VICTORIA CROP TECHNOLOGY CENTRE

FAR AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

FIELD DAY

INCREASING PRODUCTIVITY & PROFITABILITY IN THE HRZ OF VIC

Thursday 26th October 2023

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Thanks to the following host farmer:
Ewen Peel and family

SOWING THE SEED FOR A BRIGHTER FUTURE

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

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

Thank you for your cooperation, enjoy your day.

INCREASING PRODUCTIVITY AND PROFITABILITY IN THE VICTORIA HRZ

FEATURING THE GRDC'S NATIONAL HYPER YIELDING CROPS (HYC) & PULSE AGRONOMY PROJECTS

On behalf of our investor, the **Grains Research & Development Corporation,** along with the Hyper Yielding Crops (HYC) and Pulse Agronomy project collaborators, I am delighted to welcome you to our 2023 Victoria Crop Technology Centre Field Day featuring HYC and Pulse Agronomy.

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.

I would also like to thank the GRDC for investing in these research programmes. Also a big thanks to Ewen Peel and family, our host farmers for their tremendous practical support given to the team, and to today's sponsors RAGT, Western Ag and AGF Seeds.

Should you require any assistance throughout the day, 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 into your own farming business.

Nick Poole
Managing Director
FAR Australia

Hyper Yielding Crops

Hyper Yielding Crops (HYC) has been built on the success of the GRDC's four-year Hyper Yielding Cereals Project in Tasmania which attracted a great deal of interest from mainland HRZ regions. The project demonstrated that increases in productivity could be achieved through sowing the right cultivars, at the right time and with effective implementation of appropriately tailored management strategies. The popularity of this project highlighted the need to advance a similar initiative nationally which would strive to push crop yield boundaries in high yield potential grain growing environments.

With input from national and international cereal breeders, growers, advisers and the wider industry, this project is working towards setting record yield targets as aspirational goals for growers of wheat, barley and canola.

In addition to the research centres, the project also includes a series of focus farms and innovative grower networks, which are geared to road-test the findings of experimental plot trials in paddock-scale trials. This is where in the extension phase of the project we are hoping to get you, the grower and adviser involved.

HYC project officers in each state (Ashley Amourgis here in VIC) are working with innovative grower networks to set up paddock strip trials on growers' properties with assistance from the national extension lead Jon Midwood.

Another component of the research project is the HYC awards program. The awards aim to benchmark the yield performance of growers' wheat paddocks and, ultimately, identify the agronomic management practices that help achieve high yields in variable on-farm conditions across the country. This season, HYC project officers are seeking nominations for 50 wheat paddocks nationwide (about 10 paddocks per state) as part of the awards program.

For more details on the project contact:

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Scan the QR code for 2022 HYC project results

Pulse Agronomy

A Grains Research & Development Corporation (GRDC) Investment across eastern Australia aims to close the economic gap in grain legume production. Victoria is led by Agriculture Victoria (Jason Brand), South Australia by SARDI (Penny Roberts), and Brill Ag (Rohan Brill) in NSW along with other regional partners including FAR Australia across all states at spoke sites focusing on Faba Beans.

Faba bean is the most dominant pulse in this region. The key point about Faba Beans is that they are not limited in yield potential. For example, if every flower on every faba bean plant produced a pod, and every pod produced between 2 – 3 seeds their yield potential would far exceed that of the 10t/ha of wheat and barley. The explanation for this has not been fully explored in the higher production regions but we believe aspirational yields exceeding 8t/ha should be possible in Faba Beans.

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Canola Yield Potential in 2023 – How does it compare to other years?

Rohan Brill, Brill Ag

When water, nutrition, disease and pests are not an issue, crop yield potential is driven by the photothermal quotient – often referred to as the PTQ. PTQ is the ratio of the amount of light (energy) available to plants relative to the temperature level. It can be easily calculated as the sum of solar energy falling on a flat surface in one day (Solar Exposure), divided by the mean daily temperature. Very wet years are often cloudy so light availability is lower and crop yield potential is reduced. In contrast, dry years often have a high PTQ, as there is little cloud. However, in dry years, water is often limiting so a high yield potential is not going to be realised.

PTQ is most important during the crop critical period, which is the period from about 10 days after the start of flowering to close to the end of flowering. This is the period when grain number is set, which usually correlates closely with grain yield. Crop management should be focused on ensuring that the crop critical period overlaps with the period with highest resource availability, e.g., high but not excessive water supply, high PTQ (without extreme shock events) and high nutrient availability.

Table 1 shows a summary of Solar Exposure, Mean Daily Temperature and PTQ for September for Geelong and Mount Gambier. These locations were chosen as the closest Bureau of Meteorology stations to Gnarwarre and Millicent respectively. The conditions at these BOM stations will likely have been slightly different than the trial locations but the trends across seasons will be similar. At Geelong in 2023, Solar Exposure in September has been well above average, but this benefit for crops in the region has been all but cancelled out by high mean daily temperature in September, with only a slightly higher PTQ than average. The 2022 season was quite different, characterised by low Solar Exposure and mean daily temperature with a resulting PTQ just slightly below average.

The trend was similar near the SA research site as it was for Victoria. Mount Gambier September Solar exposure was well above average, but temperature was also well above average, resulting in a PTQ very close to average.

Table 1. *Solar exposure, mean daily temperature and photothermal quotient (PTQ) at two locations in 2022, 2023 and the average across seasons for these locations.*

	Solar Exposure (MJ/m²)	*Mean Daily Temperature (°C)*	*PTQ (MJ/m²/Day/°C)*
Geelong Average	13.70	12.70	1.08
Geelong 2022	12.70	11.95	1.06
Geelong 2023	15.60	14.13	1.10
Mount Gambier Average	13.90	11.10	1.24
Mount Gambier 2022	13.90	10.05	1.38
Mount Gambier 2023	16.40	13.20	1.25

2023 trial activities

A core component of research in 2023 at all HYC sites across Australia is experimenting with crop nutrition and variety choice to increase growth through the crop critical period, with the aim of increasing crop yield potential. We have included six or nine varieties combined with high and low nutrient input in a YieldMax trial with sampling conducted at the start and end of the crop critical period, as well as at crop maturity.

A trial with a more detailed focus on crop nutrition is also being run at each site. These trials examine the nitrogen response at each site with rates from nil to 300 kg N/ha. Due to its success at raising crop yield potential in trials in recent years, we are also examining further canola response to manure compared to the inorganic nutrients (nitrogen, phosphorus, potassium and sulfur) that are supplied by manure.

Overall, these trials are designed to close the gap between yield potential (as set by PTQ) and achieved yield in higher rainfall environments.

GRDC Southern Grain Legume Agronomy: Balancing faba bean physiology and pathology

Aaron Vague[1], Nick Poole[1], Darcy Warren[1]
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Background

The Grains Research & Development Corporation (GRDC) “Development and extension to close the economic yield gap and maximise farming systems benefits from grain legume production” investment (commonly referred to as the Pulse Agronomy Project) is being run throughout eastern Australia. NSW (GRDC Code: BRA2105-001RTX) is led by Brill Ag, Victoria by Agriculture Victoria (GRDC Code: DJP2105-006RTX), and South Australia is led by SARDI (GRDC Code: UOA2105-013RTX). The project is underpinned by the contribution of regional partners, including FAR Australia who have managed a pulse ‘spoke’ site at Daysdale, Bundalong, and Gnarwarre in the HRZ in 2021 and 2022. As part of the GRDC Southern grain legumes project we are targeting 6-8t/ha dryland yields in faba beans in NE Victoria and SW Vic, and 4 – 6t/ha in NSW.

Disease Management for Faba Beans

Recent research conducted by FAR Australia under the leadership of Ag VIC as part of the GRDC investment has delved into the timing of fungicide application related to both plant and disease development. Rather than solely focusing on disease pathology and fungicide efficacy, investigations are directed towards optimizing the application of fungicide products and timing to target the leaves that play a pivotal role in determining crop yield.

Although we possess a reasonable amount of knowledge regarding the disease and the conditions conducive to infection in faba beans, our understanding of which specific parts of the plant should be prioritized for disease protection, in comparison to wheat and barley, remains somewhat limited. The “critical period” in faba bean development, where seed number and overall yield potential are determined, occurs shortly after flowering, typically spanning 1 to 3 weeks (Fakir 1997; Biswas et al. 2005; Mondal 2007). Presently, the available evidence suggests that the most crucial fungicide timings are during mid-flowering (approximately 14 days after the first flower) and early pod set. Additional timings before and after this period are contingent on seasonal variations and specific pathogen issues. For instance, the management of severe Cescospora infections may necessitate earlier fungicide application.

An annual disease management approach should encompass the safeguarding of specific segments of the canopy that are most likely to contribute to the final yield. Consequently, the central question that the fungicide trials aim to address is: "When is the optimal timing for fungicide application within the canopy to maximise yield returns?"

Faba Bean Disease Management Trials: Key Learnings from 2021 and 2022

- Consider better performing chemistry applied at the key timings of mid flower and early pod set, ideally no more than 3 weeks apart.
- While yields were lower in 2022 compared to 2021, the key fungicide application timing of flowering under a conventional protectant fungicide approach (based on chlorothalonil) remained consistently higher yielding compared to later applications with fewer fungicide units, highlighting the efficacy of this chemistry (Figure 2).
- A two-spray strategy combining a SDHI fungicide at 14 days after the first flower yielded similar to a 4 and 3 spray strategy combining cheaper protectant fungicides.
- PBA Bendoc showed higher levels of chocolate spot due to its poorer genetic resistance to the disease (rated S) (Figure 1). PBA Amberly has improved genetic resistance to chocolate spot (rated MRMS) and showed no statistically significant yield response to fungicide.
- The addition of tebuconazole to at an earlier timing did not further increase yield to a 3-spray strategy (Table 1).

Disease management under higher disease pressure in SW Vic

Table 1. *Influence of faba bean cultivar and disease management on grain yield (t/ha) at Gnarwarre 2022.*

					Grain Yield (t/ha)					
Trt	**4th node**	**1st flower**	**1st flower +14 days**	**1st flower +28 days**	**PBA Amberly (MRMS)**		**PBA Bendoc (S)**		**Mean**	
1	---	---	---	---	1.33	-	1.07	-	1.20	e
2	---	---	---	Chlorothalonil +Carbendazim	1.68	-	1.35	-	1.52	de
3	---	---	Chlorothalonil +Carbendazim	Chlorothalonil +Carbendazim	1.73	-	1.61	-	1.67	cd
4	---	Mancozeb +Procymidone	Chlorothalonil +Carbendazim	Chlorothalonil +Carbendazim	2.69	-	2.23	-	2.46	b
5	Tebuconazole	Mancozeb +Procymidone	Chlorothalonil +Carbendazim	Chlorothalonil +Carbendazim	2.60	-	2.29	-	2.44	b
6	---	---	Miravis Star	Veritas	2.56	-	2.51	-	2.54	b
7	---	---	Miravis Star	---	2.49	-	1.73	-	2.11	bc
8	Tebuconazole	Mancozeb +Procymidone	Miravis Star	Veritas	3.27	-	2.71	-	2.99	a
Mean					2.29	-	1.94	-		
Cultivar LSD p=0.05					ns		**P val**		0.236	
Fungicide Strategy LSD p=0.05					0.45		**P val**		<0.001	
Cultivar x Fungicide LSD p=0.05					ns		**P val**		0.849	

