NSW CROP TECHNOLOGY CENTRE

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Hyper Yielding Crops (HYC) Field Day

20th October 2021

Wallendbeen, NSW

The GRDC Hyper Yielding Crops project is led by FAR Australia in collaboration with:

SOWING THE SEED FOR A BRIGHTER FUTURE

VISITOR INFORMATION

We trust that you will enjoy your day with us at our New South Wales 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

- COVID-19: Please ensure you practice social distancing rules, if required, wear a face mask at all times and use the hand sanitiser provided.
- 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 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

- Should you require any assistance, please ask a member of the FAR Australia team.

LITTER

- 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 marquee or gazebo.

Thank you for your cooperation, enjoy your morning.

COVID-19

Help us keep COVID-19 away

If you are visiting FAR Australia offices or trial sites, please observe the following good hygiene practices to reduce the risk of COVID-19 infection:

- Sanitise your hands when entering the office or trials site and at regular intervals.

- Wash your hands regularly for 20 to 30 seconds. If soap and water is not available, use an alcohol-based hand sanitiser. Hand sanitiser does not replace washing your hands after using the bathroom.

- Avoid touching your eyes, nose and mouth.

- Cover your mouth and nose when coughing and sneezing with a tissue or cough into your elbow.

- Dispose of used tissues into a bin immediately and wash your hands afterwards.

- Practice social distancing:
    - Keep a distance of 1.5 metres between you and other people.
    - Avoid crowds and large public gatherings.
    - Avoid shaking hands or any other physical contact.

Thank you for your cooperation.

WELCOME TO THE 2021 NEW SOUTH WALES CROP TECHNOLOGY CENTRE FIELD DAY

FEATURING THE GRDC'S HYPER YIELDING CROPS PROJECT

On behalf of Hyper Yielding Crops (HYC) project team, I am delighted to welcome you to the 2021 New South Wales Crop Technology Centre Field Day. The centre currently hosts the GRDC's Hyper Yielding Crops (HYC) project.

The GRDC's Hyper Yielding Crops project is a national initiative led by FAR Australia in collaboration with a number of project partners; here in New South Wales we are working closely with regional partner Riverine Plains Inc.

Today you will be joined by Rohan Brill of Brill Ag and Tom Price of FAR Australia who will guide you through the trials and discuss the following:

Canola topics:

- What were the required tactics to achieve 5t/ha canola in 2020?
- How important is cultivar choice and fungicide management to reduce disease levels in Hyper yielding canola?
- What learnings can be extrapolated to low and medium rainfall environments?

Cereal topics:

- Nutrition trials - How much N was required to grow 10t/ha crops of feed wheat last season?
- Disease management x germplasm trial - What did we learn from our fungicide evaluations in wheats of differing disease resistance?
- Genotype x Environment x Management (G.E.M) trial – What level of management maximised margins in crops yielding 7 – 11t/ha?
- How big is the gap in yield performance between feed and milling wheats in HYC trials in 2020?

Should you require any assistance throughout the day, please don't hesitate to contact a member of the team who will be more than happy to help.

If you would like to learn more about the results from this GRDC investment, please contact Rachel Hamilton at rachel.hamilton@faraustralia.com.au.

Thank you once again for taking the time to join us today; we hope that you find the presentations useful, and as a result, take away new ideas which can be implemented in your own farming business. Have a great day and we look forward to seeing you again at future project events.

Nick Poole
Managing Director
FAR Australia

Funding Acknowledgements
The Hyper Yielding Crops project team would like to place on record their grateful thanks to the Grains Research & Development Corporation (GRDC) for their funding support for this event and featured project.

Other Acknowledgements
Thank you to our host farmer Charlie Baldry for all his support throughout the season.

What is this project aiming to achieve and how did it originate?

Hyper Yielding Crops

Hyper Yielding Crops (HYC) builds 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 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 this project contact:

Rachel Hamilton – HYC Communications and Events, FAR Australia (rachel.hamilton@faraustralia.com.au)
Nick Poole – HYC Project Leader, FAR Australia (nick.poole@faraustralia.com.au)
Jon Midwood - HYC extension coordinator, TechCrop (techcrop@bigpond.com)
Kate Coffey, NSW HYC Project Officer, Riverine Plains Inc, (kate@riverineplains.org.au)

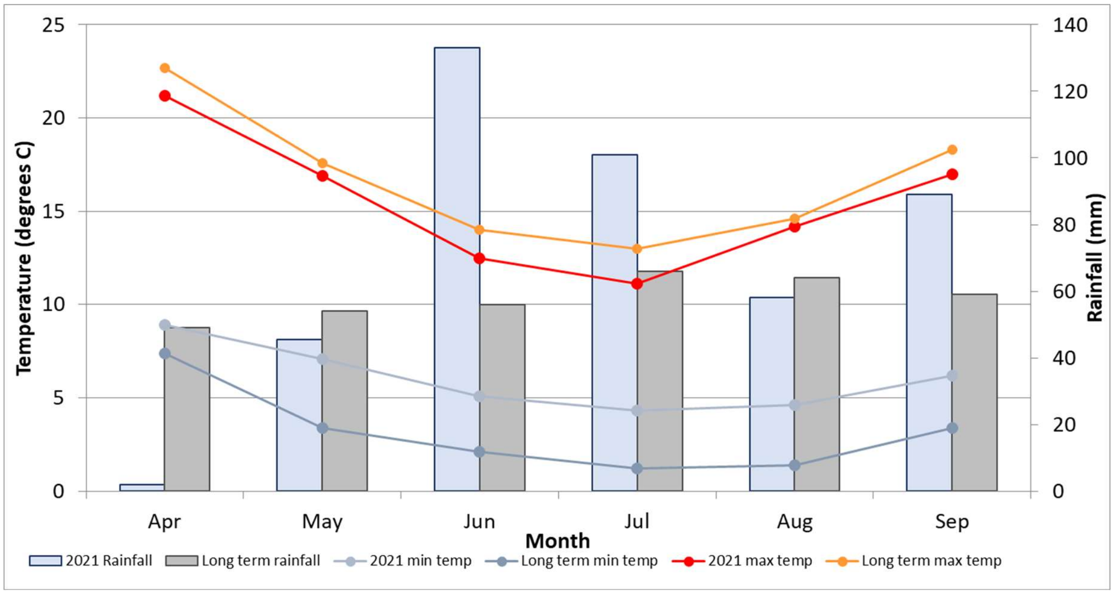

Figure 1. 2021 growing season rainfall as of end September and long-term rainfall (1955-2021) (recorded on farm), 2021 min and max temperatures (recorded on farm) and long-term min and max temperatures (1995-2021) (recorded at Cootamundra Airport) for the growing season.

Note: Above average rainfall in January, February and March meant a full profile of water was present in April.

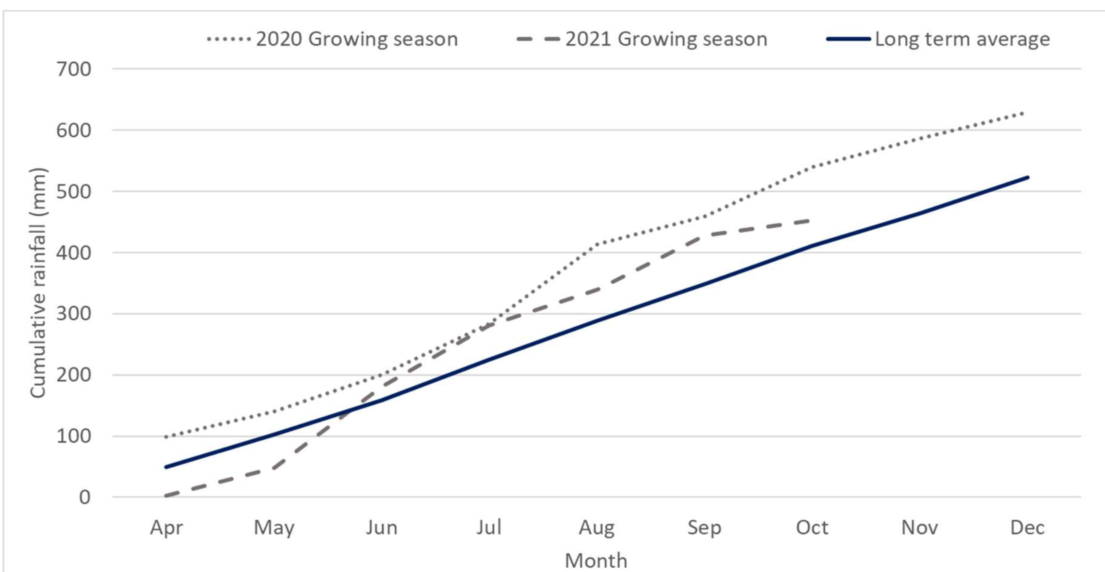

Figure 2. Cumulative growing season rainfall for 2021, 2020 and the long-term average (recorded on farm).

