WA CROP TECHNOLOGY CENTRE (ALBANY)

Friday 17 September 2021

12:30PM – 4:30pm followed by refreshments
Gunwarrie, Frankland WA

Thank you to our event sponsor Seed Force

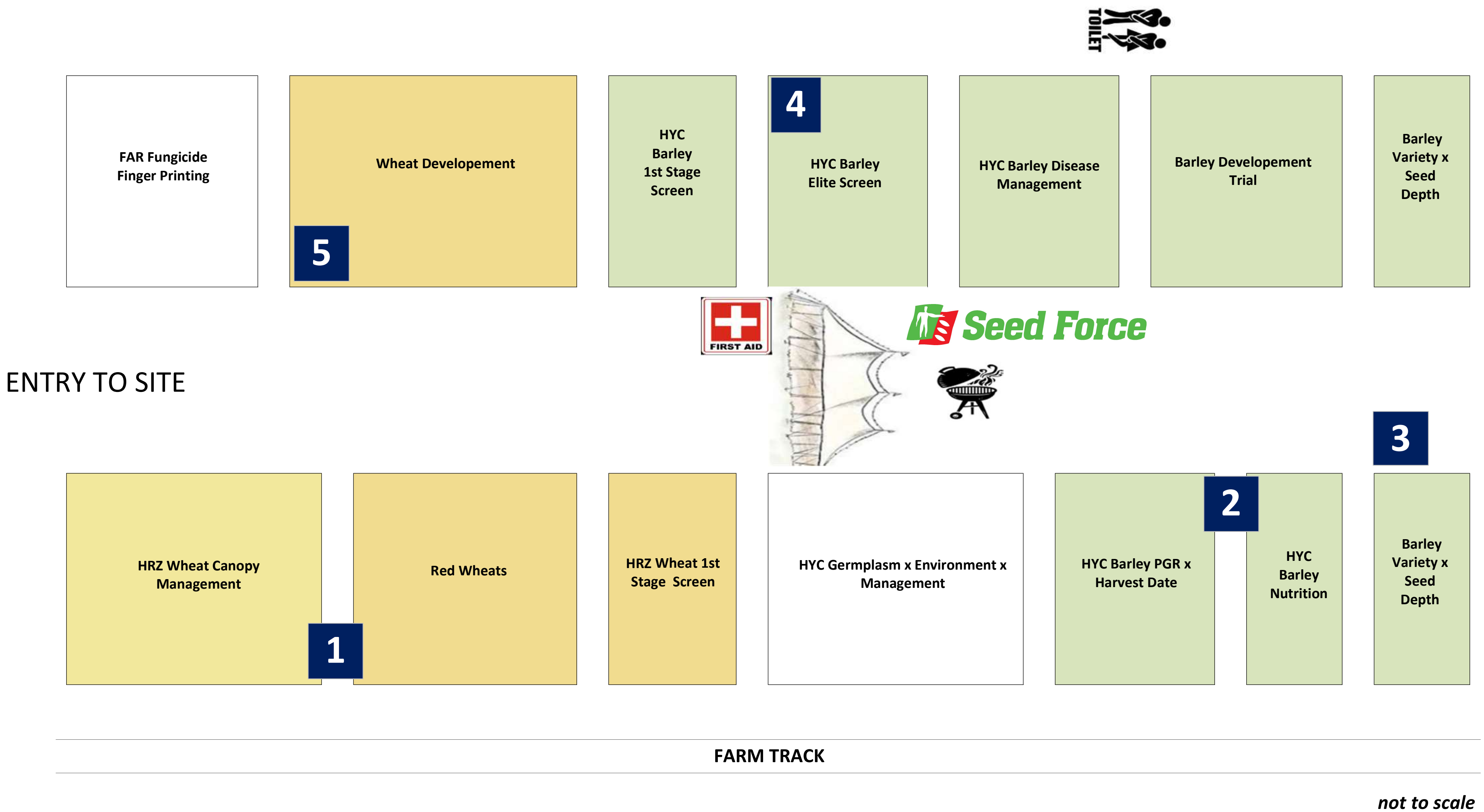
The GRDC Hyper Yielding Crops project is led by FAR Australia in collaboration with:

The GRDC HRZ Farming Systems Project is led by DPIRD in collaboration with:

WA CROP TECHNOLOGY CENTRE (ALBANY)

SITE MAP: WA CROP TECHNOLOGY CENTRE (ALBANY)

Featuring the GRDC's High Rainfall Zone Farming Sytems and Hyper Yielding Crops projects



WA CROP TECHNOLOGY CENTRE (ALBANY)

TIMETABLE

WA CROP TECHNOLOGY CENTRE FIELD DAY (ALBANY): FRIDAY 17 SEPTEMBER 2021

Featuring the GRDC's High Ranfall Zone Farming Systems and Hyper Yielding Crops (HYC) Projects

In-field presentations	Station No.	9.30 - 11.30	12:30	1:15	1:30	2:00	2:30	3:00	3:30	4:00
Sam Flottman, CSIRO and Heping Zhang, HYC Canola Researcher Canola agronomy in the high rainfall zone - Sam discusses canola results from WA HRZ project and Heping discusses the Hyper Yielding Crops trials in canola.	Canola research sites		Lunch kindly sponsored by Seed Force	Welcome and opening address, Darrin Lee, GRDC Western Panel Chair and Nick Poole, Managing Director FAR Australia						Closing address and refreshments Seed Force
Nick Poole, FAR Australia Pushing the productivity of wheat in our HRZ farming systems.	**1**				1			3	2	
James Rollason, FAR Australia and Jeremy Curry, DPIRD What have we leant so far from HYC in terms of barley agronomy for the WA HRZ?	**2**				2	1			3	
Dan Fay, Nathan Dovey, Stirlings to Coast Farmers and Jon Beasley, Grower Hyper Yielding Crops: Capturing yield potential through innovation and benchmarking.	**3**				3	2	1			
Mark Lawrence, Farmanco Agronomist, Gunwarrie Where to next with cereal production in the WA high rainfall zone? Bridging the yield gap - an agronomist's view.	**4**					3	2	1		
Andrew Fletcher, CSIRO What does crop modelling tell us about our yield potential in the region?	**5**						3	2	1	
In-field presentations	**Station No.**		**12:30**	**1:15**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**	**4:00**

We would be obliged if you could remain within your designated group number throughout the day.