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

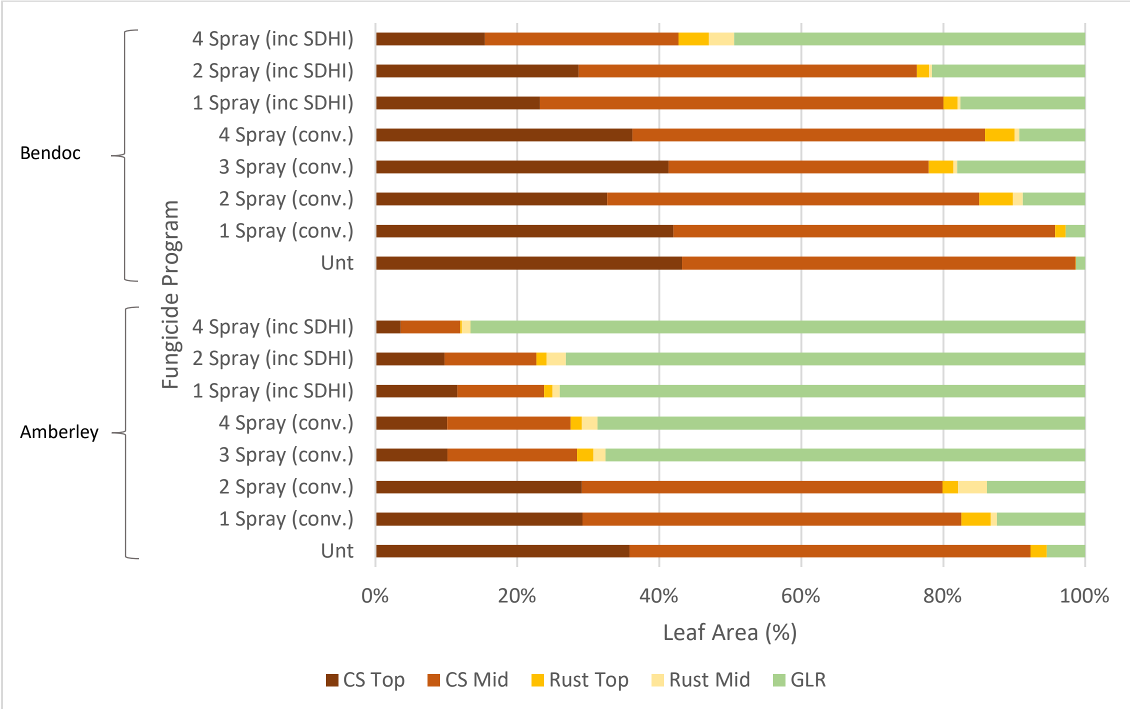

Figure 1. *Effect of fungicide strategy on early season disease (chocolate spot and rust) on the lower third of the canopy (% leaf area infected), assessed on 21 October, 2022.*

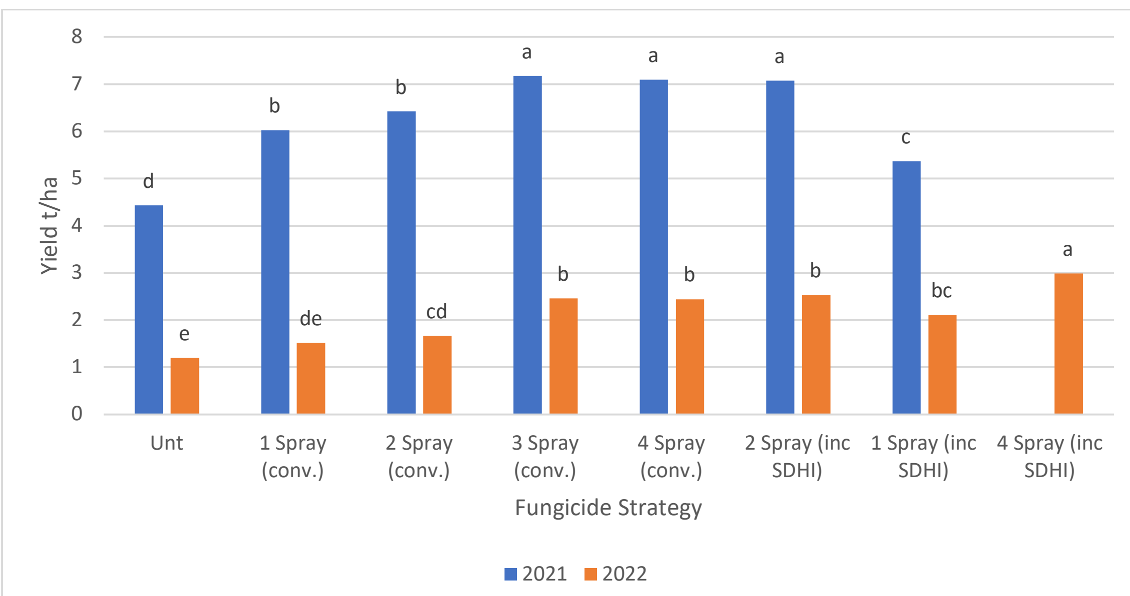

Figure 2. *Effect of fungicide strategy on grain yield (t/ha) in 2021 and 2022. Letters denoting significant differences apply to datasets for individual years only.*

Table 2*. Details of the management levels (kg, g, ml/ha).*

Sowing date:	**2 May**
Variety:	PBA Amberley & PBA Bendoc
Seed Rate:	24 Seeds/m2
Sowing Fertiliser:	100kg MAP
Inoculant	Nodulator
Nitrogen:	Nil
Fungicide:	As per treatment list

Legume Nutrition

The utilisation of grain legumes in the rotation offers the potential to reduce the need for nitrogen (N) inputs and enhance the efficiency of nitrogen utilization in subsequent crops, ultimately leading to improvements in overall soil quality. Research completed as part of GRDC's Hyper Yielding Crops Project has suggested that relying solely on annual applications of synthetic N fertilizers may not be adequate for achieving exceptionally high crop yields, particularly when targeting canola yields >4t/ha, and cereal yields >8t/ha.

Grain legumes are known to fix an average of 20 kilograms of shoot-N per tonne of dry matter, with the actual quantity of fixed N varying between 15 and 25 kilograms. More recently it has been suggested that N associated with the above ground biomass maybe higher with ~33 kg N/ha fixed per tonne of above ground biomass (Brill et al, GRDC Update 2023). This variation depends on factors such as soil type, management practices, the specific legume species used, and the prevailing season (Peoples et al. 2009). It's important to recognize that the N fixed through the biological nitrogen fixation process significantly contributes to the N requirements of the grain legume crop itself. Furthermore, a substantial portion of the fixed N is exported in the harvested grain.

It's worth noting that nodulation, a critical aspect of nitrogen fixation, may be diminished in acidic soils, potentially necessitating supplemental N applications. To address these aspects, a nutrition trial was initiated at all research sites with the primary objective of investigating whether the yields of pulse crops might be constrained by nitrogen, phosphorus and nodulation constraints.

2022 Key Learnings Nutrition Reponses

- In a high disease pressure environment in spring 2022, there was no evidence that applied nutrition influenced grain yield (Table 3).
- The application on 100 kg/ha of nitrogen in the form of urea at sowing negativity effected branch number compared to untreated and the application of P (table 4).
- Although not statistically significant, the omission of inoculant showed a negative trend on yield, as expected in acidic soils. Further investigation is taking place in 2023 on applied nutrition with and without inoculant.

Table 3. Influence of nutrition on grain yield (t/ha).

Trt	Variety	Grain Yield (t/ha)	
1	Untreated	2.12	-
2	100N + 50P	1.96	-
3	Manure*	2.04	-
4	50P	1.77	-
5	100N	1.88	-
6	No Inoculant	1.66	-
Mean		2.05	
LSD 0.05		0.34	
P Val		0.112	
CV		11.08	

*Manure applied at 3 t/ha pig manure dry weight.

Table 4. Influence of applied nutrition on canopy structure at crop maturity for PBA Amberly.

Treatment	Dry Matter		Stems		Stem height		Pods		Lowest pod height		Highest pod height		Pod length on stem		Seed per Pod	
Seed rate (m^2) + Nutrition	t/ha		m^2		cm		m^2		cm		cm		cm		Seed/ pod	
Untreated	6.8	-	62.2	ab	121.8	-	154.7	-	47.0	-	66.0	-	15.7	-	1.8	-
100N + 50P	6.3	-	52.2	bc	135.3	-	101.7	-	52.6	-	67.9	-	10.3	-	1.9	-
Manure	6.2	-	65.0	ab	122.8	-	113.5	-	51.6	-	69.8	-	11.5	-	2.3	-
50P	8.0	-	69.4	a	129.4	-	206.5	-	52.5	-	74.9	-	20.9	-	1.9	-
100N	5.4	-	48.9	c	125.9	-	145.1	-	49.5	-	65.6	-	14.7	-	2.2	-
No Inoculant	5.6	-	57.2	abc	120.6	-	126.7	-	45.4	-	62.8	-	12.8	-	2.2	-
Mean	6.4		59.2		126.0		141.4		49.8		67.8		14.3		2.0	
LSD 0.05	ns		13.3		ns		ns		ns		ns		ns		ns	
P Val	0.242		0.038		0.230		0.434		0.585		0.558		0.434		0.737	

Table 5. Details of the management levels (kg, g, ml/ha).

Sowing date:		**2 May**
Variety:		PBA Amberley
Seed Rate:		24 pl/m^2
Sowing Fertiliser:		100kg MAP
Inoculant		Nodulator
Nitrogen:		N/A
Fungicide:	1st Flower	Mancozeb 2kg/ha
	1st Flower+ 14 days	Aviator Xpro 600 mL/ha
	1st Flower+ 28 days	Chlorothalonil 2L/ha

Big canopies mean big yields and big management.
Creating a large canopy is the necessary pathway to achieving faba bean yields> 8 t/ha. Current faba bean canopy management strategies consist of agronomic decision made at sowing such as sowing date, plant density, and cultivar. Limited options are available in-season which provides difficulty in adapting to the consequences of large canopies such as lodging, increased disease pressure and phenological inefficiencies. While great advances have been made with research into sowing density and sowing date, more work needs to be done on in-season management strategies to deal with the annual environment risk and to promote greater conversion of biomass into yield.

Crop Nutrition and Seeding Density Experiment in SW Vic
Key Points:

- Higher seed densities were beneficial in 2022, 12 seeds/m2 yielded 1.61t/ha, 24 seeds/m2 at 2.19 t/ha, and 2.97 t/ha at 35 seeds/m2 in PBA Amberley respectively (Table 6).
- When tested at a sowing rate of 24 seeds/m2, the highest yielding variety was Samira at 3.75 t/ha followed by Amberley 2.19 t/ha and Bendoc 1.54 t/ha (Table 6).
- In season canopy managements that included an experimental PGR application, or an early defoliation did not influence yield however a late defoliation at the start of flower did cause a reduction in yield.
- In a cool wet environment late in season that caused stress post flowering Samira produced more seeds/pod which proportionately affected yield compared to other varieties (Table 7).

***Table 6**. Influence of faba bean cultivar, canopy management strategies, and seed rate (seeds/m^2) on grain yield (t/ha).*

Trt	Variety	Lodging Index (0-500)		Grain Yield (t/ha)	
1	**Bendoc;24 Seeds/m2**	167.5	a	1.54	de
2	**Amberley;24 Seeds/m2**	97.5	bc	2.19	cd
3	**Samira;24 Seeds/m2**	165.0	a	3.75	a
4	**Amberley;36 Seeds/m2**	120.0	ab	2.97	b
5	**Amberley;12 Seeds/m2**	137.5	ab	1.61	de
6	**Amberley;Early PGR**	112.5	ab	2.50	bc
7	**Amberley;Late PGR**	135.0	ab	2.46	bc
8	**Amberley; Defol 4 Node**	95.0	bc	2.22	cd
9	**Amberley; Defol Start Flower**	32.5	c	1.37	e
Mean		118.1		2.29	
LSD 0.05		67.0		0.69	
P Val		38.9		20.56	
CV		0.012		<0.001	

Lodging Index = % area lodge x Severity (0-5) scale. Experimental plant growth regulator used for experimental purposes and not permitted for off label use. Plant population is 24 seeds/m^2 unless stated otherwise.

