share insights into the latest research and trends shaping the Australian grains industry.
- Interactive Discussions: Engage in group discussions on crucial topics such as fungicide management strategies and the future of crop profitability, particularly in light of the new GRDC Hyper Profitable Crops project.
- Innovative Research: Learn from the latest findings of the GRDC's Hyper Yielding Crops high rainfall zone project, and explore opportunities to enhance the use of winter germplasm in the lower to medium rainfall zones.

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 speaker Dr Fran Lopez who has made the trip over from WA to join us today. Dr Lopez is based at the Centre for Crop and Disease Management (CCDM) at Curtin University where he leads the fungicide resistance group.

Finally I would like to thank the GRDC for investing in some of the research that will be featured in today's programme, and also a big thanks to our host farmers the Peel family and Travis Everett for their tremendous practical support given to our team, and to today's sponsors AGF Seeds and WesternAg.

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 new ideas which can be implemented in your own farming business.

Nick Poole Managing Director
FAR Australia


VICTORIA CROP TECHNOLOGY CENTRE
FAR AUSTRALIA
NFNB Germ x Fung
NFNB Fungicide
RiskWi$e
Wheat Fungicide Fingerprinting cv. RGT Cesario
Barley Germplasm Evaluation Network (GEN) TOS 1
3
Barley Germplasm Evaluation Network (GEN) TOS 2
Wheat Fungicide Fingerprinting cv. Stockade
1
2
6
5
4
Wheat Fungicide Fingerprinting cv. Revenue
Wheat Fungicide Germplasm Evaluation Network (GEN) TOS 1
FIRST AID
Barley Fungicide Germplasm Evaluation Network (GEN) TOS 2
TOS Modelling
Wheat Fungicide Germplasm Evaluation Network (GEN) TOS 2
TOILET
AGF seeds
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KNOWLEDGE INNOVATION RELIABILITY COMMITMENT

TIMETABLE

VICTORIA CROP TECHNOLOGY CENTRE FIELD DAY
THURSDAY 10 OCTOBER 2024

10:00 - 10:30am Coffee and opening address by Nick Poole, FAR Australia's Managing Director

Session	In-field presentations (canola and pulses)	Site	10:30	11:30
Canola agronomy	***Dr Steve Marcroft, Marcroft Grains Pathology*** *Canola diseases - when should I apply a fungicide?*	**Canola site**	**All**	
Pulse agronomy	***Dr Josh Fanning, AgVIC and Aaron Vague, FAR Australia*** *Faba bean disease management and the importance of an integrated disease managemnet (IDM) strategy to reduce the threat of disease.*	**Pulses site**		**All**

Thanks to our Keynote Speaker sponsor:

Thanks to our lunch and post event refreshments sponsor:

Session #	In-field presentations (cereals)	Station #	12:30	1:30	2:00	2:30	3:00	3:30	4:00
1	***Dr Fran Lopez, Centre for Crop and Disease Management (CCDM)*** *From the shed to field failure: strategies to ensure fungicide longevity.*	**1**	**Lunch including an introduction to the GRDC RiskWi$e initiative by Ben Morris and Nick Poole**	**1**	**2**				**Session 6 in the marquee over post event refreshments**
2	***Nick Poole, FAR Australia*** *The high rainfall zone now and then - the imact on germplasm and management input.*	**2**			**1**	**2**			
3	***Darcy Warren, FAR Australia*** *Barley Net form net blotch management under evolving circumstances in south-west Victoria.*	**3**				**1**	**2**		
4	***Broden Holland, NSW grower*** *Precision ag and nitrogen management: insights and strategies from a grower's perspective.*	**4**					**1**	**2**	
5	***Dr Ben Jones*** *Model vs Reality: improving a wheat simulation model with high yielding crop data, and why it matters.*	**5**		**2**				**1**	
6	***Nick Poole, FAR Australia joins growers Craig Drum, Lachie Morrison, and agronomists Tom Toose and Ed Hilsdon to discuss:*** *As the nation's economy moves to ways to reduce emissions where do we stand with crop profitability in VIC HRZ with our new GRDC Hyper Profitable Crops project?*	**6**							**All**
Session	**In-field presentations**	**Station #**	**12:30**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**	**4:00**

For the afternoon in field presentations, we would be obliged if you could remain within your designated group number.

Thank you for your cooperation.

Advancing Agriculture through better seeds and service!

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STOCKADE
APW SPRING MILLING WHEAT

A unique APW Spring milling wheat that offers growers in long season environments a high yielding milling wheat that can compete with red wheats currently grown on farm. Built on Trojan with key improvements.

MATURITY SPEED: VERY QUICK — VERY SLOW

SCEPTORIA RESISTANCE	POWDERY MILDEW	STRIPE RUST	LEAF RUST
MS	SVS	MR	MR

SPRING WHEAT | HIGH YIELDING | WHITE AWNED APW

CAPTAIN CL
WINTER CANOLA

The market leading winter canola, Captain CL, has proven itself again and again in independent trials and in the paddock it will produce market leading yields, biomass, and oil percentage. If you want to maximise your profits with winter canola then grow Captain CL.

MATURITY SPEED: VERY QUICK — VERY SLOW

BLACKLEG RATING	BLACKLEG GROUP	POD SHATTER RESISTANCE
R	AH	

Clearfield Production System | WINTER CANOLA | DUAL PURPOSE

LONGFORD
WINTER WHEAT

From the breeders who brought you BigRed, Longford is a long season high yield potential red wheat with a strong disease package and lodging tolerance. Longford is suited to dual purpose (graze/grain) or grain only farming systems

MATURITY SPEED: VERY QUICK — VERY SLOW

SCEPTORIA RESISTANCE	POWDERY MILDEW	STRIPE RUST	LEAF RUST
MRMS	RMR	RMR	RMR

WINTER WHEAT | DUAL PURPOSE | AWNED RED FEED

TRIPLE 2
WINTER WHEAT (AGFWH010222)

Triple 2 is an awned, high yield potential, red winter wheat that is being released in 2025. A mid maturity wheat that is slightly slower than LRBP Beaufort, Triple 2 is suited to medium and long-environments and has shown incredible potential in years of independent trials.

MATURITY SPEED: VERY QUICK — VERY SLOW

SCEPTORIA RESISTANCE	POWDERY MILDEW	STRIPE RUST	LEAF RUST
MRMS p	RMR p	RMR p	MRMS p

WINTER WHEAT | DUAL PURPOSE | AWNED RED FEED

GRDC NATIONAL VARIETY TRIALS™

NATIONAL SEPTEMBER 2024

Spring 2024 update: Crown Canker and Upper Canopy blackleg ratings

Blackleg can cause severe yield losses in canola, but it can be successfully managed. Blackleg occurs in two forms in Australia; crown canker is still the main risk to growers, but upper canopy infection (UCI) can also cause significant yield losses

Crown canker results from infection of canola seedlings that allows the pathogen to grow from the cotyledons/leaves to the plant crown, causing vascular tissue damage within the crown.

UCI results from infection of flowers, stems and/or branches that allows the same process as crown canker, but the infection causes damage to the vascular tissue in the branches and stem and does not affect the crown.

Pod infection (not covered here) is a result of infection post-flowering, where lesions form directly onto the pods.

Is this a year of crown canker or UCI?
In most seasons crops will not be prone to both crown canker and UCI. Early sown crops that also germinate early, grow quickly avoiding seedling infection and therefore will also avoid crown canker (plant growth prior to winter may avoid blackleg infection). However, these early sown crops may start flowering early in mid-to-late winter when blackleg is still active. Flowering during winter is critical for UCI to occur.

KEY POINTS

- **Never sow your canola crop into last year's canola stubble**
- **Choose a cultivar with adequate blackleg resistance for your region**
- **Relying only on fungicides to control blackleg poses a high risk of fungicide resistance**
- **If your monitoring has identified yield loss is occuring, follow the steps in this guide to manage blackleg**
- **By monitoring your crops at maturity you can determine if you need to change your blackleg management in future years**

Leptosphaeria maculans, the causal agent of blackleg, is a sexually reproducing pathogen that may overcome cultivar resistance genes and fungicides. Fungal spores are released from canola stubble and spread extensively via wind and rain splash. The disease is more severe in areas of intensive canola production.

STEP 1: Identify your farm's blackleg risk.

Table 1: Regional blackleg factors.

Environmental factors that determine risk of severe blackleg infection	Crown canker and UCI blackleg severity risk factor								
	High risk			Medium risk			Low risk		
Regional canola intensity (% area sown to canola)	above 20	16–20	15	11–14	11–14	10	6–9	5	below 5
Annual rainfall (mm)	above 600	551–600	501–550	451–500	401–450	351–400	301–350	251–300	below 250
Total rainfall received March–May prior to sowing (mm)	above 100	above 100	above 100	above 100	91–100	81–90	71–80	61–70	below 60

Combined high canola intensity and adequate rainfall increase the probability of severe blackleg infection.

STEP 2: Determine each crop's blackleg severity at plant maturity (windrowing/swathing time).

Crown canker: Assess the level of disease in your current crop. Ideally, sample the crop within a few days after windrowing/swathing (prior to windrowing is OK but it is difficult to move within the crop and difficult to observe cankers). Look for plants that have fallen over and have external visible crown cankers. Pull 60 randomly selected stems out of the ground, cut off the roots with a pair of secateurs and, using the reference photos in Table 2a, estimate the amount of disease in the crown cross-section. Yield loss will commonly occur when more than 30 per cent of the cut crown is discoloured.

Upper canopy infection (UCI): Mid-flower is the first growth stage that UCI can be observed, although it is not a good indicator of yield loss. UCI mid-flower infection can cause lesions on the flowers and stems/branches (see reference photos in Table 2b). At windrowing/swathing, UCI symptoms can cause a range of symptoms including causing individual branches to die, individual branches to be dark in colour, and external cankers to be visible on the branches and stem. In addition, UCI will cause the pith within the stem and branches to become black in colour. Therefore, observe the external symptoms and then cut the plant with secateurs to confirm the blackened pith.

The following steps apply equally to crown canker and UCI.

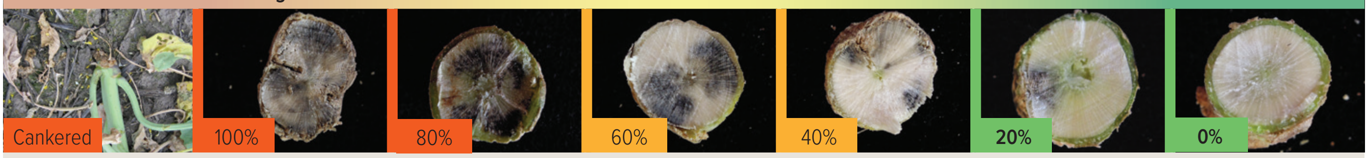
If you have identified that you are in a medium to high-risk situation (steps 1 and 2), use steps 3 and 4 to reduce your risk of blackleg in future seasons.

Cut a plant at the crown (into the top of the root) to assess internal infection. PHOTO: STEVE MARCROFT

If you are in a low-risk situation and you have not identified yield loss due to blackleg infection when assessing your crop, continue with your current management practices.

Table 2a: Crown canker blackleg severity.

High risk | Medium risk | Low risk



Yield loss occurs when more than half of the cross-section is discoloured.

Table 2b: Upper canopy infection symptoms.

External stem lesion. PHOTO: STEVE MARCROFT

Branch death. PHOTO: STEVE MARCROFT

Darkened branch that is indicative of yield loss. PHOTO: STEVE MARCROFT

Cut stems to observe for blackened pith. PHOTO: STEVE MARCROFT

Cutting branches to inspect for blackened pith. PHOTO: STEVE MARCROFT

Infected flower lesion. Blackleg will grow from the flower into the branch. PHOTO: STEVE MARCROFT

STEP 3: Change management practices to reduce the risk of blackleg infection.

If your crop monitoring (step 2) showed yield loss in the previous year, consider changing your management practices for each canola paddock to be sown to reduce blackleg severity. Review each management practice to determine which are increasing risk and how the risk can be reduced.

WARNING: 'CANOLA ON CANOLA' PLANTING WILL CAUSE A SIGNIFICANT YIELD LOSS AND WILL REDUCE THE EFFECTIVE LIFE OF CANOLA CULTIVARS AND FUNGICIDES.

There are several blackleg management practices that determine risk of blackleg infection, discussed here from highest (A) to lowest (H) effectiveness.

A. BLACKLEG RATING

The cultivar blackleg rating is the most important blackleg management tool. If your previous crop had a high level of disease, choose a cultivar with a higher blackleg rating. The 2024 blackleg ratings are listed in Table 3.

Crown canker

High risk				Moderate risk				Low risk
VS	S-VS	S	MS-S	MS	MR-MS	MR	R-MR	R

VS = very susceptible, S = susceptible, MS = moderately susceptible, MR = moderately resistant, R = resistant.

For UCI, the cultivar blackleg rating will reduce the probability of large yield losses. R-rated UCI cultivars are unlikely to have yield loss, whereas MR and MRMS will have increasing yield losses depending on starting date to first flower and disease severity. MS should only be used in environments of lower disease severity.

Upper canopy infection

High risk				Moderate risk				Low risk
		MS		MRMS	MR			R

B. DISTANCE FROM LAST YEAR'S CANOLA STUBBLE

The distance of your current crop from last year's canola stubble will determine disease severity. **NEVER** sow your canola crop into last year's canola stubble. Distances from last year's stubble of at least 500 metres will reduce blackleg severity.

High risk				Medium risk				Low risk
0m	100m	200m	300m	400m	500m	>500m		

C. FUNGICIDE USE

Reliance on fungicides to control disease poses a high risk of fungicide resistance.

Crown canker

Fungicides complement other management practices. Fungicides will provide an economic return only if your crop is at high risk of yield loss. Fungicides are generally warranted where crops have lower blackleg ratings, are sown into higher disease severity situations, and have germinated later so that plants are still small seedlings during early winter. The GRDC/DPIRD BlacklegCM app is an excellent economic fungicide application decision-support tool for crown canker.

High risk				Medium risk				Low risk
No fungicide		Foliar-applied fungicide		Seed dressing fungicide	Fertiliser-applied fungicide	Seed dressing + fertiliser-applied fungicide	Seed dressing or fertiliser-applied + foliar fungicide	

Upper canopy infection

Fungicides complement other management practices. Fungicides will provide an economic return only if your crop is at high risk of yield loss. Fungicides are generally warranted where crops have lower UCI/blackleg ratings, have started flowering early and are sown into higher disease severity situations. Fungicides cannot be applied after 50 per cent bloom due to maximum residue limit (MRL) restrictions. The GRDC/DPIRD UCI/BlacklegCM app is an excellent economic fungicide application decision support tool for UCI.

High risk				Medium risk				Low risk
	No fungicide						Foliar fungicide applied at early bloom	

D. YEARS OF SAME CULTIVAR GROWN

The pathogen will overcome cultivar resistance genes if the cultivars containing the same resistance genes are used each year. By sowing a cultivar based on different resistance genes, the ability of the pathogen to overcome resistance will be reduced. All cultivars have been placed into different blackleg resistance groups based on their resistance gene complement (see Table 3).