Thank you for your cooperation.

1	**GROUP 1**
2	**GROUP 2**
3	**GROUP 3**

WA Crop Technology Centre (Albany Port Zone)

Frankland

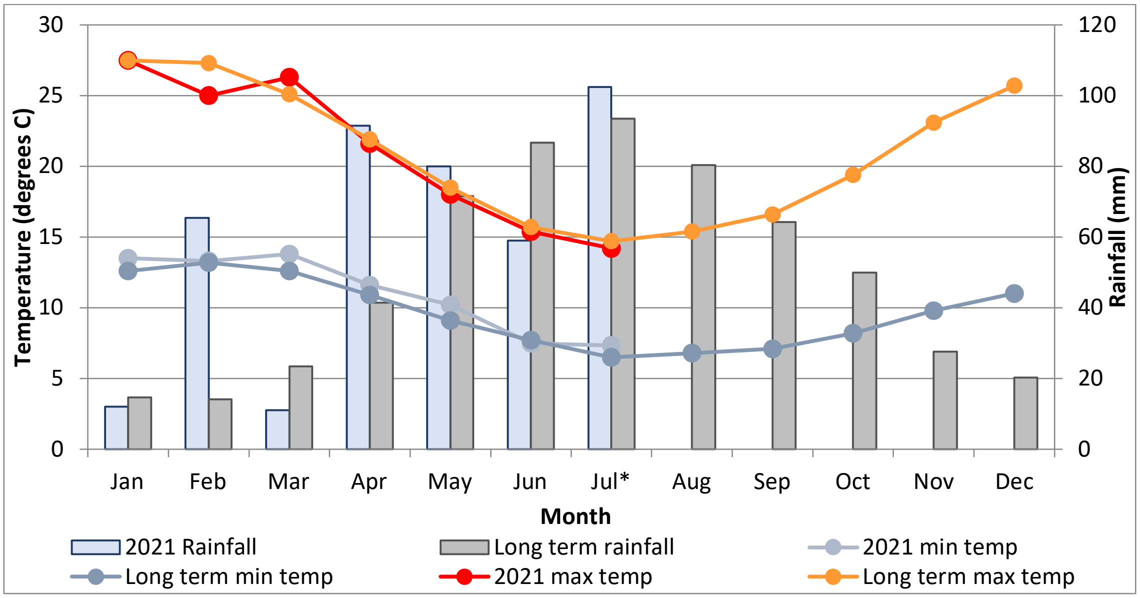


Figure 1. 2021 yearly rainfall so far (as of 27 July) and long-term rainfall (1923-2021) (recorded at Frankland), 2021 min and max temperatures and long-term min and max temperatures (1995-2021) (recorded at Rocky Gully). *Rainfall April to July 28th= 333.0mm (Decile 9).*

Higher than average rainfall in April and May have resulted in April to June producing a decile 9 start to the season. Rainfall for July is already above the long-term average with four days still remaining for the month.

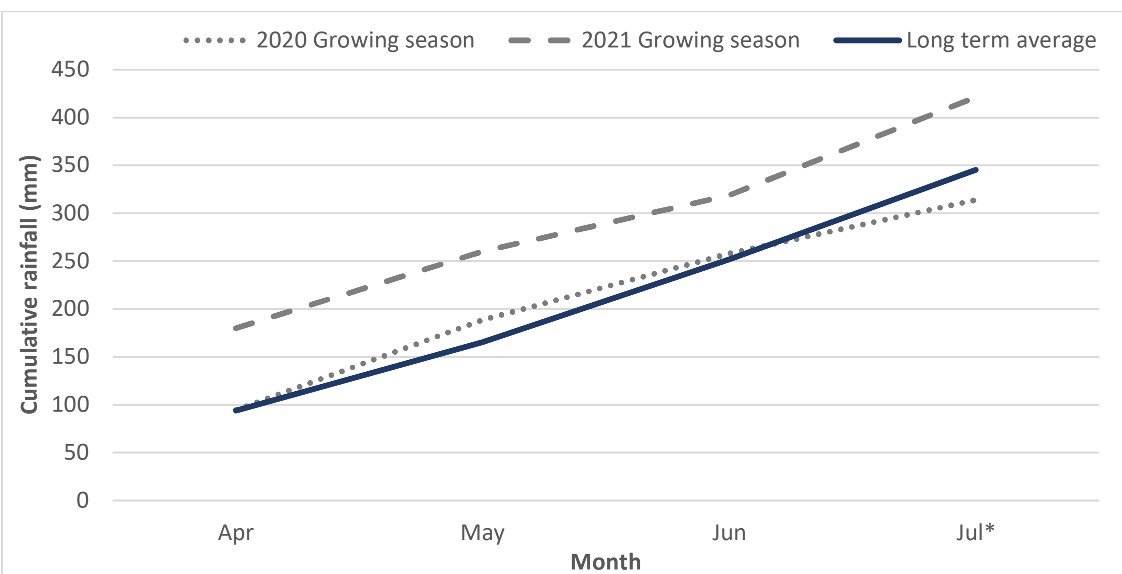


Figure 2. Cumulative growing season rainfall for 2020, 2021 and the long-term average for the growing season.

VISITOR INFORMATION

We trust that you will enjoy your day with us at our Crop Technology Centre (Albany Port Zone) Field Day. Your health and safety is paramount, therefore whilst on the property we ask that you both read and follow this information notice.