Table 7. *Influence of cultivar, canopy management strategies**,** seed rate seed rate (seeds/m^2) on canopy structure at crop maturity.*

Treatment	Dry Matter	Stems	Pods	Stem height	Lowest pod height	Highest pod height	Pod length on stem	Seed per Pod
Seed rate (m^2) + Nutrition	**t/ha**	**m^2**	**m^2**	**cm**	**cm**	**cm**	**cm**	**Seed/ pod**
Bendoc;24 Seeds/m2	6.2 -	61.6 -	142.6 -	115.9 abc	49.5 a	68.2 ab	18.7 -	2.3 b
Amberley;24 Seeds/m2	7.7 -	63.3 -	243.5 -	110.5 bc	41.3 ab	62.3 abc	21.0 -	2.0 b
Samira;24 Seeds/m2	8.1 -	57.2 -	255.7 -	100.9 cd	44.2 ab	76.1 a	32.0 -	3.1 a
Amberley;36 Seeds/m2	7.5 -	71.0 -	229.7 -	118.0 abc	42.2 ab	65.9 ab	23.7 -	2.2 b
Amberley;12 Seeds/m2	6.0 -	58.3 -	200.5 -	121.6 ab	35.9 bc	51.0 cd	15.1 -	2.0 b
Amberley;Early PGR	9.5 -	69.4 -	300.6 -	101.4 cd	40.9 b	69.5 ab	28.5 -	2.2 b
Amberley;Late PGR	6.7 -	62.7 -	219.0 -	88.1 d	41.9 ab	61.0 bc	19.1 -	2.2 b
Amberley;Early Defol	7.7 -	67.7 -	239.3 -	111.6 bc	36.6 bc	58.5 bc	21.8 -	2.0 b
Amberley;Late Defol	4.3 -	52.2 -	94.1 -	132.8 a	29.2 c	41.1 d	12.0 -	2.0 b
Mean	7.1	62.6	213.9	111.2	40.2	61.5	21.3	2.2
LSD 0.05	ns	ns	ns	19.1	8.5	14.8	ns	0.5
P Val	0.058	0.602	0.183	0.010	0.004	0.003	0.114	0.006

Experimental plant growth regulator used for experimental purposes and not permitted for off label use. Plant population is 24 seeds/m^2 unless stated otherwise.

Table 8. *Details of the management levels (kg, g, ml/ha).*

Sowing date:		**2 May**
Variety:		PBA Amberley, PBA Bendoc, PBA Samira
Seed Rate:		As per treatment list
Sowing Fertiliser:		100kg MAP
Inoculant		Nodulator
Nitrogen:		N/A
Fungicide:	1st Flower	Mancozeb 2kg/ha
	1st Flower+ 14 days	Aviator Xpro 600 mL/ha
	1st Flower+ 28 days	Chlorothalonil 2L/ha

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What we know about growing high wheat yields in Canterbury, New Zealand

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New Zealand is known for high productivity of crops (Figure 1). We do not have "scale" so we need efficiency per unit area. It is the same for other crops like maize (average yield of ~ 11t/ha) and barley (average yield of ~ 6 - 7 t/ha).

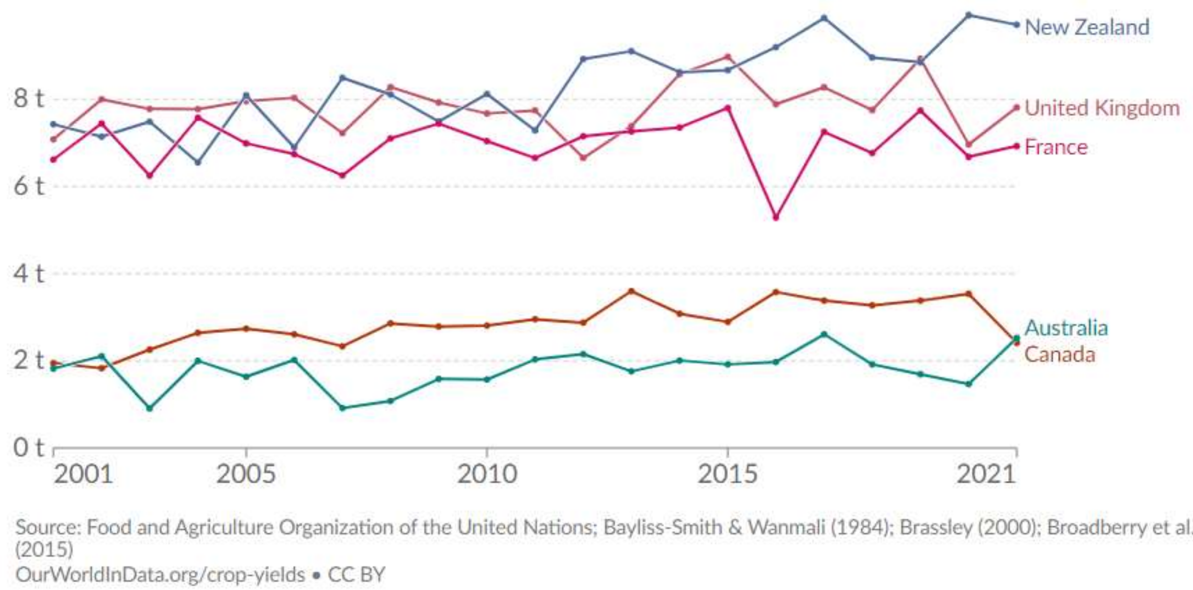

Figure 1. *Average wheat yield in New Zealand, United Kingdom, France, Australia and Canada (Source: https://ourworldindata.org).*

Can we explain the high yields? Yes and no. Yes because we understand crop production depends on the amount of light intercepted and radiation use efficiency (RUE). No because we cannot pin point specific management strategies that maximise yield or that we can adjust to optimise the management of high yield crops.
When we maximise fuel acquisition (light interception) and efficiency of fuel usage (RUE), we promote higher yields. However, management decisions affect how resources are acquired and how they are used. Therefore, we need to understand basic requirements of crops to be able to adapt management strategies to fulfil crop demand.

How a Canterbury growth season works to promote high yields

Most of our autumn/winter wheat is sown from mid-April to mid to late May (Figure 2). Because of vernalisation and photoperiod requirements, double ridge and terminal spikelet occur from mid-July to early September. During this period, crops will experience low temperatures, a full soil moisture profile and enough residual nitrogen in the soil to maintain their biomass. This maximises the number of potential sites for grains during terminal spikelet (potential spikelet number/head).

Flag leaf emerges around mid to late October, depending on the sowing date. Throughout the whole stem elongation period, when the number of spikelets per plant is determined, soil moisture and temperature are not usually limiting. This supports the maintenance of a high number of potential spikelets/head.

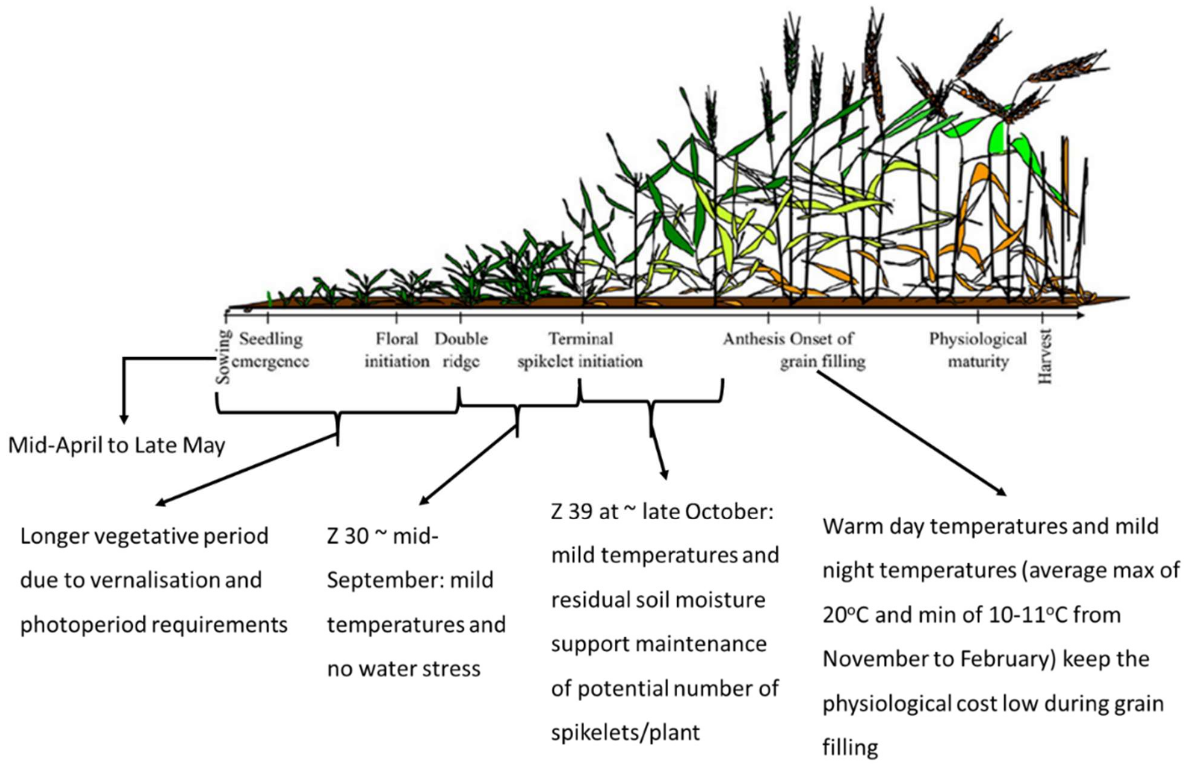

Figure 2. *Developmental stages from sowing to harvest of wheat and environmental characterisation for a typical season in New Zealand (adapted from: Slafer et al., 2021).*

Vernalisation and photoperiod requirements, combined with sowing dates, result in longer vegetative periods, which produces more leaves and tillers. Therefore, by the time these crops reach Z30 – 32, they are close to, or at, canopy closure (intercepting 90 – 95% of the incoming radiation). As a result, the crop goes into the stem elongation at, or close to, its maximum growth rate. This provides assimilates (source) to meet the demand established and support the maintenance of a high number of potential grain sites.

Environmental conditions at grain filling are characterised by warmer days and cold nights (average amplitude from November to February is around 10°C). During the day crops photosynthesize and respire. At night, crops only respire. Low night temperatures experienced in Canterbury during grain filling reduce the rate of respiration at night. This results in a physiologically more efficient process for the crop. The crop spends less carbon to fill the grains.

It is necessary to understand these basic physiological principles to adapt management to produce crops with approximately 600 heads/m^2 to reach yields of 12+ t/ha. It sounds simple until we try to manage the bulk of biomass needed to produce these yields. This is when crop protection and mineral nutrition play major roles. There is no free lunch in crop production, especially when you operate at this high level of yield.

Current management challenges for high yield crops are related to canopy management. Chemistry resistance for weed and disease control, timing and restrictions of fertiliser application and costs are the current issues faced by NZ farmers. Resistance to fungicides and herbicides are a major problem that will only be kept at bay if farmers are on point with their management and rotation of chemistry. At this level of yield, attention to detail is crucial.

References

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FUNGICIDE RESISTANCE DYNAMICS OF SEPTORIA TRITICI BLOTCH IN THE UK: what does it tell us about Victoria, Australia?

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Aim

The aim of this contribution is to summarise the historic trends in the development of fungicide resistance in Septoria tritici blotch (STB) in the UK, to describe the current resistance status of fungicides in Victoria, Australia, and how to manage its further development.