If you have:

- high or increasing levels of blackleg in your crop (from monitoring disease levels each year);
- used the management practices outlined in step 3; and
- sown cultivars from the same resistance group in close proximity (within two kilometres) for three or more years, then sow a cultivar from a different resistance group (see Table 3).

High risk				Medium risk				Low risk
Sown the same cultivar/resistance group for more than three years			Sown the same cultivar/ resistance group for three years			Sown the same cultivar/ resistance group for two years	Sown the same cultivar-resistance group the previous year	Sown cultivar from a different resistance group

E. DISTANCE FROM TWO-YEAR-OLD CANOLA STUBBLE

Stubble older than two years produces fewer blackleg spores and will normally have minimal effects on blackleg severity, even where canola is sown into two-year-old stubble. However, two-year-old stubble may cause disease if inter-row sowing canola (see point F, Canola stubble conservation) or if the cultivar resistance has been overcome.

High risk				Medium risk				Low risk
				0m	100m	250m	500m	>500m

F. CANOLA STUBBLE CONSERVATION

Stubble destruction is generally not effective in reducing blackleg infection. Inter-row sowing canola into two-year-old canola stubble, where germinating seedlings are immediately next to standing stubble, may result in higher levels of blackleg infection.

High risk				Medium risk				Low risk
			Inter-row sowing	Disc tillage	Knife-point tillage	Burning/burying tillage		

G. MONTH SOWN

Canola is most vulnerable to crown canker blackleg when infected in the seedling stage. If crops are sown early in warmer conditions and develop through the seedling growth stage quickly, they may escape high blackleg severity.

Crown canker infection only

High risk				Medium risk				Low risk
			June to August	15 to 31 May	1 to 14 May	15 to 30 April		

H. COMMENCEMENT OF FLOWERING DATE

Canola is only vulnerable to UCI if infection occurs early enough in the growing season for the pathogen to grow into the vascular tissue within the branches and stem to cause a blockage. Later infections can occur but are unlikely to cause yield losses. Short growing regions (mature in October) may have only a moderate risk if flowering commences early (June).

Upper canopy infection only

High risk				Medium risk				Low risk
June	1 to 15 July	15 to 30 July	1 to 15 August		15 to 30 August			September onwards

BlacklegCM app. Get the app for your iPad or tablet.
The app is an interactive format of this management guide that allows you to enter individual crop data and estimate blackleg severity for your crop.

GRDC

Table 3: 2024 spring blackleg ratings and resistance groups.

Variety	2024 blackleg rating Bare	2024 blackleg rating ILeVo®	2024 blackleg rating Saltro®	2024 upper canopy infection blackleg rating	Type	Major gene resistance group of cultivar
CONVENTIONAL VARIETIES						
Outlawᶲ	RMR			MR-UCI	Open pollinated	A
Nuseed® Quartz	RMR			MR-UCI	Hybrid	ABD
Nuseed® Diamond	RMR	R	R	MR-UCI	Hybrid	ABF
TRIAZINE-TOLERANT VARIETIES						
HyTTec® Trifecta	R			MR-UCI	Hybrid, Triazine	ABD
HyTTec® Trident	R			MR-UCI	Hybrid, Triazine	AD
Monola® H524TT	R			MR-UCI	High stability oil, hybrid, Triazine	AD
DG Bidgee TTᶲ	R	R	R	R-UCI	Open pollinated, Triazine	H
Pioneer® PY429T	R		R	R-UCI	Hybrid, Triazine	ABH
HyTTec® Trophy	R	R	R	MR-UCI	Hybrid, Triazine	AD
DG Torrens TTᶲ	RMR			R-UCI	Open pollinated, Triazine	H
Hyola® Blazer TT	RMR		R	MR-UCI	Hybrid, Triazine	ADF
InVigor® T 4511	RMR	R		MR-UCI	Hybrid, Triazine	Unknown
Monola® H421TT	RMR			MR-UCI	High stability oil, hybrid, Triazine	BC
ATR-Bluefinᶲ	RMR			MR-UCI	Open pollinated, Triazine	AB
DG Avon TTᶲ	MR	R	R	MR-UCI	Open pollinated, Triazine	AC
SF Spark™ TT	MR	R	R	MR-UCI	Hybrid, Triazine	ABDS
Renegade TTᶲ	MR			MR-UCI	Open pollinated, Triazine	A
HyTTec® Velocity	MR			MR-UCI	Hybrid, Triazine	AB
Monola® 422TT	MRMS			MRMS-UCI	Open pollinated, Triazine	BC
ATR-Swordfishᶲ	MRMS			MRMS-UCI	Open pollinated, Triazine	AB
SF Dynatron™ TT	MRMS	R	R	MRMS-UCI	Hybrid, Triazine	BC
RGT Baseline™ TT	MRMS	R	R	MRMS-UCI	Hybrid, Triazine	B
Bandit TTᶲ	MRMS	R	R	MRMS-UCI	Open pollinated, Triazine	A
RGT Capacity™ TT	MRMS	RMR	R	MRMS-UCI	Hybrid, Triazine	B
AFP Cutuburyᶲ	MS	MR	RMR	MS-UCI	Open pollinated, Triazine	AB
ATR-Bonitoᶲ	MS	RMR	R	MS-UCI	Open pollinated, Triazine	A
IMIDAZOLINONE-TOLERANT VARIETIES						
Hyola® Solstice CL	R		R	R-UCI	Hybrid, Clearfield®	ADFH
Captain CL	R			R-UCI	Winter, hybrid, Clearfield®	AH
Hyola® Feast CL	R		R	R-UCI	Winter, hybrid, Clearfield®	H
RGT Nizza™ CL	R			MR-UCI	Winter, hybrid, Clearfield®	B
Hyola® 970CL	R		R	R-UCI	Winter, hybrid, Clearfield®	H
Phoenix CL	R			MR-UCI	Winter, hybrid, Clearfield®	B
Pioneer® 45Y93 CL	R		R	MR-UCI	Hybrid, Clearfield®	BC
RGT Clavier™ CL	R			R-UCI	Winter, hybrid, Clearfield®	ACH
Pioneer® PN526C	RMR			MR-UCI	High stability oil, hybrid, Clearfield®	ABD
Pioneer® 45Y95 CL	RMR		R	MR-UCI	Hybrid, Clearfield®	C
Nuseed® Ceres IMI	RMR			MR-UCI	Hybrid, Imidazolinone	AD
Pioneer® 43Y92 CL	RMR		R	MR-UCI	Hybrid, Clearfield®	B
Pioneer® 44Y94 CL	RMR		R	MR-UCI	Hybrid, Clearfield®	BC
Pioneer® PY421C	RMR		R	MR-UCI	Hybrid, Clearfield®	A
VICTORY® V75-03CL	RMR			MR-UCI	High stability oil, hybrid, Clearfield®	AB

Continued on next page

Table 3: 2024 spring blackleg ratings and resistance groups (continued).						
Variety	**2024 blackleg rating Bare**	**2024 blackleg rating ILeVo®**	**2024 blackleg rating Saltro®**	**2024 upper canopy infection blackleg rating**	**Type**	**Major gene resistance group of cultivar**
IMIDAZOLINONE AND TRIAZINE-TOLERANT VARIETIES						
Hyola® Defender CT	R		R	MR-UCI	Hybrid, Clearfield®, Triazine	ADF
Hyola® Enforcer CT	R			MR-UCI	Hybrid, Clearfield®, Triazine	ADF
Nuseed® Griffon TTI	RMR			MR-UCI	Hybrid, Imidazolinone, Triazine	AC
Pioneer® PY520 TC	MR		R	MR-UCI	Hybrid, Clearfield®, Triazine	BC
GLYPHOSATE-TOLERANT VARIETIES						
DG Hotham TF	R			R-UCI	Hybrid, TruFlex®	ABH
Nuseed® Raptor TF	R			MR-UCI	Hybrid, TruFlex®	AD
Nuseed® Eagle TF	R			MR-UCI	Hybrid, TruFlex®	ABD
VICTORY® V55-04TF	R	R	R	MR-UCI	High stability oil, hybrid, TruFlex®	AB
DG Lofty TF	R			R-UCI	Hybrid, TruFlex®	ABH
Nuseed® Hunter TF	RMR			MR-UCI	Hybrid, TruFlex®	AB
Pioneer® 44Y27 RR	RMR	R	R	MR-UCI	Hybrid, Roundup Ready®	B
Pioneer® PY422G	MR		R	MR-UCI	Hybrid, Optimum GLY®	AB
Nuseed® Emu TF	MR			MR-UCI	Hybrid, TruFlex®	AB
Pioneer® PY525G	MR		R	MR-UCI	Hybrid, Optimum GLY®	AB
InVigor® R 4520P	MRMS	R		MRMS-UCI	Hybrid, Truflex®	B
Pioneer® PY323G	MRMS		R	MRMS-UCI	Hybrid, Optimum GLY®	BC
GLYPHOSATE AND IMIDAZOLINONE-TOLERANT VARIETIES						
Hyola® Regiment XC	R		R	R-UCI	Hybrid, TruFlex®, Clearfield®	ADFH
Hyola® Battalion XC	RMR			MR-UCI	Hybrid, TruFlex®, Clearfield®	ADF
Pioneer® PY424GC	MRMS		R	MRMS-UCI	Hybrid, TruFlex®, Clearfield®	BC
GLUFOSINATE AND TRIAZINE-TOLERANT VARIETIES						
InVigor® LT 4530P	RMR	R		MR-UCI	Hybrid, LibertyLink®, Triazine	BF
GLUFOSINATE AND GLYPHOSATE-TOLERANT VARIETIES						
InVigor® LR 5040P	RMR	R		MR-UCI	Hybrid, LibertyLink®, TruFlex®	AB
InVigor® LR 4540P	RMR	R		MR-UCI	Hybrid, LibertyLink®, TruFlex®	B
InVigor® LR 3540P	MR	R		MR-UCI	Hybrid, LibertyLink®, TruFlex®	AB

ⓟ denotes Plant Breeder's Rights apply, (p) Provisional, R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible.

STEP 4: Manage variety resistance.

Blackleg disease is controlled by two forms of genetic resistance – major gene and quantitative. These two forms of resistance are both important for controlling blackleg and require management to maintain them. The blackleg rating for each variety takes in a combination both major gene and quantitative resistance.

Major gene resistance (MGR)

Major genes in canola varieties recognise the blackleg fungus, which creates an immune response in the plant and enables it to stop the fungus growing. Major gene resistance controls blackleg at all stages of plant development and therefore protects against leaf lesions, crown canker, upper canopy infection and pod infection.

The major genes are identified in all canola varieties. Each MGR is allocated a resistance group letter (A, B, C, D, F, H and S), as shown in Table 3. Varieties can have a single or multiple MGR. As MGR results in immunity, varieties will always receive an R blackleg rating while the MGR is effective and will not have any yield losses from blackleg. However, the blackleg fungus is adept at overcoming MGR and this will change the status of the blackleg rating (see next paragraph).

Effectiveness of MGR

MGR is only effective if the plant's MGR recognises the blackleg fungus. If the fungus evolves to overcome the plant MGR (via mutation, sexual recombination or population structure), the variety's MGR no longer recognises the blackleg fungus and the plants will become susceptible. The MGR will still be present in the variety, but it will no longer be effective. Most MGRs in Australian canola varieties are no longer effective; therefore, breeders combine MGRs to restore effectiveness and/or combine MGR and quantitative resistance (QR) to create resistance. MGRs can be partially effective; this scenario occurs when a blackleg population consists of a range of blackleg isolates, only some of which have evolved to avoid recognition by the plant.

MGR monitoring in Australia

MGR effectiveness is monitored each year across Australian canola growing regions (GRDC project MGP2307-001RTX).

GRDC

Table 4 gives an indication of which MGR may be effective in your growing region. Varieties that contain these MGRs are likely to be highly resistant in your region. However, individual blackleg populations on your farm may have overcome the MGR. The best way to assess the effectiveness of the MGR on your farm is to consult Table 4 and to monitor the performance of the MGR in your crop (see Step 2).

If the MGR is effective, there should be no/few leaf lesions present. However, as the effectiveness of the MGR is reduced overtime you may observe increased leaf lesion severity and increased crown canker severity. It is advisable to monitor leaf lesion severity as well as cut crowns each year to determine if MGR is reducing on your property.

If you have grown a variety or varieties with the same MGR over several years and blackleg severity has increased, it may be beneficial to change to a variety with different MGR (Table 3). Use Table 4 to identify an MGR that is still effective in your region. If your variety has a MGR stack (multiple letters, e.g. ABD), then choose a cultivar that has at least one new letter that is green or yellow in Table 4. If all letters in your preferred variety are red in Table 4 you will need to rely on quantitative resistance. Many cultivars have excellent quantitative resistance and are very effective at controlling blackleg; see the section headed 'Quantitative resistance (QR)' for more information.

Blackleg resistance group monitoring

Representative cultivars from all blackleg resistance groups are sown in trial sites in all canola-producing regions across Australia and monitored for blackleg severity. This data provides regional information on the effectiveness of each blackleg resistance group.

Table 4: 2024 regional major gene resistance effectiveness.

2024 SITE	RESISTANCE GROUP						
NSW	A	B	C	D	F	H	S
Beckom	Red	Red	Red	Green	Red	Green	Yellow
Cootamundra	Red	Red	Yellow	Green	Red	Yellow	Yellow
Cudal	Red	Red	Red	Green	Red	Green	Green
Gerogery	Red	Red	Red	Yellow	Red	Green	Yellow
Lockhart	Red	Red	Red	Green	Yellow	Green	Green
Parkes	Red	Red	Red	Green	Yellow	Green	Green
Wagga Wagga	Red	Red	Red	Green	Yellow	Green	Green
Wellington	Red	Red	Red	Green	Yellow	Green	Green
SA	A	B	C	D	F	H	S
Arthurton	Red	Red	Red	Green	Yellow	Green	Green
Cummins	Red	Red	Red	Red	Red	Green	Yellow
Keith	Red	Red	Red	Green	Red	Green	Green
Riverton	Red	Red	Red	Green	Yellow	Green	Green
Spalding	Red	Red	Red	Green	Green	Green	Green
Wangary	Red	Red	Red	Red	Red	Green	Green
Wasleys	Red	Red	Red	Yellow	Yellow	Green	Yellow
Yeelanna	Red	Red	Yellow	Red	Red	Yellow	Red
Victoria	A	B	C	D	F	H	S
Charlton	Red	Red	Red	Yellow	Red	Green	Green
Diggora	Red	Red	Yellow	Yellow	Red	Yellow	Green
Hamilton	Red	Red	Yellow	Green	Red	Red	Green
Horsham	Red	Red	Red	Red	Yellow	Green	Yellow
Kaniva	Red	Red	Red	Yellow	Yellow	Green	Green
Lake Bolac	Red	Red	Red	Yellow	Yellow	Green	Green
Wunghnu	Red	Red	Red	Yellow	Yellow	Green	Yellow
Yarrawonga	Red	Red	Red	Yellow	Yellow	Green	Green
WA	A	B	C	D	F	H	S
Bolgart	Red	Red	Red	Yellow	Yellow	Green	Green
Gibson	Abandoned – waterlogging						
Kendenup	Insufficient disease						
Kojonup	Insufficient disease						
Munglinup	Red	Red	Red	Yellow	Yellow	Green	Yellow
Stirlings South	Red	Red	Red	Red	Green	Green	Green
Wagin	Red	Red	Red	Green	Yellow	Green	Green
Williams	Insufficient disease						

Green = effective Yellow = partially effective Red = ineffective

Quantitative resistance (QR)

Quantitative resistance (QR) is the combination of several resistance genes (of which there are many) where each gene has a small effect on reducing blackleg severity. Therefore, a greater number of these genes will result in higher blackleg resistance. The blackleg rating of a variety is used to indicate the level of QR. For example, an MR-rated variety may have more QR genes than an MS cultivar. Recent research has shown that QR controls both crown canker and UCI severity.