HEALTH & SAFETY

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

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 WA CROP TECHNOLOGY CENTRE (ALBANY PORT ZONE) FIELD DAY

FEATURING THE GRDC'S HIGH RAINFALL ZONE FARMING SYSTEMS AND HYPER YIELDING CROPS PROJECTS

On behalf of both project teams, I am delighted to welcome you to the 2021 WA Crop Technology Centre (Albany Port Zone) Field Day. The centre currently hosts two research projects – The GRDC's High Rainfall Zone (HRZ) Farming Systems project and the GRDC's Hyper Yielding Crops (HYC) project.

The GRDC's HRZ Farming Systems project is led by the Department of Primary Industries and Regional Development (DPIRD) in collaboration with FAR Australia and Commonwealth Scientific and Industrial Research Organisation (CSIRO).

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 WA we are working closely with Nathan Dovey and his team at Stirlings to Coast Farmers.

Today you will have an opportunity to discuss the following:

- April sowing in Frankland – what should we be growing - winter or spring germplasm?
- What limits our yields in the WA HRZ and which is more productive wheat or barley?
- How much nutrition do we need for high yielding crops of canola and cereals?
- Cereal disease management in a new era of fungicide resistance and reduced sensitivity. – what does it mean for management?
- Where to next with barley production in the WA High Rainfall Zone - bridging the yield gap. A breeder and an agronomist view.

Speakers at today's event

The event will feature a range of research trial demonstrations in canola (Kojonup canola research sites), barley and wheat and a line-up of speakers who will discuss various aspects of the climate effect on HRZ farming systems in WA, improved germplasm and agronomy, fungicide management and new varieties.

We are fortunate to have secured the following speakers who will share their expertise in topics relevant to the WA HRZ farming system:

Nick Poole and James Rollason, FAR Australia
Andrew Fletcher and Sam Flottmann, CSIRO
Heping Zhang, Canola Researcher
Mark Lawrence, Farmanco
Nathan Dovey and Dan Fay, Stirlings to Coast Farmers
Jon Beasley, Grower
Jeremy Curry, DPIRD

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

If you would like to learn more about the results from these GRDC investments, 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 High Rainfall Zone (HRZ) Farming Systems and Hyper Yielding Crops project teams 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 projects.

Other Acknowledgements
Thank you to our host farmers Terry Scott and Kellie Shields for all their support throughout the season and to SeedForce for sponsoring today's event.

What are these projects aiming to achieve and how did they originate?

HRZ Farming Systems

Over the past decade there has been a trend towards more cropping in the High Rainfall Zone (HRZ) but yields are typically 1-3 t/ha below water-limited yield potential for wheat and 0.5-1.5 t/ha for canola in an average season. This presents a significant opportunity to lift the profitability of cropping systems in the HRZ, defined in Western Australia as arable areas with annual rainfall above 450mm. This GRDC project was created to support growers to overcome major constraints, adopt superior long-season varieties and develop management packages to express superior yield potentials. In this project, DPIRD, CSIRO and FAR Australia have combined their expertise in farming systems, bio-economic modelling, disease management, and systems agronomy to work with growers to develop high production packages for the HRZ.

Over the three years of the project, the team will focus on supporting growers to increase the value of the cropping phase in the HRZ farming system by 10%. This will be done by addressing both crop yield potential and the gap between potential and realised yield in wheat and canola crops grown in the HRZ of the Albany and Esperance port zones.

In 2019 the project team ran workshops at Dandaragan, Green Range and Esperance with farmers and advisers to help define the key elements of the HRZ and R&D needs to support increased productivity and profit. Issues, opportunities and priority questions identified guided the establishment of the experimental program in 2020. Key priorities coming from these workshops included how to best manage agronomy when potential is increased with soil amelioration, how to lift production through a combination of early sowing, improved genotypes and appropriate agronomy in cereals, how to manage nutrition to target high yields in HRZ environments, and how to improve the harvest index (achieved yield from established biomass) in large and bulky HRZ crops.

The project team is also working closely with SEPWA and Stirlings to Coast Farmers who are running paddock-scale demonstration projects (under PROC-9175784). This provides regular engagement with growers and consultants and ensures promising results from small-plot trials are validated at a paddock scale using commercial machinery.

This project will deliver a better understanding of the yield potential of different combinations of germplasm (i.e. winter vs spring germplasm) and farming systems inputs, identify options to reduce the yield gap, and quantify the economic risks associated with potentially higher input farming systems. The intensively monitored field experiments and paddock-scale demonstrations provide a focus for extension activities to improve grower knowledge and cropping aspirations. We are working with leading growers and consultants to develop guidelines about the profitability and risks of incorporating new agronomic practices and more diverse crop sequences into HRZ farming systems.

By working together, we can refine and transform HRZ farming systems towards increasing the average yield by 2t/ha in cereals and 1t/ha in canola (i.e. the five-year stretch target set by GRDC for the HRZ).

For more information on cereals contact James Rollason (james.rollason@faraustralia.com.au) or Nick Poole (nick.poole@faraustralia.com.au) from FAR Australia.
For more information on canola contact Jens Berger from CSIRO (jens.berger@csiro.au) or Jeremy Curry from DPIRD (jeremy.curry@dpird.wa.gov.au).

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 (Dan Fay from Stirlings to Coast farming group here in the West) 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:

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)
Dan Fay, WA HYC Project Officer, Stirlings to Coast Farmers, (dan.fay@scfarmers.org.au)

Optimising high rainfall zone cropping for profit in the Western and Southern Regions (DAW1903-008RMX)

2021 WA Cereal Research Programme

The research programme at this site has a focus on late April sowing. Two trials will be pursued that allow the research team to compare the economics of winter and spring wheat germplasm sown in the traditional ANZAC day sowing window.

Trial 1. April sown germplasm (winter vs spring) x management interaction trial

Cultivar: various

Objectives: To assess a comparison of early sown winter and spring wheat germplasm managed under different levels of management (Late April sown).