Differences between UK and AU wheat cropping

There are considerable differences in wheat cropping between the UK and Australia that affect the use of fungicides to control plant diseases and affect the development of resistance to these fungicides. The field size in Australia is an order of magnitude larger than in the UK. This affects for example the advice on the management of wheat stubble to reduce infection by ascospores at the start of the crop growing season. More importantly the cropping system in the UK can be characterised as high-input high-output with intensive fertiliser and pesticide programmes and yields around 7-10 tonne per hectare. The cost of a fungicide treatment in the UK is small relative to the yield gain, where in Australia costs relative to gains are relatively high. This has led to a much earlier introduction of fungicides in the UK than in Australia as well as a much more intense use of fungicides to control wheat diseases.

Historical trends in efficacy of fungicides for the control of Septoria tritici blotch in the UK

The intensive use of fungicides in the UK has led to the development of resistance and reduced sensitivity to many fungicides in STB. The trends in efficacy of current key fungicides are shown in Figure 2.

<u>The QoI fungicides</u> (Group 11 e.g. azoxystrobin) were introduced in the UK for the control of STB around 1998. At the time of introduction a fungicide application programme of two QoI sprays (in mixture triazoles) gave near complete control of STB. The STB pathogen can however develop virtually complete resistance to the QoI fungicides by one mutation in the mitochondrial DNA (figure 2). High levels of resistance, leading to field failure, was detected in 2001. All QoIs were affected by the same mutation, and there was complete cross resistance to all QoIs available at that time. In as little as 5 years the QoIs were ineffective for the control of STB.

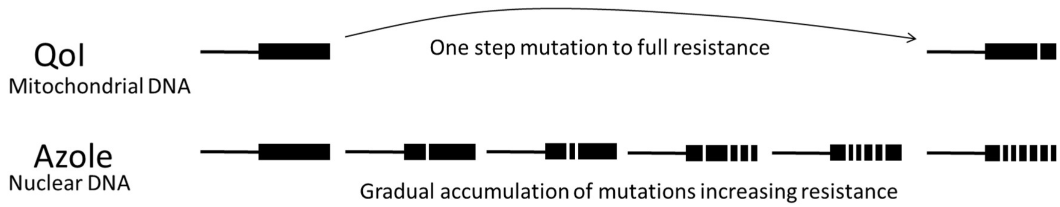

Figure 1. *The genetics of the development of resistance to the QoI and the azole fungicides.*

The azole fungicides (Group 3 DMIs e.g triazoles) were first introduced for the control of STB in the 1970s and successive generations of azoles were introduced in the following decades. Azoles like propiconazole and triadimenol were introduced in the 1970^{s}, tebuconazole was introduced in the 1980s and epoxiconazole and prothioconazole were introduced in the 1990s and 2000s.

Resistance to the azoles develops in a series of mutations each increasing the level of resistance with a small step. This partial resistance in the earlier stages of resistance build up is referred to as reduced sensitivity. This has led to the gradual decline of efficacy of each generation of azoles (figure 2). There is only partial cross resistance between the azoles, particularly at the early stages of resistance development. The consequence of this is that each azole, at introduction, is very effective and the efficacy gradually declines throughout the years. Figure 2 shows the differences in decline for some of the azoles.

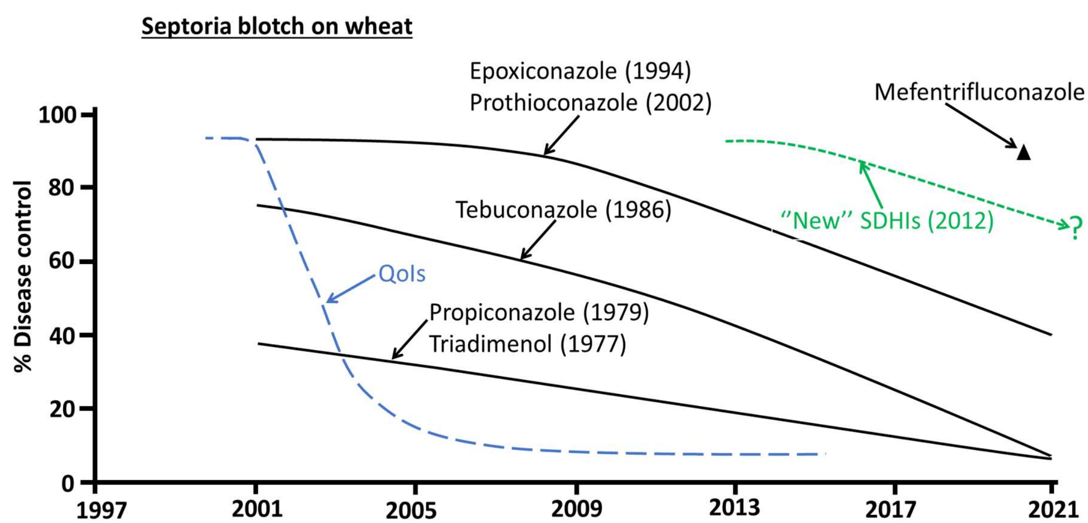

Figure 2. *Stylized efficacy trends of QoI, Azole and SDHI fungicides for the control of Septoria blotch in wheat in the UK. Based on data from the HGCA fungicide performance trials https://ahdb.org.uk/fungicide-performance-guide.*

The protective efficacy of the azoles has declined slower than the curative efficacy (protective meaning the reduction of the infection efficiency of the pathogen spores; protective meaning the slowing down of the pathogen development and spore production once infected) Figure 3 shows this for epoxiconazole in the UK between 1999 and 2017.

Recently a new azole was introduced for the control of STB (mefentriflucopnazole) which has a high efficacy. It is currently unknown whether the efficacy of this new azole will decline in a similar way as seen for the other azoles.

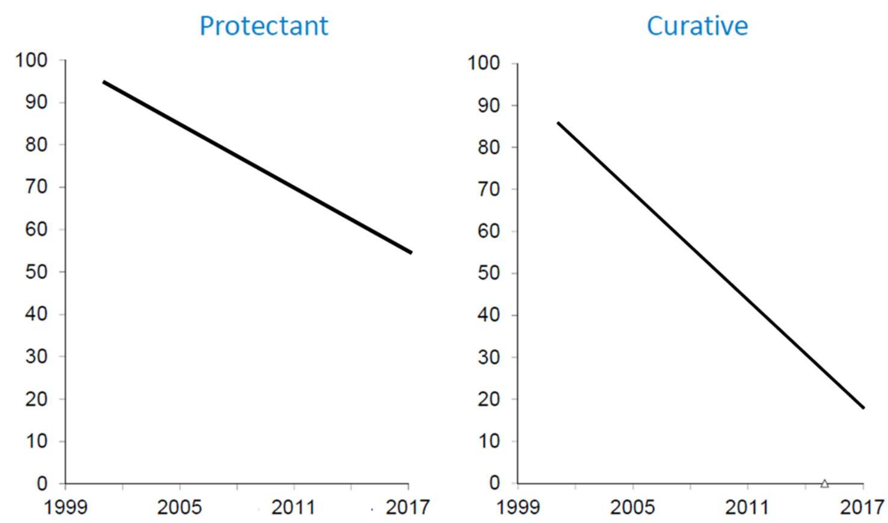

Figure 3. *Stylised efficacy trends in protective and curative action of epoxiconazole. Figure based on data from the HGCA fungicide performance trials* [*https://ahdb.org.uk/fungicide-performance-guide.*](https://ahdb.org.uk/fungicide-performance-guide)

The SDHIs (Group 7) have been introduced for the control of STB in wheat more recently (2012) and resistance development has already been found. Several mutations in the nuclear genes are responsible for different levels of resistance. Some of the mutations causing a high level of resistance also cause a significant fitness cost to the pathogen (meaning that the pathogen does not develop as quickly as the rest of the pathogen population or fails to persist). Some field failure of the SDHIs has been observed in the UK. It is currently not clear whether the resistance will erode further and how fast this erosion will take place (figure 2).

Current resistance status of STB Australia and its further development.

Resistance to the QoIs, azoles and SDHIs fungicides in STB has been found in Southeastern Australia. Figure 4 shows the location of the various samples analyses. The map is certainly not exhaustive, so conclusions about the spatial distribution of the various types of resistance cannot be drawn. However, the map shows that resistance is emerging at several places in Southeastern Australia.

Resistance to the QoI fungicides has been found in SA and Tasmania and has been shown to depend on the same mutation in the mitochondrial DNA that caused the resistance to the QoIs in the UK and NZ. The frequency of the resistance is small where it is found and has not led to a reduction in efficacy in STB control at this stage.

Reduced susceptibility to the azole fungicides has also been detected in Southeastern Australia. A reduced efficacy of triadimefon, triadimenol, tebuconazole and propiconazole has been found. It has been shown that the mutations resulting in the reduced sensitivity are the same mutations as those causing the reduced sensitivity in the UK. At this moment the developing resistance has not led to field failure to control STB.

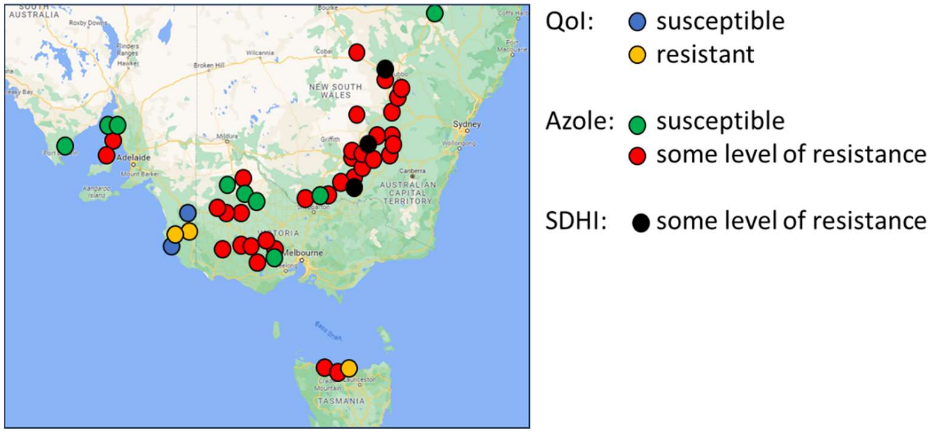

Figure 4: *Distribution of the resistance to fungicides found in Septoria tritici blotch in Southeastern Australia (courtesy of Centre of Crop Disease Management).*

SDHI fungicides remain effective. Some strains have been found with a slightly reduced sensitivity. There are no instances of full resistance to this group of fungicides has been found in Septoria botch in Australia yet.

Outlook: Since the mutations leading to resistance (QoI) or reduced sensitivity (azole) found in Southeastern Australia are the same as those found in the UK, and also in wider Europe, it is to be expected that the selection processes are the same in the UK/Europe and Australia. The intensity of use in Australia is lower than that in the UK/Europe. This leads us to expect that the resistance will increase at a slower rate than has been observed in the UK. It is therefore to be expected that resistance will develop to levels where field failure may happen. Any resistance management method available to slow down the further spread and intensification of resistance should thus be used to increase the expected lifetime of the fungicides currently available.

Fungicide resistance management

The Australian Fungicide Resistance Extension Network (AFREN) has developed a set of rules of thumb to help growers to reduce the development of fungicide resistance. This set of rules is known as the ''The Fungicide Resistance Five''.

1. Avoid susceptible crop varieties
   It is well established that growing (partially) resistant crop varieties decreases the rate of development of fungicide resistance. Additionally, the fungicide

application programme needed to keep effective control of the disease is less intensive for (partially) resistant varieties. A reduction of fungicide use also reduces the rate of development of resistance.

2. <u>Rotate crops – use time and distance to reduce disease carry-over</u>
   Rotating crops decreases the disease carry-over from cropping season to cropping season. Reducing disease helps to reduce the frequency of resistance in the pathogen population.