Quantitative resistance is difficult to characterise; therefore, we cannot characterise the precise QR genetics in a variety. Canola varieties may have the same or different QR genes or different combinations of these genes. QR may not completely protect against the blackleg fungus, so plants will likely still get some crown canker and UCI.

Effectiveness of QR

The blackleg fungus will overcome individual QR genes over time. If you sow the same cultivar intensively for more than three years, the effectiveness of that cultivar's QR may decline on your farm. Reduced resistance will be evident by increased crown canker severity observed by cutting stems at the windrowing maturity timing. For some QR, increased leaf lesion severity will also occur overtime. It is advised to cut crowns each year to determine if resistance is reducing (see step 2 of this guide).

If QR is being overcome on your farm, treat the variety as having a lower blackleg rating than advertised. That is, if the official rating of your variety is R but you have observed increasing crown canker on your property, then manage your variety as MR rated or change to a new variety. Although we do not necessarily know the genetics underlying QR, generally swapping to a variety with a higher blackleg rating will ensure sound QR in the new variety.

Blackleg ratings – definitions and management

Blackleg ratings are determined by the performance of each variety in blackleg disease nurseries. The ratings are a product of both the MGR and QR in each variety. Blackleg ratings are now available for both crown canker and UCI. The definitions and management options for these two types of blackleg rating are provided.

Crown canker blackleg ratings

R (resistant)

R-rated varieties have excellent crown canker blackleg resistance. These varieties are unlikely to have yield loss from blackleg even when grown in high-rainfall canola/cereal/canola rotations. They are unlikely to benefit from fungicide applications. Consult BlacklegCM app for more detail.

RMR (resistant moderately resistant)

RMR-rated varieties have excellent crown canker blackleg resistance. These varieties are unlikely to have yield loss from blackleg. However, if sown in high-rainfall canola/cereal/canola rotations small yield losses may be possible. They are also unlikely to benefit from fungicide applications. Consult BlacklegCM app for more detail.

MR (moderately resistant)

MR-rated cultivars have very good blackleg resistance. These cultivars are unlikely to have yield losses from blackleg where sound cultural practices are used, that is, 500m isolation between the crop and the previous year's canola stubble. When MR varieties are sown into high disease severity situations they may respond well to fungicide applications. Consult BlacklegCM app for more detail.

MRMS (moderately susceptible moderately resistant)

MRMS-rated varieties have moderate blackleg resistance. MRMS varieties should only be sown in situations of low blackleg severity, that is, 500m isolation between the crop and the previous year's canola stubble and moderate to lower-rainfall regions. When these varieties are sown into higher disease severity situations, they are likely to respond well to fungicide applications. In the event of above-average rainfall years in lower-rainfall regions, it is advised to apply fungicide to MRMS varieties. Consult BlacklegCM app for more detail.

MS (moderately susceptible)

MS-rated varieties have low blackleg resistance. They should only be sown into situations of low blackleg severity, that is, low canola intensity and lower rainfall. When MS varieties are sown into higher disease severity situations, they are likely to respond very well to fungicide applications. Consult BlacklegCM app for more detail.

Upper canopy infection blackleg ratings

R-UCI varieties are likely to have effective MGR and will therefore be unlikely to have yield loss associated with UCI. Check Table 4 for your region and the presence of leaf lesions in your crop to confirm that the MGR is effective. If leaf lesions are found, treat your variety as MR-UCI. Consult UCI-BlacklegCM app for more detail.

MR-UCI varieties have resistance to UCI. Yield losses will only occur if disease severity is high, that is, flowering starts early in the growing season, there is sufficient rainfall and higher risks such as high canola intensity. Fungicide application at 30 per cent bloom is recommended if flowering is early, there is higher canola intensity and there is rainfall during flowering. Consult UCI-BlacklegCM app for more detail.

MRMS-UCI varieties have low resistance to UCI. Yield losses will occur if disease severity is moderate, i.e., flowering starts early in the growing season. Fungicide application at 30 per cent bloom is recommended if flowering is early and there is rainfall during the flowering growth stage. Consult UCI-BlacklegCM app for more detail.

MS-UCI varieties have low or no resistance to UCI. These varieties should only be sown into situations of low blackleg severity, that is, low canola intensity and lower rainfall. Fungicide application at 30 per cent bloom is recommended if flowering is early and there is rainfall during the flowering growth stage. Consult UCI-BlacklegCM app for more detail.

USEFUL RESOURCES

BlacklegCM app, developed with GRDC investment, allows the user to input information such as paddock selection, variety choice, seed dressing and banded or sprayed fungicide, and takes into account costs, yield benefits and grain prices to give the best/worse-case scenario and likely estimated economic return. Growers can change the parameters on the app to tailor the output to their own individual crop. It can be downloaded onto tablets (not smartphones) from both the App Store and Google Play, agric.wa.gov.au/apps/blacklegcm-blackleg-management-app

UCI BlacklegCM is a new app to assist grain growers in managing blackleg UCI in canola during flowering stage and also to aid in fungicide management decisions.
agric.wa.gov.au/apps/uci-blacklegcm-blackleg-upper-canopy-infection-management-app

Diseases of Canola and their Management: The Back Pocket Guide
Available from *GroundCover*™ Direct, 1800 110 044,
grdc.com.au/GRDC-BPG-CanolaDiseases

Canopy Infection by Blackleg – a New Evolution, a podcast,
grdc.com.au/news-and-media/audio/podcast/canopy-infection-by-blackleg-a-new-evolution

Marcroft Grains Pathology marcroftgrainspathology.com

Fungicide Resistance Management
croplife.org.au/resources/programs/resistance-management/canola-blackleg

Blackleg upper canopy infection videos (follow link or search on GRDC website)
grdc.com.au/search?query=blackleg%20upper%20canopy&s&personal=false&form=search-new&collection=grdc-multi&profile=_default&smeta_error_not=found&sort=off&smeta_archive_not=1&f.Typelctype=Video

GRDC CODES

MGP1905-001SAX
MGP2307-001RTX

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Faba bean Disease Management

Joshua Fanning[1], Chloe Findlay[1] and Dharushana Thanabalasingam[1].
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Key Messages

- It is important to implement integrated disease management (IDM) strategies to reduce the threat of disease.
- Where possible, choosing more resistant varieties will reduce grain yield losses caused by disease and reduce the reliance on fungicides.
- The faba bean variety, PBA Amberley, although most resistant is still rated MRMS and will require fungicide applications to prevent grain yield losses in conducive years.
- Following the ‘Fungicide Five’ strategies will reduce the risk of fungicide resistance development.

Faba bean Diseases

There are three main faba bean diseases in Victoria.

1. Cercospora leaf spot usually appears early in the season and is characterised by concentric circles in brown lesions. It usually does not cause significant yield loss on its own but damages plants allowing chocolate spot establishment later in the season.
2. Ascochyta blight is a white to brown lesion appearing anytime in the season characterised by black dots in the lesion (pycnidia). Last year’s results in indicate low yield losses as a result, but again can allow chocolate spot establishment.
3. Chocolate spot is the most damaging disease in faba beans. Symptoms first appear as discrete reddish-brown spots scattered over the leaves and stems. When the disease enters an aggressive stage, spots darken in colour and form larger grey-brown target spots that may eventually cover the entire plant. Definitive identification is when these spots occur on flowers. Chocolate spot can cause complete crop loss in conducive seasons.


Cercospora leaf spot


Ascochyta blight


Chocolate spot

Rust, Alternaria leaf spot and Sclerotinia white mould are other diseases but are not expected to cause significant yield losses in Victoria. Rust is a developing concern as temperatures increase.

Integrated Disease Management

A good integrated disease management program to prevent faba bean diseases will incorporate,

- Sowing clean seed – free of disease
- Crop rotations
- Resistant varieties
- Monitoring for disease
- Understanding the seasonal risk
- Fungicide Applications
    - Follow the product label
    - Optimise the fungicide strategy
    - Apply before rainfall events
    - Remember they are preventative not curative
- Protecting the seed

Fungicide Resistance

Resistance to fungicides is becoming an increasing threat to crops across Australia. Currently, there are no new detections of fungicide resistance in pulses within Australia. Samples have been taken and tested across the Southern region and resulted in absence of novel fungicide resistance, which suggests that this is not occurring, but the threat is always present.

Pulse production is reliant on foliar fungicides and many crops have only single active fungicide products applied at multiple times throughout the season. Therefore, there is a high probability that we may observe fungicide resistance in the future if growers do not take preventative steps at present.

Fungicide Five

There are five strategies that growers can adopt to slow the development of resistance in pathogen populations and therefore, extend the longevity of the limited range of fungicides available:

- **Rotate crops.** Avoid planting crops back into their own stubble or adjacent to their own stubble
- **Avoid susceptible crop varieties.** Where possible select the most resistant varieties suitable and/or avoid putting susceptible varieties in high-risk paddocks
- **Use non-chemical control methods to reduce disease pressure**. Delaying sowing and early grazing are examples of strategies that can reduce disease pressure
- **Spray only if necessary and apply strategically.** Avoid prophylactic spraying and spray before the disease gets out of control

- **Rotate and mix fungicides/modes of action.** Use fungicide mixtures formulated with more than one mode of action, do not use the same active ingredient more than once within a season, and always adhere to label recommendations.

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From the shed to field failure: strategies to ensure fungicide longevity

Associate Professor Fran Lopez-Ruiz

Fungicides are essential tools for protecting grain crops from fungal diseases, contributing to increased yields and quality. This is not unique to Australia. In fact, all relevant grain producers worldwide use fungicides as part of their IDM management strategies. Unfortunately, the intensive and often repeated use of fungicides selects for resistant fungal populations which can lead to field failure.

Fungicide resistance is an issue that the grains Australian industry is well familiar with. The biggest fungicide resistance outbreak ever recorded in the world happened in WA between 2007 and 2010. During this period, the barley industry lost around $300M due to resistance to some old demethylase inhibitor fungicides (Group 3) in barley powdery mildew.

To reduce the chance of this situation repeating again in the future, the GRDC funded the development of the Australian Fungicide Resistance Extension Network (AFREN), which aims at training the grains industry on disease and fungicide resistance management strategies through the development of regionally relevant resources.

The speed at which a fungicide will lose effectiveness due to resistance depends on the fungicide mode of action, the biology of the pathogen and the agronomic practices. In any case, pathogen strains carrying mutations that confer fungicide resistance emerge naturally in the field. However, it is important to make a distinction between the time required until fungicide resistance is selected and field failure. This is because fungicide resistance might be already present in the environment even before the first use of a fungicide, or selection can occur very rapidly, often within just a growing season, from its first application. On the other hand, field failure can range from rapid to very slow depending on factors such as the fungicide mode of action (MoA), the agronomic practices and the pathogen's lifecycle.

Once resistance to a particular fungicide has been selected, pathogen populations resistant to that same fungicide will begin to increase in abundance. However, fungicide performance will not be impacted in the field until pathogen populations are dominated by the resistant type.

This means that fungicide lifespan will be shorter or longer depending on the strength and speed of the selection pressure. In other words, when the use of fungicides from the same group is high, selection pressure increases resulting in a faster accumulation of resistant individuals. Every fungicide is different and for some of them, such as multi-site fungicides, field failure has never been observed.

In this talk, I will discuss the drivers behind the selection of fungicide resistance in the paddock and strategies to mitigate this process so that fungicides remain within our disease management toolbox for as long as possible.

“The HRZ now and then”
Impact on germplasm choice & crop inputs

Nick Poole, Darcy Warren, Aaron Vague, Daniel Bosveld, Rajdeep Sandhu and Sean Mackenzie.
Field Applied Research (FAR) Australia.

Keywords
- Wheat varieties, crop development, stripe rust,

Take home messages
- The HRZ region does not always behave as its title suggests, it’s not always wet. **It is the HRZ region “now and then” and seasons can be vastly different!**
- With drier years the growing season becomes shorter, and with it the focus on variety and crop can change, with barley starting to outyield wheat (Vic CTC - 2023 highest yielding barley – 7.96t/ha cv Neo v 6.92t/ha RGT Waugh) and shorter season wheat varieties becoming more advantageous than longer season wheats.
- In 2023 the new variety Triple 2 (AGFWH010222) performed strongly when the spring stem elongation period was drier and was a growth stage ahead of the longer season feed wheats such as Big Red at the start of grain fill.
- Research conducted at FAR Australia sites in SA and NSW in 2023 demonstrated that Triple 2 also looks to have good upper end yield potential when the spring conditions are slightly more favourable.
- Longford which is a slightly longer season red feed wheat than Big Red performed very strongly in 2022 with a treated yield of almost 9t/ha but was pegged at 6.0-6.5t/ha in 2023 along with most other varieties.
- Stockade (APW) first tested in 2020 by FAR has performed consistently over wet and dry seasons but hasn’t exhibited the top end yields in the higher yielding seasons compared to the feed wheats.
- At FAR Australia’s Victoria Crop Technology Centre near Winchelsea, stripe rust has caused the greatest yield loss in wheat over both wet and dry seasons. Its shorter latent phase enables it to out compete Septoria tritici blotch (STB) to the top of the canopy.
- Drier than average conditions during stem elongation and the emergence of the top three leaves has shown to significantly reduce Septoria tritici blotch (STB) development in the upper canopy and has had less impact than stripe rust when comparing 2022 and 2023.
- High input approaches such as 200kg N/ha, PGR application and 4 fungicide units of fungicide do not tend to be the most profitable approaches in seasons such as 2023, so looking to adjust strategies at key development timings is a key way to adapt management for HRZ seasons that might not be typical.
- The key growth stages to adjust management strategy from a wet HRZ season to a dry HRZ season is between GS31 (first node) and GS39 (flag leaf emergence).

- This is the key development period to consider N top up, expenditure on fungicide for flag leaf and beyond, and plant growth regulator input.

Influence of variable HRZ seasons on cereal crop yields and variety choice.
In the 2020 season (479mm GSR) the highest yielding wheat at FAR Australia's Victoria Crop Technology Centre was 11.34t/ha, with a number of other wheat varieties exceeding 10t/ha. In contrast the highest yielding barley in 2020 had a yield of 8.84t/ha illustrating a clear yield advantage to wheat over barley. In contrast, in 2023 on the same research site in the same paddock with GSR of 375mm, the highest yielding barley was 1t/ha higher yielding than wheat (7.96t/ha cv Neo vs. 6.92t/ha RGT Waugh). In 2020 the September rainfall was approximately 90mm compared to little more than 20mm in 2023. This trend is typical of a long season HRZ region that swings between wet and dry springs, with rainfall in the September period being particularly important for overall yield potential and disease profile for the season.

