TASMANIA HYC RESEARCH CENTRE

FAR AUSTRALIA

Industry Innovations

leading the way to a brighter grains industry

FIELD DAY

INCREASING PRODUCTIVITY & PROFITABILITY IN THE TAS HRZ

Thursday 21st November 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

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SOWING THE SEED FOR A BRIGHTER FUTURE

Thanks to our host farmer Botanical Resources Australia

TASMANIA HYC RESEARCH CENTRE

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TIMETABLE

TAS CROP TECHNOLOGY CENTRE FIELD DAY
THURSDAY 21 NOVEMBER 2024

FAR AUSTRALIA

Thanks to our lunch and post event refreshments sponsor: AGF seeds

Session #	In-field presentations (cereals)	Station #	1:00	1:30	2:00	2:30	3:00	3:30	4:15
1	**Anthony Kakafilas-Bek, Malt Barley Merchant, BOORTMALT** Anthony will share his views on the current malting market and what effect this is having on growers inTasmania.	1	Coffee and registration followed by opening address by Dr Ben Jones, FAR Australia Senior Research Manager						Closing address and post event refreshments kindly sponsored by BOORTMALT
2	**Daniel Bosveld, FAR Australia** What wheat will you be growing in 2025? Daniel will cover the latest results from the germplasm evaluation network (GEN).	2							
3	**Dr Ben Jones, FAR Australia** Crop physiology: Ben continues his look at the physiology underlying high yields in Tasmania.	3							
	Daniel Bosveld, FAR Australia Daniel will share which barley varieties have been performing so far spring sown.	4							
4	**Dr Ben Jones will be joined by Terry Horan, Angus Lyne, James Clutterbuck and Michael Nicholls for a facilitated discussion:** As the nation's economy moves to ways to reduce emissions where do we stand with crop profitability in Tasmania with our new GRDC Hyper Profitable Crops project?	5							
	In-field presentations	**Station #**	**1:00**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**	**4:15**

VISITOR INFORMATION

We trust that you will enjoy your day with us at our Tasmania 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.

TASMANIA HYC RESEARCH CENTRE

INCREASING PRODUCTIVITY AND PROFITABILITY IN THE TAS HRZ

FEATURING INDUSTRY INNOVATIONS

Whilst I must apologise for my absence today, on behalf of myself and the FAR Australia team, I am delighted to welcome you to our 2024 SA Crop Technology Centre Field Day featuring Industry Innovations covering cereal 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.
- 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 guest speaker Anthony Kakafilas-Bek, Malt Barley Merchant, BOORTMALT. Anthony will share his views on the current malting market and what effect this is having on growers in Tasmania.

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 farmer Botanical Resources Australia for their tremendous practical support given to our team, and to today's sponsors AGF Seeds and Boortmalt.

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

7

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SW & Central Vic, SE SA, Murray NSW & Tas
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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

FAR Field Day 2024

Anthony Kakafikas-Bek 14/11/2024

Boortmalt is a global malting company with malting assets all over the world. The company has 27 malting plants in total including Argentina, North America, Africa, Europe and Australia. These 27 plants spanning 5 continents gives the company a production capacity of 3 million metric tonnes of malted barley per year.

In addition we have two innovation centers that have pilot malting and pilot brewing facilities as well as food ingredient capabilities. This allows us to offer innovative malts, such as, infusion malt (malt infused with desirable flavors).

Within Australia there are a total of 7 plants. Western Australia is home to our largest plant, producing 211kmt of malt per year. We also have 2 plants in South Australia, 2 plants in New South Wales, 1 in Victoria and 1 in Tasmania. Combined, these plants produce a total of 550k of malt tonnes which is equivalent to 650kmt of raw barley. There is also a technical center in Sydney which is where we send all of the samples of malt, in this center we are able to micro malt and test samples of barley from around Australia. This allows us to get an idea of how the barley will react when we put it into the malting process

The Devonport plant was opened in 1967 and is a drum malting plant. The plant has 3 of these drums, with each drum producing around 25mt giving a total production of 6000mt of malt per year, equating to 7200mt of barley. The plant also has 2 large sheds which have the capacity to hold 3000mt of barley each. This means that we need to balance the incoming barley to aim for an overall similar specifications in the shed.

Before malting of the barley can be done, the grain must germinate. After harvest the barley goes into dormancy which can last for up to 3 months. This means after harvest in what month we are unable to use the new season's crop until April.

The process of malting
The barley is subjected to single or multiple phases of steeping in water in a specially designed steeping vessel.

Duration: 2 days.
Purpose: hydrate the embryo.
Process: Moisten the grain until its moisture content reaches 45%. Steeping is done via immersion or spraying, accompanied by oxygenation to allow the grain to breathe.

Step 2: Germination
The chitted barley is placed on perforated floors to promote germination of the grain. This is controlled (temperature 15 to 18°C, humidification, ventilation) and the complete bed of grain is turned at regular intervals to prevent matting.

Duration: 4 to 5 days.
Purpose: develop the necessary enzymes to change the structure of the barley endosperm, the degradation of the Β glucans and creation of a well modified malt.
Process: The grain is spread out and ventilated on "beds" in a warm, humid atmosphere. The barley embryo continues its development, undergoing biochemical changes that result in the liberation and activation of enzymes from the endosperm. This then leaves us with "Green Malt".

Step 3: Kilning
The green malt is placed on a perforated floor and dried by blowing controlled volumes of heated air through the grain, using a product specific kilning recipe.
Duration: 1 to 2 days.
Purpose: Stop the germination, dry the malt while preserving the enzymatic activity, develop the colour and aroma of the malt.
Process: The malt is dried in hot air to accelerate enzyme production, to stop the germination of the grain and the enzymatic activity and to create a stable product by lowering the moisture content to 4%.

This is the process of producing malt from barley.

One of the big factors for malting barley is the quality of the barley. For the best malt production, we aim to have homogeneous barley going into the malting process as this allows the best quality malt to be produced.

Different barley varieties respond differently to malting the 'levers'; time, temperature, and water. Since as we don't have many production factors which can be adjusted, it is important that we acquire homogonous barley in order to produce a high-quality product.

How the market has changed for malting barley in Tasmania.
Through the more recent years, there has been a shift in the market globally. We have seen a downward trend in total per capita volume consumption of beer, however, increase in premiumisation of beer. Premium beers use more malt Kg/Hl of beer, eg craftbrewer may use 20kg/hl where as a corporate may use 10kg/hl and low quality beer may be as low as 6kg/hl.