3. <u>Use non-chemical control methods to reduce disease pressure</u>
   Non-chemical control methods can reduce disease pressure and therewith the intensity of the fungicide treatment programme. Carefully choosing your planting date, stubble management, and cultivar helps to reduce the need for fungicide applications.

4. <u>Spray only if necessary and apply strategically</u>
   Reducing the number of fungicides applied will reduce the rate of selection for fungicide resistance. The key message is to use the amount of fungicide needed to keep effective control of the disease, but not more than that.

5. <u>Rotate and mix fungicides/MoA (mode of action) groups</u>
   Research has shown that mixing fungicides with different modes of action reduces the selection for fungicide resistance. The same holds for rotating fungicide mode of actions.

   For more detail: https://afren.com.au/

Maximising barley yields in the Vic HRZ – Gnarwarre, Vic

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Key point summary

- Lower solar radiation over spring resulted in reduced yield potentials for barley varieties in 2022 when compared to the long-term average.
- The average yield in the April sown screening trial was 7.25 t/ha with the highest yielding variety being the coded InterGrain line IGB1130 (8.45 t/ha), this was also the highest yielding treatment on site.
- A wetter than average spring, high inoculum in the environment and the use of susceptible varieties, meant Net Form of Net Blotch (NFNB) pressure was extremely high in 2022, particularly for late April sowings.
- There was no yield difference between a single spray propiconazole application and the untreated, suggesting this level of management is not appropriate for high disease pressure environments when growing susceptible varieties.
- Applying 2-4 units of fungicide significantly improved yield compared to the untreated, but there was little significant improvement from 2 through to 4 units, regardless of seed treatment/foliar spray combinations. The cheaper fungicide managements based on a single spray gave poorer test weights and retention figures as well as increased brackling when assessed at crop maturity.
- New barley varieties in the pipeline are proving good candidates to be both higher yielding and more disease resistant than RGT Planet.
- Although RGT Planet still remains among the highest yielding in the Hyper Yielding Crops (HYC) screening trial, it requires a robust fungicide management program.
- Varieties such and Rosalind and Neo (tested by FAR in 2022 as IGB22102T) show much better resistance to NFNB however may need more management around Spot Form of Net Blotch (SFNB) and leaf rust, respectively.

Barley yield potential

The Hyper Yielding Crops project in Victoria has been fortunate to have experienced three higher than average rainfall seasons since it's commencement in 2020. Following on from the extremely wet and waterlogged season of 2021, less winter rainfall saw top yields in 2022 reach 8.45 t/ha (IGB1130). It is now known through the work of HYC over the last three seasons that good solar radiation and cooler temperatures are essential to maximise grain number in the HRZ. Grain number is determined in the period approximately 3 weeks before flowering, referred to as the critical period. Maximising growth of the crop in this window is associated with higher yield potential (as a result of higher grain number per head) provided the crop is not subject to other stresses such as frost, heat stress or moisture stress. In 2022 water logging during the grain fill period still provided additional stress reducing barley yield potential further, albeit less so than the previous year.

Although temperature was close to average, solar radiation was well below the long-term average during the critical period in 2022. Varieties reaching flowering in early October e.g. May sown RGT Planet and Laureate were likely to be impacted by reduced yield potential calculated by Photothermal Quotient (PTQ). Earlier flowering varieties would have been less impacted as PTQ potential yields were on average through September for wet years however this comes at a time of year when the long-term average PTQ is naturally lower. There were some peaks in PTQ potential yields for varieties flowering in mid-October 2022 however these still failed to raise the yield potential past the historical average, as experienced in 2021.

Disease management a major driver in barley yields

Given the wetter and warmer than average conditions experienced at the Gnarwarre site in 2022, it's no surprise that disease was a major influence on yield. These climatic conditions coupled with high inoculum loads in the environment and the use of RGT Planet (rated SVS to NFNB) generated a 1.33 t/ha response to fungicide when tested on site (Table 1).

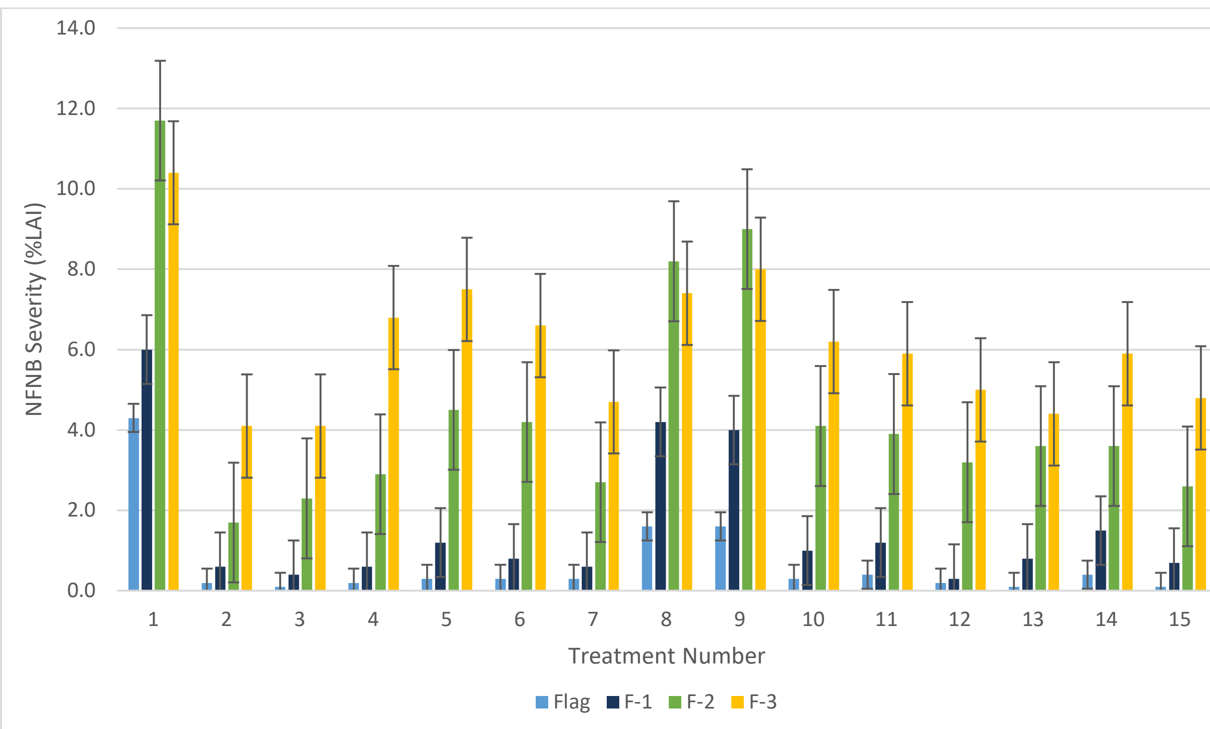

Figure 1. *The severity of Net Form Net Blotch (NFNB, %Leaf Area Infection(LAI)) at GS50 (start of head emergence) on the Flag to Flag-3 (Treatment list as per table 1).*

The HYC barley fungicide trial in RGT Planet, in which NFNB was the dominant disease, demonstrated that a single early (GS31) spray of propiconazole was insufficient to control disease and not significantly different in yield compared to the untreated plots. However, the combination of 2 DMI actives at the same timing (prothioconazole and tebuconazole) was significantly higher yielding, although still less effective than a 2-spray program. When assessed at the start of head emergence growth stage (GS50), a single application of Tilt 250 mL/ha (Propiconazole) or Prosaro (Prothioconazole and

Tebuconazole) applied at early stem elongation (GS31) were seen to have the highest levels of NFNB on Flag-1 (the most important yield contributing leaf in barley) outside of the untreated plots (Figure 1). There were little differences between the 2, 3 and 4 fungicide unit treatments. Combinations of SDHI and strobilurin chemistry all showed good control on the flag-1 leaf layer and little statistical difference in yield come harvest.

Table 1. *Influence of fungicide management on grain yield (t/ha).*

	Treatment				Yield		% of mean
	GS00	**GS30**	**GS39-49**	**GS59**	t/ha		%
1	---	---	---	---	5.80	e	89.9
2	Systiva	Prosaro 300 mL/ha	Radial 840 mL/ha		6.96	ab	107.8
3	Systiva	Prosaro 300 mL/ha	Radial 840 mL/ha	Opus 500 mL/ha	6.83	ab	105.9
4	---	Prosaro 300 mL/ha	Aviator Xpro 420 mL/ha		6.76	ab	104.8
5	---	---	Aviator Xpro 420 mL/ha		6.72	b	104.2
6	---	Prosaro 300 mL/ha	FAR F1-19 750 mL/ha		6.68	b	103.5
7	---	FAR F1-19 750 mL/ha	Radial 840 mL/ha		7.13	a	110.6
8	---	Prosaro 300 mL/ha	----		6.26	cd	97.0
9	--	Tilt 500 250 mL/ha	----		6.09	de	94.3
10	Systiva	---	Radial 840 mL/ha	---	6.76	ab	104.8
11	---	Prosaro 300 mL/ha	Radial 840 mL/ha	---	6.64	bc	103.0
12	---	Prosaro 300 mL/ha	Aviator Xpro 420 mL/ha	Opus 500 mL/ha	6.86	ab	106.4
13	---	Aviator Xpro 420 mL/ha	Radial 840 mL/ha		6.99	ab	108.3
14	---	Prosaro 150 mL/ha	Radial 420 mL/ha		6.87	ab	106.5
15	Systiva	Prosaro 300 mL/ha	Aviator Xpro 420 mL/ha	Opus 500 mL/ha	6.72	b	104.1
				Mean	6.67		103.4
				LSD (P=0.05)	0.38		6.0
				P-Value	<0.001		<0.001

Cultivar performance in FAR Australia Germplasm Evaluation Network (GEN)

After a number of years at the top there is now some evidence that newer barley cultivars are coming through that have a higher yield potential than RGT Planet and have greater disease resistance in trials conducted in the SA, Vic and WA HRZ. The screening work conducted in Gnarwarre (Figure 2) as part of FAR Australia's Industry Innovation GEN trial network showed the coded line IGB22102T, now named as Neo, significantly out-yielded Planet (average of 6.22 t/ha vs 7.39 t/ha). This variety has shown a greater resistance to NFNB when compared to RGT Planet although is seen to be more susceptible to leaf rust. The other coded Intergrain variety in this trial IGB21130, again showed much better NFNB resistance and was also significantly higher yielding (7.00 t/ha) than RGT Planet and was the highest yielding barley variety in the Victorian HYC screening trials. It has long been the aim in the HYC project to not only produce high yielding crops but more importantly produce ‘hyper profitable’ crops. Research completed in the HYC suggests that selection of newly emerged germplasm on farm can not only increase yields, but also reduce the reliance on fungicides and protect fungicide chemistry from the build-up of fungicide resistance.