The science behind high yielding crops

John Kirkegaard CSIRO

There is nothing that gets a conversation going better at the pub than record-yielding crops. Although there may be some luck involved, there is no magic. We understand a lot about the key factors required to achieve high yields. In this article, I will briefly outline the major factors driving high yield and use a recent world record canola crop (7.2 t/ha) grown right here in Australia to demonstrate the point. The crop was grown at Oberon in NSW in 2020.

(1) Light and temperature in the "critical period"

All crops have a 'critical period" in which the number of grains is set, and grain number drives very high yields. In cereals, the critical period is concentrated in the 3 weeks before flowering. In canola and pulses it is in the period 1-4 weeks after the start of flowering. Minimising stress and maximising growth in this critical period are the key to high yields.

To minimise stress, flowering should be timed to minimise the risk of frost, heat and drought and ensure water and nutrients are in good supply.

To maximise growth, the crop requires cool temperatures – which increase the duration of the critical period - and sunny days which increase photosynthesis for growth.

More photosynthesis for more days means more grain and more yield.

A common way to measure this is the photo-thermal quotient (PTQ) – or CSI – the cool sunny index which is simply (total radiation/average temperature) in the critical period. This ranges from low values of 1.0 in places like Bangladesh up to 2.0 in places like UK and NZ.

Its no surprise that world-record crops are often achieved in places like UK or New Zealand with crop flowering in long summer days, with cool temperatures.

In Australia, typical PTQ's in the critical period may be 1.0 in the Ord River WA, 1.2 at Gatton in QLD, 1.5 at Yanco, 1.7 in Canberra and can vary with season depending on temperature and cloud cover.

The PTQ puts an upper limit on the potential yield in any environment.

(2) Water limited potential

Due to our dry and variable climate, Australian farmers are much more used to thinking of water as the main limiting factor for crop yield. Water is more plentiful in the high rainfall zone or under irrigation, but it will still limit yield in many years.

Rules of thumb to estimate yield potential from water supply have been used and updated since French and Schultz first studied wheat crops in South Australia in the 1980.

The best crop with no other limits on yield will produce 25 kg/ha/mm water supply for cereals and 15 kg/ha/mm for canola.

Water supply (mm) can be estimate as [in-season rainfall + 0.3 x fallow rainfall – 60 (evaporation)].

We often cap this at a maximum of ~500mm as higher amounts are likely to generate runoff or leaching in most soils – there is only so much water that can be held by the soil in a given season.

(3) Nitrogen

We know from numerous published studies that to grow each tonne of grain yield will require a total nitrogen supply to the crop (from soil and fertiliser) of 40kg/ha N for wheat and 80 kg/ha for canola.

We can use this rule of thumb to estimate whether we had a sufficient supply of N to support the yield potential that was possible from the PTQ and the water supply at the site.

Do these factors make sense for the Oberon world record crop?

Light and temperature in the critical period

Oberon is located in the southern Tablelands of NSW at 1000m elevation and features fertile basalt soils. As a result, it experiences very cool conditions through the spring period during the critical period. The winter canola crop (Hyola970) sown in February has an ideal flowering window and avoided frost and heat. Despite above average rainfall in 2020 the critical period was sunny.

The calculated PTQ in 2020 was 1.72, sufficient for **8.0 t/ha canola** or **13 t/ha wheat**.

Water supply

In 2020, the area received a total of 900mm rainfall, evenly distributed throughout the growing season (676mm in season; 214mm in summer fallow) with no periods of waterlogging. This calculates as 680mm water supply, so the maximum 500mm cap was easily reached.

The 500mm total water supply cap was sufficient for **7.5 t/ha canola yield** or **12.5 t/ha wheat yield.**

Nitrogen supply – probably the key in 2020!

The crop was sown in a long-term pasture paddock with no previous cropping history. The grower had run free-range cattle <u>with grain feeders</u> on the paddock in a fattening business for the previous 15 years. Together with the inherent fertility of the basalt soil, this means the crop was likely to be supplied with enormous rates of soil fertility.

The crop received only 103 kg N/ha as fertiliser - 80 kg/ha MAP (8 kg N/ha) at sowing and 200 kg/ha urea top-dressed on 2 September (95 kg N/ha). This means that of the 576 kg N/ha required by the 7.2 t/ha canola crop, around 480 kg N/ha has been provided by the soil! Is this possible?

No soil measurements were taken at the site, but previous measurements of mineral N in southern NSW over many years have shown that it is not uncommon to find 200-300 kg mineral N/ha in the soil to 1.8m depth after removal of long-term pastures. Grain feeding cattle with manure return would have boosted fertility levels even more. In-season mineralisation in such a wet season would also have been high, and up to 200 kg N/ha have mineralised in season after lucerne-based pastures. The very long growing season (Feb-Dec) would have facilitated a long mineralisation period and the deep-rooted winter canola (can root to 4m depth) would have accessed any N moving to deeper layers.

It is likely that the specific paddock history at Oberon provided enormous natural N fertility was the key reason that this crop was able to come very close to its true potential as defined by PTQ and water supply.

Don't forget the excellent agronomy!

Obviously, no crop can reach its potential without excellent management to establish, manage and protect the potential. The timely and effective operations of Peter Brooks (grower) and James Cheetham (agronomist) are clearly a very large part of the success!

2021 is on target for 10 tonne yields, how frequent is this at Wallendbeen?

Kenton Porker, John Kirkegaard, Nick Poole, Tom Price, Ben Morris

Based on simple water use efficiency metrics, and the photothermal quotient calculations outlined in the previous paper it is possible to aspire to achieve grain yields of 10t/ha at Wallendbeen. These data also demonstrate that yields greater than **10t/ha where possible in almost 50% of years since 2010.**

When flowering on the 10th October for wheat, the following table highlights that grain yields has likely been **water limited in 6 out of the last 10 years**, whereas yields has been **light limited 4 out of the last 10** years in our quest to achieve 10 tonnes per hectare. The question then becomes how we do set our crops up for 10tonne per hectare and protect yield. The GRDC Hyper yielding are key to answering this question.

Table 1. *Grain Yield potentials based on water use efficiency, and photothermal quotient equations for Wallendbeen over the last 10 years (using SILO Bom Data) shaded cells indicates the factor with the lowest yield potential limiting yield.*

Year	Water Limited Yield Potential (t/ha)	Photothermal Quotient Yield Potential (t/ha)#
2010	>12.5*	13.5
2011	12.5	11.4
2012	10.3	14.2
2013	9.0	14.4
2014	8.7	14.2
2015	>12.5*	12.0
2016	>12.5*	9.8
2017	8.9	10.8
2018	6.9	10.4
2019	6.2	11.4
2020	>12.5*	9.2
2021	>12.5*	10.3

*assumes runoff after 500mm of water supply
#based on a flowering date of 10th October

Choosing a cultivar and sowing date to achieve 10tonne potential?

New genetics offer improved yield and may convert light and water into yield more efficiently than older genetics in the high rainfall zones. In particularly cultivars that are coming out of Europe where breeding for high yield potential is a greater focus. Breeding programs in Australia are understandably more focused on breeding for improved water use efficiency for the wheat belt. However, as this data highlights, yield may be limited by light in 50% of years, and top end yield potential rather than water. For a cultivar to achieve 10t/ha, it needs to have the genetic yield potential to do so, but it must also have the correct flowering behaviour to align its critical period with the environment. Some of the slower developing winter feed wheats have realised this potential in the southern states and when sown in the high rainfall environments, such of Tasmania. However, our data suggests that cultivars such as Accroc and Anapurna are equally as well adapted to Wallendbeen, particularly when sown in April in seasons like 2020. This is because their critical period is aligned with the most optimal conditions to achieve 10t/ha and they flower in the week from the 7th October to the 14th in 2020. Based on long term data, this date is the period in which highest yields could be achieved based on the photothermal quotient (light and temperature in the critical period). (figure 1). While it must be noted high yields can be achieve by flowering earlier and later than this the frost and heat risk are considerably higher and will reduce yields.

2021 looks set to offer growers the opportunity to achieve 10tonnes again, and growers should look to long term data and consider the gross margins of newer high yielding feed wheats.

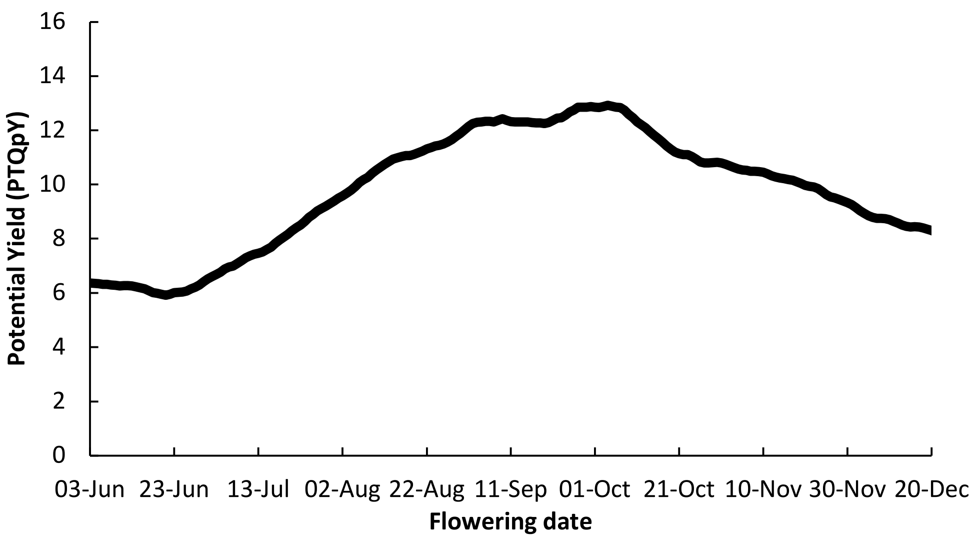

***Figure 1**. Long Term (last 10 years) yield potential and relationship with flowering date at Wallendbeen based on the photothermal quotient.*

Grain yields from 2020 at Wallendbeen reflect these differences in flowering time when disease is controlled (table 2). However, when the crop canopy was not managed the crop failed to achieve its potential, as outlined in the next article by Tom Price.