In addition, drier springs and shorter seasons influence germplasm performance with slightly shorter season wheat varieties performing well when the season is more austere. RGT Accroc over the last seven years has been remarkably resilient in terms of delivering 10t/ha in better seasons and 6t/ha in drier springs, however its performance has been increasingly reduced by significant disease infection, particularly STB and stripe rust. Therefore, the hunt is on to identify high yielding disease resistant germplasm that can take advantage of better springs, but also perform in dry springs such as 2024. Varieties such as Longford have good yield potential but may be a little longer season and as such perform strongly in seasons such as 2022 but may not be able to express their upper end yield potential in seasons such as 2022 and 2023 (Figure 1 & 2). The new feed red wheat Triple 2 (formerly AGFWH010222) performed strongly across SA, VIC and NSW both in terms of disease resistance and yield performance. It is only one year of data so far, but the potential in higher yielding trials indicated good upper end yield for better seasons. If it performs well in 2024 this could be a good candidate if we are in for a run of drier seasons.

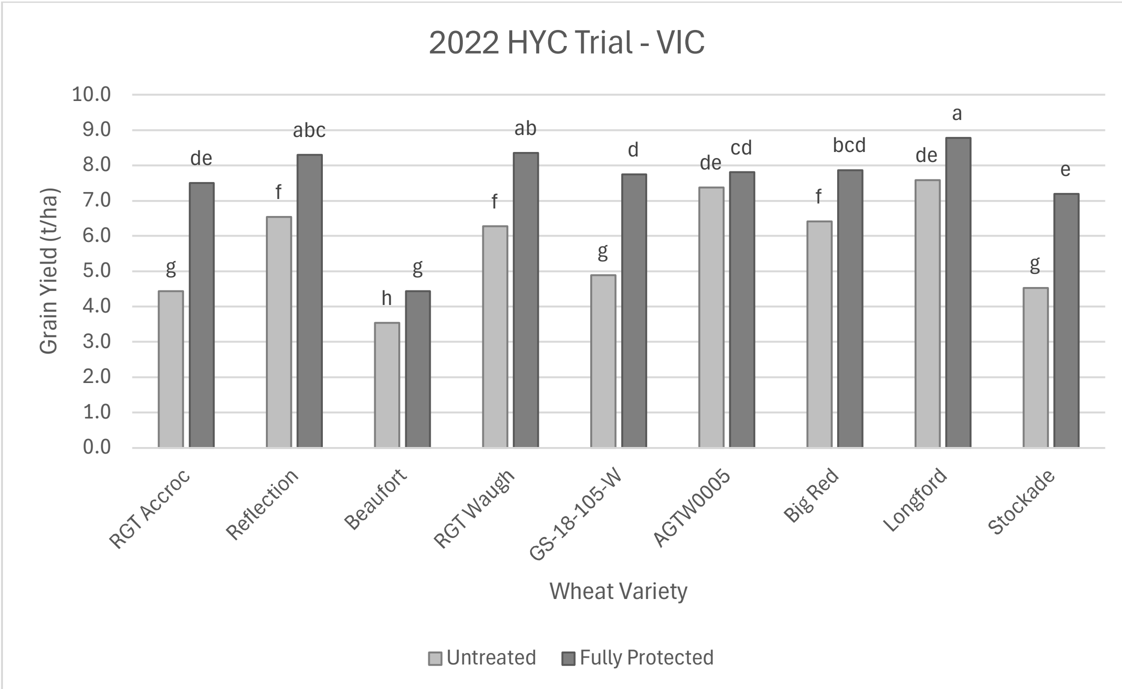

Figure 1. *Influence of cultivar and fungicide application on grain yield (t/ha) in* ***2022****.*
Victoria Crop Technology Centre.
Bars with the same letters are not significantly different (p=0.05).

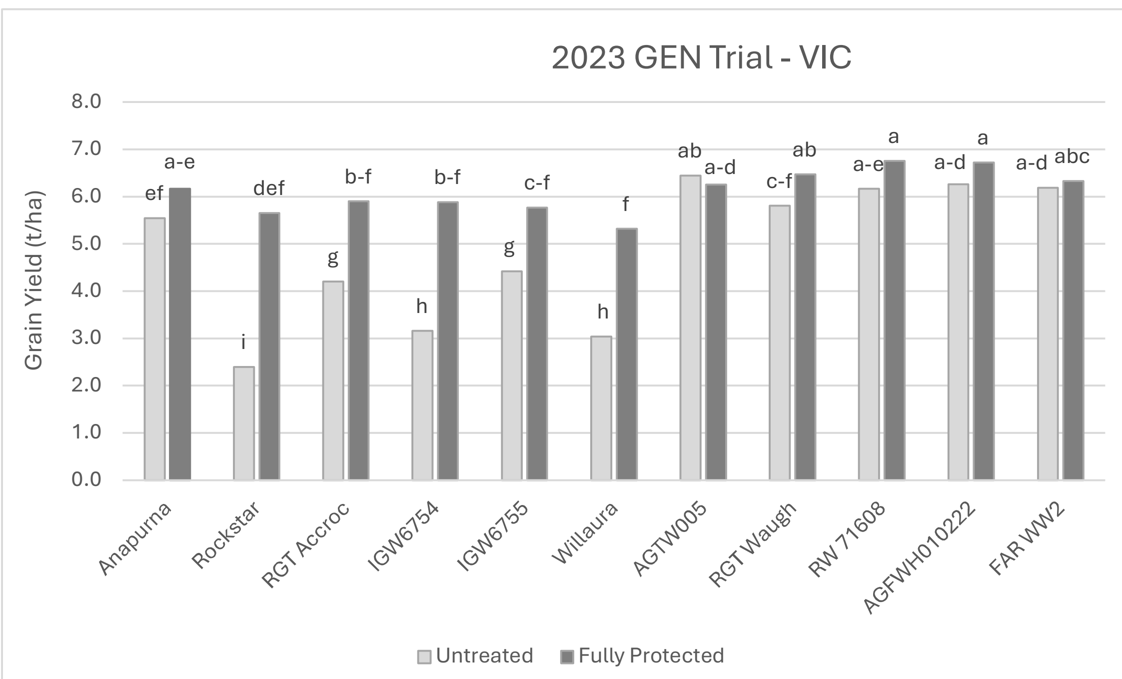

Figure 2. *Influence of cultivar and fungicide application on grain yield (t/ha) in* ***2023****.*
Victoria Crop Technology Centre.
Bars with the same letters are not significantly different (p=0.05). IGW6754 – Genie, AGFWH010222 – Triple 2, FAR WW2 – KWS Ultim.

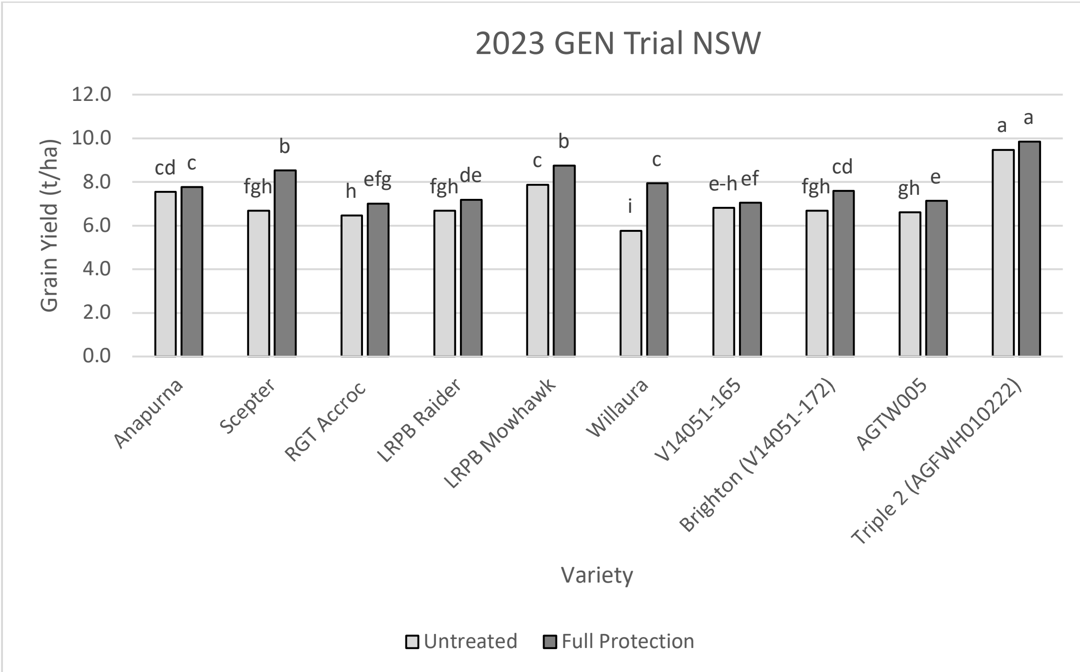

Figure 3. *Influence of cultivar and fungicide application on grain yield (t/ha) in* ***2023****. NSW Crop Technology Centre, Wallendbeen, NSW (4mm rain in September but wetter August than Victoria).*
Bars with the same letters are not significantly different (p=0.05).

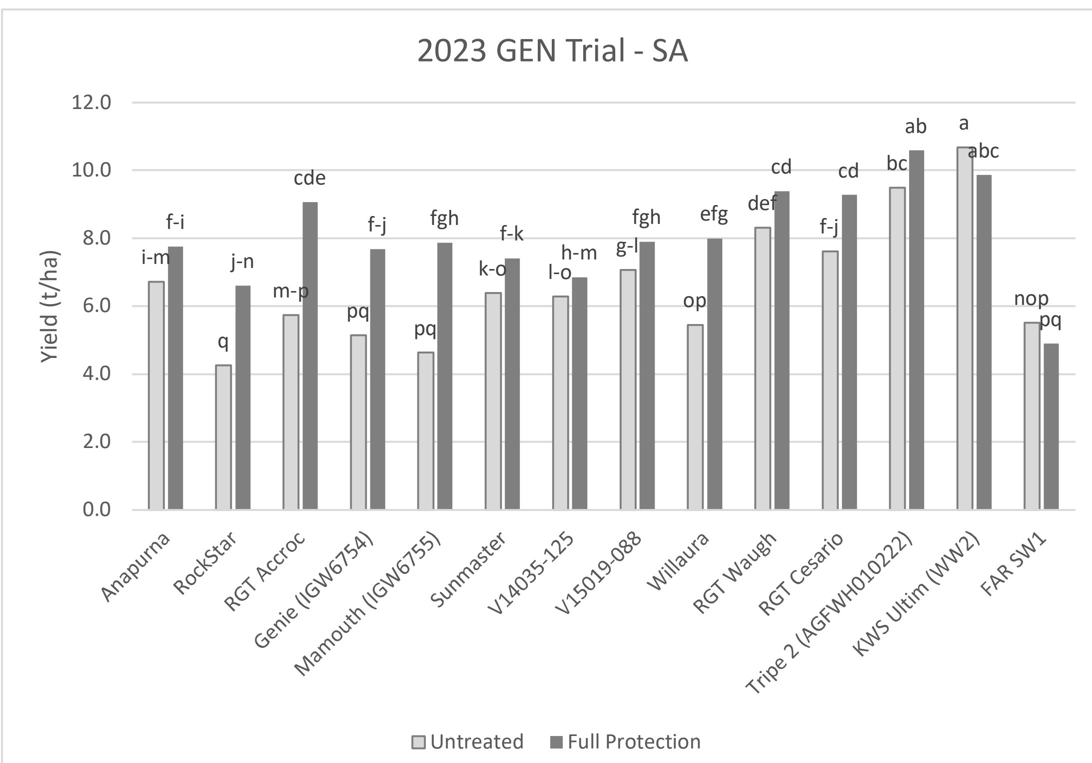

Figure 4. *Influence of cultivar and fungicide application on grain yield (t/ha) in* ***2023****. SA Crop Technology Centre, Millicent, SA.*


VICTORIA CROP TECHNOLOGY CENTRE
FAR AUSTRALIA
Wheat Fungicide Fingerprinting cv. RGT Cesario
Barley Germplasm Evaluation Network (GEN) TOS 1
NFNB Germ x Fung
NFNB Fungicide
Barley Germplasm Evaluation Network (GEN) TOS 2
RiskWi$e
Wheat Fungicide Fingerprinting cv. Stockade
1
Wheat Fungicide Fingerprinting cv. Revenue
2
Wheat Fungicide Germplasm Evaluation Network (GEN) TOS 1
3
FIRST AID
6
Barley Fungicide Germplasm Evaluation Network (GEN) TOS 2
5
TOS Modelling
4
Wheat Fungicide Germplasm Evaluation Network (GEN) TOS 2
TOILET
AGF seeds
westernAG The Best in Agronomic Advice
KNOWLEDGE INNOVATION RELIABILITY COMMITMENT

TIMETABLE

VICTORIA CROP TECHNOLOGY CENTRE FIELD DAY
THURSDAY 10 OCTOBER 2024

10:00 - 10:30am Coffee and opening address by Nick Poole, FAR Australia's Managing Director

Session	In-field presentations (canola and pulses)	Site	10:30	11:30
Canola agronomy	***Dr Steve Marcroft, Marcroft Grains Pathology*** *Canola diseases - when should I apply a fungicide?*	**Canola site**	**All**	
Pulse agronomy	***Dr Josh Fanning, AgVIC and Aaron Vague, FAR Australia*** *Faba bean disease management and the importance of an integrated disease managemnet (IDM) strategy to reduce the threat of disease.*	**Pulses site**		**All**

Thanks to our Keynote Speaker sponsor:

Thanks to our lunch and post event refreshments sponsor:

Session #	In-field presentations (cereals)	Station #	12:30	1:30	2:00	2:30	3:00	3:30	4:00
1	***Dr Fran Lopez, Centre for Crop and Disease Management (CCDM)*** *From the shed to field failure: strategies to ensure fungicide longevity.*	**1**	**Lunch including an introduction to the GRDC RiskWi$e initiative by Ben Morris and Nick Poole**	**1**	**2**				**Session 6 in the marquee over post event refreshments**
2	***Nick Poole, FAR Australia*** *The high rainfall zone now and then - the imact on germplasm and management input.*	**2**			**1**	**2**			
3	***Darcy Warren, FAR Australia*** *Barley Net form net blotch management under evolving circumstances in south-west Victoria.*	**3**				**1**	**2**		
4	***Broden Holland, NSW grower*** *Precision ag and nitrogen management: insights and strategies from a grower's perspective.*	**4**					**1**	**2**	
5	***Dr Ben Jones*** *Model vs Reality: improving a wheat simulation model with high yielding crop data, and why it matters.*	**5**		**2**				**1**	
6	***Nick Poole, FAR Australia joins growers Craig Drum, Lachie Morrison, and agronomists Tom Toose and Ed Hilsdon to discuss:*** *As the nation's economy moves to ways to reduce emissions where do we stand with crop profitability in VIC HRZ with our new GRDC Hyper Profitable Crops project?*	**6**							**All**
Session	**In-field presentations**	**Station #**	**12:30**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**	**4:00**

For the afternoon in field presentations, we would be obliged if you could remain within your designated group number.

Thank you for your cooperation.