Individual objectives specific to the trial are:

- Assessing the phenology, dry matter production, yield and profitability of winter versus spring wheat sown in late April.
- To examine the effect of defoliation in winter and spring wheat on dry matter removed, final dry matter, phenology, grain yield and profitability.
- To compare the performance of feed and milling winter wheats sown in late April.

Trial 2. Wheat April sowing germplasm screening trial – winter and spring (not taken to yield).

Objectives: To assess elite breeders' lines for late April sowing opportunities.

Individual objectives specific to the trial are:

- Assessing the phenology, standing power, disease resistance of earlier generation winter and spring wheat candidates sown in the late-mid April sowing window.
- To select the promising candidates for inclusion in future agronomy studies that would be taken to yield.
- To compare the performance of feed and milling winter wheats.

Hyper Yielding Crops (FAR2004-002SAX)

2021 WA Barley Trials

Trial 1. HYC 1st Stage Screen

Objectives:

To examine the phenology, disease resistance and standing power of new barley germplasm established in the traditional late April/early May sowing window relative to current practice.

Individual objectives specific to the trial are:

- Evaluating the phenology response of new 2 and 6 row winter barley germplasm relative to current spring controls and new European spring cultivars.
- Evaluate foliar disease resistance profile and any viral responses.
- Evaluate plant type characteristics related to stand ability, row type, tillering capacity, and head retention.

Trial 2. HYC Elite Screen

Objectives: To examine the yield potential of new winter and spring germplasm grown under HYC Management packages against spring and winter controls in the traditional late April/early May sowing window.

Individual objectives specific to the trial are:

- Examining the yield potential of a new range of two and six row winter barleys never before tested in the Australian HRZ region.
- Determine Harvest Index and Biomass benchmarks in the HRZ under current best practice (on selected lines).
- Inform experimental direction for elite screening (HYC Elite Screen) and management considerations.

Trial 3. HYC G.E.M Trial series

Objectives: To assess the performance of winter and spring barley germplasm managed under four different management intensities (mid-April to early May sown) at two levels of fungicides.

Individual objectives specific to the trial are:

- Assessing the phenology, dry matter production, yield and profitability of current winter versus spring barley sown in April (early May if not possible).

- To examine the effect of defoliation in winter and spring barley on dry matter removed, final dry matter, phenology, grain yield and profitability.
- Determine why the harvest index higher of winter barley is lower than spring barley and whether that constraint can be removed.

Trial 4. HYC Disease Management germplasm interaction

Objectives: To develop profitable and sustainable approaches to disease management in HRZ barley.

Individual objectives specific to the trial are:

- Monitor the effectiveness of fluxapyroxad (Systiva) for early disease control in barley.
- To evaluate whether newer germplasm (improved resistance) or new fungicide chemistry allows a reduction in the number of fungicide applications whilst increasing barley profit (reducing the number of fungicides is seen as a key measure for slowing down resistance development in cropping systems.

Trial 5. HYC PGR x harvest date interaction

Cultivars: Planet and Buff

Objectives: To assess the value of PGRs with delayed harvest in HRZ regions.

Individual objectives specific to the trial are:

- Most evaluations of PGRs conducted on trials looking at yield effects (HI prevention of lodging) rather than brackling. Are PGRs more beneficial when harvest is delayed in the HRZ in the prevention of brackling?
- Inform PGR use for subsequent seasons and the effect of PGRs on harvest index.
- Establish links with European trials and introduce ethepon.

Trial 6. Nutrition for Hyper Yielding Barley

Cultivar: RGT Planet (full disease protection and PGR input)

Objectives: To assess the value of higher nutrition input for barley.
Individual objectives specific to the trial are:

- Assess whether growers are currently under fertilising barley crops in the region and N requirements required to reach benchmarked PTQ limited yields within each region.

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

Jens Berger, Sam Flottmann, Heping Zhang, Adam Brown, Andrew Fletcher
(CSIRO)

High Rainfall Zone (HRZ) Project Canola Field Program

Introduction
Canola productivity in the HRZ is determined primarily by biomass accumulation, trading off against harvest index (Zhang et al. 2016). Typically, hybrid canola accumulates high biomass at a reduced harvest index to produce a high yield, which is rarely matched by the higher harvest index (HI), lower biomass open-pollinated cultivars. However, input management strategies aimed at producing high biomass carry greater financial risk, particularly if the growing season rainfall does meet the HRZ norms. Moreover, high biomass production can have negative consequences for growers, including harvesting difficulties associated with tall crops, high stubble loads and in-season water use, and an increased Sclerotinia risk. These tensions promote serious discussion among canola growers as to the optimal strategy that balances risk against reward, biomass against harvest index, captured in the so-called ‘fat versus fit crops’ debate.

In GRDC DAW001903-008RMX CSIRO is investigating these concerns by on-farm trialling at Qualeup, Ben Webb’s property in the western HRZ between Kojonup and Boyup Brook, using a range of contrasting factorial treatments designed to impact on canopy size and yield potential both individually and in combination. In season 2020 we ran the following treatments:

- Cultivar vigour: high (Roundup Ready) versus lower-vigour Triazine Tolerant cultivars
- Plant density: low vs. high density
- Fertility. Standard grower practice (150 kg N/ha, 12 kg S/ha) versus very high input (300 kg N/ha, 44 kg S/ha). To further dissect the role of N and S, low and high levels of each were allocated factorially.
- Grazing: plots mechanically grazed prior to bud formation vs ungrazed controls

Results & discussion
The factorial combinations of agronomy (density x grazing x N x S) x genetics treatments (hi (RR) vs low vigour (TT)) returned wide ranging canopy sizes, measured in terms of population (17-34 plants/m^2), height (119-176 cm), biomass (8.2-15.7 t/ha) and yield (1.9-6.2 t/ha, see Table 1). While these treatments had a huge impact on productivity, harvest index was remarkably stable. For example, grazing, our strongest lever, reduces canopy height, yield and biomass and delays flowering, but has no effect on harvest index. Nor were there any cultivar differences in biomass (P=0.502), or interactions with agronomy. Therefore, all the yield differences we found could be attributed to HI: harvest index is important! These yield differences occurred within, rather than between TT and RR canola groups (P<0.846):