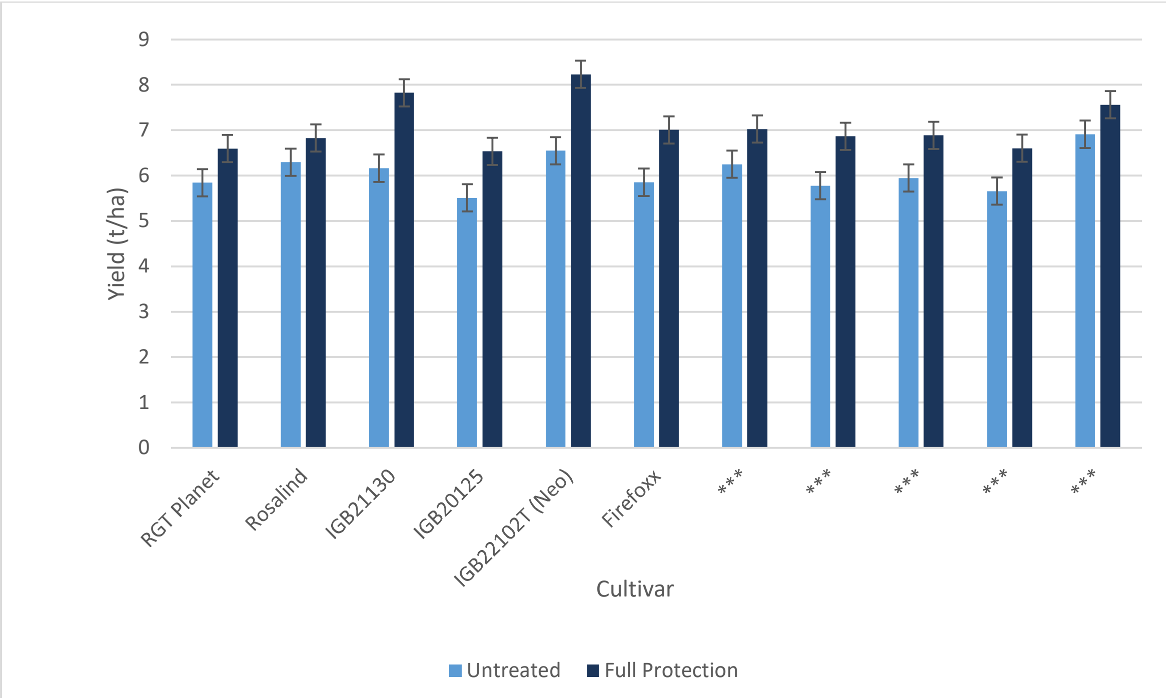

Figure 2. *Interaction between variety and grain yield (t/ha) – 2022 Gnarwarre Barley Germplasm Evaluation Network (GEN) trial.*
**** - Confidential experimental lines*

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SOWING THE SEED FOR A BRIGHTER FUTURE

Yield stability of wheat under reduced fungicide input – HYC Project findings 2020 – 2022

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[1] Field Applied Research (FAR) Australia

Key point summary

- Over the last four years, principally under La Nina weather patterns, it has not been possible to achieve the highest yields without fungicide intervention.
- However, over that same period some varieties have indicated stable resistance to disease whilst others have succumbed to increased disease susceptibility, particularly stripe rust.
- A number of varieties have shown good disease resistance to Septoria tritici blotch (STB), in particular Longford (AGF WH04818), AGTW0005 (to be commercial in 2024), Big Red, RGT Cesario, Anapurna, RGT Waugh, Tabasco and Refection.
- Since 2021 RGT Cesario, RGT Accroc and Tabasco have succumbed to significant stripe rust infection as a result of new stripe rust pathotypes (239).
- The resistance to STB has slipped with RGT Accroc compared to its year of introduction 2017. To a lesser extent this has also been the case with Anapurna.
- Although 2022 was unlikely to be typical of fungicide response and the need for genetic resistance currently the cultivars showing most resistance to disease and yield stability under a reduced fungicide input are Anapurna, Longford, AGTW0005, Big Red and Reflection (not currently commercial).
- In addition all of these cultivars (red grained feed wheats) have been high yielding.
- Of the white wheats Stockade and RGT Waugh have been the most consistent in HYC trials but with slightly less disease resistance and grain yield.

Disease resistance in the absence of fungicide application – HYC Screening Victoria and SA 2020

In 2020 when HYC commenced a number of varieties illustrated excellent disease resistance to STB and stripe rust (in that year 198 pathotype) in both Victoria and SA (Figure 1 & Table 1). These varieties were Longford (AGFWH004818), AGTW0005, RGT Cesario (SFR86-090), Tabasco, Big Red (AGFWH004718), Reflection and RGT Waugh. Since 2022 on the mainland RGT Cesario, Tabasco and a large number of milling wheats have succumbed to the new stripe rust 239 pathotype which has also affected RGT Accroc. RGT Accroc had not broken down to stripe rust in 2020 when the 198 pathotype was dominant.

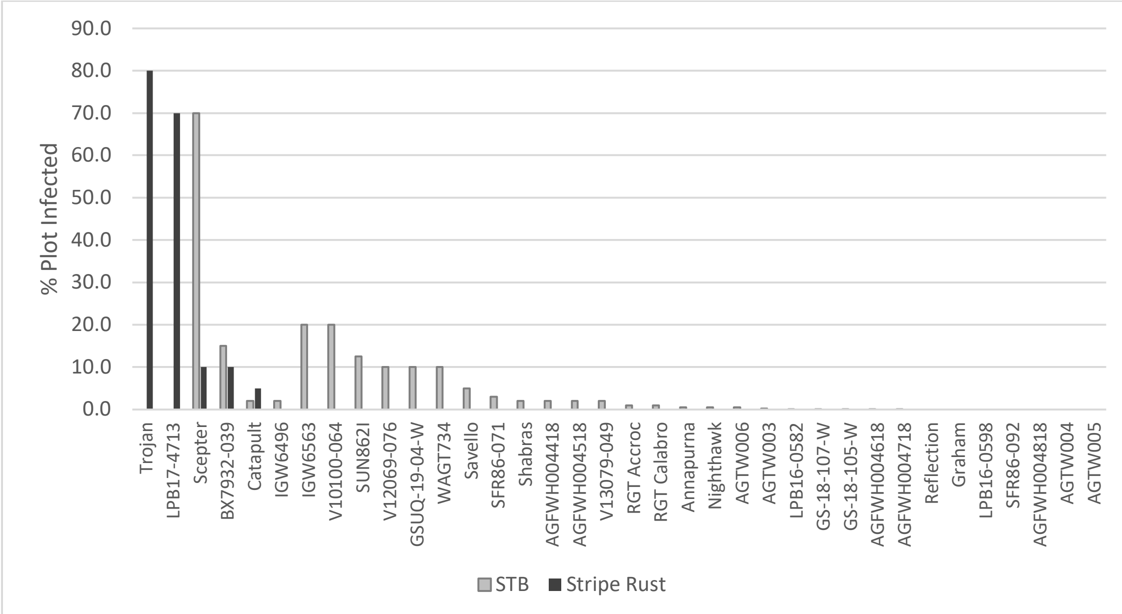

Figure 1. *% Plot infection of Septoria tritici blotch and stripe rust assessed on 26 October (GS59 – GS74) –* ***Gnarwarre, Victoria 2020****.*

Table 1. *Disease Severity (% plot infection - Septoria tritici blotch (STB), stripe rust, leaf rust, stripe rust and lodging on 26 October (GS61 – 80) –* ***Millicent, SA 2020.***

Variety	Septoria	Leaf Rust	Stripe Rust	Lodging Severity	Lodging Index
	% Plot	% Plot	% Plot	0-5	0-500
Scepter	98	0	0	1.7	131.0
Trojan	85	0	1	0.5	20.0
Anapurna	15	2	0	0.5	15.0
RGT Accroc	70	20	0	0.0	0.0
Reflection	6	1	0	0.0	0.0
RGT Waugh	5	1	0	0.5	35.0
Big Red	9	1	0	0.0	0.0
Longford	3	0	0	0.0	0.0
AGTW005	4	2	0	0.0	0.0
Willaura	80	0	0	1.5	45.0

Note: Shaded varieties had similar phenology to the winter wheat control Anapurna that performed consistently at the SA CTC over the 2018 – 2020 period.

The disease resistance (to stripe rust and STB) of the a range of cultivars including RGT Cesario, Anapurna, RGT Accroc, Tabasco, SF Adagio and Calabro in 2020 allowed a number of varieties to be farmed successfully with only one fungicide unit at flag leaf in both Victoria and SA, with no statistical significant advantage to 4 units over one unit of fungicide (Tables 2 & 3).

Table 2. *Influence of management strategy/input on variety grain yield performance (t/ha)* ***– Gnarwarre, Victoria 2020.***

	Management Level						
	Untreated		**GS39 Fungicide**		**Full Protection**		**Mean**
Cultivar	**Yield t/ha**		**Yield t/ha**		**Yield t/ha**		**Yield t/ha**
Trojan	2.19	p	2.97	o	9.04	d-g	**4.73**
Scepter	5.85	n	7.93	jkl	8.84	e-h	**7.54**
Nighthawk	7.21	m	7.62	lm	8.12	jk	**7.65**
Anapurna	8.37	hij	9.04	d-g	9.30	b-e	**8.91**
RGT Acrocc	7.94	jkl	9.24	c-f	9.69	abc	**8.96**
RGT Calabro	7.72	kl	8.69	ghi	9.01	efg	**8.47**
Beaufort	6.01	n	9.26	cde	9.93	a	**8.40**
Tabasco	7.82	kl	7.96	jkl	8.29	ij	**8.02**
SF Adagio	8.77	fgh	9.74	ab	9.51	a-d	**9.34**
Revenue	5.79	n	8.02	jkl	8.70	ghi	**7.50**
Mean	**6.77**	**c**	**8.05**	**b**	**9.04**	**a**	**7.95**
LSD Cultivar p = 0.05			0.27		**P val**		<0.001
LSD Management p=0.05			0.19		**P val**		<0.001
LSD Cultivar x Man. P=0.05			0.47		**P val**		<0.001

Table 3. *Influence of management strategy and variety on grain yield (t/ha)* *–* ***Millicent, SA 2020.***

	Management Level						
	Untreated		**1 Fungicide Unit**		**4 Fungicide Units**		**Mean**
Cultivar	**Yield t/ha**		**Yield t/ha**		**Yield t/ha**		**Yield t/ha**
Trojan (spring)	4.89	mn	5.50	lm	6.07	jkl	**5.49**
Scepter (spring)	4.34	n	5.88	kl	6.23	ijk	**5.48**
Nighthawk (facultative)	6.89	hi	7.40	gh	7.39	gh	**7.22**
Anapurna (winter)	8.22	def	9.65	a	9.65	a	**9.18**
RGT Acrocc (winter)	5.12	m	7.98	efg	8.93	bc	**7.35**
SF Adagio (winter)	6.72	ij	8.49	c-f	8.88	bcd	**8.03**
Calabro (winter)	5.92	kl	7.97	fg	8.49	c-f	**7.46**
RGT Cesario (winter)	8.64	cde	9.45	ab	8.96	bc	**9.01**
Tabasco (winter)	8.00	efg	9.49	ab	9.95	a	**9.15**
Einstein (winter)	6.59	ij	7.96	fg	8.94	bc	**7.83**
LSD Cultivar p = 0.05			0.38 t/ha		P val		<0.001
LSD Fungicide p=0.05			0.33 t/ha		P val		<0.001
LSD Cultivar x Fung. P=0.05			0.66 t/ha		P val		<0.001

In 2022 with the effect of the new stripe rust pathotype RGT Cesario, RGT Accroc and Tabasco become higher risk for disease susceptibility and the cost of protection increased, a minimum of two units being necessary for RGT Cesario and more than two for RGT Accroc. In the period 2020-2021 the high yield credentials of Big Red, RGT Cesario, Anapurna and RGT Accroc were proven. In 2022 under extremely high disease pressure in Victoria, NSW and SA the disease resistance of AGTW0005 and Longford (red wheats) was outstanding with Big Red and RGT Waugh (low levels of stripe rust compared to RGT Cesario and RGT Accroc) slightly inferior but still standing up well to stripe rust (Figure 2).