Which disease caused the greatest yield loss in wheat in the southern HRZ region over 2022 & 2023?
In 2023 season in southern Victoria, stripe rust caused by the pathogen *Puccinia striiformis* f. sp. *tritici* was the principal disease that caused yield loss in wheat. Despite well below average rainfall in the period from July to October, this disease was very aggressive in many cultivars and new lines evaluated. In contrast, the wet weather stubble-borne disease Septoria tritici blotch (STB) failed to develop substantially on the upper leaves as a result of drier conditions during the emergence of the top three leaves (often referred to as the money leaves).

The milling wheats gave the greatest dollar return for fungicide spend in our 2023 research, with Willaura[A], Genie[A] and RockStar[A] giving returns of between $6.60–$10.10 for each dollar invested in a fungicide product and application (Table 1). The reward of controlling disease in these cultivars came from both yield gain and grain quality improvement. Using the same risk reward ratios, it was shown that the yield increases achieved with fungicides were not effective with RGT Waugh, RW 71608, AGF010222, AGTW005 and FAR WW2, all of which gave less financial return than dollars spent. The cost benefit ratio of using fungicides shown in Table 1 expresses the benefit of fungicide application in terms of $ return for each $ spent on the variety.

Table 1. *Influence of fungicide application on income return expressed as ratio of $ return/ha for each $ spent.*

	Fungicide Treatment			
Cultivar	**Gross $ Untreated**	**Gross $ Full protection**	**Income improvement**	**$ return for each $ spent**
Genie[A] (IGW6754)	1033	2107	1074	10.1
RockStar[A]	735	1741	1006	9.4
Willaura[A]	933	1632	700	6.6
Accroc[A]	1291	1706	415	3.9
IGW6755[A]	1446	1781	335	3.1
RGT Waugh (FED1)	1783	1880	97	0.9
Anapurna	1703	1787	84	0.8
RW 71608	1894	1968	75	0.7
AGFWH010222	1922	1957	36	0.3
FAR WW2	1901	1838	-64	-0.6
AGTW005	1980	1814	-166	-1.6

Notes: Gross income of untreated and fungicide treated crop based on the value of the grain yield and quality grade, with the treated crop values expressed after fungicide and application cost ($/ha) has been subtracted. Genie[A] (IGW6754) and IGW6755[A] classed as milling quality, RW 71608 as red feed grain for purposes of this calculation. Fungicide costs based on a three-spray programme of Prosaro® 300mL/ha (Group 3 DMIs prothioconazole & tebuconazole), Aviator Xpro® 500mL/ha (Group 3 DMI prothioconazole & Group 7 SDHI bixafen) and Opus® 500mL/ha (Group 3 DMI epoxiconazole) with $15/ha spray application cost. Total cost of fungicide programme *and application $106.50. Grain costed at FED1 – $307/t, SFW1 and AGP1 – $327/t, APW1 – $376/t.*

High input approach questionable for wheat varieties in dry springs
Following good seasons such as 2020 -2022 it is easy to consider high input approaches as the most appropriate management strategies, however results from Hyper Yielding Crops rarely illustrated that high input approaches to nitrogen input and PGR application were the most cost effective. Although high fungicide input frequently paid for itself in stripe rust susceptible varieties, it is not a given with more resistant varieties or in wheats with susceptibility to STB where dry weather during stem elongation is a very effective fungicide. In 2023 in the last of the HYC research project trials, it was management approaches specifically tailored to the variety and the season that generated the most cost-effective returns (Figure 5).

The key growth stages to adjust management strategy from a wet HRZ season to a dry HRZ season is between GS31 (first node) and GS39 (flag leaf emergence). This is the key development period to consider N top up, expenditure on fungicide for flag leaf and beyond and plant growth regulator input. In 2023 note low input (150N, 2 triazoles, no PGR) approach was most profitable with Longford (disease resistant variety) and Stockade (which is susceptible to STB but which did not develop).

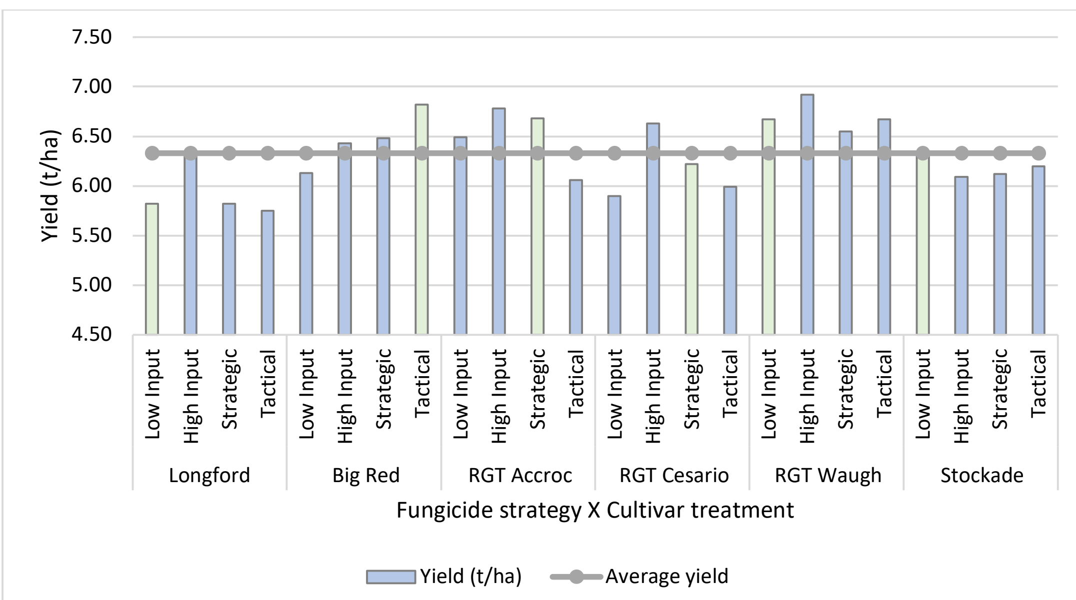

Figure 5. *Influence of cultivar and management approach on grain yield t/ha in 2023 – Victoria Crop Technology Centre.*
(Lsd cultivar x management – not significant p=0.05). Light green bars most profitable management approach. See 2023 HYC results for more details – FAR Australia website.

Contact details

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GERMPLASM

evaluation network (GEN)

your trusted research partner for germplasm evaluation

HOW GOOD IS YOUR VARIETY? WHY NOT GET IT TESTED IN GEN?

An Industry Innovations (II) initiative

SOWING THE SEED FOR A BRIGHTER FUTURE

GERMPLASM EVALUATION NETWORK (GEN)

Background:

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 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.

FAR Australia has been delivering extremely successful germplasm evaluation network (GEN) pilot programmes across an established series of trial sites in order to test different germplasm in wheat and barley. The five Crop Technology Centres that test GEN are located in WA, SA, Vic, NSW and Tas.

What is Proposed:

Once again, the 2025 programme will focus on genetic yield potential and disease resistance. The trials, in wheat barley and canola, will be managed ‘plus and minus’ fungicide using FAR Australia’s expertise in disease management.

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

All trial results will be reported to the breeders within 21 days of harvest. FAR Australia will report results of all trials to the wider industry after all breeders have been informed of their results.

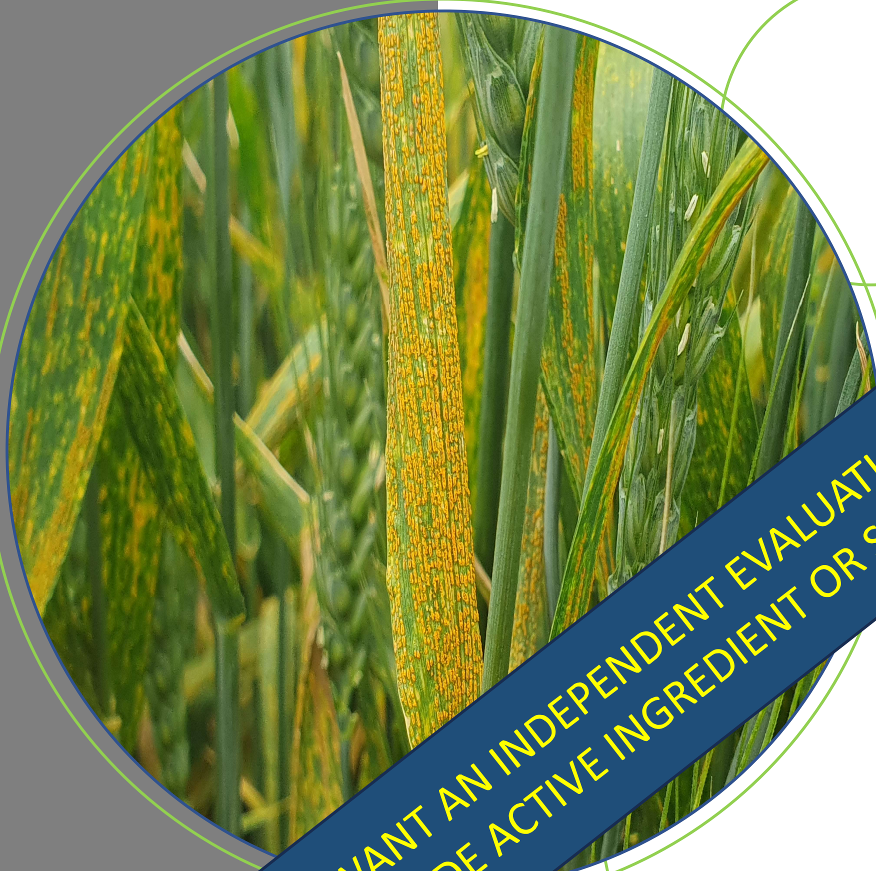
The breeders and FAR Australia will jointly own the results produced. Pre commercialisation breeding lines can be identified by the breeders or a FAR Australia code.

GERMPLASM evaluation network
your trusted research partner for germplasm evaluation

FAR AUSTRALIA

FUNGICIDE FINGERPRINTING

an independent fungicide evaluation network



DO YOU WANT AN INDEPENDENT EVALUATION OF YOUR FUNGICIDE ACTIVE INGREDIENT OR STRATEGY?

SOWING THE SEED FOR A BRIGHTER FUTURE

An Industry Innovations (II) initiative

Industry Innovations

leading the way to a brighter grains industry

FUNGICIDE FINGERPRINTING - FIRST IN ITS FIELD

Fungicide Fingerprinting, developed by FAR Australia, was launched in 2021 and is the first coordinated and independent fungicide evaluation network in Australia. This initiative aims to generate an independent evaluation of existing and newly developed fungicide strategies to help growers and advisers make better decisions when managing disease. It is:

- Independent
- accurate
- consistent in the approach to disease assessment
- within the label stipulations and AFREN compliant control framework

Collaborating Industry Stakeholders

This industry initiative is of benefit to agrichemical manufacturers involved in both new active and generic, fungicide resellers with agronomists in the field, private advisers and regional farming groups.

Overall Objective:

Individual objectives specific to the trial are:

- To assess the efficacy of different fungicide strategies and active ingredients against foliar pathogens prevalent in the HRZ of Australia.
- To assess the most cost-effective fungicide strategies in different HRZ regions of Australia (long season and short season) using less expensive generic chemistry alongside the latest development material.
- To evaluate whether newer generation fungicide chemistry is more effective than DMI based standard controls.
- To determine the impact of introducing Group 7 and QoI Group 11 chemistry SDHI into two spray programmes.
- To allow development material to be entered under a FAR code (where it is pre commercial) which is revealed when the new active is commercialised.

The Fungicide Fingerprinting initiative is conducted at FAR Australia's Crop Technology Centres in the HRZ regions of Australia where disease is more prevalent, thus an important component of cereal crop agronomy.

Costs:

Should you wish to invest in entries into FAR Australia's Fungicide Fingerprinting Evaluation Network or Germplasm Evaluation Network (GEN), please contact Rachel Hamilton on 0428 843 456 or email rachel.hamilton@faraustralia.com.au

FUNGICIDE FINGERPRINTING
an independent fungicide evaluation network

Barley Net form net blotch management under evolving circumstances in south-west Victoria

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

Key point summary

- Despite a drier than average spring, Net form net blotch (NFNB) was observed at moderate to high levels in susceptible barley varieties and was the most dominant disease on site.
- RGT Planet (SVS) and Zena CL (S) gave the biggest response to fungicides for NFNB severity when assessed on 3 October 2023.
- Rosalind, Cyclops and Minotaur demonstrated good inherent resistance to NFNB showing only low levels 0.1 – 2.3% plot infection on October 3, however scald and leaf rust were present in Cyclops and Minotaur.
- Foliar fungicide programs where 3 to 4 fungicide units were used gave the best yields when tested with the NFNB susceptible variety RGT Planet.
- Fungicide programs where a single, or double fungicide unit was used were insufficient in increasing yield over the untreated plots.
- Despite yielding significantly more than the untreated, the best yielding treatments were still unable to fully control the disease in a SVS variety, giving only around 40% control compared to the untreated when assessed on 3 October at early milk development growth stage.

Background

Since the widespread cultivation of susceptible barley varieties, Net form net blotch (NFNB) has become the most important foliar disease to control in southern Victoria. The new GRDC investment "Integrated management strategies for Net form net blotch in low, medium, and high rainfall zones" led by Queensland Department of Agriculture and Fisheries aims to develop and deliver cost effective IDM strategies for NFNB across all rainfall zones of the Northern and Southern regions. In 2023 FAR Australia ran two trials sown in early May at the Victoria Crop Technology Centre looking at both fungicide strategy in a susceptible variety (RGT Planet) as well as the role of cultivar susceptibility ratings in terms of controlling the disease.

Trial 1. NFNB Germplasm x fungicide strategy trial (FAR VIC NF B23-01)

Net form net blotch (NFNB) was prevalent in research plots, however was most common in susceptible varieties and could be controlled with more resistant germplasm. RGT Planet, rated SVS and Zena Cl, rated S, showed 47.5% and 42.5% disease severity respectively when assessed on a plot basis in early October (Table 1). Both varieties saw statistically significant reduction in disease when fungicide was applied reducing severity to 12.5% in RGT Planet and 5.6% in Zena CL. Despite all showing some sign of NFNB infection when untreated, Cyclops, Minotaur, Neo CL and Rosalind gave no response to fungicide in disease severity and showed significantly lower levels of disease than the susceptible varieties, with the exception of fungicide treated Zena CL.

Table 1. *Influence of fungicide management and cultivar on Net form net blotch (NFNB) (% Plot). Assessed on 3 October 2023.*

	Net Form of net blotch severity (%Plot)					
Cultivar	**No Fungicide**		**Full Protection**		**Mean**	
1. Cyclops	0.3	c	0.0	c	**0.1**	**c**
2. Minotaur	2.3	c	0.5	c	**1.4**	**c**
3. Neo CL	6.3	bc	0.7	c	**3.5**	**c**
4. RGT Planet	47.5	a	12.5	b	**30.0**	**a**
5. Rosalind	0.1	c	0.0	c	**0.1**	**c**
6. Zena CL	42.5	a	5.6	bc	**24.1**	**b**
Mean	**16.5**	**a**	**3.2**	**b**		
LSD P=0.05 Cultivar	5.4		**P Value**		<0.001	
LSD P=0.05 Management	5.4		**P Value**		0.004	
LSD P=0.05Cul. X Man.	7.7		**P Value**		<0.001	

Despite these interactions between variety and management with disease severity, differences did not translate into yield (Figure 1). There was no statistical interaction between variety and management for yield, or indeed between untreated and fully protected plots. There were however significant yield differences due to variety, with Neo Cl yielding the highest (7.50t/ha) and Cyclops (7.15t/ha) not significantly different. The susceptible varieties of RGT Planet and Zena CL yielded the lowest on average and were significantly lower than all varieties with the exception of Minotaur, which despite showing good NFNB control, did see scald and leaf rust infections.