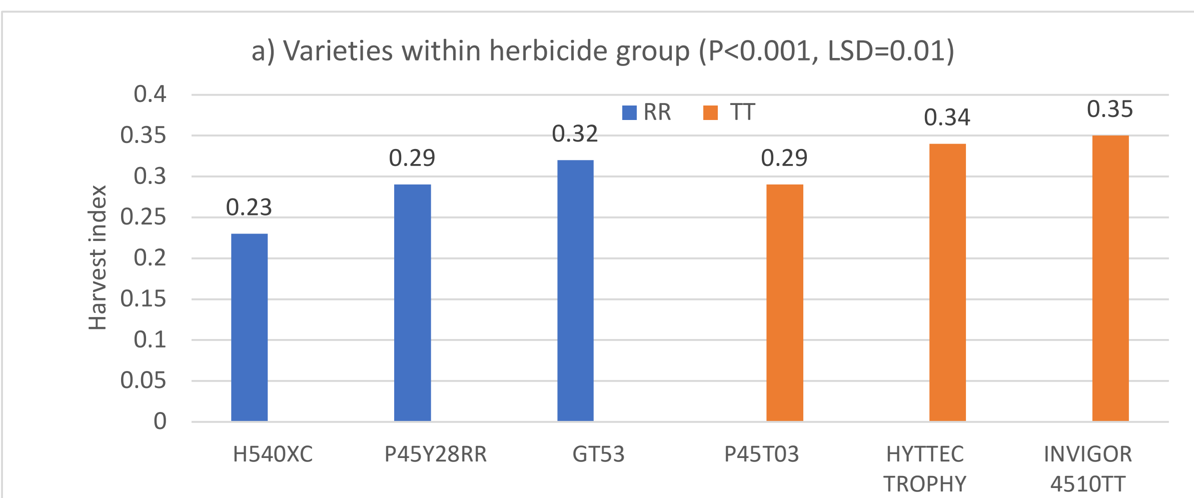
- High yield: GT 53RR, P45Y28RR, Invigor 450TT, Hytech Trophy TT (3.5-3.9 t/ha, averaged across all treatments-individual treatment means in Table 1)
- Low low yield: H540XC RR, P45T03 TT (2.7-2.9 t/ha)

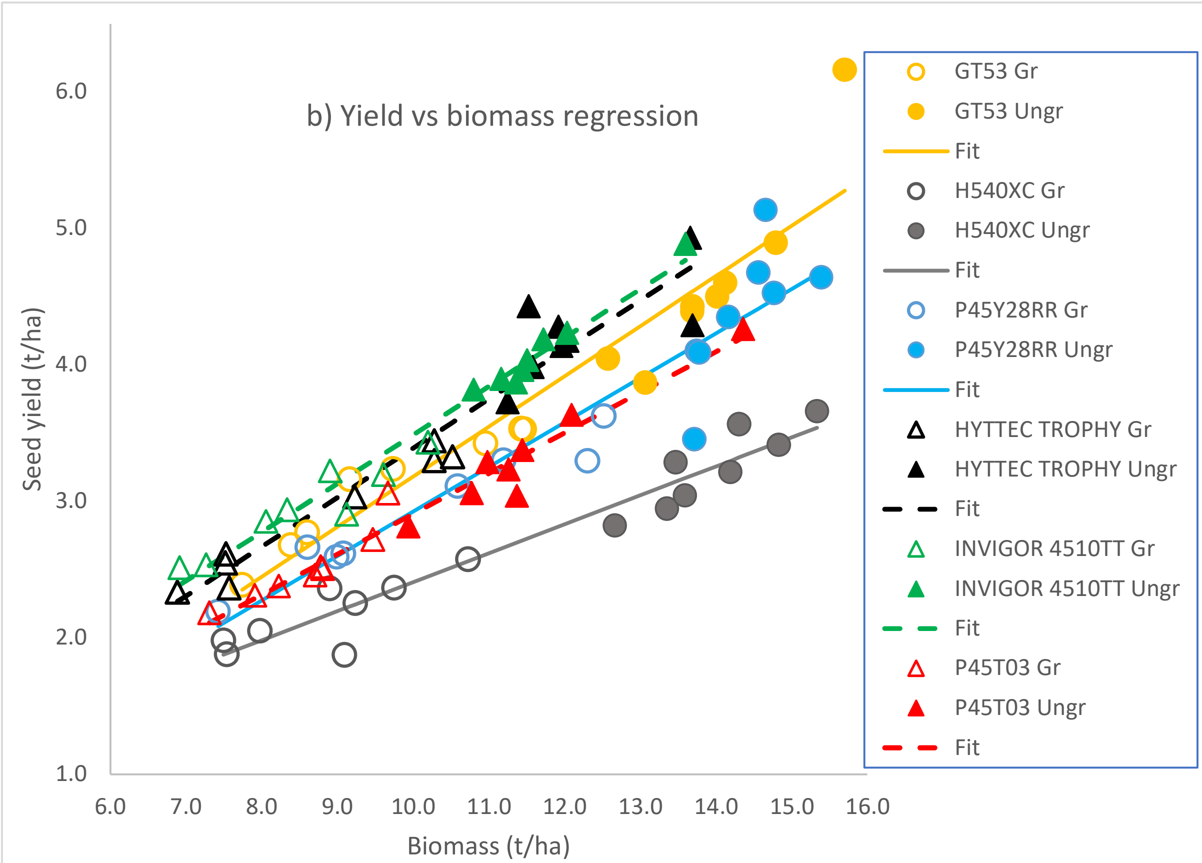
Harvest index differences were dominated by genetics and its interaction with agronomy. Harvest index in Roundup Ready was lower than TT canola (P<0.001) but there were important varietal differences and interactions within these 2 groups (Fig. 1a):

- TT: Invigor 450 (35%), Hytech Trophy (34%), P45T03 (29%)
- RR: GT 53 (32%), P45Y28 (29%), H540XC (23%)

Regressing yield against biomass shows that most lines had stable harvest index that was not modified by agronomy (Fig. 1b). TT Invigor 450 and Hytech Trophy yield as much as GT 53 and P45Y28RR, but produce less biomass (Fig. 1b). Harvest index was only unstable in the low harvest index cultivars. Thus, harvest index reduced with increasing biomass only in P45T03 and particularly in H540XC (Fig. 1b). Fig. 1b clearly shows that while grazing has dramatic effects on biomass and yield, it plays no role in harvest index as indicated by the common regression lines fitted to the 2 grazing treatments.