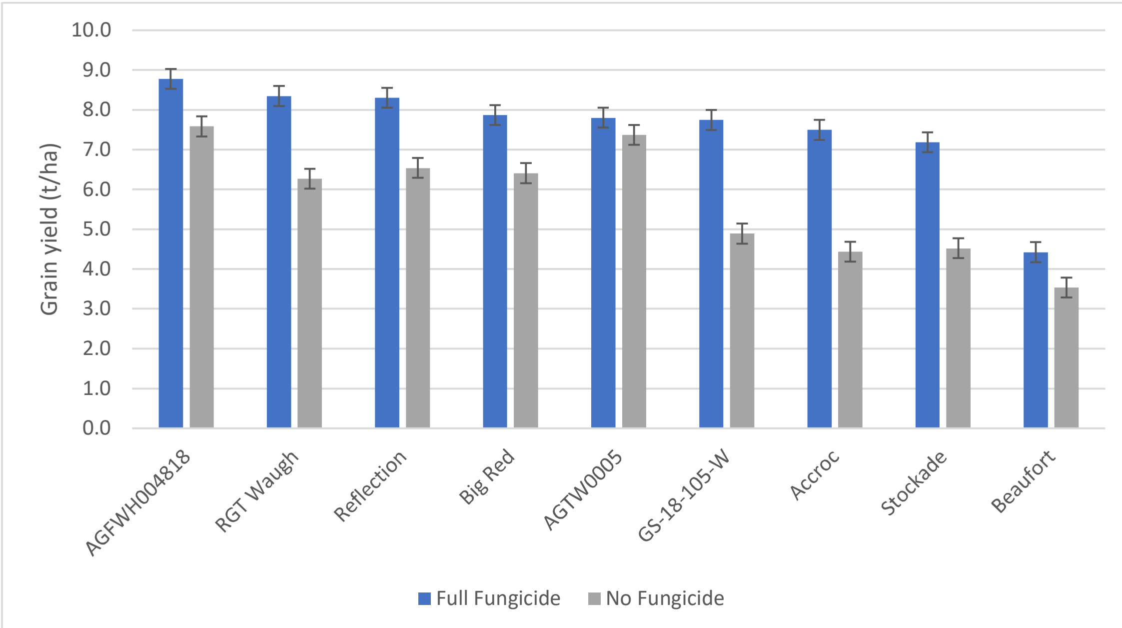

Figure 2. *Grain yield (t/ha) of wheat cultivars under high disease pressure with and without fungicide –* ***Gnarwarre, Victoria 2022 sown 28 April****.*

Underpinning these results at Gnarwarre in 2022 were differences in variety susceptibility to STB and Stripe rust (Figure 3 & 4).

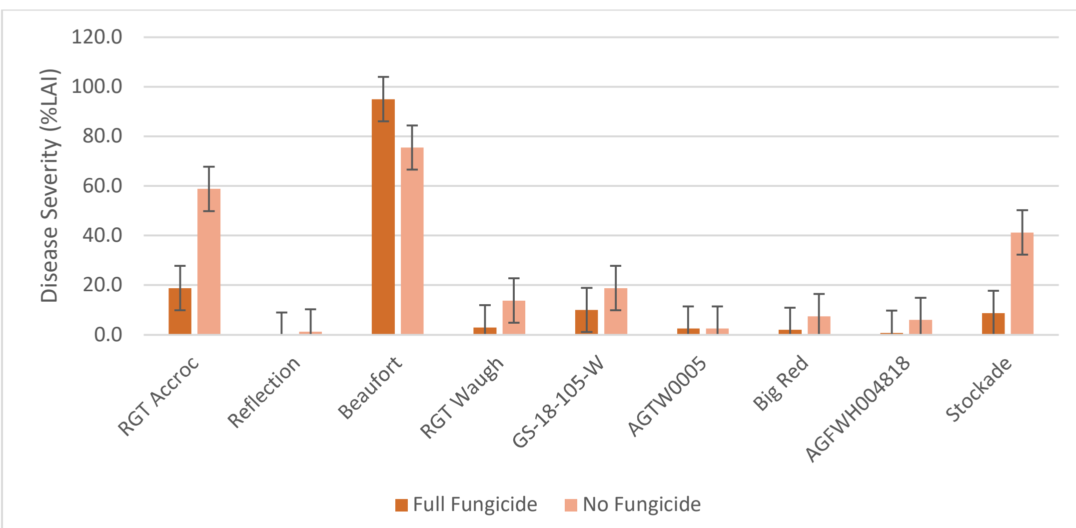

Figure 3. *Septoria tritici blotch (STB) disease severity (%) in plot scores of each variety and fungicide management –* ***Gnarwarre, Victoria 2022****.*

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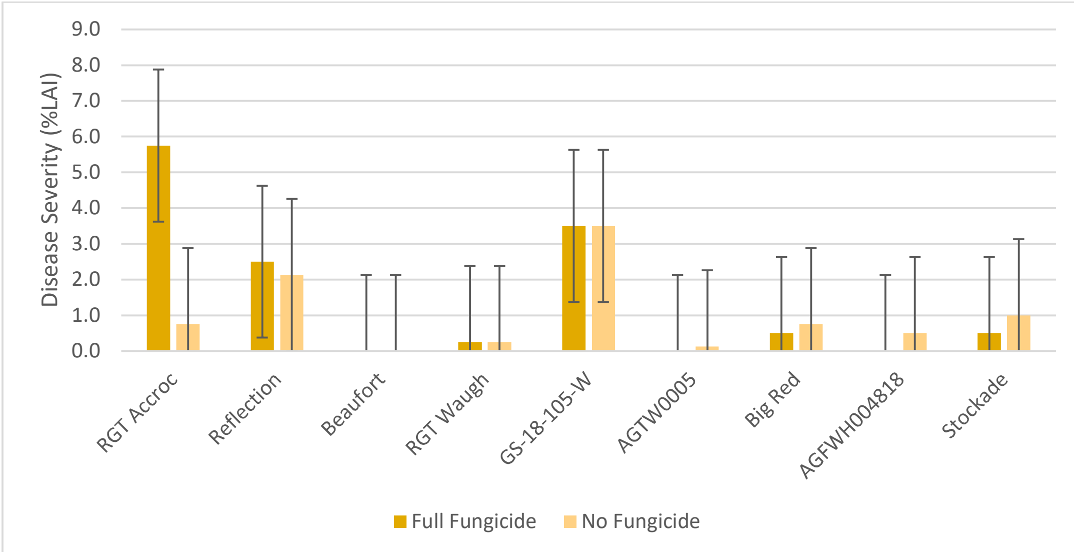


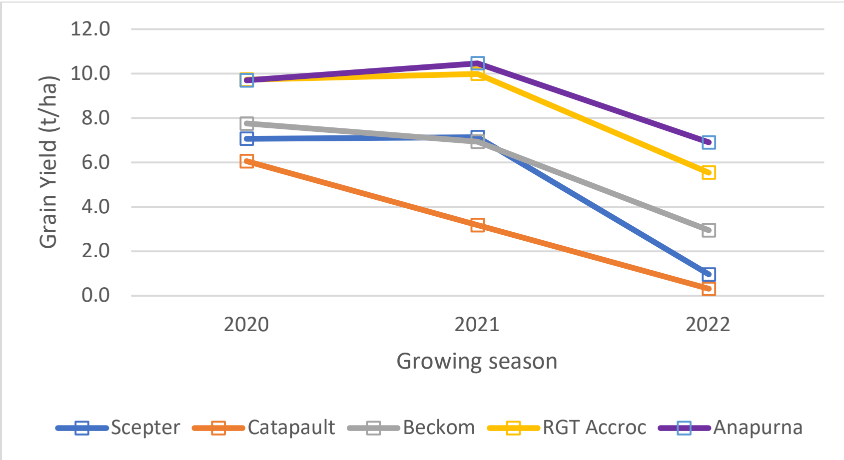
Figure 4. Stripe rust (YR) disease severity (%) in plot scores of each variety and fungicide management (GS75-80) – **Gnarwarre, Victoria 2022**.

Anapurna which was not part of this trial but also performed well in 2022 under reduced fungicide input (Table 4) and although its STB resistance is not as good as Longford, AGTW0005 and Big Red it did not succumb to the stripe rust to the same extent as RGT Accroc and RGT Cesario. This was also apparent in NSW at the Wallendbeen HYC research site (Figure 5-7). In NSW over the three-year period (2020-2022), the most stable yields with reduced fungicide input (one unit) have been observed in Anapurna, which despite the poorer solar radiation in 2022 still produced over 10t/ha in all three years of experimentation at the Wallendbeen site.

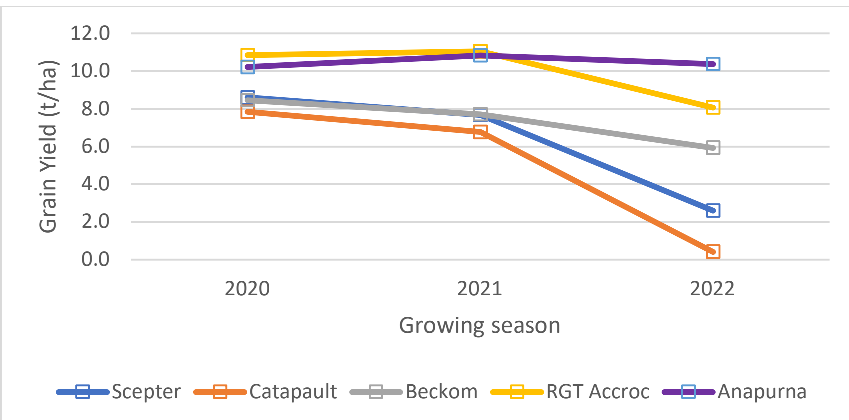
Table 4. *Grain yield of four wheat varieties grown with different levels of fungicide input –* ***Gnarwarre, Victoria 2022.***

		RGT Cesario		Anapurna		RGT Accroc		Revenue		*Mean*	
Fungicide Management Regime											
Untreated		5.23	-	4.54	-	4.16	-	1.69	-	**3.91**	c
1 Fungicide Unit		5.98	-	6.14	-	5.92	-	3.07	-	**5.28**	b
2 Fungicide Units		5.38	-	5.72	-	5.61	-	3.24	-	**4.99**	b
4 Fungicide Units		6.58	-	6.69	-	6.94	-	4.53	-	**6.19**	a
Fungicide Management Regime	***LSD***		***0.34***					***P-Value***		***<0.001***	
Cultivar x Fung Mgmt Regime	***LSD***		***ns***					***P-Value***		***0.051***	

Untreated with fungicide.



Single fungicide at flag leaf (GS39).



Four units of fungicide (flutriafol plus three foliar sprays GS31/32, GS39 and GS59/61).