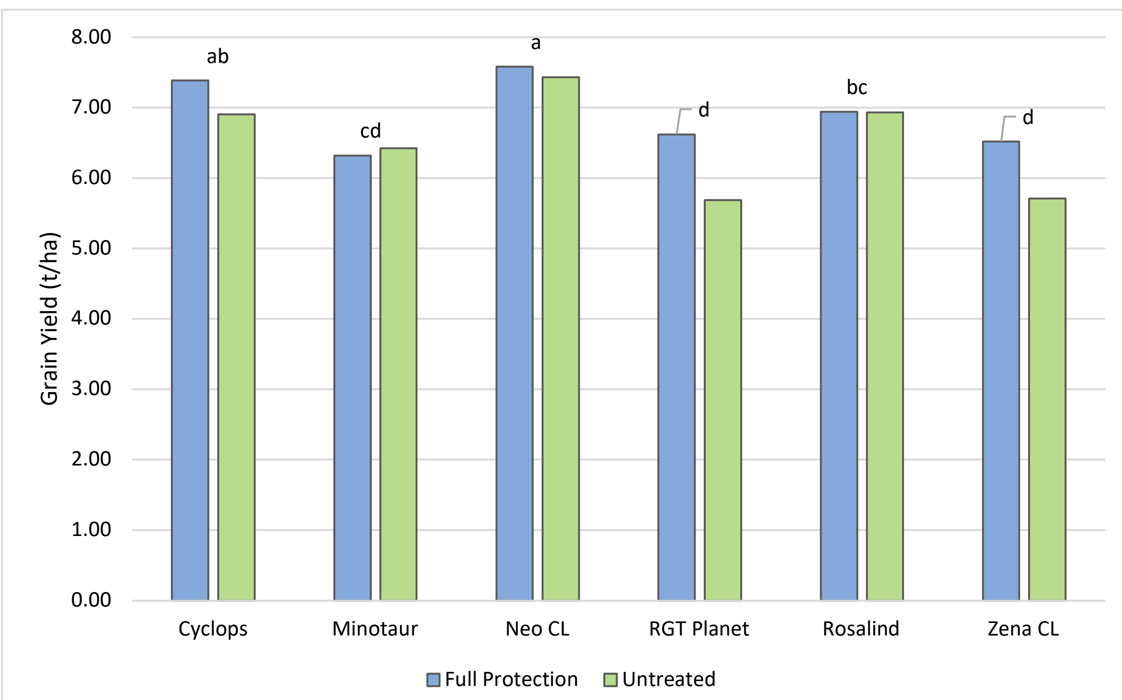


Figure 1. *Influence of fungicide management and cultivar on grain yield (t/ha).*

Trial 2. NFNB Fungicide strategy trial (FAR VIC NF B23-02)

Sown with the susceptible variety RGT Planet, NFNB was again the dominant disease in this trial with severity levels of over 90% being recorded on the Flag-2 leaf layer in early October (Figure 3). This trial looked at a number of fungicide managements exploring timings and products (Table 2). Early season disease assessments (GS31, early stem elongation) showed the inclusion of Systiva seed treatment to provide significant reduction of NFNB on the flag-5 leaf layer, as well as similar trends on flag-4 and flag-3, albeit at low severity levels at this point in the season (Figure 2). However, caution must be taken when using SDHI seed treatments to control NFNB following recent test results showing fungicide resistance to Group 7 fungicides in 2023.

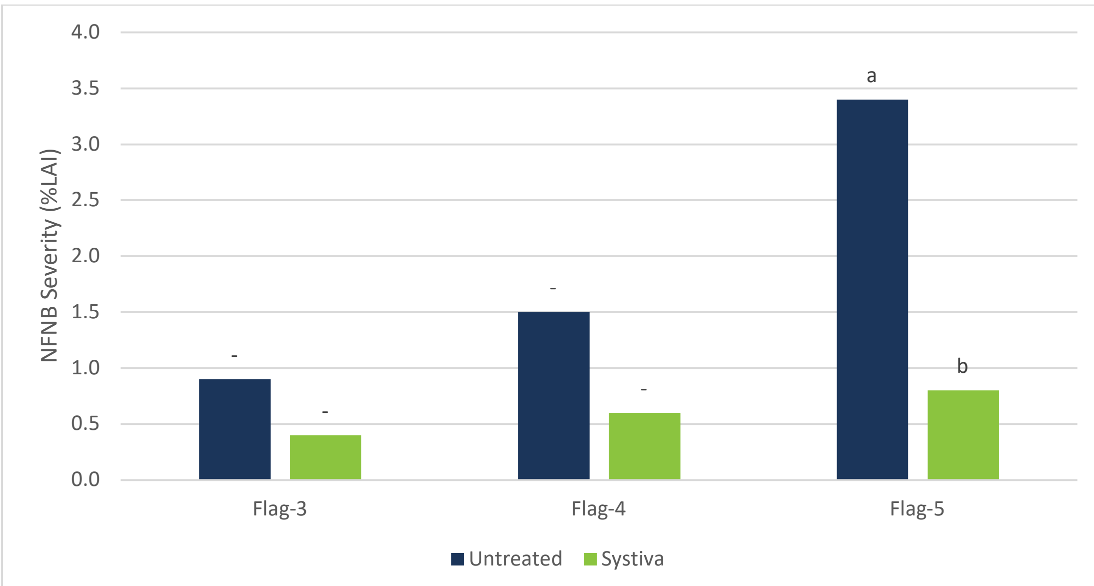


Figure 2. *Influence of seed treatment (Systiva) on Net form net blotch (NFNB) severity, assessed on 2 August at early stem elongation (GS31).*

Disease assessments at early milk development growth stage (GS71) in early October showed that untreated plots or plots with only a single or double fungicide applied early in the season, were the least effective at controlling disease. These treatments saw NFNB severity of between 40% and 55% on Flag-1 (Figure 3).

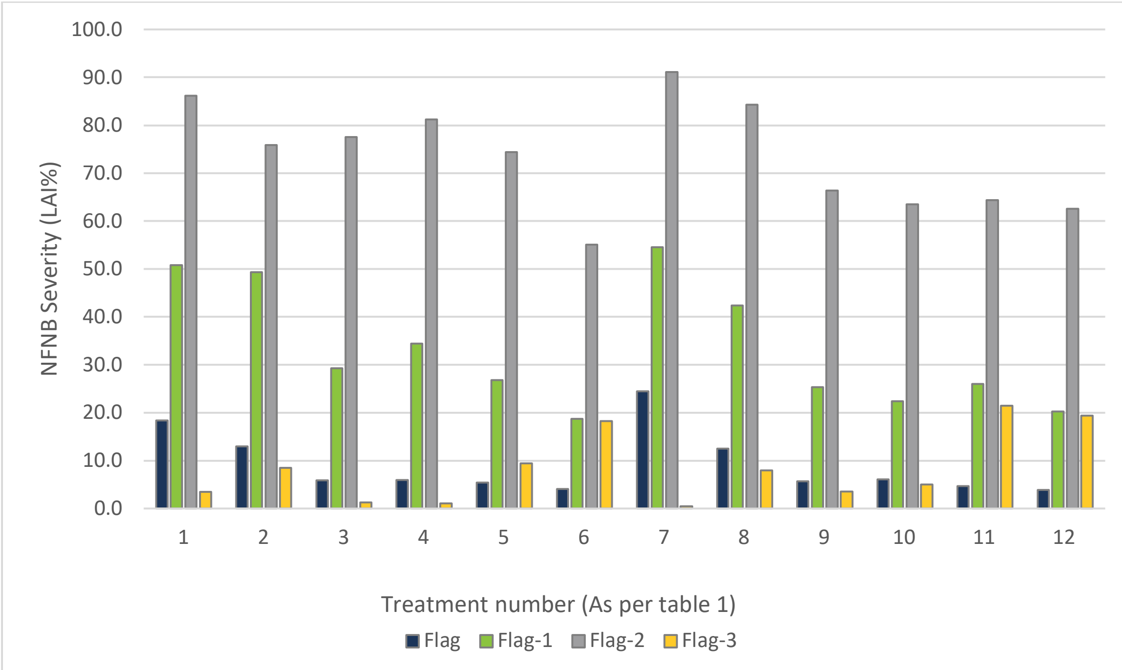


Figure 3. *Influence of fungicide management on Net form net blotch (NFNB) severity, assessed on 3 October at early milk development (GS71). Treatment details outlined in table 2.*

In terms of yield treatment 12, 11 and 6 were the highest yielding and also significantly higher yielding than the untreated plots (table 2). They all contained three to four fungicide units and a mix of fungicide groups. Although significantly better yielding than the untreated, it is important to note that these treatments were still unable to provide complete protection from NFNB and gave up to 40% severity control when assessed in early October. Fungicide management did not impact grain protein, test weight or screening however lower retention figures were recorded in untreated and Systiva only treatments.

Table 2. *Influence of fungicide management on grain yield (t/ha).*

	Treatment				Yield		% of mean	
	GS00	**GS30**	**GS39-45**	**GS59**	t/ha		%	
1	---	---	---	---	5.04	cd	92.7	cd
2	---	Opera 500 mL/ha	---	---	5.26	bcd	96.6	bcd
3	---	---	Aviator Xpro 500mL/ha	---	5.38	bcd	98.8	bcd
4	---	---	Aviator Xpro 500mL/ha	Opus 500mL/ha	5.27	bcd	96.8	bcd
5	---	Opera 500 mL/ha	Aviator Xpro 500mL/ha	---	5.50	abc	101.1	abc
6	---	Opera 500 mL/ha	Aviator Xpro 500mL/ha	Opus 500mL/ha	5.70	ab	104.7	ab
7	Systiva	---	---	---	4.85	d	89.2	d
8	Systiva	Opera 500 mL/ha	---	---	5.59	abc	102.7	abc
9	Systiva	---	Opera 500 mL/ha	---	5.54	abc	101.7	abc
10	Systiva	---	Opera 500 mL/ha	Opus 500mL/ha	5.35	bcd	98.3	bcd
11	Systiva	Opera 500 mL/ha	Aviator Xpro 500mL/ha	---	5.84	ab	107.2	ab
12	Systiva	Opera 500 mL/ha	Aviator Xpro 500mL/ha	Opus 500mL/ha	6.01	a	110.4	a
				Mean	5.44		100.0	
				LSD (P=0.05)	0.60		11.1	
				P-Value	0.026		0.026	

Conclusion

These trials have demonstrated the need for robust fungicide management in controlling Net form net blotch in disease susceptible varieties, but in doing so, highlight concerns around fungicide resistance. Despite yield increases where a mix of group 3, group 7 and group 11 fungicides were used, actual control of the disease late in the season was disappointing. NFNB continued to develop late into the season, even where previously effective chemistry such as Aviator Xpro had been used, which is in line with findings throughout Victoria of SDHI resistance (trial samples sent to CCDM, results pending at time of writing). Despite this, these trials also suggested there was still some effectiveness from Systiva seed treatment up until early stem elongation and therefore careful monitoring must be employed when using these products.

These results further emphasise the need to employ IDM strategies and the usefulness of using resistant genetics to control NFNB, albeit with the caveat that different germplasm may give rise to a shift in foliar disease prevalence such as scald or leaf rust. Research in subsequent years will continue to explore germplasm IDM options, monitor fungicide strategies and will provide insights into stubble management and paddock hygiene strategies.

Broden Holland, grower

KOOLPARI ENTERPRISES

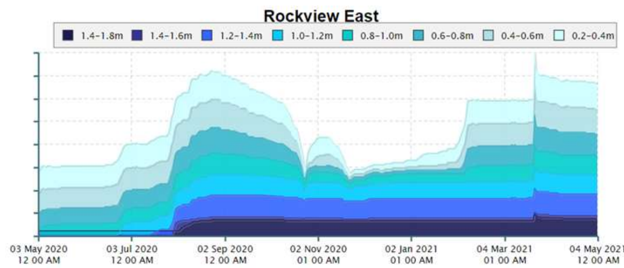
- 5000ha mixed cropping/sheep family farming enterprise located at Young, NSW
- Rotation consisting of lucerne pasture phase (2 years) followed by alternating wheat / canola cropping phase (8 years)
- Trying faba beans*

Previous approach to N management

- Assessment of previous seasons yield and (average) protein
- Consideration of how long each paddock has been in cropping phase
- Deep N testing of select paddocks
- Urea budget formulated working with advisor
  - > Starting yield targets approx. 3.5t/ha (wheat) and 1.8t/ha (canola)
  - > Blanket rates

Previous approach to N management

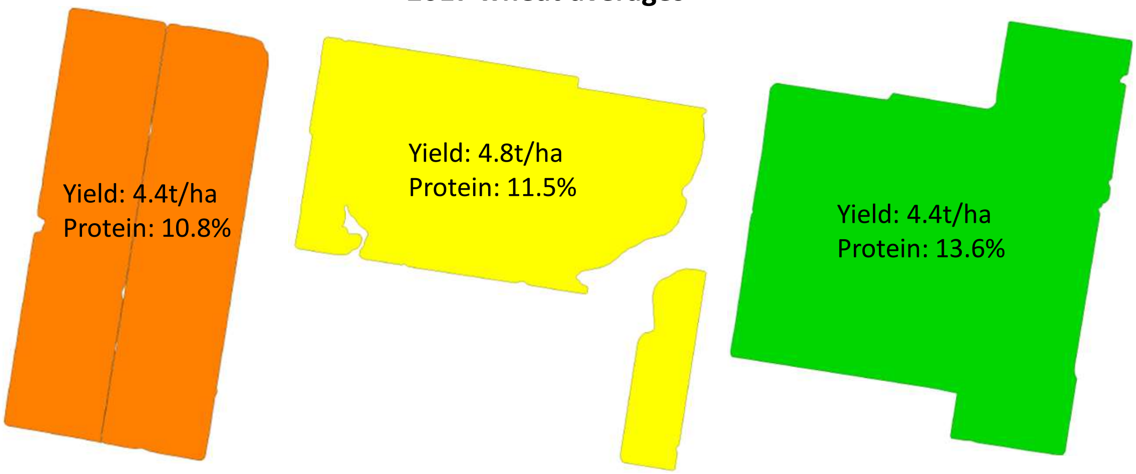
- Monitoring:
  - Visual assessments
  - Soil moisture (probe)
  - Yield Prophet
  - NDVI
- Yield targets revised/ additional urea applied if season is favourable



Evolving N management strategy

- Purchased Cropscan grain analyser in 2016
- Variable Rate urea on one block in 2017
- Full VR N in 2018 on all paddocks where applicable
- Still using basically the same tools as previously to determine average rates