Craft brewers like to tell a story so origin & sustainability is important, they also use to producing variable flavored beers so they have more flexibility. Corporates have very strict specifications and whilst they brand themselves as local are careful to ensure they always have malt supply and so origin is not as important.

The distilling market is growing, and we are drawing on Boortmalt global insights and experience to develop Devonport Tasmania as a credible supplier. This has led there to be an increase in the use of Tasmanian malt for distilling customers. This has been a large growth area for Boortmalt, and is opening the door to new markets, as the origin of the barley is big factor for the distillers. This opportunity for distilling malt for use both locally Tasmania as well as for export to countries such as Japan and Korea.

Following on from this, there needs to be a focus on meeting the specification for these distillers to allow for this opportunity to flourish. This means that we need to be using a non-glycosidic nitriles (GN) barley variety. Glycosidic nitriles, whilst harmless in the malting process, can catalyse in the distilling process, forming a carcinogen. This is where the variety which we have been working with, Firefoxx comes in, as this is a non-GN variety.
Another factor which needs to be noted is the maximum residue limits (MRL) for some of these countries. For example, countries such as Korea have a nil tolerance to diquat. This means it cannot be used as a desiccant for the barley if the intended use is export.

We hope to continue working with the farmers of Tasmania to produce the highest quality malting and distilling barley we can.

Boortmalt Asia Pacific Pty Ltd
ABN 62 004 287 352
Level 11, 28 Freshwater Place
Southbank, Victoria 3006

GERMPLASM

evaluation network (GEN)

your trusted research partner for germplasm evaluation

FAR AUSTRALIA

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

An Industry Innovations (II) initiative

Industry Innovations
leading the way to a brighter grains industry

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.

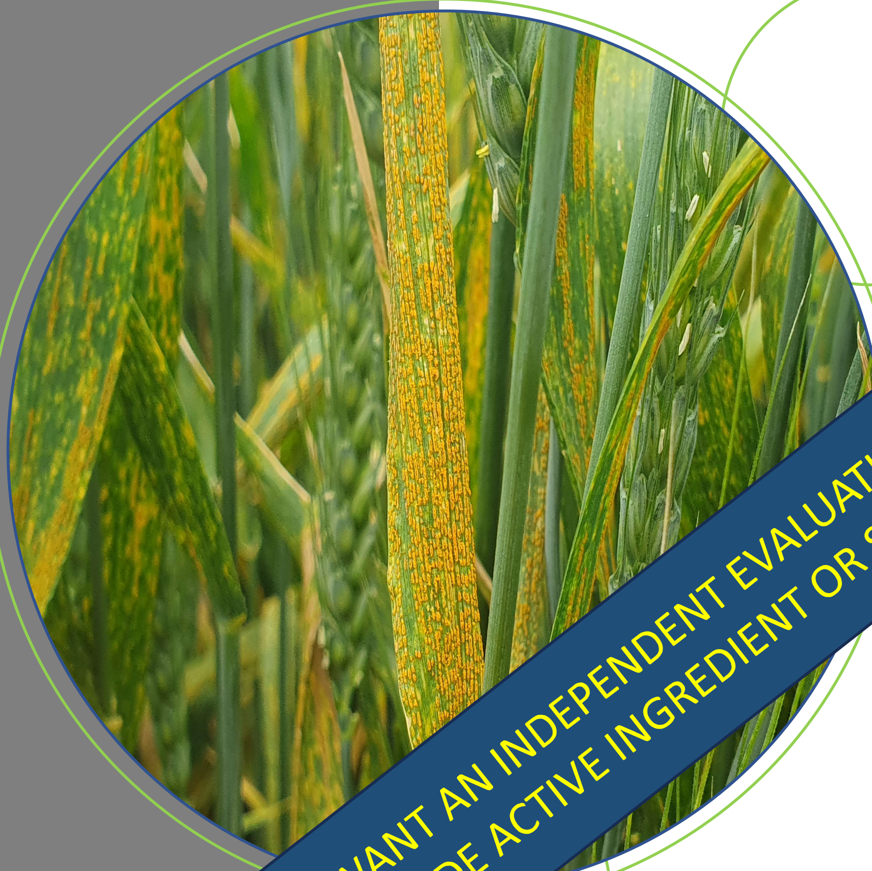
All trial results will be reported to the breeders within 21 days of harvest. FAR Australia will report results of all trials to the wider industry after all breeders have been informed of their results.

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

FUNGICIDE FINGERPRINTING

an independent fungicide evaluation network



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

FAR AUSTRALIA

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

The Tasmania Wheat Germplasm Evaluation (GEN) Network Trial Results

Nick Poole[1], Daniel Bosveld[1], & Darcy Warren[1]
[1] Field Applied Research (FAR) Australia

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

Key Points:

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

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

Table 1. Influence of fungicide on the grain yield (t/ha) of wheat cultivars plus and minus fungicide.

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

Note: w = Winter Wheat, s = Spring Wheat

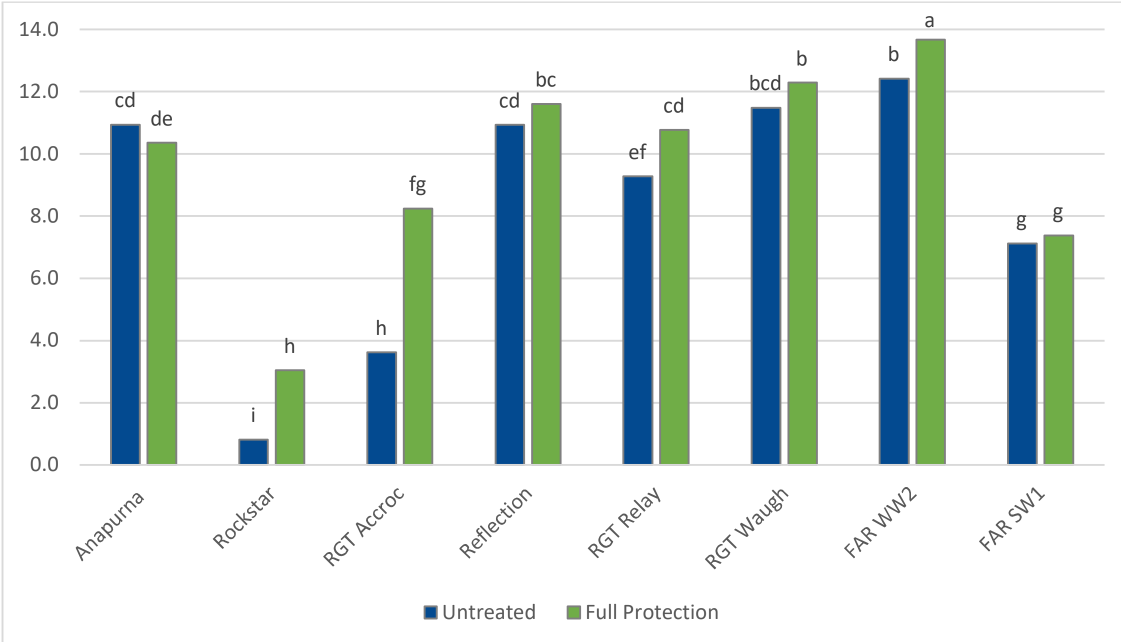


Figure 1. Influence of cultivar and fungicide on grain yield (t/ha), harvested on 26 January.