Fig. 1. *Canola type and variety within herbicide class differences in harvest index (a), and as biomass-yield regression curves accounting for 93.6% of variance (b). (While variety regression curves are fitted across all agronomic treatments, grazed treatments are represented by empty markers, ungrazed treatments as full markers. RR canola varieties are represented by circles, TT types by triangles).*





The results show that there is little capacity to change the yield-biomass relationship with agronomy. As long as growers select cultivars with common yield over biomass slopes, there will be no harvest index trade-offs across their agronomic treatments. However, to avoid the negative consequences of excess biomass production, the 2020 results suggest that growers are better off choosing higher harvest index varieties such as Invigor 450TT or Hytech Trophy TT, that returned similar yields as the most productive RR treatment combinations in GT 53 and P45Y28RR, at lower biomass (Fig. 1b).

These results highlight the degree to which harvest index appears to be a genetic trait, rather than one which is open to agronomic intervention. Key questions remain: what explains the genetic harvest index differences, where does the biomass go? Why does harvest index reduce as biomass increases in varieties such as H540XC, while remaining consistently high in others such as Invigor 450TT? Are these biomass-harvest index relationships consistent from year to year; will we get the same results in a more productive year, or can agronomy play a role under those conditions? Our field research is addressing these questions in 2021 and 2022.

***Table 1**. 6-way interaction variety mean yields (t/ha) for all experimental treatment combinations at Qualeup 2020. Highlighted values are within 1 LSD of the highest yielding treatment.*

HT	Var	Grazing	N	S_treat	20 plants/m^2	40 plants/m^2
RR	GT53	Grazed	150	High	3.5	2.4
				Low	2.7	3.2
			300	High	3.5	3.2
				Low	3.9	2.8
		Ungrazed	150	High	4.1	4.4
				Low	4.5	3.4
			300	High	6.1	4.6
				Low	4.9	4.4
	H540XC	Grazed	150	High	2.4	2.0
				Low	1.9	2.4
			300	High	2.6	2.1
				Low	2.3	1.9
		Ungrazed	150	High	3.7	3.3
				Low	3.0	2.8
			300	High	3.2	3.6
				Low	3.4	3.0
	P45Y28RR	Grazed	150	High	3.3	2.7
				Low	3.1	2.6
			300	High	3.3	2.6
				Low	3.6	2.2
		Ungrazed	150	High	4.5	4.6
				Low	5.1	4.1
			300	High	3.5	4.1
				Low	4.7	4.4
TT	HYTTEC TROPHY	Grazed	150	High	3.3	2.6
				Low	3.0	2.4
			300	High	3.4	2.3
				Low	3.3	2.6
		Ungrazed	150	High	4.4	4.2
				Low	4.1	3.7
			300	High	4.3	4.3
				Low	4.9	4.0
	INVIGOR 4510TT	Grazed	150	High	3.2	2.9
				Low	2.9	2.5
			300	High	3.4	2.9
				Low	3.2	2.5
		Ungrazed	150	High	4.2	4.2
				Low	4.0	3.9
			300	High	4.9	3.8
				Low	4.0	3.9
	P45T03	Grazed	150	High	3.1	2.5
				Low	2.7	2.3
			300	High	2.5	2.2
				Low	2.4	2.5
		Ungrazed	150	High	3.6	3.3
				Low	3.4	3.1
			300	High	4.3	3.2
				Low	2.8	3.0
Interaction LSD						1.2

Jeremy Curry and Mark Seymour
(DPIRD)

2020 WA HRZ Project Canola Results – Esperance Canopy Manipulation

Aim

To investigate whether chemical (plant growth regulators) or mechanical (defoliation) manipulation of canola during growth can improve harvest index while maintaining yield in the HRZ.

Treatments:

A range of experimental plant growth regulators and defoliation treatments were imposed to HyTTec Trophy canola sown on 30 April at Gibson.

Trt	Name	Detail
1	Control	-
2	Experimental PGR #1	Applied at green bud stage
3	Experimental PGR #1	Applied at green bud stage and at first flower.
4	Experimental PGR #2	Applied at green bud stage
5	Experimental PGR #2	Applied at green bud stage and at first flower.
6	Experimental PGR #3	Applied at green bud stage
7	Experimental PGR #3	Applied at green bud stage and at first flower.
8	Defoliation x 1	Defoliated* at 9cm height at 6-8 leaf stage (16 June).
9	Defoliation x 2	As per Defoliation x 1 plus defoliated at 9cm height at BBCH50 (30 June).
10	Defoliation x 3	As per Defoliation x 2 plus defoliated at 9cm height at green bud (16 July).