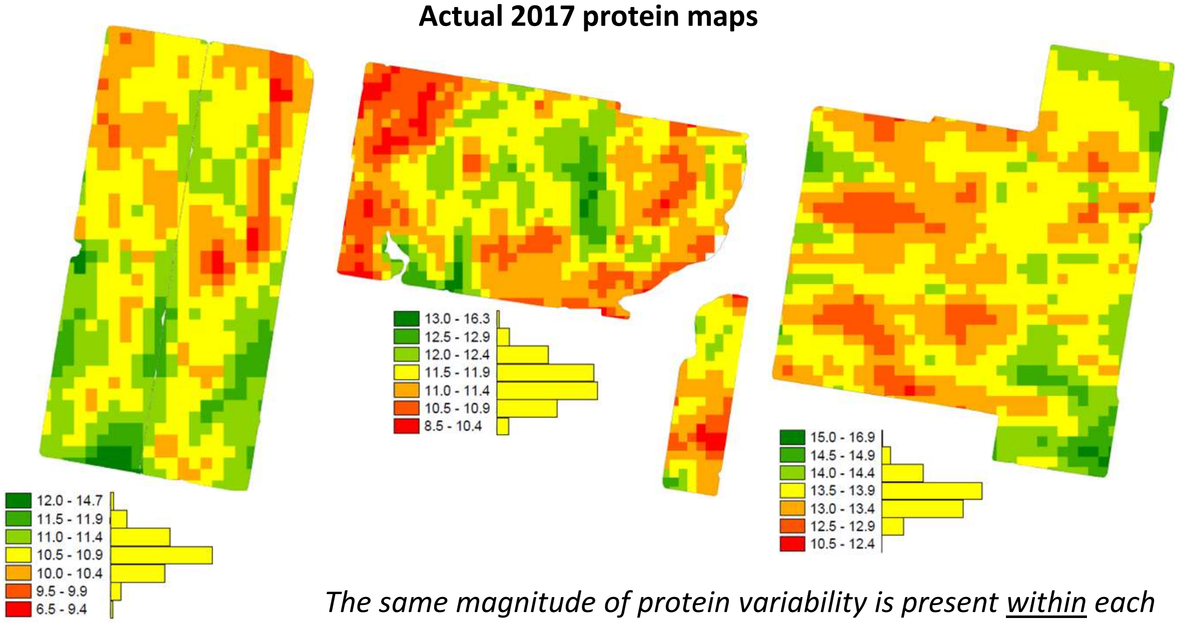
2017 wheat averages



Based on this information, how would you approach 2018 urea rates?

120kg/ha? **90kg/ha?** **30kg/ha?**

Actual 2017 protein maps



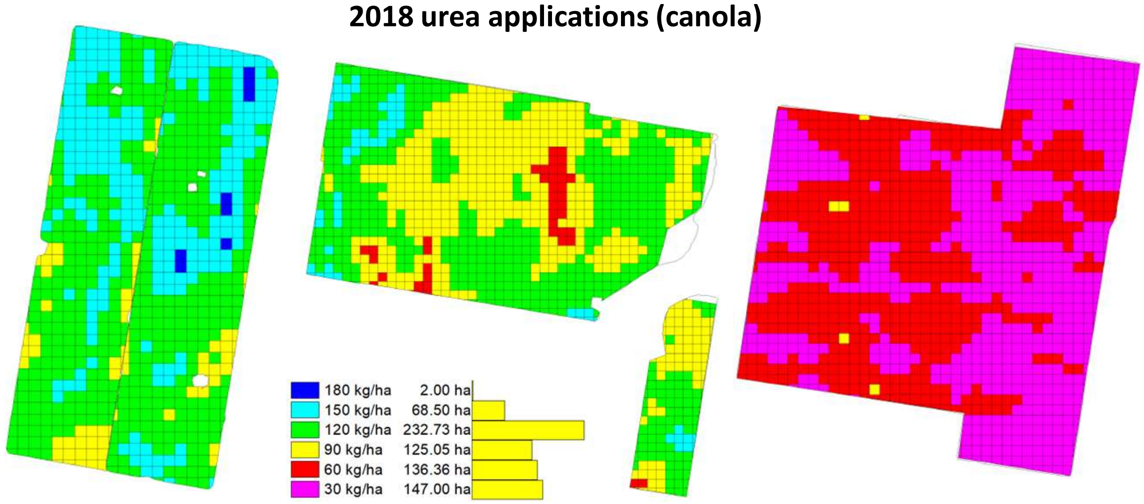
The same magnitude of protein variability is present <u>within</u> each paddock as between the three paddock averages on the previous slide

Urea rates

2017 wheat protein	2018 urea rate
> 13.5%	30 kg/ha
12.5% - 13.5%	60 kg/ha
11.5% - 12.5%	90 kg/ha
10.5% - 11.5%	120 kg/ha
9.5% - 10.5%	150 kg/ha
< 9.5%	180 kg/ha

- Simple formulas used in AFS software (Farmworks) to apply more N to low protein areas and mine excessive N in higher protein areas
- Rates are adjusted depending on the previous season's conditions (i.e., to account for higher protein levels in dry years)
- **Still using the same processes and tools to determine overall average rates (e.g., deep N testing, moisture probe data, etc.) → just tweaking the distribution in-paddock**

2018 urea applications (canola)

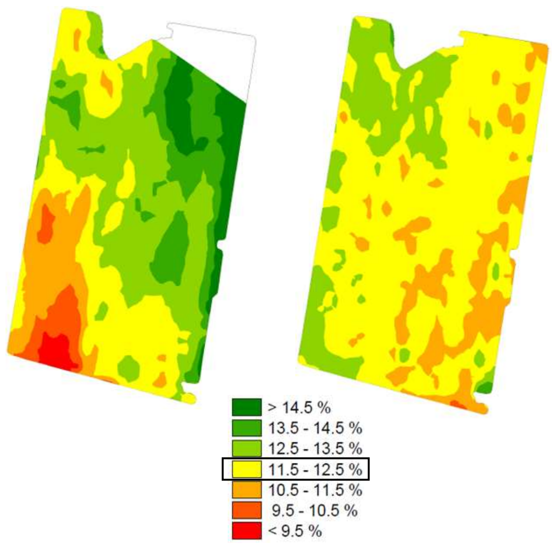


Average rates are similar to initial whole paddock rates, just more targeted

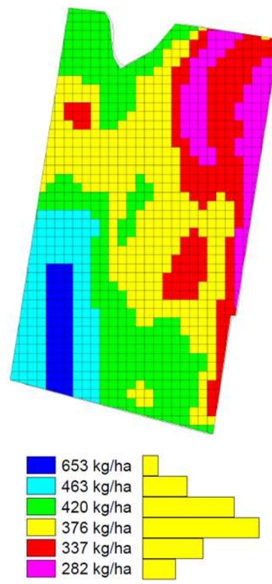
130kg/ha **107kg/ha** **44kg/ha**

Is it working?

2018 wheat protein ⟶ 2020 wheat protein

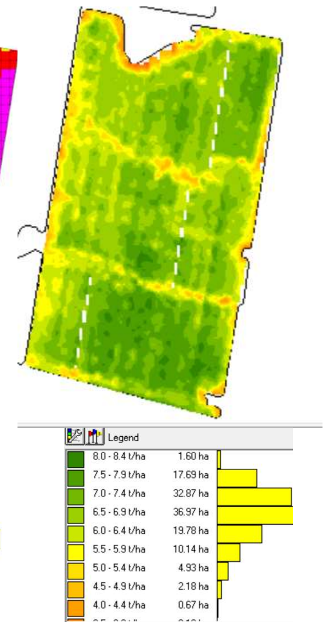


2020 VR urea



(over 3x applications)

2020 yield

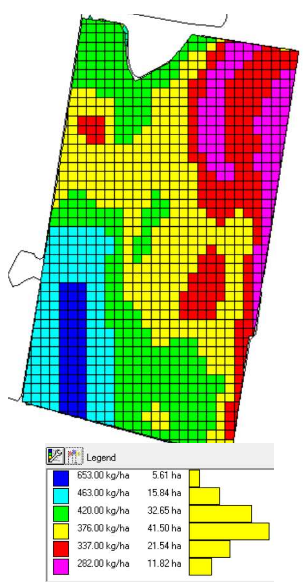


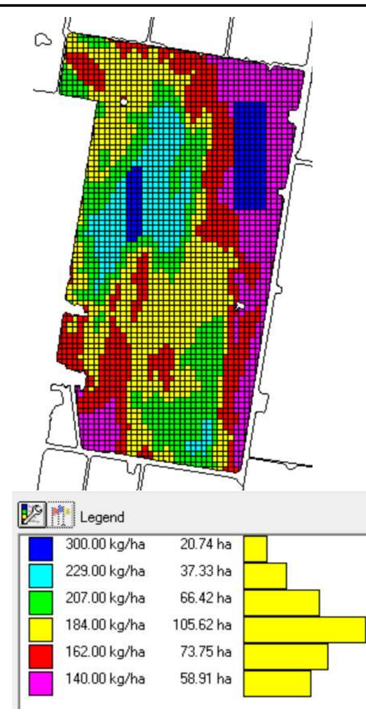
2020 Applications year of big changes

- Almost all paddocks were spread VR
- Rates ranged from 200 to 650kg urea per Ha
- Had avg yield aims, kept increasing as season continued (3, 4.5, 6t/ha)
- Applied VR map 3 times in some paddocks

- VR strategy (11.5-12.5% protein), gained a 0.8 to 1t yield
- That's roughly 20% of high and low protein areas per paddock
- $260/ha ($468,000)

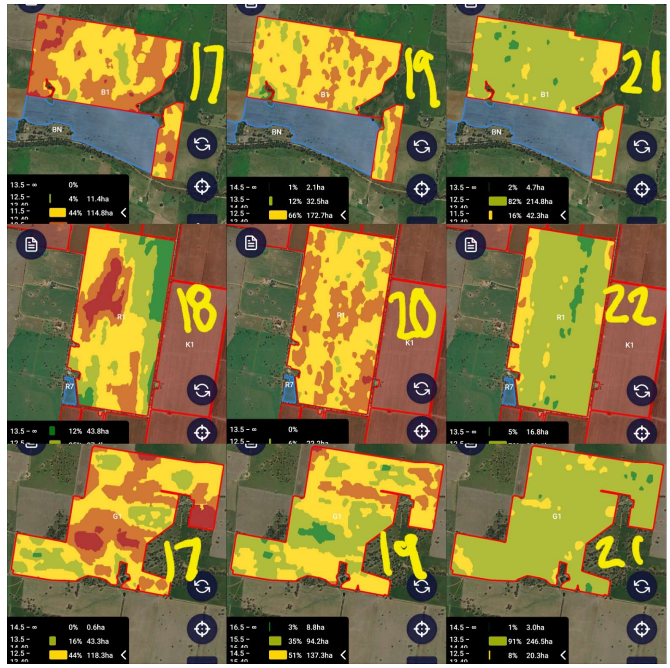
- 2018 maps show 40% was outside the target range of protein
- 3 years to see the results?





Has it worked

- All legends are the same
- Every colour 1% protein
- From 5-6 % variation to now 1-2%
- From variation in yields of 4t to now1-2t



Model vs reality: improving a wheat simulation model with high yielding crop data, and why it matters

Dr Ben Jones, Senior Research Manager, Field Applied Research (FAR) Australia

Take-home:

- Crop simulation models have been fundamental to the development of many recent agronomic techniques.
- To be useful, model behaviour needs to match the behaviour of comparable crops (the "validation" process).
- FAR and other high yielding data is being used to improve the APSIM NextGen wheat model.
- Model developers are working on improving simulation of early growth, storage of nitrogen, and individual cultivar parameters around grain number and weight.
- Adequate interpolated weather data has also been shown a limitation to the use of models in typical Australian high yielding crop areas.

Introduction

Crop simulation models ("models") have become more relevant to growers and advisers, even though they seldom use them directly. They've become the tool of choice to answer "what-if" questions, as researchers and policy-makers use them to extend research results over the long-term, in future climates, or even as research tools in their own right.

> Q: What is a "model"?
>
> A: It's a mathematical representation of the processes in a crop, and the soil underneath. The model we are working with is APSIM NextGen. There are many others.

Models were important to the development of early sowing and grain/graze systems in wheat, N-bank concepts, and estimating and understanding optimum flowering windows and "yield gaps". The APSIM model is behind the "Yield Prophet" service, which if not used directly, has helped many to develop concepts around risk and input application. With such a deep reach into research, development and the setting of policy, it's important that models represent reality well enough. It's also important that users are aware of their limitations.

Since early 2023, FAR Australia has been working on a GRDC-funded project that is improving the performance of the APSIM model on high yielding wheat.

How are models tested and improved?

The process of testing models is known as "validation". Data gathered from real-world crops is compared to the output of the model, set up to simulate the same crop. Ideally the comparison focuses on the relevant aspects of the model. For example, if the model is being used to simulate a nitrogen response, the model output of a nitrogen experiment is compared to measurements on a crop in a real-world nitrogen experiment.

More often, validation has been seeing if a model simulates the differences between environments. This is relatively easy for water-limited crops, where the differences between available water are the main crop-relevant differences between environments. This approach may have obscured sub-optimal model performance in dryland Australia.

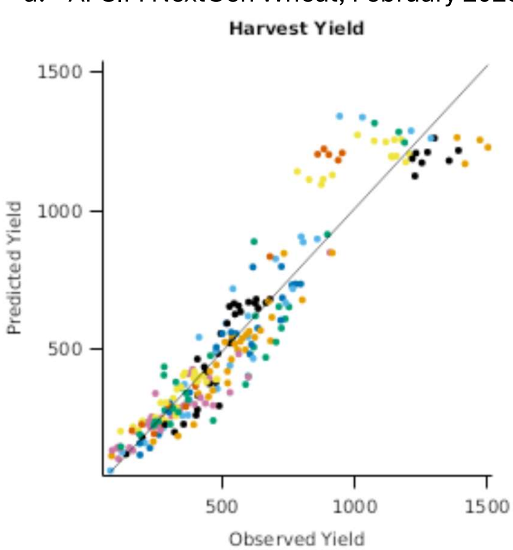
APSIM NextGen: a new model and more rigorous validation

APSIM began (as AUSIM, a CSIRO project) some time before 1989, as an adaptation of the CERES-MAIZE model (released 1983; the first AUSIM paper in turn refers to an early effort at modelling in 1953!). AUSIM persists as APSIM Classic, which underwent many modifications but retained the same essential structure, until its last release in 2018. APSIM NextGen, released in 2014 and updated many times since, was a significant re-think, intended to allow model developers (generally plant scientists) to focus more on how the model performed, and less on the programming.

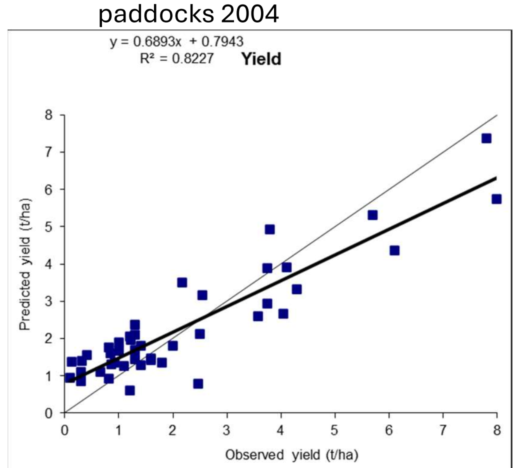
A major change with APSIM NextGen was the assembly (and regular publication and updating) of a comprehensive validation dataset. The author of the new wheat model was also involved in New Zealand higher yielding wheat experiments. These were included in the validation set, in turn exposing the new model's rather poor performance at high yields (Figure 1a). The validation figure is how this project came about.