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

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

Table 3. Influence of fungicide and cultivar on the screenings (% < 2.2mm) of wheat cultivars (26 January) and the effect of cultivar on phenology (10 November).

	10 November	Management Level				
	Growth Stage	Untreated		Full protection		Mean
Cultivar	Zadoks 0-100	Screenings %		Screenings %		Screenings %
Anapurna	59	2.5	c-g	2.1	efg	**2.3**
Rockstar	65	9.6	a	5.1	b	**7.3**
RGT Accroc	59	5.0	b	1.7	g	**3.4**
Reflection	37	5.2	b	5.6	b	**5.4**
RGT Relay	38	3.3	c	3.2	cd	**3.2**
RGT Waugh	42	2.3	d-g	1.9	fg	**2.1**
FAR WW2	55	2.8	cde	2.7	c-f	**2.7**
FAR SW1	39	2.9	cde	3.3	c	**3.1**
	Mean	**4.2**		**3.2**		**3.7**
	Cultivar	**LSD p = 0.05**	0.63	**P val**		<0.001
	Management	**LSD p = 0.05**	0.49	**P val**		0.007
	Cultivar x Man.	**LSD p = 0.05**	0.89	**P val**		<0.001

Disease Assessment data

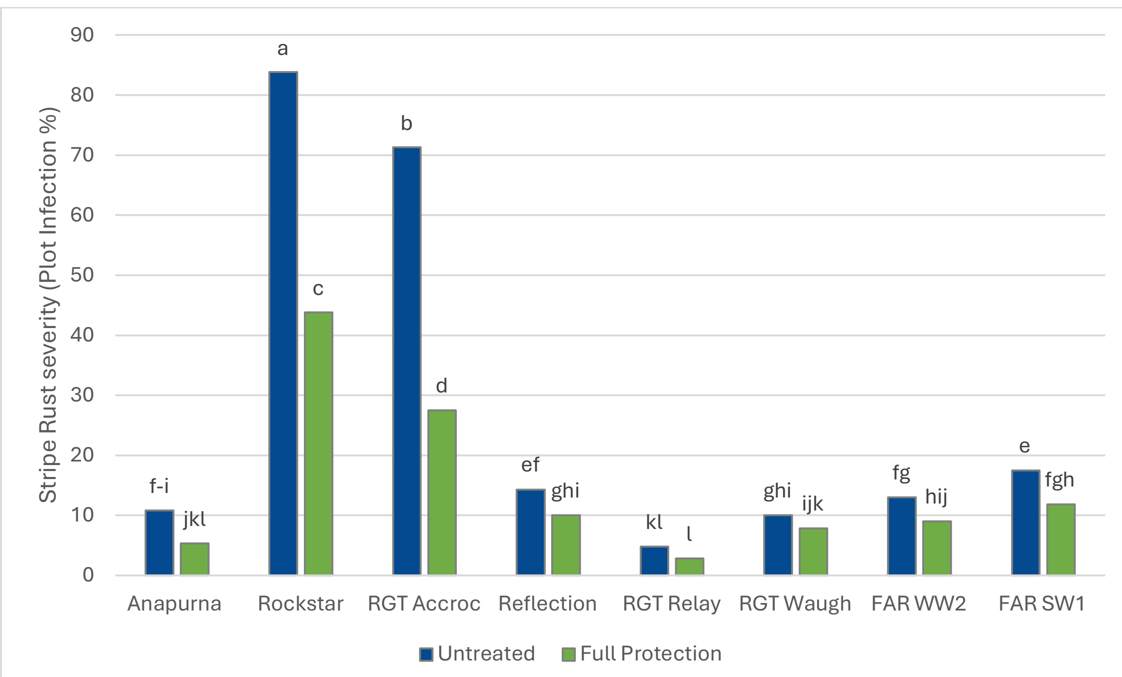


Figure 2. Influence of variety and fungicide management on Stripe Rust severity, assessed on 11 October 2023.