Table 2. *Flowering responses and yield data (when disease is controlled) at Wallendbeen in 2020 Hyper Yielding site.*

Variety	Flowering Week	2020 Yield
Trojan (spring)	23-Sep	8.3
Scepter (spring)	23-Sep	8.3
Beckom (spring)	23-Sep	8.5
Catapult (spring)	23-Sep	8.3
Gregory (spring)	23-Sep	7.2
Nighthawk (facultative)	8-Oct	8.6
RGT Accroc (winter)	***8-Oct***	***10.3***
Kittyhawk (winter)	8-Oct	8.0
Anapurna (winter)	***14-Oct***	***10.4***
DS Bennett (Winter)	14-Oct	9.7
Variety (LSD)		0.031

HYC Disease management germplasm interaction

Tom Price and Nick Poole
Field Applied Research (FAR) Australia, Mulwala, NSW, 2647, Australia

The following article is based on results from the southern NSW Hyper Yielding Crops research programme which is a national GRDC investment taking place across the higher yielding regions of southern Australia. The research is taking place at Wallendbeen at 540m altitude which naturally creates a generally cooler longer season environment for growing high yielding crops. At this altitude disease infection can be delayed until later in the season compared to lower altitudes in the Riverine Plains region. Please note these are first year results.

Objectives: This trial aims to develop profitable and sustainable approaches to disease management in high yielding wheats grown in regions with higher yielding potential.

Key messages:

- In seasons that favour higher yield potential, one of the most important components in growing high yielding cereal crops is disease management.
- The feed winter wheats RGT Accroc and Anapurna significantly out yielded all other cultivars at all three levels of disease management and achieved over 10t/ha with fungicide input.
- There was a significant interaction between cultivar and fungicide management with the stripe rust susceptible cultivars LRPB Trojan and DS Bennett giving yield responses of 5.27 and 3.07 t/ha to a single flag leaf fungicide compared to less than a 1t/ha with the majority of cultivars.
- Septoria tritici blotch (STB) was the principal disease in untreated crops of Scepter and Beckom, whilst stripe rust was the main disease in LRPB Trojan, DS Bennett, Coolah, RGT Accroc and Catapult. Other cultivars were subject to low levels of both stripe rust and STB disease pressure.
- Only LRPB Trojan, Catapult, Coolah and DS Bennett gave significant yield increases to the application of four units of fungicide (seed treatment and three foliar fungicides) over a single flag spray.
- Where genetic resistance in a wheat cultivar is not sufficient to delay fungicide decisions until flag leaf emergence (GS37-39), look to target the following three key timings for fungicide intervention; first node GS31, flag leaf emergence GS39 with an optional third application at head emergence GS59.
- Avoid repeated use of the same fungicide active ingredients, and in the case of the newer Group 11 QoI (strobilurins) and Group 7 SDHIs, where possible restrict strategies to just one application per season in order to slow down and help prevent the selection of resistant strains.

Method:
A replicated small plot trial was established during the 2020 season at the NSW hyper yielding research site, Wallendbeen New South Wales, as part of the GRDC funded hyper yielding crops (HYC) project lead by FAR Australia.

This trial assessed the performance of 10 wheat cultivars, 5 national cultivars and 5 regionally specific cultivars sown 21 April 2020. These cultivars consisted of both winter and spring germplasm with a variety of different disease ratings (Table 1) to fully assess the yield potential of these cultivars under different disease management strategies.

Table 1. *Cultivar, type, and disease ratings of wheat cultivars used. First 5 are national varieties, standard to all sites across project, and last 5 are regional varieties, chosen to suit local environment.*

Cultivar	**Type**	**Disease Rating**		
		Stripe Rust	**Septoria tritici blotch**	**Yellow leaf spot**
LRPB Trojan	Spring	S-VS	MS	MS-S
Scepter	Spring	MS-S	S	MR-MS
LRPB Nighthawk	Facultative	MR	MS-S	MR-MS
Anapurna	Winter	R-MR	MR-MS	MR-MS
RGT Accroc	Winter	R-MR	MR-MS	MR-MS
Beckom	Spring	MR-MS	S	MS-S
Catapult	Spring	MR-MS/S-VS	MS-S	MR-MS
EGA Gregory*	Spring	MR	MS-S	S
Coolah*	Winter	R-MR	MS-S	MS-S
DS Bennett	Winter	S	MS-S	MR-MS

Figures from most recent data source: Cereal disease guide VIC 2021.
** Figures from Winter crop variety sowing guide NSW 2020.*

Each cultivar was exposed to 3 different levels of disease management, these being; an untreated control, a single fungicide spray, and a full fungicide control. The details of each treatment can be found in Table 2. Other than fungicide application, all other management applications were standard across the trial to maximise yield potential as per the seasonal conditions.

Table 2. *Treatment description.*

	Untreated	**1 Fungicide unit**	**Complete control**
Seed treatment	Vibrance/Gaucho	Vibrance/Gaucho	Vibrance/Gaucho + Systiva
GS 31 spray	-	-	Prosaro 300ml
GS 39 spray	-	Amistar Xtra 800ml	Amistar Xtra 800ml
GS 59-61 spray	-	-	Opus 500ml

Sowing date: 21 April 2020
Harvested: 14 December 2020
Rotation position: 1st cereal after canola 2019
Rainfall: GSR (April-October) 587mm

Soil mineral nitrogen: 68.5 kg N/ha (0-60 cm)
In season applied N: 12kg N/ha at sowing as MAP + 110kg N/ha as urea

Results:

i) **Disease assessment**

The 2020 growing season generated high disease pressure in a number of susceptible varieties. Full disease assessments were conducted after flag leaf emergence (GS39) and during grain fill (GS75-80), however only the results from the grain fill assessment have been shown.

There were significant levels of stripe rust in the unsprayed treatments of LRPB Trojan, DS Bennett and Catapult with lower levels in, Coolah, RGT Accroc, and Scepter (Figure 1). LRPB Trojan had the highest levels of infection with 80% of the flag leaf and 68% of the F-1 leaf infected by stripe rust. In all infected varieties, the application of 1 fungicide at GS39 significantly reduced the levels of infection giving over 90% control in all varieties except Catapult which only gave 78% control of stripe rust. The application of 4 fungicide units (complete control) gave 100% control in Scepter and RGT Accroc and over 97% control in all other varieties.