It's worth noting that no similarly comprehensive validation has been done for APSIM Classic, but two examples from the Yield Prophet dataset illustrate the range of possibilities, from "not bad" (2004; Figure 1b) to "not so good" (2009; Figure 1c).

a. APSIM NextGen Wheat, February 2023



b. APSIM Classic 7.10 Yield Prophet paddocks 2004



c. APSIM Classic 7.10 Yield Prophet paddocks 2009

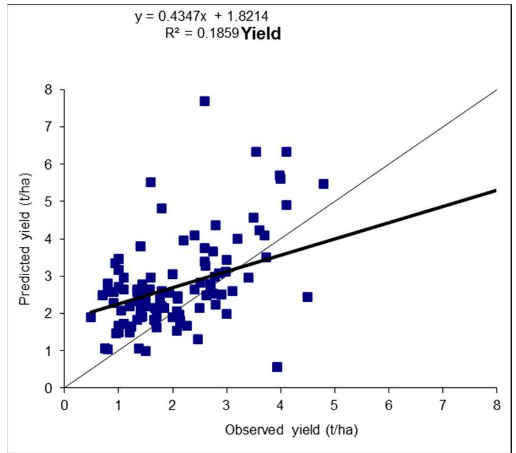


Figure 1. APSIM Yield validations for NextGen Wheat (a), and Classic 7.10 for Yield Prophet paddocks in 2004 (b) and 2009 (c).

More validation data and a closer look

This project has assembled FAR wheat experimental data between 2016 and 2023, from some intensively measured Lincoln University (New Zealand) field experiments in 2021 and 2023, and an experimental program with a nitrogen focus 2005-7 at Lincoln and also in the UK. Where possible, the experimental data has been paired with APSIM simulations to check model performance. What have we learnt?

NZ and Aust high yielding environments aren't that different

High yield environments in Australia (Tasmania) are similar to world record wheat growing environments in New Zealand, with favourable solar radiation and temperature in November/December, and also irrigation (Figure 2). South west Vic is a bit too warm, and cloudy, and elevated regions of central NSW offer abundant solar radiation at low temperature, but with a much higher risk of damaging temperatures during grain-fill (not shown).

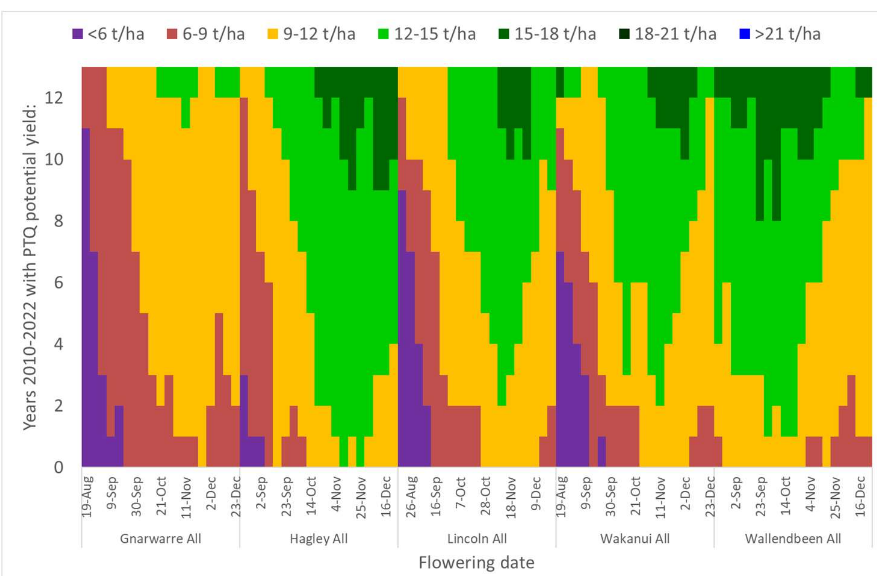


Figure 2. Distribution of potential yields determined by solar radiation and temperature (PTQ; PhotoThermal Quotient) in the 30 days before flowering for a range of flowering

weeks, 2010-2022. Colours show different yield potentials. Distributions for FAR sites in Vic (Gnarwarre), Tas (Hagley) and NSW (Wallendbeen), Lincoln University, and world record wheat locality Wakanui (NZ).

Early growth performance is poor

The existing APSIM NextGen wheat model under-estimates canopy development (whether measured by NDVI, green ground cover, or crop biomass). In the example for a 2021 time of sowing experiment at Lincoln (Figure 3), simulated NDVI lags actual NDVI considerably, and then persists well past canopy senescence. This has likely not been such an issue for crops that are mostly water-limited.

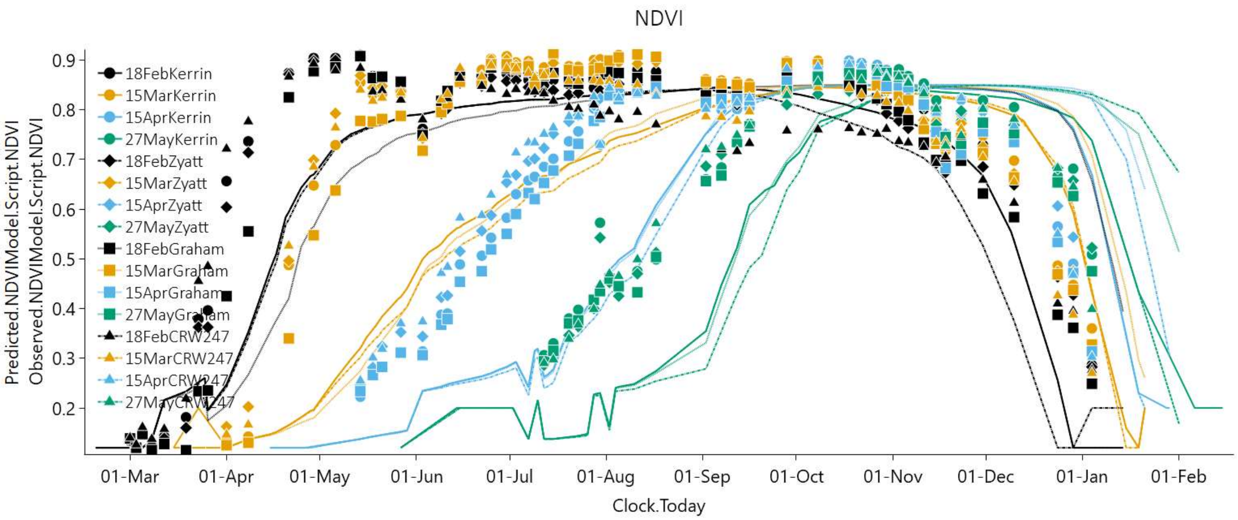


Figure 3. Observed (symbols) vs simulated (lines) canopy development, as measured by NDVI, in the 2021 Lincoln cultivar x time of sowing experiment. Data from Webb (unpublished); existing APSIM wheat model.

The effect of sub-zero temperatures on development isn't well simulated

Plant development slows and stops as temperature goes below a certain threshold (often assumed to be 0°C). Usual available weather data for modelling only contains a minimum and maximum temperature for the day, so the model needs an interpolation method to estimate the variation in temperature through the day, and hence the amount of plant development that occurs.

In 2023 Lincoln data, main stem leaf number aligned well with model predictions, diverged during a period with sub-zero night temperatures, and returned to alignment afterwards (not shown). This is will likely be fixed by adapting the within-day temperature interpolation method.

Interpolated temperature data for coastal regions in Australia tends to be poor

The main source of weather data for modelling studies in recent decades has been "Silo" (Queensland DPI). The "Silo" service takes Bureau of Meteorology Automatic

Weather Station (and other) temperature, rainfall, solar radiation and humidity data and interpolates it to a 0.05 x 0.05 degree latitude/longitude grid.

The interpolation method assumes that points that are closer are similar. This works well inland, but between inland weather stations and coastal stations, tends to over-estimate the effect of coastal warmth on temperatures inland. On the August 1 2024 frost event (Figure 4), interpolated temperatures (the background colours) are >1°C warmer than the inland weather stations, and some five degrees warmer than our on-site weather station at Gnarwarre (-2.9°C).

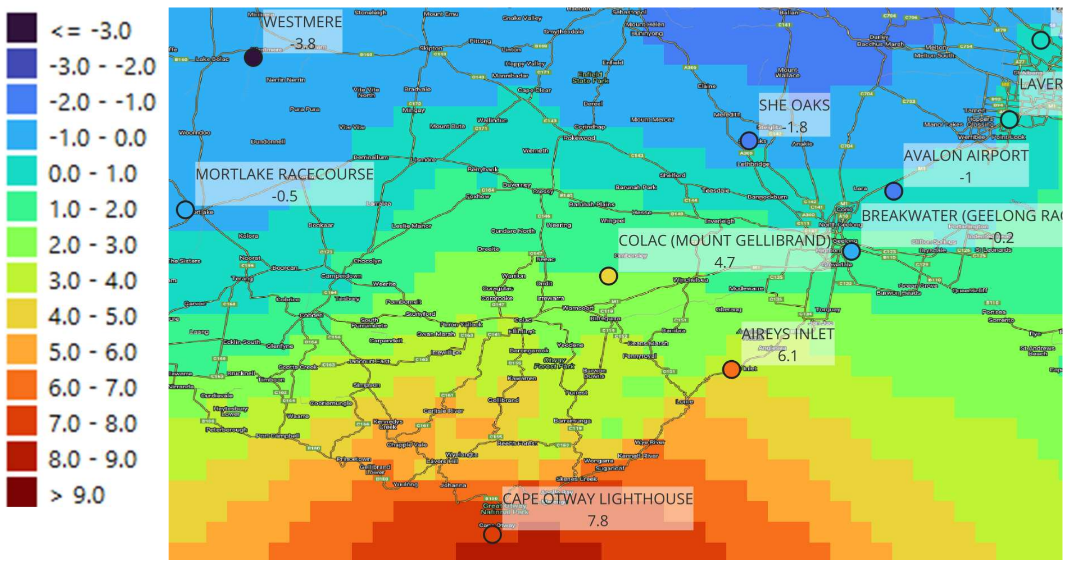


Figure 4. Interpolated minimum temperatures from "Silo" (map colours) for August 1, 2024. Actual BOM Automatic Weather Station minimum temperatures are shown on the labels, and with the same legend.

A cost to nitrogen storage during grain-set may be needed in the model

The 2024 Lincoln experiment focuses on nitrogen. As part of the preparation for this, we have done a combined analysis of all of the FAR nitrogen experiments between 2016 and 2023. This has shown that for crops yielding more than 9 t/ha, excess nitrogen application leads to reduced yield, at rates up to 15 kg grain/kg N. The mechanism for this is likely related to competition between carbohydrate required for nitrogen storage and grain set, but a similar mechanism is not present in APSIM.

Variation in cultivar grain number and weight could do with more rigorous study

APSIM cultivars have parameters for setting grain number and individual grain weight, but these have been set in a fairly ad-hoc way. When, for example, the default maximum grain weight (50 mg/grain, dry basis) is compared to the observed range, it is often different. There is scope to define these parameters in a meaningful way, perhaps using NVT data.

Conclusion

When models are being used to develop or test the effectiveness of real-world practices, it's important to validate the mechanisms in the model that will drive the results.

The current APSIM NextGen wheat model suffers from some serious limitations in simulating high yielding wheat crops.

Any analysis that relies on interpolated weather data in Australian high yielding environments will also be seriously affected by limitations caused by the way the interpolation is done.

The project (and others) are addressing these limitations and should result in more valid use of models in areas of Australia where high yielding wheat is grown.

‘Growers Leading Change’
Hyper Profitable Crops

Overview:
the Hyper Profitable Crops (HPC) initiative is a new GRDC investment aimed at significantly boosting on-farm profitability for wheat and barley growers in Australia's high rainfall zones. Despite the progress made by previous research initiatives, a considerable gap remains between actual crop yields and the potential profitability in these regions. The HPC initiative seeks to bridge this gap by putting cutting-edge research into practice on the farm, enabling a wide range of growers to enhance their profitability.

Project Goals:
Building on the success of earlier GRDC Hyper Yielding Crops investment, which demonstrated improved crop water use efficiency and higher yields through informed decisions on variety, sowing date, fertiliser, and disease management, the HPC initiative will focus on translating this knowledge into actionable strategies for growers. The ultimate goal is to equip wheat and barley growers in high rainfall environments with the motivation, agronomic support, and expertise needed to close the yield gap while maximising profit by April 30, 2027.

Innovation and Benchmarking Hubs:
Central to the initiative are seven innovation and benchmarking hubs strategically located across key high rainfall zones, including the South Coast of Western Australia, South-eastern South Australia, Southern Victoria, Tasmania, and Southern New South Wales. These hubs will act as centres for knowledge exchange, facilitated discussions, and hands-on crop inspections. They will enable growers to learn from each other and explore and implement innovative agronomic practices that can lead to increased, on-farm profitability.

Discussion Groups and On-Farm Benchmarking:
As part of the HPC initiative, 17 discussion groups have been established across the high rainfall zones. These groups aim to not only boost on-farm profitability but also build confidence among Generation Y growers and advisors, who will play a pivotal role in leading change within their regions. Through on-farm benchmarking of paddock performance and smaller HPC-specific trial programs, growers will have the opportunity to refine their management practices, optimise crop yields, and achieve more profitable outcomes.

Collaboration and Support:
FAR Australia has partnered with regional farming systems groups to provide dedicated project officers in each region. These officers will work closely with farmers and agronomists to collect input and operational data, which will be costed generically per region using the Agworld data platform. Importantly, no individual financial data will be requested from participating growers. In addition to this support, the initiative will

produce a comprehensive high rainfall zone cropping manual, offering valuable insights and case studies to guide future decision-making.

How to get Involved:

To become involved in the Hyper Profitable Crops initiative, growers can contact the HPC Project Officer in their respective region:

- Southern Farming Systems:
    - (VIC) Ashley Amourgis (aamourgis@sfs.org.au) or Greta Duff (gduff@sfs.org.au)
    - (TAS) Brett Davey (bdavey@sfs.org.au)
- Stirlings to Coast Farmers: Dan Fay (dan.fay@scfarmers.org.au)
- South East Premium Wheat Growers Association (SEPWA): David Cook (david@sepwa.org.au)
- Farmlink: Caroline Keeton (caroline@farmlink.com.au)
- Riverine Plains Inc: Kate Coffey (kate@riverineplains.org.au)
- Mackillop Farm Management Group: Gina Kreeck (research@mackillopgroup.com.au)

Project Leadership:

The HPC initiative is led by Rachel Hamilton of FAR Australia, supported by a technical team including Dr. Ben Jones, Darcy Warren, Tom Price and Nick Poole.

For further information, please contact Rachel Hamilton at rachel.hamilton@faraustralia.com.au.

FAR Australia has collaborated with the following organisations:

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