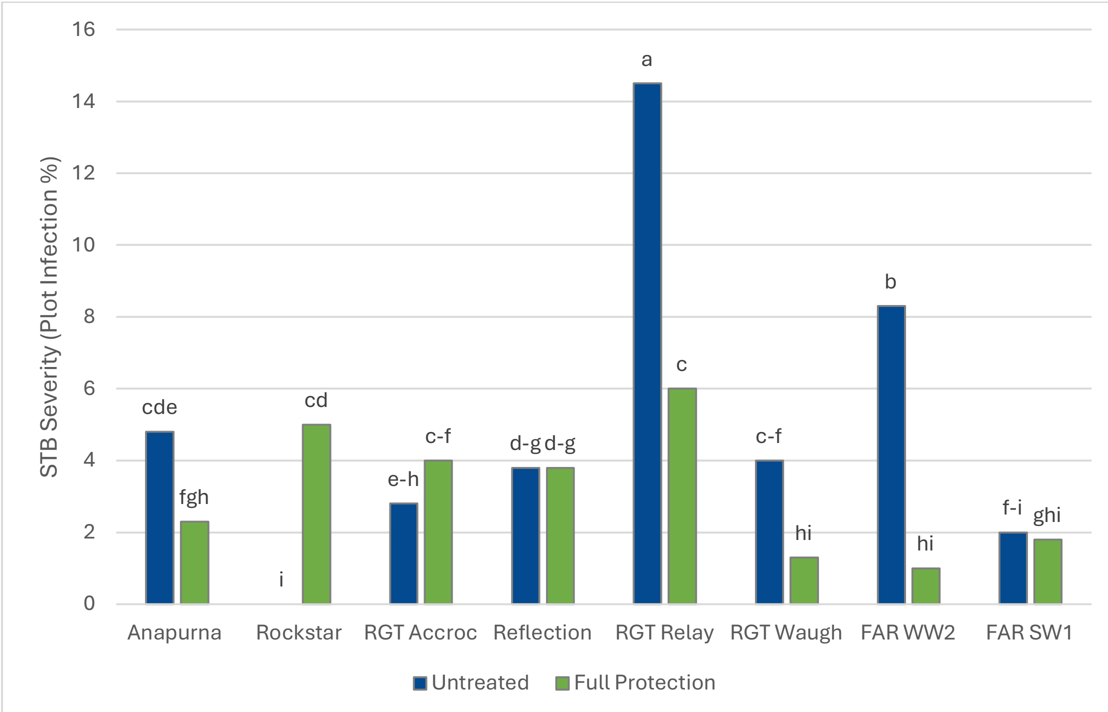


Figure 3. Influence of variety and fungicide management on Septoria tritici blotch (STB) severity, assessed on 11 October 2023.

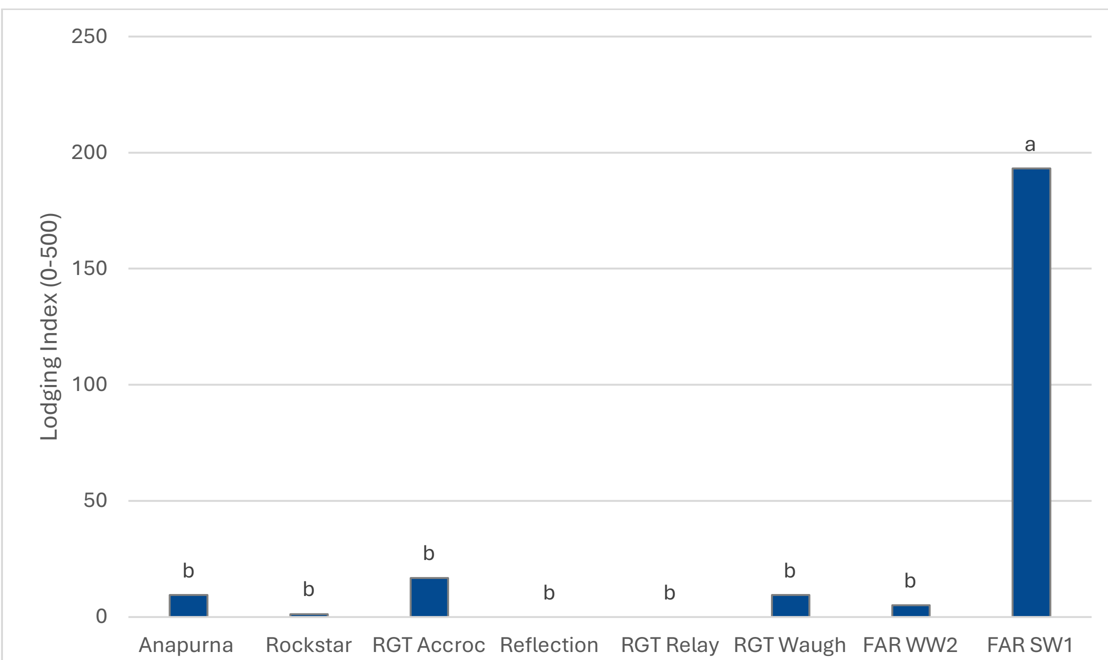


Figure 4. Influence of variety on lodging index (0-500), assessed on 26 January 2024 at harvest maturity.

Trial Inputs

Table 4. Trial input and management details (kg, g, ml/ha).

Sowing date:		**26 April**	
Harvest date:		**26 January**	
Seed rate:		180 seeds/m2	
Basal fertiliser:		100 kg MAP	
Nitrogen:	28 July	46 kg N/ha	
	29 Aug	92 kg N/ha	
Fungicide:		**Untreated**	**Full Protection**
	GS31	----	Opus 0.50 L/ha
	GS39	----	Radial 0.84 L/ha
	GS59-61	----	Prosaro 0.30 L/ha

Weather data 2023 - Hagley, Tas

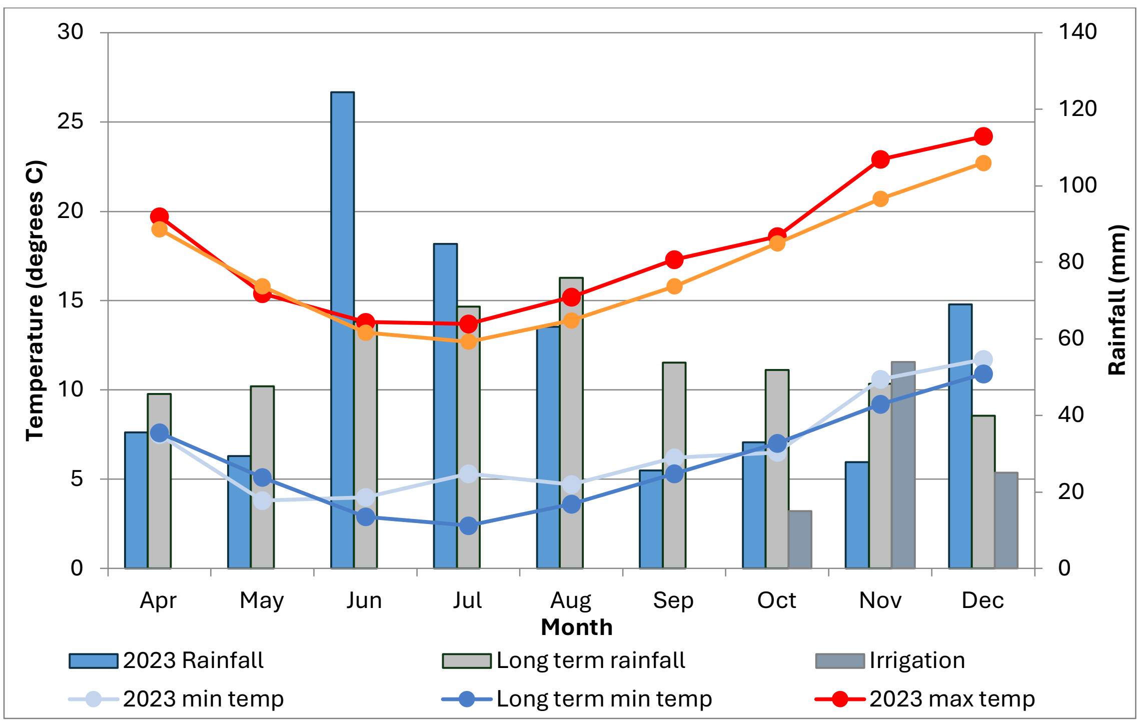


Figure 5. 2023 growing season rainfall and long-term rainfall recorded at Strathbridge (Meander River) (1985 -2023) and long-term min and max temperatures recorded at Launceston (Ti Tree Bend) (1980 to 2023) for the growing season (April to December). *Rainfall and irrigation April to December = 586.8mm.*

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 Australia 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.