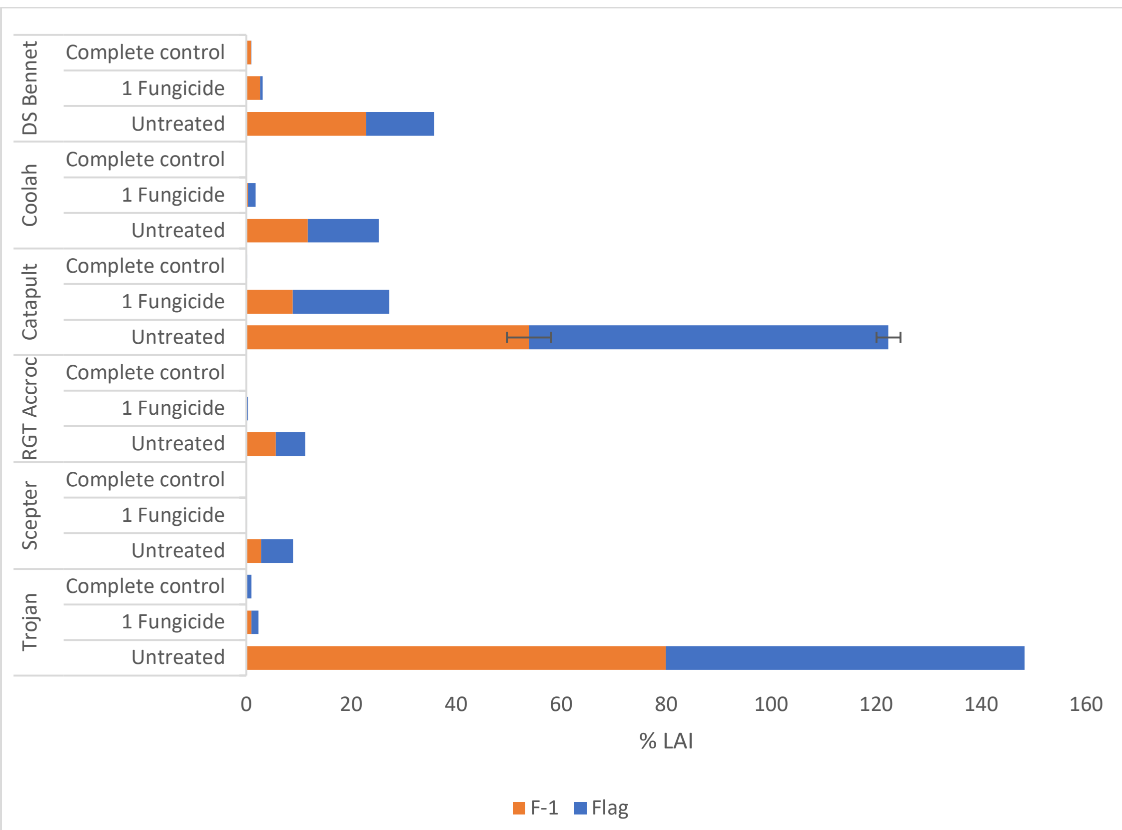

***Figure 1**. Stripe rust infection (% leaf area infected (LAI)) at grain fill (GS75-80, 3-Nov), only showing varieties that had significant infection levels. F-1 P= <0.001, LSD= 8.4. Flag P=<0.001, LSD= 4.6. Error bars represent LSD.*

Septoria tritici blotch (STB) caused by the pathogen *Zymoseptoria tritici* was much less prevalent at the site with only Scepter showing high levels of infection (Figure 2) with 15% of the leaf area of the flag leaf and 28% of the F-1 leaf area affected.

Yellow leaf spot, leaf rust and wheat powdery mildew present at the site but at low levels.

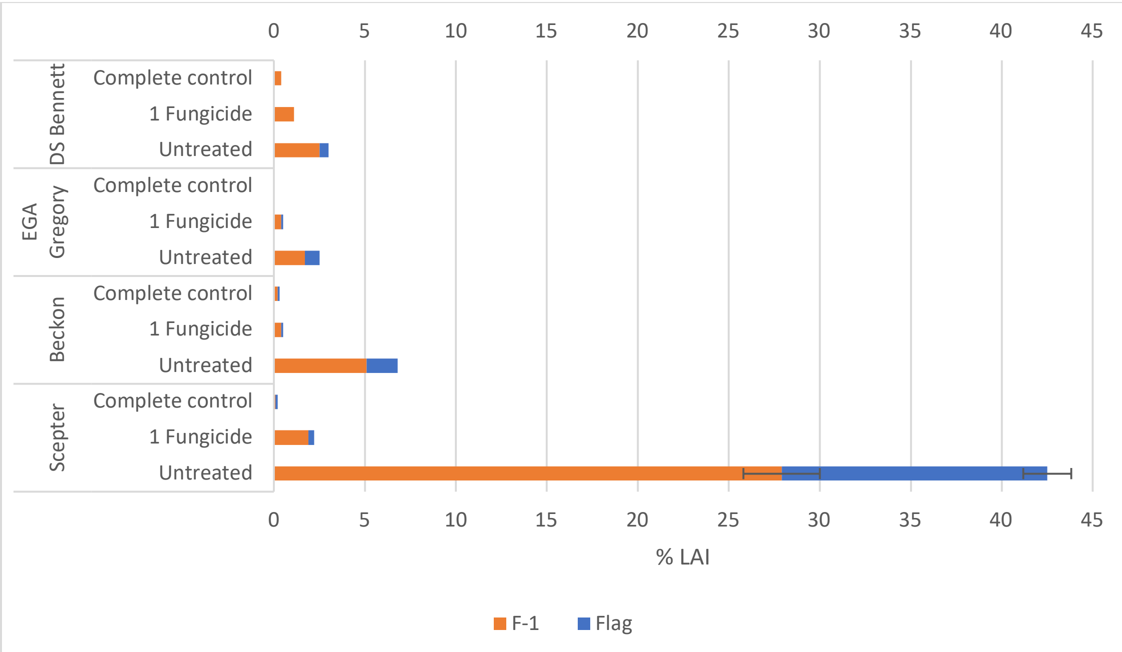

***Figure 2**. Septoria tritici blotch infection (% leaf area infected (LAI)) at grain fill (GS75-80, 3-Nov), only showing varieties that had significant infection levels. F-1 P= <0.001, LSD= 2.6. Flag P=<0.001, LSD= 4.2. Error bars represent LSD.*

ii) Grain yield and quality

The trial was harvested on 14 December with an average yield of 8.2 t/ha with highest yields of 10.8 and 10.5 t/ha in complete control RGT Accroc and Anapurna. As a result of high disease pressure at the site, there was a significant interaction for grain yield between fungicide management and cultivar (Table 1). All varieties showed a yield response to a single flag leaf spray compared to the untreated. However, only 4 varieties gave a significant yield response to 4 fungicide units compared to the single fungicide application.

Table 3. *The effect of fungicide management and cultivar on grain yield (t/ha) at harvest, 14 December.*

	Management Level						
	Untreated		1 Fungicide Unit		Complete control		Mean
Cultivar	**Yield t/ha**		**Yield t/ha**		**Yield t/ha**		**Yield t/ha**
LRPB Trojan	2.28	n	7.55	hij	8.13	efg	**5.98**
Scepter	7.07	kl	8.60	d	8.55	de	**8.07**
LRPB Nighthawk	7.98	gh	8.47	def	8.54	de	**8.33**
Anapurna	9.69	c	10.22	b	10.46	ab	**10.12**
RGT Accroc	9.72	c	10.86	a	10.83	a	**10.47**
Beckom	7.75	ghi	8.46	def	8.66	d	**8.29**
Catapult	6.06	m	7.84	ghi	8.46	def	**7.45**
EGA Gregory	6.75	l	7.15	jkl	7.40	ijk	**7.10**
Coolah	7.26	jk	8.07	fg	8.75	d	**8.03**
DS Bennett	5.68	m	8.75	d	9.48	c	**7.97**
Mean	**7.02**		**8.60**		**8.93**		
LSD Cultivar p = 0.05		0.26		P val		<0.001	
LSD Management p=0.05		0.28		P val		<0.001	
LSD Cultivar x Man. P=0.05		0.45		P val		<0.001	

Grain protein varied significantly between varieties. EGA Gregory and Scepter had the highest proteins of 11.9% and 11.8% respectively, while RGT Accroc and DS Bennett had the lowest proteins with 10.3% and 10.4% respectively.

Conclusion:

2020 was a high disease pressure season and high yield potential at the Wallendbeen site. Results processed so far in HYC research in southern NSW show not only the significant influence of disease management but also the large differences in genetic resistance to disease. In a season with higher yield potential and higher disease pressure (primarily Stripe rust (pt. 198 E16 A+ J+ T+ 17+), Septoria tritici blotch and lower levels of leaf rust, powdery milder and yellow leaf spot), all wheat cultivars gave a significant yield response to fungicide application, but where cultivars had greater genetic resistance there was no statistical yield difference between a single unit of fungicide (where the flag leaf spray was based on a full rate azoxystrobin/epoxiconazole mixture (Radial® 840 mL/ha) compared to where plots were kept free of disease with four units of fungicide.

Acknowledgements:

FAR Australia would like to place on record its grateful thanks to our host farmer Mr Charlie Baldry and the GRDC for funding the national initiative Hyper Yielding Crops project

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April sown wheat – what's the productivity difference of winter & spring germplasm in a season of high yield potential?

Tom Price, Nick Poole & Ben Morris
Field Applied Research (FAR) Australia, Bannockburn, Victoria 3331, Australia

Objectives: To assess the performance of winter and spring wheat germplasm managed under three different levels of management (22nd April sown) at the HYC Wallendbeen research site.

The details surrounding the 2020 key points can be found in Tables 1 – 4 and Figures 1 – 3.

Key Points:

- *Winter feed wheats RGT Accroc and Anapurna were significantly higher yielding than all other cultivars tested giving yields over 10t/ha and a 2t/ha advantage over Scepter.*
- *The ASW wheat DS Bennett was significantly higher yielding than all other white wheat milling varieties.*
- *Of the AH classified wheats Nighthawk and Beckom were the highest yielding (mean of the three managements).*
- *There was a significant reduction in yield as a result of defoliation (simulated grazing) at GS30 when the results from all cultivars were averaged.*
- *Although there was some evidence that the different varieties responded to management differentially the interaction was not statistically significant (p=0.06).*
- *Dry matter (DM) contents at harvest ranged from 17 – 20t/ha with significantly higher DM accumulation in the longer season winter wheats such as RGT Accroc, Anapurna and DS Bennett compared to Scepter.*
- *Greater dry matter accumulation with the winter wheat up to GS30 was the result of a longer vegetative period that correlated to higher tiller number per unit area and tillers/plant.*
- *At harvest however although there were more heads/m2 with winter wheats they were not always significantly higher than spring wheats indicating greater tiller mortality in winter wheats compared to springs.*
- *In general, disease (principally Septoria and stripe rust) has been controlled by the two spray programme set out in the standard management approach, however those varieties that tended to give higher yields at higher input (not significant) were in general the more susceptible.*
- *The increased nutrition (18kg N/ha and 25kg S/ha) and PGR applied with the high input approach did not generate any notable yield gains.*
- *In those cultivars that lodged (Gregory, Catapult, Beckom and Trojan) there was no indication that the PGR application reduced lodging, although there were significant positive effects from grazing on standing power.*

- *Protein levels averaged just 11% and indicated that yields were optimised at the level of N application (122 – 140kg N/ha).*
- *Harvest indices for winter wheats were in general closer to 37-40% compared to higher yielding spring wheats that were closer to 45%.*

Treatments: Three management levels (see Table 4) differing in defoliation, nitrogen, fungicide and PGR input were applied to 10 varieties of winter and spring wheat.