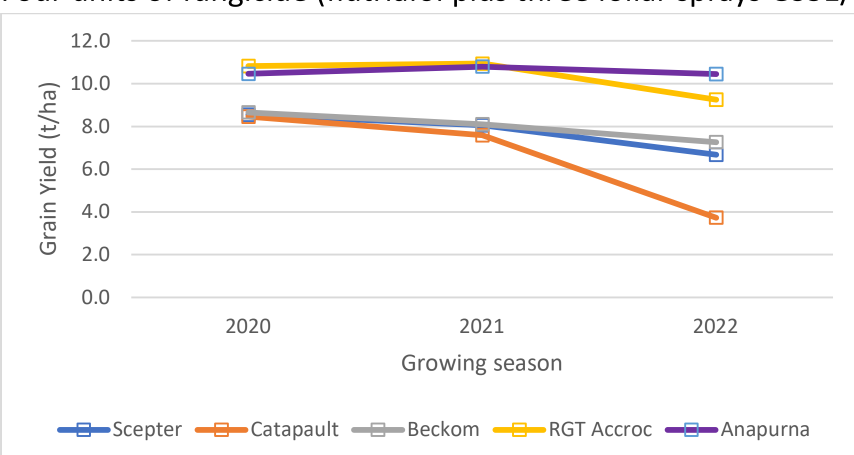


Figure 5 – 7. *Grain yield of five varieties under two levels of fungicide input compared to the untreated.*

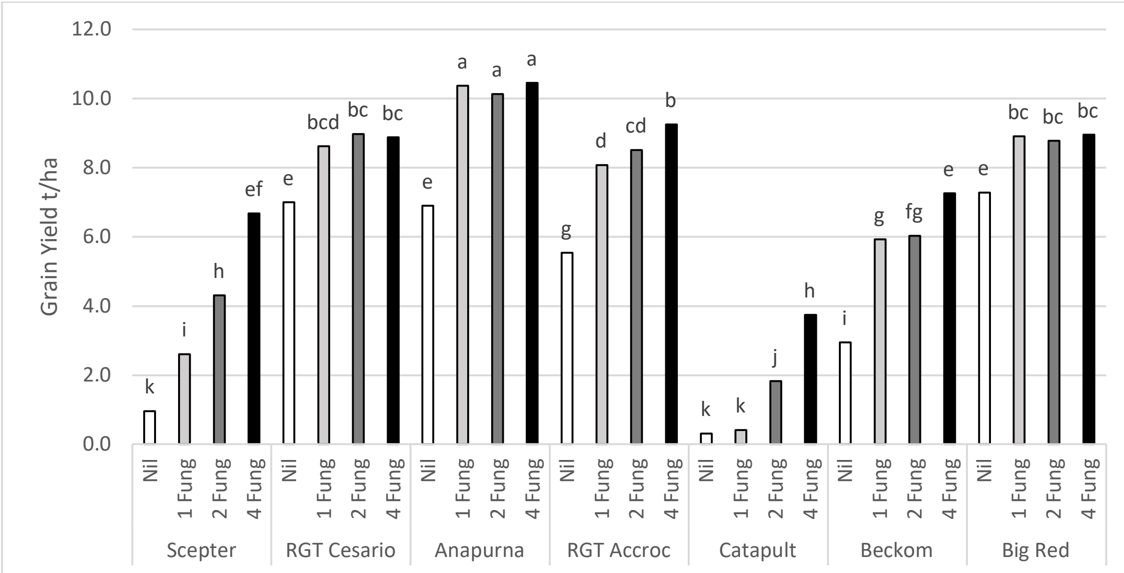


Figure 8. *The influence of the number of applied fungicide sprays on different varieties at the HYC trial at Wallendbeen, NSW 2022. All cultivars presented are protected by plant breeders' rights.*

Although 2022 was unlikely to be typical of fungicide response and the need for genetic resistance currently the cultivars showing most resistance to disease and yield stability under a reduced fungicide input have been Anapurna, Longford, AGTW0005, Big Red and Reflection (not currently commercial).

References

More results from previous HYC research can be found on the FAR website https://faraustralia.com.au/resource

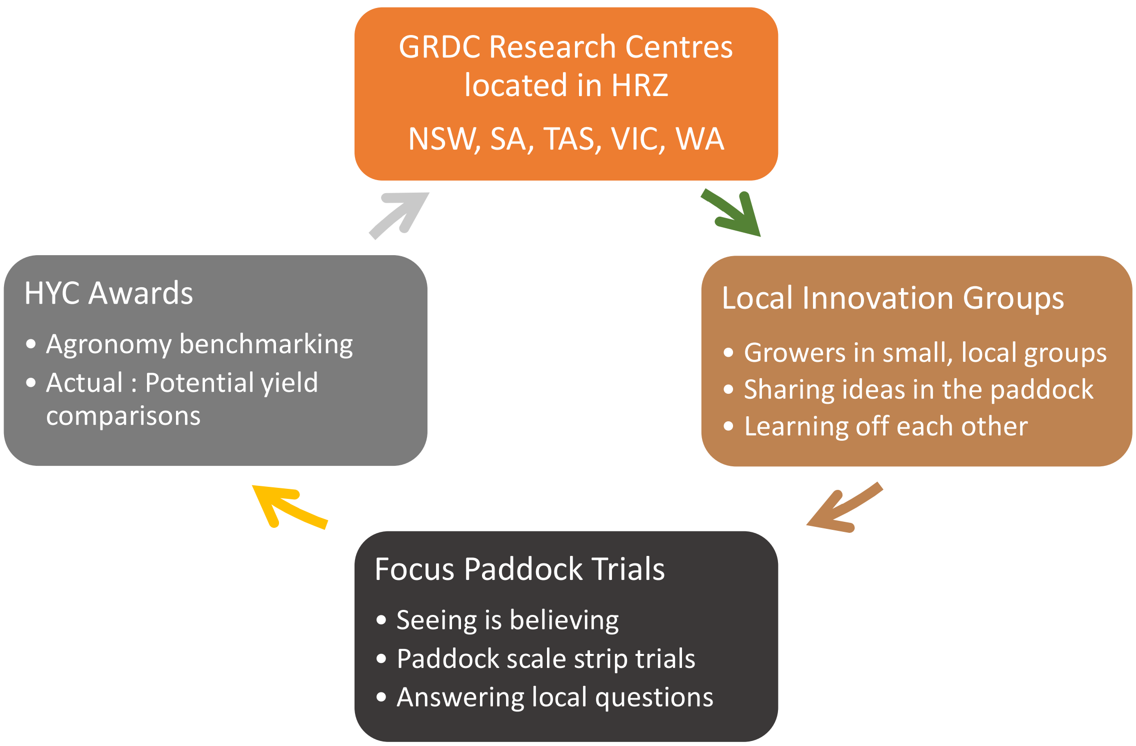
Acknowledgements

The research undertaken as part of these projects is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the authors would like to thank them for their continued support. FAR Australia gratefully acknowledges the support of all of its research and extension partners in the Hyper Yielding Crops project. These are CSIRO, the Department of Primary Industries and Regional Development (DPIRD) in WA, Brill Ag, Southern Farming Systems (SFS), Techcrop, the Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia, MacKillop Farm Management Group (MFMG), Riverine Plains Inc and Stirling to Coast Farmers.

GRDC Hyper Yielding Crops

Jon Midwood (TechCrop), Ashley Amourgis (Southern Farming Systems)

In 2020 the GRDC Hyper Yielding Crops project started. The project is being conducted in Victoria, Tasmania, South Australia, New South Wales, and Western Australia, with each state hosting a GRDC Centre of Excellence. These sites have been selected to run research trials to help determine some of the major factors growers and advisors can use, in their specific environment, to achieve optimum yields through variety and agronomic management of wheat, barley and canola. The following graphic shows the various outputs from the project and how they are inter related with each other:



In combination with the research centres there is a large emphasis on local grower involvement in the project and so in the HRZ of VIC, Southern Farming Systems have been contracted to run this part of the project. As the graphic above shows, this involves the setting up of local grower led innovation groups, facilitating and setting up Focus paddock scale trials and gathering information and measurements for the local HYC Award paddocks. Jon Midwood (TechCrop) oversees this part of the project, in a national role, alongside Nick Poole as project leader.

HYC Awards

Once nominated we collect all the paddock input data and we record specific wheat paddock information to provide an agronomic benchmarking report which compares that paddock to all the others entered, both regionally and nationally, whilst still keeping individual paddock information confidential to the individual grower. Nominated paddocks have their validated yields compared to a biophysical 'potential yield' for that paddock, which allows for the variability of soil types, rainfall, temperature and radiation across all regions. All agronomic information such as sowing dates, variety, crop development timings, soil data – pH, soil organic carbon, N, P, K etc., and in-season applications were collected by the project officer from SFS. Paddock yields, harvest maturity samples, harvest index calculations and grain samples were also collected for analysis. Reports were sent out to all participating growers allowing them to benchmark their agronomy from over 50 factors and compare it to other growers in their region.

The winner for the highest wheat yield in VIC in 2022 was Ben Findlay from Ascot nr Ballarat, with a 10.59t/ha crop of RGT Cesario wheat following canola.

Ben also won the award for the highest yield as a percentage of the potential yield in VIC. His 10.59t/ha crop of Cesario wheat was 87% of the 12.2 t/ha calculated potential for his paddock.

In 2022 we added barley to the Awards programme with 35 paddocks being submitted nationally.

The winner for the highest barley yield in VIC in 2022 was Ed Weatherly from Streatham with a 7.5t/ha crop of RGT Planet barley following wheat in 2021 and a double break of canola and faba beans in the previous 2 seasons.

Ed also won the award for the highest yield as a percentage of the potential yield in VIC. His 7.5t/ha crop of Planet wheat was 70% of 10.72t/ha calculated potential for his paddock.

The following are an example of some of the agronomic benchmarks produced in the HYC Wheat Awards report for VIC in 2022:

Agronomic Factor	Top 20% Award paddocks	Remaining 80%
Yield (t/ha)	8.3	6.1
N applied (kg N/ha)	178	133
N applied per tonne yield kg N/ha)	22	24
Fungicides ($/ha)	$60	$59
Fungicides ($/t)	$7.3/t	$9.9/t
Harvest biomass (t/ha)	24	22
Harvest index	49%	45%
Head count (m2)	576	492
Grains per head	40	36
1000 grain weight	42	40

The following are an example of some of the agronomic benchmarks produced in the HYC Barley Awards report for VIC in 2022:

Agronomic Factor	**Top 20% Award paddocks**	**Remaining 80%**
Yield (t/ha)	7.2	5.4
N applied (kg N/ha)	118	110
N applied per tonne yield kg N/ha)	16	21
Fungicides ($/ha)	$50	$52
Fungicides ($/t)	$7.2/t	$9.8/t
Harvest biomass (t/ha)	24	22
Harvest index	49%	45%
Head count (m2)	687	676
Grains per head	26	22
1000 grain weight	44	40

MEDIA
RELEASE

Tuesday 5th September 2023

FAR Australia adds value to the Australian grains industry with innovative e-Products

Australian based field applied researcher, developer and extension provider proudly announces the launch of its cutting-edge suite of e-Products, a series of written, audio and visual extension and education aids designed to assist growers and industry in making good agronomic management decisions throughout the growing season.

With decades of expertise in the grains industry, FAR Australia has continually pioneered advancements to enhance the productivity and sustainability of farming practices. This latest range of e-Products marks a significant milestone in the organisation's commitment to driving innovation and excellence in the Australian grains industry.

The newly launched e-Products includes 1. 'inGRAINed' a branded series of Cropping Strategies, written to cover different management strategies which will be mailed to subscribers and published online; 2. FARmacy Podcasts, a series of audio content; and 3. FARmacy YouTube videos, a series of visual content.

FAR Australia's e-Products are designed to cater to the specific needs of the Australian grains industry, harnessing the latest field observations and research results to address the complexities and demands faced by growers and advisers throughout the growing season.

"We are thrilled to unveil e-Products that we trust will provide the Australian grains industry with new independent references around key management decisions being considered on farm," said Nick Poole, FAR Australia's Managing Director. "The release of e-Products follows an extensive strategic review by the board of FAR Australia activities, who felt that these independent educational and extension tools should be a key part of the organisation's future."

Updates based on the latest findings from the field will be produced, these will aim to assist growers in the drive for efficiency and productivity gains on farm, ultimately contributing to a more resilient grains industry.

The launch of these e-Products is a testament to FAR Australia's commitment in creating solutions that have a positive and lasting impact on the Australian grains industry. The company remains dedicated to supporting growers in their pursuit of excellence and sustainability.

Issues 1 and 2 of inGRAINed Cropping Strategies have been published on the FAR Australia website. These talk about disease management in wheat and faba beans 2023 and can be found on the FAR Australia website at https://faraustralia.com.au/resource

Should you wish to receive FAR Australia's e-Products, please email info@faraustralia.com.au advising you wish to be added to its mailing list.

Scan the QR codes on the next page to download our latest eProducts

inGRAINed Cropping Strategy: Issue 1 – Disease Management in wheat (2023)

SCAN ME

inGRAINed Cropping Strategy: Issue 2 – Disease Management in faba beans (2023)

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Phoenix CL Winter Canola
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