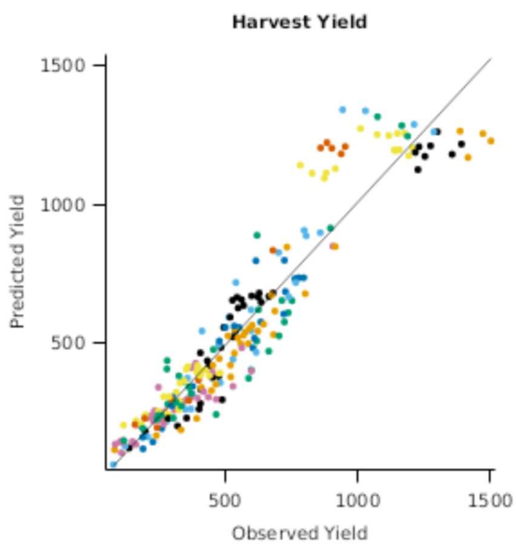
APSIM NextGen: a new model and more rigorous validation

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.

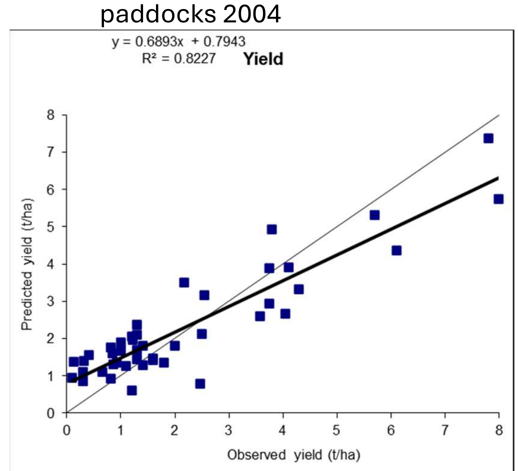
A major change with APSIM NextGen was the assembly (and regular publication and updating) of a comprehensive validation dataset. The author of the new wheat model was also involved in New Zealand higher yielding wheat experiments. These were included in the validation set, in turn exposing the new model's 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

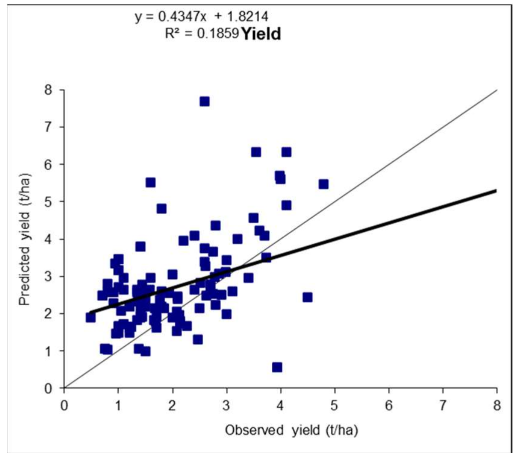


Figure 1. APSIM Yield validations for NextGen Wheat (a), and Classic 7.10 for Yield Prophet paddocks in 2004 (b) and 2009 (c).

More validation data and a closer look

This project has assembled FAR Australia 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).

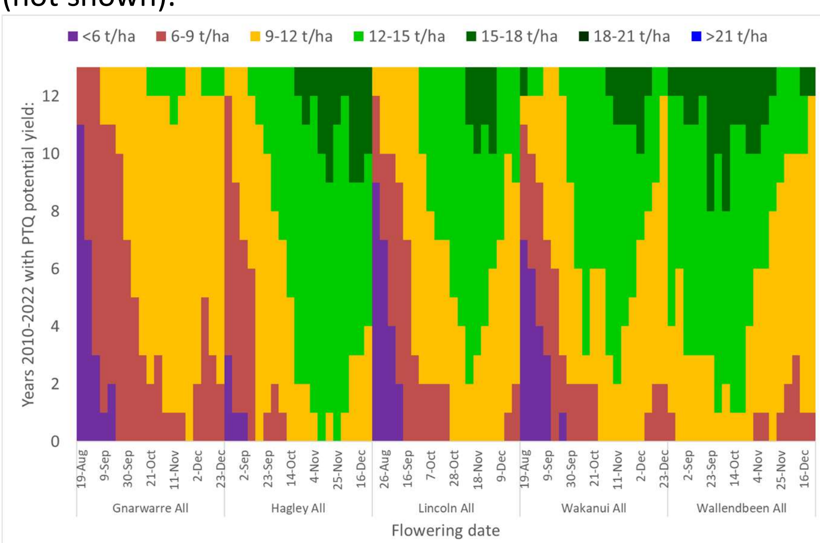


Figure 2. Distribution of potential yields determined by solar radiation and temperature (PTQ; PhotoThermal Quotient) in the 30 days before flowering for a range of flowering weeks, 2010-2022. Colours show different yield potentials. Distributions for FAR Australia sites in Vic (Gnarwarre), Tas (Hagley) 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.