Table 1. *Influence of management strategy and variety on grain yield (t/ha)*

	Management Level (Yield t/ha)							
Cultivar	**Standard**		**Grazed* Standard**		**High Input**		**Mean**	
Trojan (spring)	8.04	-	8.18	-	8.25	-	**8.15**	**d**
Scepter (spring)	7.92	-	8.29	-	8.34	-	**8.18**	**d**
Nighthawk (facultative)	8.52	-	8.25	-	8.59	-	**8.45**	**c**
Anapurna (winter)	10.37	-	9.62	-	10.35	-	**10.11**	**a**
RGT Accroc (winter)	9.94	-	9.90	-	10.34	-	**10.06**	**a**
Beckom (spring)	8.40	-	8.49	-	8.45	-	**8.45**	**c**
Catapult (spring)	7.80	-	8.03	-	8.26	-	**8.03**	**de**
Gregory (spring)	7.04	-	6.96	-	7.24	-	**7.08**	**f**
Kittyhawk (winter)	7.95	-	7.67	-	7.94	-	**7.85**	**e**
DS Bennett (Winter)	9.72	-	9.10	-	9.42	-	**9.41**	**b**
Mean	**8.57**	**ab**	**8.45**	**b**	**8.72**	**a**		
LSD Cultivar p = 0.05			0.18		P val		0.031	
LSD Management p=0.05			0.25		P val		<0.001	
LSD Cultivar x Man. P=0.05			0.43		P val		0.060	

** "Grazed" – Mechanically defoliated at GS30*

Table 2. *Influence of management strategy and variety on grain protein (%)*

	Management level (Protein %)						
Cultivar	Standard		Grazed standard		High input		**Mean**
Trojan (spring)	11.4	-	11.7	-	11.3	-	**11.4**
Scepter (spring)	10.6	-	10.7	-	10.7	-	**10.7**
Nighthawk (facultative)	11.6	-	11.6	-	11.4	-	**11.5**
Anapurna (winter)	11.5	-	10.4	-	11.5	-	**11.1**
RGT Accroc (winter)	11.6	-	10.5	-	11.6	-	**11.2**
Beckom (spring)	11.1	-	10.8	-	11.2	-	**11.0**
Catapult (spring)	11.3	-	11.2	-	11.3	-	**11.3**

Gregory (spring)	10.9	-	11.6	-	11.4	-	**11.3**
Kittyhawk (winter)	11.6	-	11.6	-	11.8	-	**11.7**
DS Bennett (Winter)	11.3	-	11.4	-	10.7	-	**11.1**
Mean	**11.3**		**11.1**		**11.3**		
LSD Cultivar p = 0.05			0.515		P value		**0.021**
LSD Management p=0.05			0.323		P value		**0.526**
LSD Cultivar x Man. P=0.05			0.892		P value		**0.259**

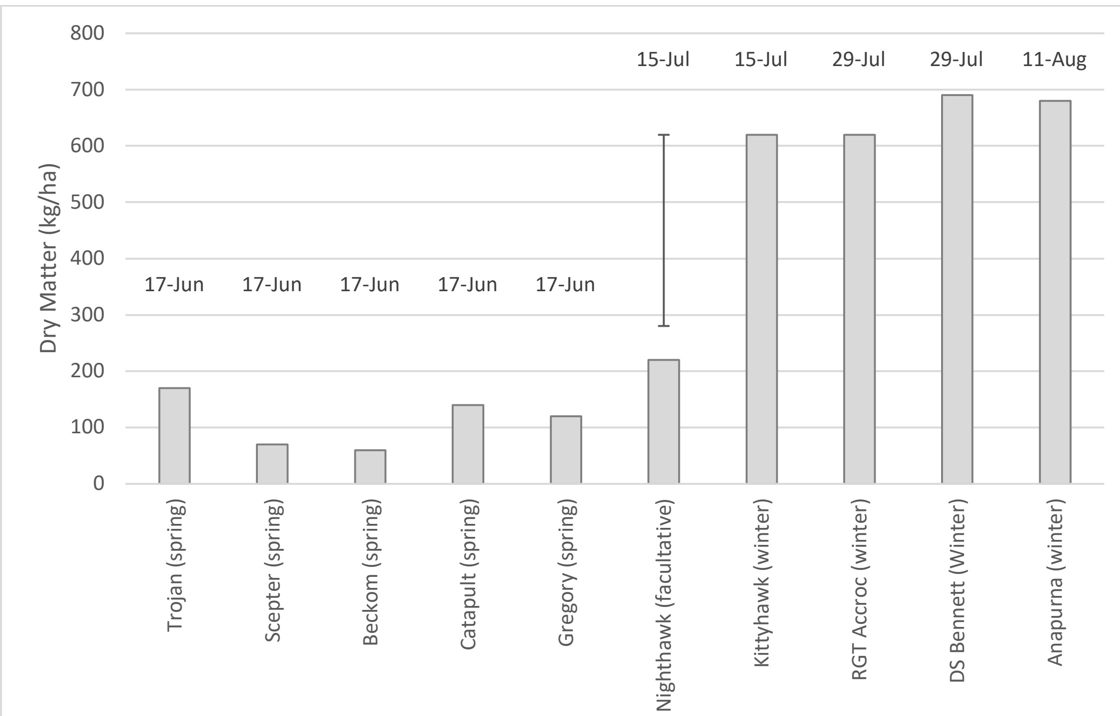

Figure 1. *Dry Matter removed (kg/ha) and date of grazing at GS30, Error bar represents LSD of 340 kg/ha at p=0.05.*

Table 3. *Plants/m2 assessed at GS12, tillers/m2 assessed GS31, heads/m2 assessed at GS90, and the number of tillers per plant.*

Variety	Plants/m2		Tillers/m2		Heads/m2		Tillers/Plant
Trojan (spring)	137	ab	324	c	494	cd	2.4
Scepter (spring)	125	bcd	343	c	463	de	2.7
Nighthawk (facultative)	143	a	484	ab	576	a	3.4
Anapurna (winter)	137	ab	517	a	520	bc	3.8
RGT Accroc (winter)	121	cd	518	a	554	ab	4.3
Beckom (spring)	122	bcd	354	c	522	bc	2.9
Catapult (spring)	142	a	362	c	599	a	2.5
Gregory (spring)	147	a	319	c	446	de	2.2
Kittyhawk (winter)	116	d	434	b	441	e	3.7

DS Bennett (Winter)	135 abc	507 a	556 ab	3.8
Mean	**133**	**416**	**517**	3.1
LSD	14.9	54.6	50.3	
P value	**<0.001**	**<0.001**	**<0.001**	

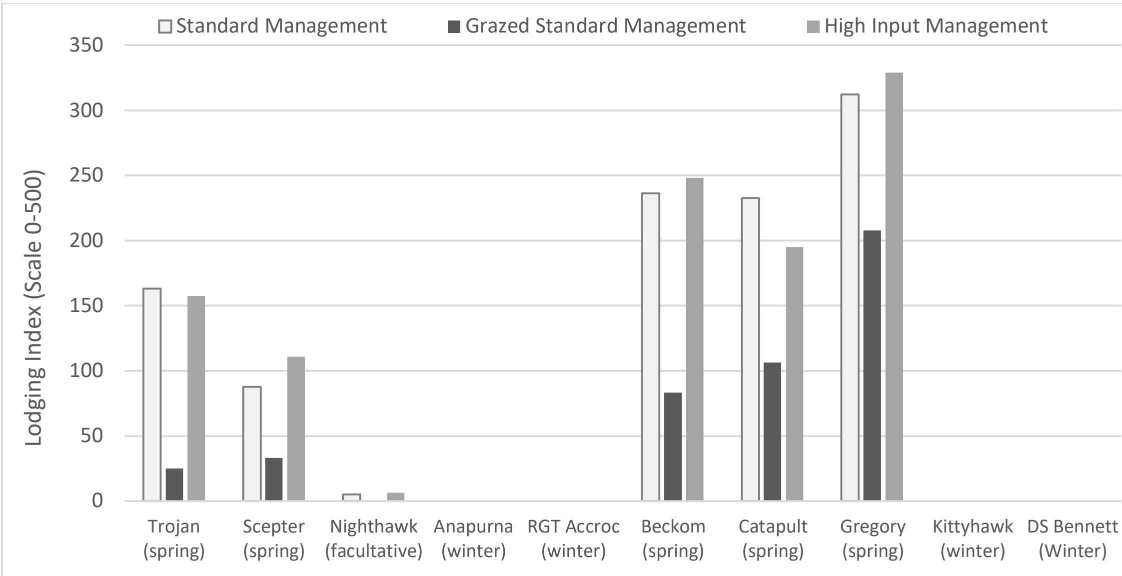

Figure 2. *Influence of variety and management on crop lodging index (0-500) at crop maturity (GS90) on 7 December.*