Key Results:

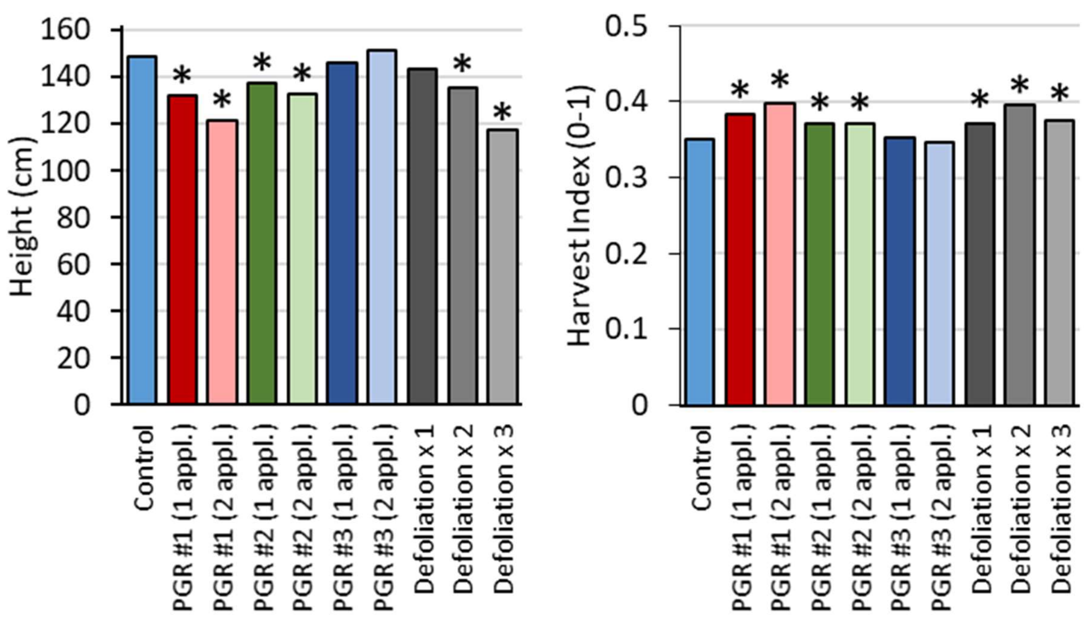


Figure 1*. Height (cm) and harvest index (ratio of yield to total biomass produced) at maturity. Asterisk indicates value is significantly different to the control.*

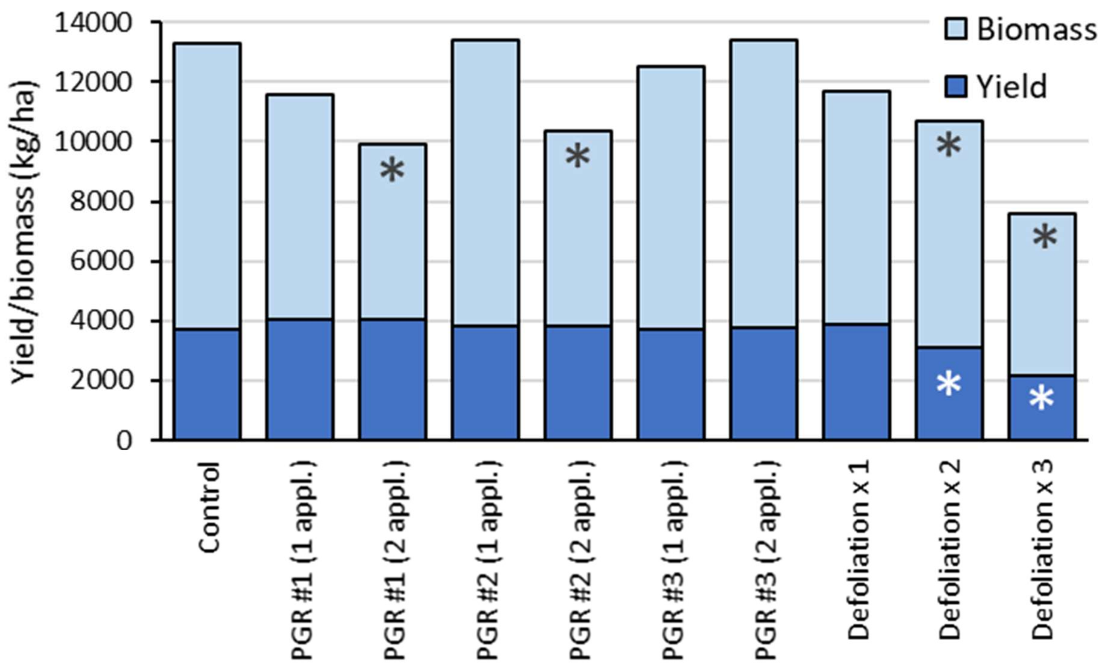


Figure 2. *Yield (dark blue, kg/ha) and biomass (light blue, kg/ha) of the canopy manipulation treatments at Gibson in 2020. Asterisk indicates value is significantly different to the control.*

Summary

- Experimental PGRs #1 and #2 were able to reduce height and improve harvest index with no impact on yield.
- Early defoliation caused only a slight reduction in height and biomass and no impact on yield, while later defoliations reduced both biomass and yield.
- While there was minimal lodging in the trial, both defoliation and PGRs appeared to reduce lodging.
- While defoliation generally increased grain contribution by the main stem, PGR applications increased grain contributions from secondary branches.
- Whilst not creating extra harvestable yield, two of the PGRs tested appear to be possible candidates to create a more compact plant type while maintaining yield, which may have other benefits (e.g. harvest efficiency).

2021 trial

In 2021, both the experimental PGRs #1 and #2 are being tested at three rates/timings based on 2020 results and still centred around the green bud stage, while only the earliest defoliation treatment (defoliation x 1) has been retained. All treatments are being tested against two nitrogen timings; early, which is based on ~¾ of N being applied in first 5 weeks of growth to promote early biomass, and late, where ~¾ of N was held back until stem elongation (around 10 weeks after sowing).

Jeremy Curry and Mark Seymour
(DPIRD)

2020 WA HRZ Project Canola Results – Esperance Nutrition

Aim
To determine whether other nutrition (P, K, S or trace elements) is limiting yield as canola growers target high yields with high nitrogen rates in the high rainfall zone of WA.