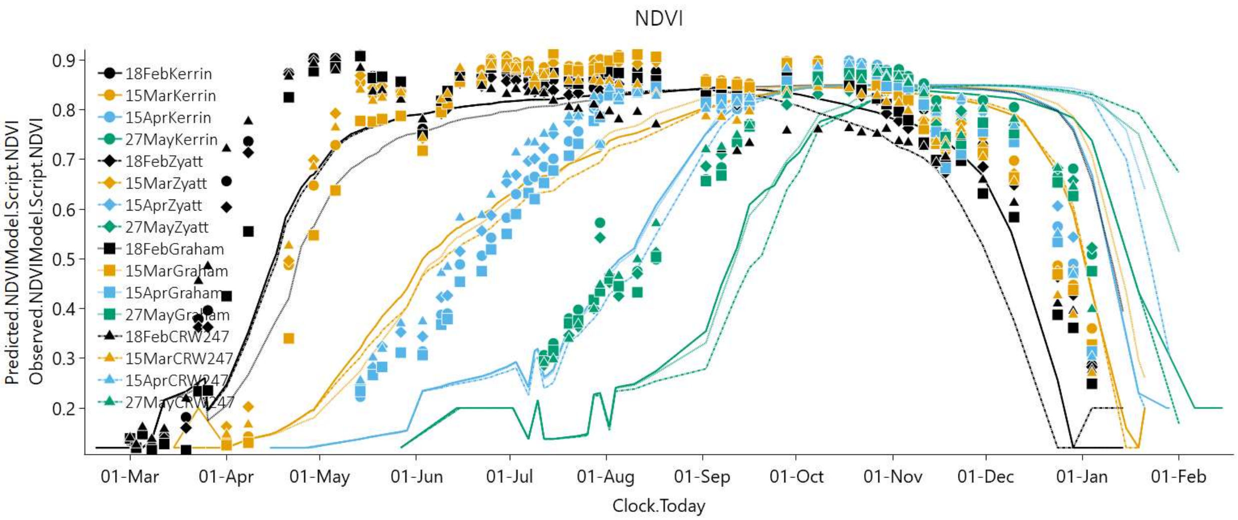


Figure 3. Observed (symbols) vs simulated (lines) canopy development, as measured by NDVI, in the 2021 Lincoln cultivar x time of sowing experiment. Data from Webb (unpublished); existing APSIM wheat model.

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 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).

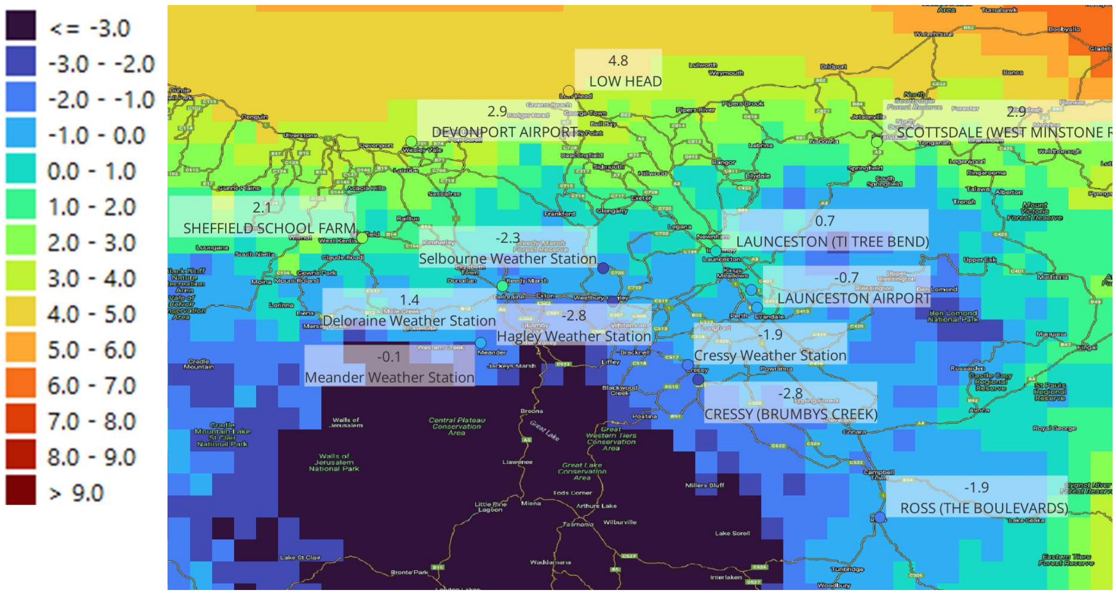


Figure 4. Interpolated minimum temperatures from "Silo" (map colours) for August 1, 2024. Actual BOM Automatic Weather Station (ALL CAPS) and AgLogic Weather Station minimum temperatures are shown on the labels. Points have the same legend as the image.

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 Australia 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.

The primary role of Field Applied Research (FAR) Australia is to apply science innovations to profitable outcomes for Australian grain growers. Located across three hubs nationally, FAR Australia staff have the skills and expertise to provide 'concept to delivery' applied science innovations through excellence in applied field research, and interpretation of this research for adoption on farm.

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SOWING THE SEED FOR A BRIGHTER FUTURE

HYC Spring-Sown Barley Lessons

Darcy Warren[1], Nick Poole[1], Brett Davey[2] & Daniel Bosveld[1]
[1] Field Applied Research (FAR) Australia [2]Southern Farming Systems

Key point summary

- Results from the Hyper Yielding Crops Project demonstrated that the intensity of inputs needed to grow spring-sown barley, particularly PGR and fungicide, are far less intense than needed in an autumn sown crop.
- HYC trials conducted between 2020 and 2023 in Hagley have not shown any response to fungicide in spring sown barley. However, there was a significant response to fungicide across the varieties grown in FAR Australia's Industry Innovation GEN trial in 2023, principally as a result of net form of net blotch (NFNB) infection (depending on variety).
- Higher levels of lodging were recorded in 2023 compared to the 2020- 2022 seasons where very limited lodging was observed.
- The highest barley yields on site, and the highest recorded in the HYC project, were achieved under the harvested on-time 'European' approach. Laureate under this management yielded 13.68t/ha and RGT Planet yielded 13.21t/ha. These plots were the only plots in this trial not to have experienced high levels of lodging and brackling

Background

Unique to the Tasmania HYC site, spring-sown European and Australian bred barley cultivars were tested under Tasmanian conditions across four seasons (2020/21-2023/24) with management variabilities focused on disease, plant growth regulators (PGRs), seed rate, and nutrition. Yields of well adapted photoperiod insensitive varieties consistently exceeded 10t/ha across the four seasons, and up to 13.68t/ha in research plots in 2023. The crops were key in illustrating that spring sown barley crops have lower input requirements than their autumn sown counterparts. This yield achieved by Laureate in 2023 likely represents a new benchmark for spring-sown barley in Australia (Figure 1).