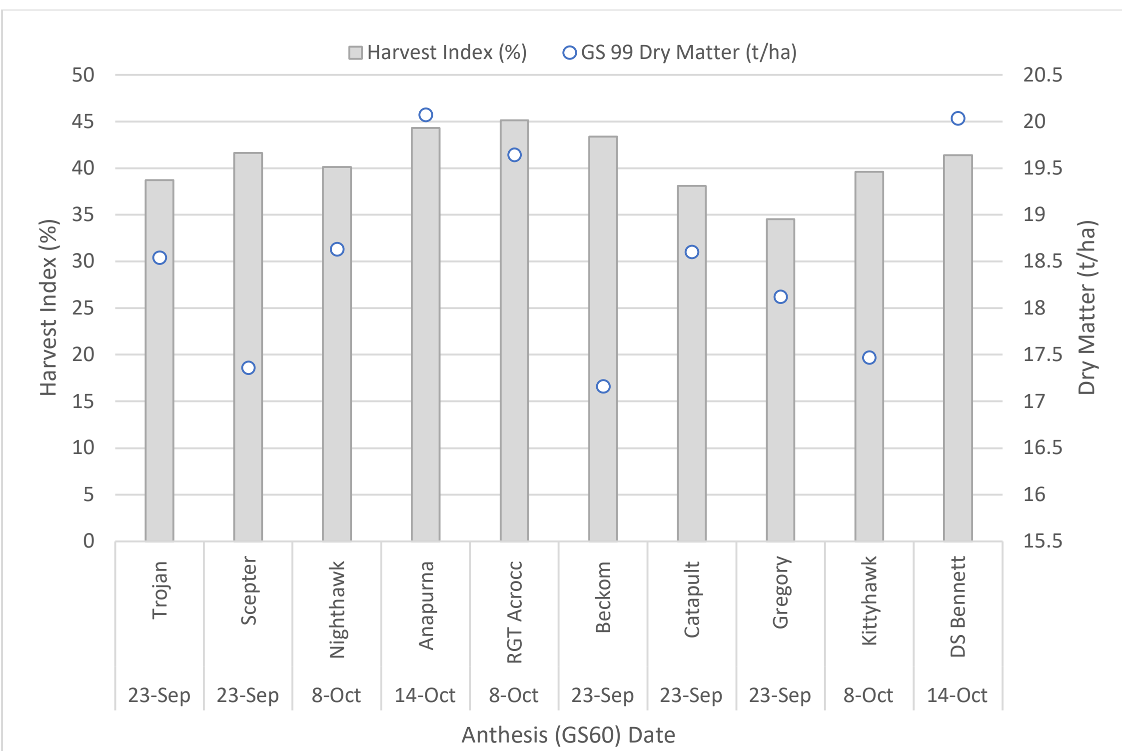

Figure 3. *Influence of cultivar on dry matter at harvest (t/ha) and harvest index (%) – mean of management levels. Anthesis date shown.*

Table 4. *Details of the management levels.*

Plant pop'n:	180 seeds/m^2 (150 plants/m2 target) - all three managements			
	Timing	**Standard**	**Grazed Standard**	**High Input**
Seed treatment:		Vibrance/Gaucho	Vibrance/Gaucho	As 1 F unit + Systiva
Basal Fertiliser:	21 April	120kg MAP (12 Kg N)	120kg MAP (12 Kg N/ha)	120kg MAP (12 Kg N/ha)
Nutrition:	18 June	40kg N/ha	40kg N/ha	40kg N +25kg S + 25kg K/ha
	23 July	70kg N/ha	70kg N/ha	88kg N/ha
Total N Applied:		**122kg N/ha**	**122kg N/ha**	**140kg N/ha**
PGR:	11 August	---	---	Moddus Evo 100ml/ha
				Errex 0.65L/ha
Fungicide*:	GS 31	Opus 500ml/ha	Opus 500ml/ha	Prosaro 300ml/ha
	GS39	Amistar Xtra 800ml/ha	Amistar Xtra 800ml/ha	Amistar Xtra 800ml/ha
	GS61			Opus 500ml/ha

All other inputs of insecticides and herbicides were standard across the trial.

**Timings of fertiliser and fungicides were adjusted to take account of the differences in spring) and winter wheat phenology (development).*

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

Hyper Yielding Canola – results from 2020 and research going forward

Rohan Brill
Agronomist – Brill Ag

Key Points

- Grain yields above 5 t/ha were achieved at Wallendbeen Hyperyielding Canola site in 2020 (maximum 5.6 t/ha).
- In 2020, variety choice was the most important factor affecting yield at Wallendbeen NSW, Gnarwarre Victoria and Millicent SA. At Wallendbeen, mid-season RR/Truflex varieties were the highest yielding varieties, including Xseed Condor and 45Y28 RR. The best yielding non-GM varieties included Quartz (Conventional), 45Y93 CL (CLF) and HyTTec Trifecta (TT).
- Applied nutrition was the second most important factor, but trials were sown on fertile soil (Wallendbeen 1.7% OC & 140 kg/ha available N 0-60 cm) with high mineralisation potential, and with favourable spring conditions, the soil supplied a large portion of the grain yield.
- Fungicide management and seeding rate had small effects on yield outcomes in 2020.
- Early blackleg infection has been higher in 2021 and variety choice and fungicide management were both important to reduce stem canker (measured at flowering).

Yield targets and yields achieved in 2020

The aim of the canola component of the Hyperyielding Crops project is to determine management practices that achieve 5 t/ha canola grain yield in high yield potential environments. Highest yields were close to 5 t/ha (Victoria and South Australia) and above 5 t/ha (NSW) in 2020. At each site, variety choice was the most important factor determining differences in grain yield outcomes. Nitrogen management was the second most important factor at all sites. Fungicide management was a small factor in NSW and Victoria but not significant in South Australia. Altering plant population targets from 15 to 75 plants/m^2 had no effect on yield in NSW or Victoria, but there was a small penalty from the lowest population in South Australia.

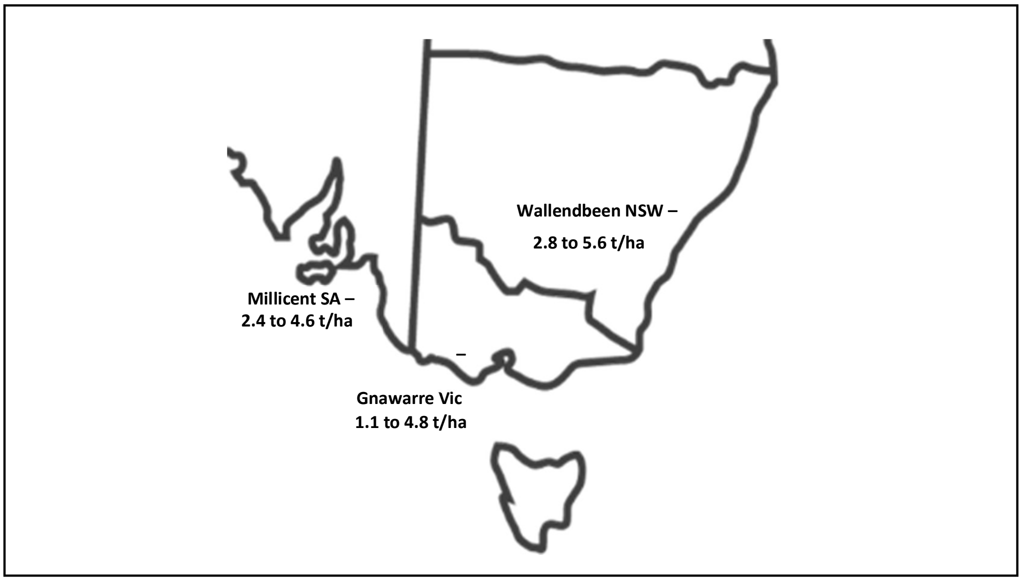


Figure 1. *Yield of the highest and lowest yielding treatments at three Hyperyielding canola sites in 2020.*

Crop nutrition for Hyperyielding canola

In 2020, the Wallendbeen site had 140 kg/ha of mineral nitrogen in the top 60 cm of soil. This would be enough to contribute about ~2 t/ha of canola grain. In addition, the site had 1.7% Organic Carbon. With this OC, estimated mineralisation would have been approximately ~100 kg/ha. Combined with starter fertiliser (130 kg/ha MAP) and sulfate of ammonia for sulfur requirements (150 kg/ha), there was enough N (~285 kg/ha N) to grow about 4 t/ha of canola with no extra N applied, which is close to what was achieved in the nil N treatment in Table 1.