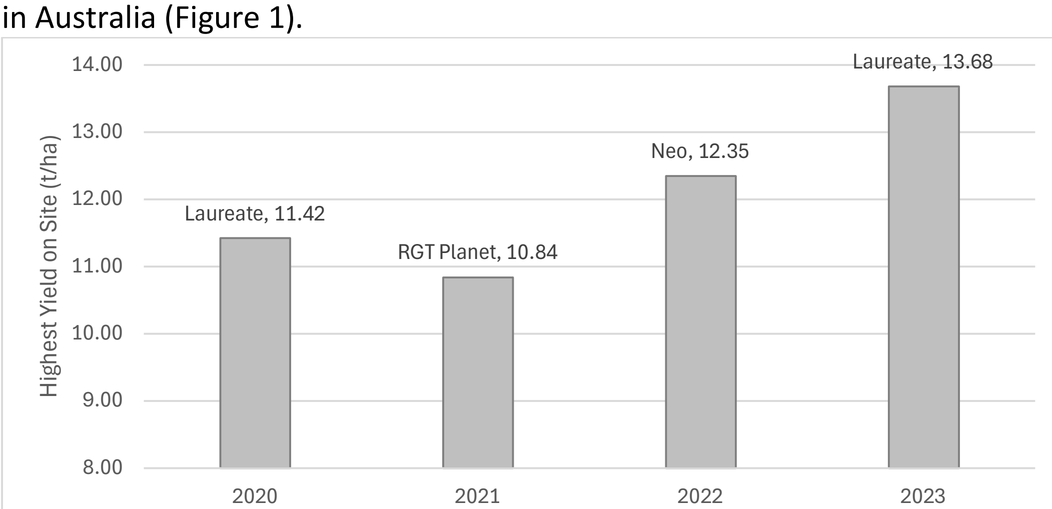

Figure 1. Highest spring-sown (early September) barley yields on site in each year at the Tasmania HYC irrigated research site.

Disease management

Results from the 2023 disease management trial (cv. RGT Planet) again showcased the reduced disease pressure that comes with spring sown barley. When compared to results from the Tasmanian 'Hyper Yielding Cereals' project (2016-2020) and autumn sown trials on the mainland, RGT Planet's biggest 'Achilles heel' is disease and therefore calls for an extremely robust fungicide program. At the Victoria HYC site, yields were improved by 1.34t/ha between the untreated and the best yielding fungicide managed plots.

With the reduced growing season period and quicker development of the crop, no significant yield differences were found in 2023/24 in response to fungicide (Table 1). This is despite low levels of Net form of net blotch (NFNB) being found in the trial.

Table 1. Influence of fungicide management on grain yield (t/ha) – sown Sept 6.

	Treatments				Yield	
	GS00	**GS31**	**GS39-49**	**GS59**	**t/ha**	
1	---	---	---	---	11.10	-
2	Systiva	---	---	---	11.60	-
3	---	Prosaro 300 mL/ha	---	---	11.28	-
4	---	---	Aviator Xpro 420 mL/ha	---	11.54	-
5	---	Prosaro 150 mL/ha	Radial 420 mL/ha	---	11.29	-
6	---	Prosaro 300 mL/ha	Radial 840 mL/ha	---	11.66	-
7	---	Prosaro 300 mL/ha	Revystar 750 mL/ha	---	11.44	-
8	---	Revystar 750 mL/ha	Radial 840 mL/ha	---	11.48	-
9	---	Prosaro 300 mL/ha	Aviator Xpro 420 mL/ha	---	11.55	-
10	---	Aviator Xpro 420 mL/ha	Radial 840 mL/ha	---	11.54	-
11	Systiva		Radial 840 mL/ha	---	11.69	-
12	Systiva	Prosaro 300 mL/ha	Radial 840 mL/ha	---	12.04	-
13	---	Prosaro 300 mL/ha	Aviator Xpro 420 mL/ha	Opus 500 mL/ha	11.67	-
14	Systiva	Prosaro 300 mL/ha	Radial 840 mL/ha	Opus 500 mL/ha	11.86	-
15	Systiva	Prosaro 300 mL/ha	Aviator Xpro 420 mL/ha	Opus 500 mL/ha	11.51	-
				Mean	**11.55**	
				LSD P=0.05	ns	
				P Value	0.292	

The exception to this pattern was seen in the Industry Innovation Germplasm Evaluation Network trial where although there was no interaction between variety and fungicide, on average plots yielded more where a fungicide had been applied (Table 2). Again, low levels of NFNB were found in this trial (<10% plot infection), predominantly in RGT Planet and FAR SB2. The coded European barleys FAR SB2, FAR SB1, and FAR SB5 were significantly higher yielding than all other varieties tested (except AGTB0318), with each of these varieties exceeding 11.8t/ha when treated with fungicide.

Table 2. Influence of fungicide on the grain yield (t/ha) of barley cultivars plus and minus fungicide – 26 January harvested.

	Management Level					
	Untreated		Full protection		Mean	
Cultivar	Yield t/ha		Yield t/ha		Yield t/ha	
RGT Planet (s)	10.89	-	11.80	-	11.34	c
Rosalind (s)	11.29	-	11.34	-	11.31	c
AGTB0318 (s)	11.17	-	11.83	-	11.50	bc
Minotaur (s)	9.57	-	9.92	-	9.74	d
FAR SB2 (s)	11.38	-	11.81	-	11.60	abc
FAR SB1 (s)	11.54	-	12.07	-	11.81	ab
FAR SB5 (s)	11.94	-	11.91	-	11.93	a
Mean	11.11	b	11.53	a	11.32	
LSD Cultivar p = 0.05	0.41		P val		<0.001	
LSD Management p = 0.05	0.30		P val		0.021	
LSD Cultivar x Man. p = 0.05	ns		P val		0.290	

Canopy management

Low amounts of lodging and brackling recorded in spring-sown barley plots between 2020 and 2022 saw no yield benefit from PGR intervention or on some occasions even a reduction in yield. The spring-sown barley trial in 2023 looked at four PGR management approaches applied to two cultivars (RGT Planet and Laureate) and harvested at two harvest dates.

Harvest dates:

1. Ontime harvested on the 24 January 2024.
2. Delayed harvested on the 28 January 2024.
3.

Plant growth regulators (PGR) treatments:

1. Untreated.
2. GS31 PGR trinexapac ethyl based (Single Moddus Evo @ 200 mL/ha (50g ai/ha).
3. GS31 + GS37 PGR trinexapac ethyl based (Double Moddus Evo @ 200mL/ha (100g ai/ha).
4. European approach based on GS31 trinexapac ethyl (Moddus Evo @ 200 mL/ha) (50g ai/ha) and at GS37 of Ethephon 720 @500 mL/ha (360g ai/ha).