Where an extra 180 kg/ha N was applied, yield increased by 1.3 t/ha to max out at a yield of 5.4 t/ha, highlighting the importance of both soil fertility and N application to achieve grain yield > 5t/ha.

Table 1. *Response of canola (45Y28 RR) to a range of fertiliser treatments at Wallendbeen NSW, 2020.*

Trt.	**Treatments**	**Nitrogen**						**Yield**	
		Kg N/ha						**(t/ha)**	
		Sowing	6L	BV	SF	MF	Total		
1	Nil	45	---	---	---	---	45	4.14	g
2	33.3%	45	30	---	---	---	75	4.46	f
3	200%	45 + 90	30	30	30	---	225	5.44	a
4	100% Upfront	45 + 90	---	---	---	---	135	4.84	e
5	100% Split	45	30	30	30	---	135	5.04	cd
6	100% Bud visible	45	---	90	---	---	135	5.13	b
7	100% Start flower	45	---	---	90	---	135	5.07	bc
8	100% Split late foliar	45	30	30	15*	15*	135	4.97	d
9	100% Split + Manure	45	30	30	30	---	135	5.00	cd
							Mean	4.90	
							LSD (p=0.05)	0.08	
							P Val	<0.001	

2021 trial program

Nutrition management

In the 2021 Hyperyielding Canola nutrient management trial at Wallendbeen, only the application of all N (225 kg/ha) at sowing increased canola biomass at flowering compared to the untreated control in spring canola (45Y28 RR). Winter canola had higher biomass than spring canola overall, increasing from 9.7 t/ha with nil N applied to 14.0 t/ha with a total of 225 kg/ha N applied (50% 6 leaf and 50% bud visible stage). A biomass of 5 t/ha at start of flowering is considered enough for maximum radiation interception, which was achieved in all treatments.

Rate of applied N is generally considered more important than timing, however we hypothesise that in Hyperyielding Crops environments there is more opportunity (with more in-crop rainfall events) to match N input with crop demand, with the greatest requirement being during the crop critical period approximately 1-4 weeks after the start of flowering. A biomass cut at crop maturity will determine if later N applications (in spring canola) can catch up to the biomass of the N application pre-sowing and if this growth will be more efficiently converted into grain yield.

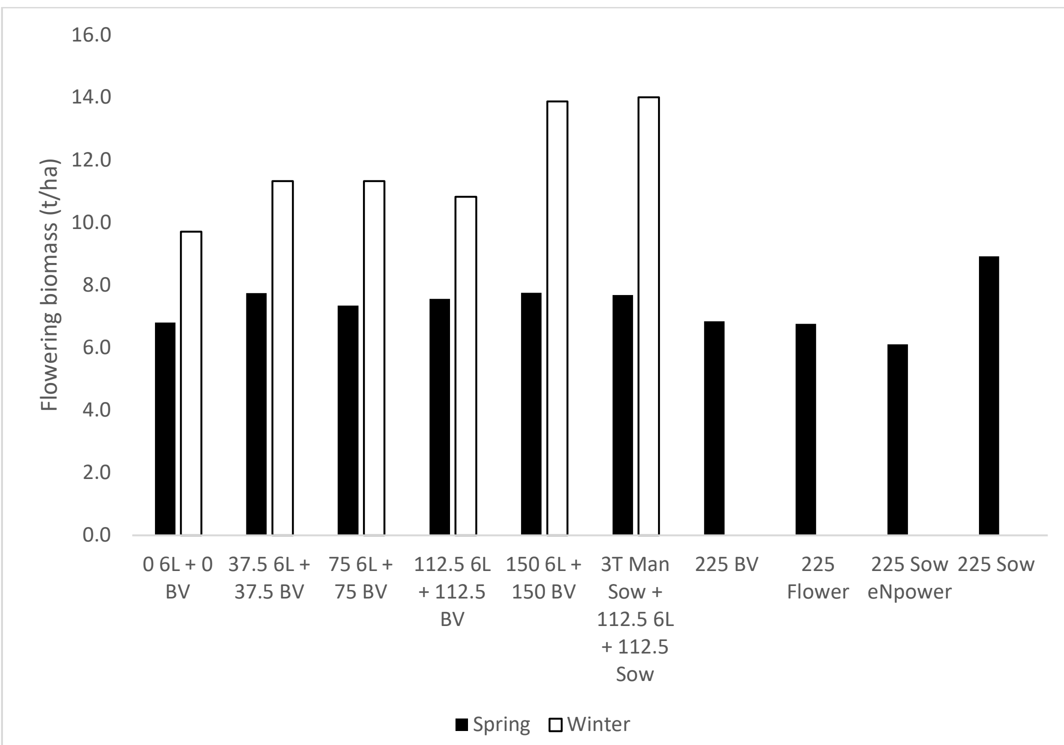


Figure 1. *Effect of nutrient management on canola (one winter and one spring hybrid) biomass at the start of flowering. 6L = 6-leaf. BV = bud visible. Man = Chicken manure. Sow = Sowing. Flower = Start of flowering. eNpower = Enhanced efficiency fertiliser with nitrification inhibitor.*

Disease management

In the Wallendbeen spring G * E * M trial, six different canola varieties were sown with three different management strategies:

	Seed fungicide	6-leaf fung.	6-leaf N	Bud visible N	20% Bloom fung.	50% bloom fung.
Low	Maxim XL	Nil	75 kg/ha	75 kg/ha	0.8 L/ha Aviator Xpro	Nil
Medium	Maxim XL	Nil	112.5 kg/ha	112.5 kg/ha	0.8 L/ha Aviator Xpro	Nil
High	Saltro Duo	0.45 L/ha Prosaro	112.5 kg/ha	112.5 kg/ha	0.8 L/ha Aviator Xpro	1 L/ha Veritas

Biomass assessments were conducted at start of flowering and at the same time an assessment of blackleg stem canker was made on the six varieties. Where Maxim XL was applied to seed (Low and Medium input), the Moderately susceptible variety ATR Wahoo averaged 13% of stems cankered from blackleg at the start of flowering. All other varieties (minimum MR resistance) had less than 5% of plants cankered. Saltro Duo reduced canker to nil in all varieties. For longevity of the highly effective Saltro Duo, it would be recommended to apply to select varieties with good levels of resistance to avoid selection pressure on the fungicide.

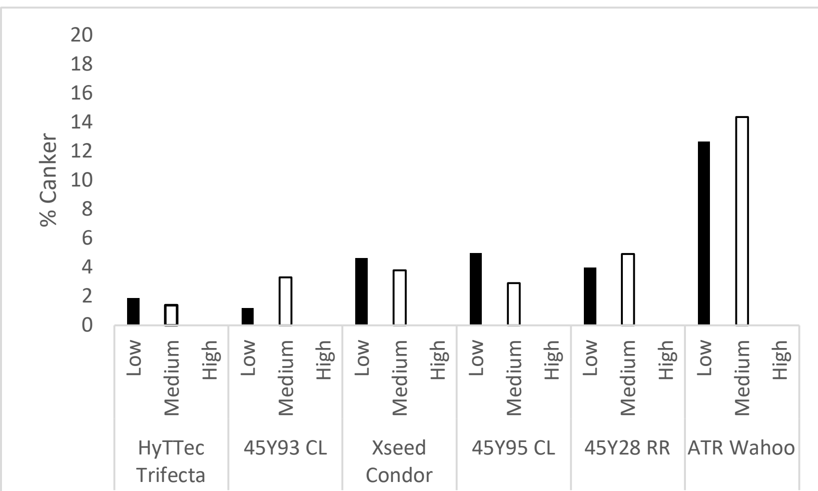


***Figure 2.** Effect of management strategy on blackleg stem canker (assessed at flowering) of six canola varieties*

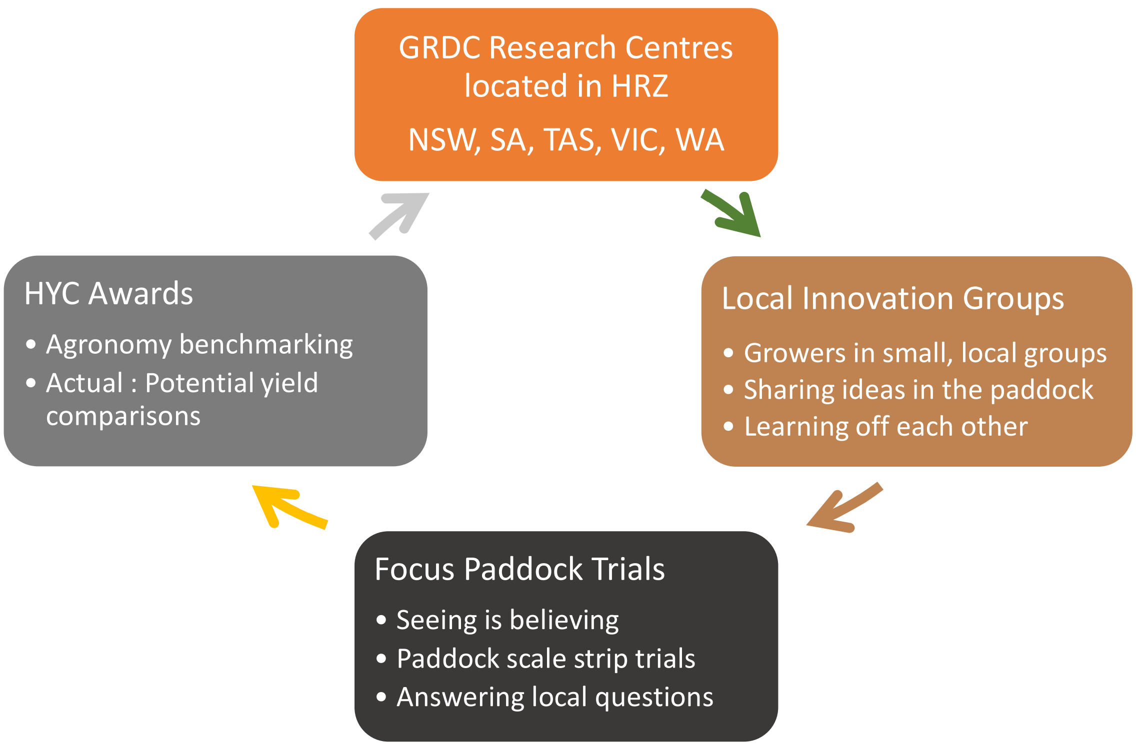
Hyperyielding canola results

Full results from 2020 are available at https://faraustralia.com.au/wp-content/uploads/2021/04/210325-HYC-Project-2020-Results-Canola-Final.pdf. Results from 2021 will also be made available through the FAR Australia website and various other channels such as through social media and GRDC Updates.

GRDC Hyper Yielding Crops NSW

Jon Midwood, TechCrop

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 NSW, Riverine Plains (RP) 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.

Innovation groups

In 2020 RP set up two innovation groups in southern NSW region and one in NE VIC. All groups had a spring crop walk during August, where the groups met out in a paddock and discussed not only the crops they looked at on the day, but also the specific questions the groups had and whether they could answer the question with a simple paddock strip trial. The layout, assessments and treatments of these strip trials were facilitated by the RP project officer and as a result three different trials were setup.

The following are details from two of these Focus paddock trials.

Focus paddock trials:

1. Culcairn Focus paddock trial 2020

Research question: If you're growing a stripe rust susceptible variety like Trojan, what sequence of fungicides and timings gives the highest yield and the best margin over fungicide costs?

Paddock details

Crop	Cereal: Wheat
Variety	Trojan
Area	68.00ha
Sow Rate	80.00 kg/ha
Sow Date	15-05-20
Harvest Date	02-12-20
Harvest Yield	7.31T/ha
Stubble Management 1	Retained Canola
Fallow Management 1	None
Seeder type	Disc (Single)
Row spacing	250mm

Fungicide Treatments

Treatment	GS30	GS32	GS39
Control	Cogito 0.125 l/ha	-	
Treatment 1	Cogito 0.125 l/ha	-	Radial 0.84 l/ha
Treatment 2	Cogito 0.125 l/ha	Prosaro 0.15 l/ha	Opus 0.5 l/ha
Treatment 3	Cogito 0.125 l/ha	Prosaro 0.15 l/ha	Radial 0.84 l/ha

Results

Measurement	Control	Treatment 1	Treatment 2	Treatment 3
Yield (t/ha)	4.11 d	7.42 b	7.67 a	7.09 c
Protein (%)	12.70	11.90	11.80	12.00
Screenings (%)	4.13	1.92	2.47	2.21
Test weight (kg/hL)	63.80	75.20	75.00	73.40

Means followed by the same letter do no significantly differ

Conclusion

If Stripe rust was left uncontrolled, the yield losses were up to 4.0t/ha. The additional gross margin from the application of fungicide was $800/ha. The highest yielding treatment statistically was Treatment 2 at 7.67t/ha which included a triazole at GS32 followed by GS39

2. Gerogery Focus paddock trial – 2020

Research question: With the forecast for a good spring can I achieve a higher yield in my canola by adding an additional 36 kg/ha or 72 kg/ha of urea on 1st August at GS59 (yellow bud)?

Paddock details

Crop	Oilseed: Canola
Variety	HyTTec Trophy
Area	17.60ha
Sow Rate	2.50 kg/ha
Sow Date	17-04-20
Harvest Date	30-11-20
Harvest Yield	2.38T/ha
Harvest Yield Method	Grain cart (Direct)
Stubble Management 1	Baled Stubble
Fallow Management 1	Grazed (Sheep)
Seeder type	Tyne (Knife Point)
Row spacing	225mm

Fertiliser Treatments

Treatment	Sowing (kg/ha)	Urea 10 June (kg/ha)	Urea 9 July (kg/ha)	Urea 1 Aug (kg/ha)	Total N (kg N/ha)
Paddock rate	80	100	80	0	**100**
Treatment 1	80	100	80	80	**136**
Treatment 2	80	100	80	160	**173**

Results

Measurement type	Stage	Control (paddock rate)	Treatment 1	Treatment 2
Dry Matter (T DM/ha)	GS65	6.1	6.1	6.1
Yield (t/ha)	At Harvest	2.73 b	2.86 a	2.87 a
Oil (%)	Post Harvest	42.7	42.8	42.1
Screenings (%)	Post Harvest	0.82	1.00	1.11
Test weight (kg/hL)	Post Harvest	69.80	66.60	66.80

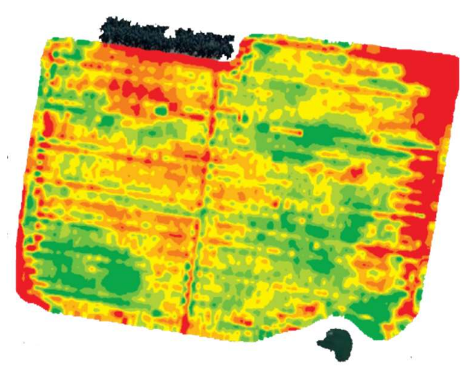
Means followed by the same letter do no significantly differ

Conclusion

Based on this trial, the additional 80 kg/ha of urea at yellow bud gave a significant (p=0.005) yield advantage over the paddock strategy. The gross margin of the additional applied nitrogen was $29/ha. Increasing the rate of urea at yellow bud to from 80kg/ha to 160 kg/ha urea didn't increase yield significantly

HYC Awards

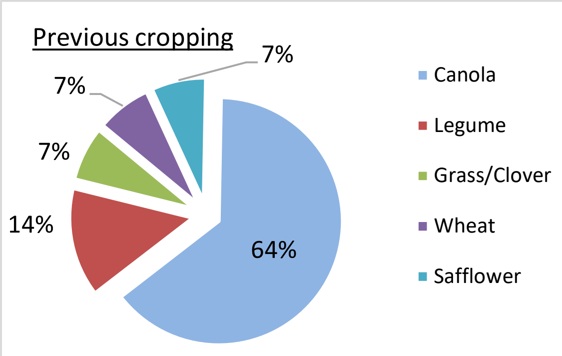
Award paddocks were nominated from the Innovation groups initially, with the aim being to collect and record specific wheat paddock information and to provide an agronomic benchmarking report which compares that paddock to all the others entered, both regionally and nationally. Nominated paddocks had 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 SCF. 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.

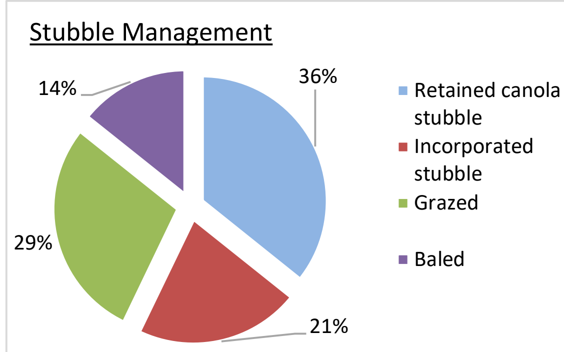


The winner for the highest yield in NSW in 2020 was Damien Schneider from Culcairn with a 7.31t/ha crop of Trojan wheat, sown after canola on 15th May.

The winner of the award for the highest yield as a percentage of the potential yield was Craig Marshall from Rennie with a crop of Sceptre wheat yielding 6.71 t/ha, which was 86.4% of the 7.77 t/ha potential yield.

The following are an example of some of the agronomic benchmarks produced in the HYC Awards report for NSW in 2020:





Agronomic Factor	Top 30% Award paddocks	Remaining 70%
Yield (t/ha)	7.4	5.3
N applied (kg N/ha)	150	116
Cost of N / tonne yield	$31/t	$35/t
Fungicides ($/ha)	$26	$18
Fungicides ($/t)	$3.5/t	$3.4/t
Number of applications	2.3	1.9
Dry Matter (t/ha)	16	12
Harvest index	51.7%	46.5%
Head count (m2)	445	384
1000 grain weight	45.3	42.3

Please contact Kate Coffey at Riverine Plains (0427 141221) for information about being part of this exciting project or to enter a wheat crop as an HYC award paddock in 2021.

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