The 2023 season saw higher levels of lodging in both Laureate (known to have a straw strength weakness in high yielding environments) and RGT Planet. The highest barley yields on site, and the highest recorded in the HYC project, were achieved under the harvested on-time 'European' approach. Laureate under this management yielded 13.68t/ha and RGT Planet yielded 13.21t/ha. These plots were the only plots in this trial not to have experienced high levels of lodging and brackling.

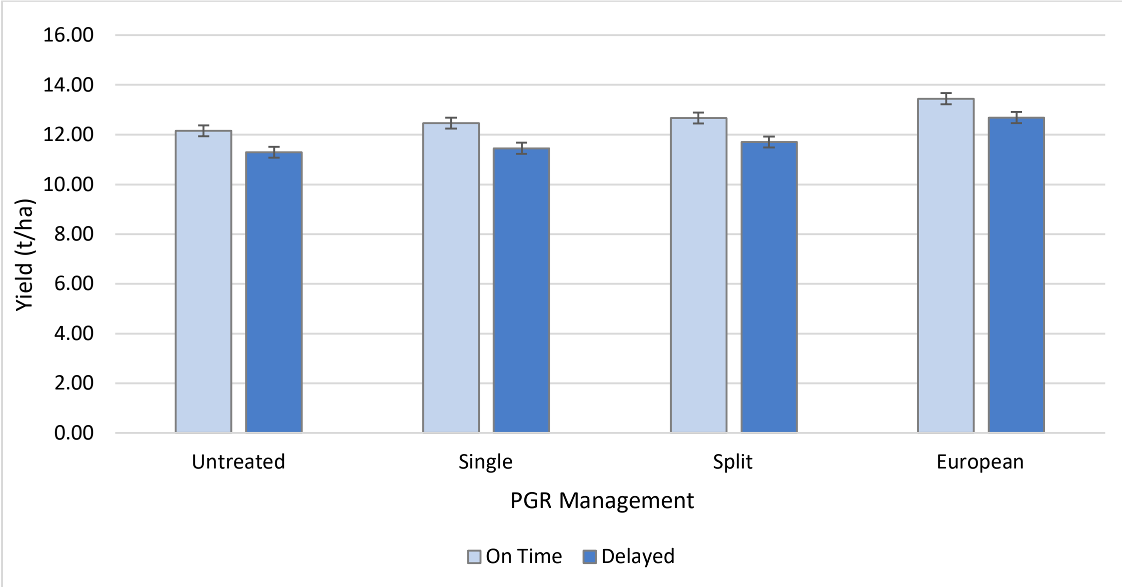

Figure 2. Influence of PGR management and harvest date on yields (t/ha) when assessed at each harvest date.

There was no yield interaction between PGR, variety and harvest date however on average the European approach was highest yielding followed by the split Moddus Evo approach which was statistically higher than the untreated. Harvesting on time was also higher yielding, especially for Laureate which yielded 1.19t/ha more than delayed harvest, compared to RGT Planet which gave a 0.61t/ha response (Figure 3). Despite harvest dates only falling 4 days apart (due to logistical constraints) extreme weather conditions between harvest timings likely caused differences in yield, lodging and brackling, particularly weather conditions on 27 January where wind gusts reached 74 km/h.

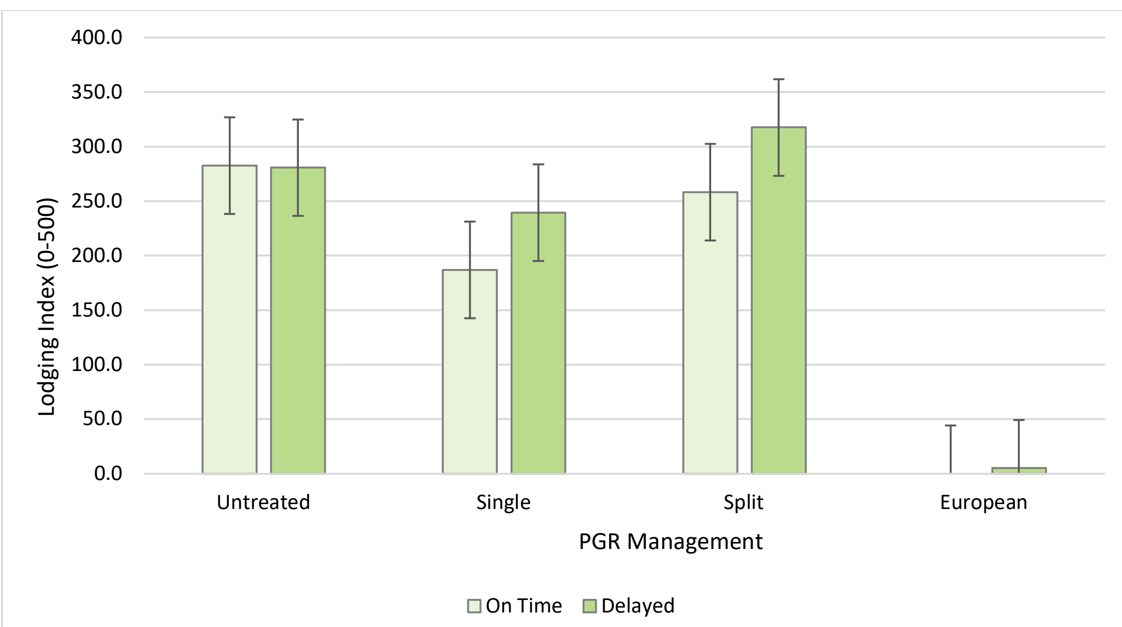

Figure 3. Influence of PGR management and harvest date on lodging index (0-500) when assessed at each harvest date.

'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:
    - **(TAS) Brett Davey (bdavey@sfs.org.au)**
    - (VIC) Ashley Amourgis (aamourgis@sfs.org.au) or Greta Duff (gduff@sfs.org.au)
- Mackillop Farm Management Group: Gina Kreeck (research@mackillopgroup.com.au)
- Farmlink: Caroline Keeton (caroline@farmlink.com.au)
- Riverine Plains Inc: Kate Coffey (kate@riverineplains.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)

Project Leadership:

The HPC initiative is led by Rebecca Murray of FAR Australia, supported by a technical team including Dr. Ben Jones, Darcy Warren, Tom Price, Aaron Vague, Max Bloomfield and Nick Poole.

For further information, please contact Rebecca Murray at rebecca.murray@faraustralia.com.au.

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