Treatments:
Table 1. *Rates of nutrients (kg/ha) applied for each of the ten nutrition treatments and the N rates to which they were applied. All plots were HyTTec Trophy sown on 30 April* at Gibson.

Nutrition Treatment	N rates	N[1]	P[1]	K[2]	S[2]	Ca[2]	TE[3]
1. All	All	15	31	50	31	37	Yes
2. Minus P	All	15	15	50	31	37	Yes
3. Minus K	All	15	31	0	31	37	Yes
4. Minus S	All	15	31	50	2	37	Yes
5. Minus TE	All	15	31	50	31	37	No
6. Base	All	15	15	0	2	37	No
7. Nil fert.	15N only	0	0	0	0	0	No
8. 15N only	15N only	15	0	0	0	37	No
9. Double All	Except 15N	30	62	99	62	74	Yes
10. Triple all	Except 15N	45	93	149	93	111	Yes

[1]banded at seeding. [2]top-dressed immediately following seeding. [3]Cu, Zn and Mn applied at 8-leaf stage.

Key Results:
Table 2. *Soil test results taken at seeding at 10cm incremental depths.*

Soil group: Grey deep sandy duplex						
Depth	**0-10cm**	**10-20cm**	**20-30cm**	**30-40cm**	**40-50cm**	**50-60cm**
pH (CaCl2)	5.3	5.1	5.0	5.3	5.4	5.7
P (HCO3) (µg/g)	13	21	14	7	5	3
K (HCO3) (µg/g)	59	62	103	155	206	177
N (NH4) (µg/g)	5	4	3	2	2	2
N (NO3) (µg/g)	32	11	8	5	4	3
S (µg/g)	9	6.2	12.2	16	19	19.1
Organic carbon (%)	0.85	0.85	0.68	0.49	0.37	0.37
PBI	6.7	19.8	46.5	79	111.5	117.6
Gravel (% by weight)	3%	41%	62%	57%	55%	55%

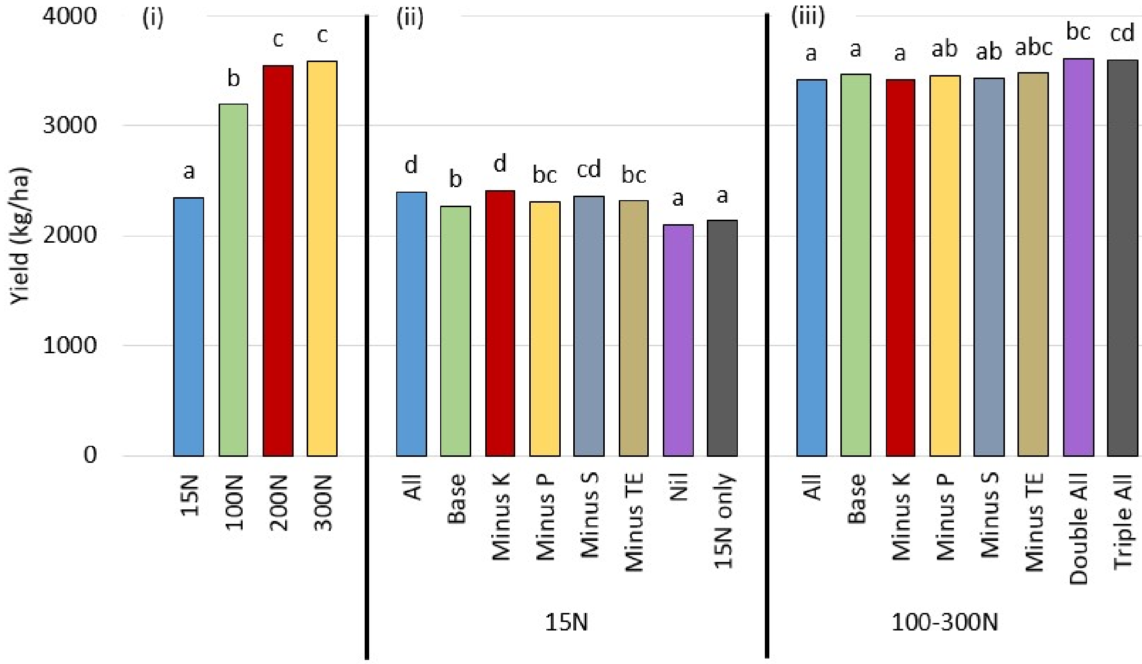


Figure 1. *Grain yield (i) averaged across N rates, (ii) at eight nutrition treatments at the 15N rate, and (iii) at eight nutrition treatments averaged across the 100-300N rates. Different letters denote values are significantly different.*

Summary

- Soil test results indicated that N levels were low, while P and S levels were close to critical levels (https://agric.wa.gov.au/n/6748) and so a yield response to these nutrients was possible.
- Yield increased from 2.3t/ha to 3.2t/ha as applied N increased from 15N to 100N, increasing further to 3.6t/ha at 200N and 300N.
- Yield responses reflected increases in total biomass, which rose from 8.6t/ha at 15N to 11.1t/ha at 100N, up to 12.4-12.5t/ha at 200N and 300N.
- There was little benefit to applying more than 15 units of P, or from applications of K or S at seeding at this site.
- Fertilisers (both banded and top-dressed) significantly decreased plant establishment and early growth (data not shown).
- Oil continued to decrease with higher applied N (43.3% at 200N to 42.5% at 300N).

2021 trial

The 2021 trial consists of similar treatments to 2020, albeit with a greater range of N rates to determine where N responses plateau between 100N and 200N and a greater range of P rates. Waterlogging pressure has also exacerbated differences in S applications between treatments.

Rohan Brill
Agronomist – Brill Ag

Hyperyielding Canola – results from 2020 and research going forward

Key Points

- In 2020, variety choice was the most important factor affecting yield in hyper yielding canola trials at Wallendbeen NSW, Gnarwarre Victoria and Millicent SA.
- Nutrition management was the second most important factor.
- Fungicide management and seeding rate had small effects on yield outcomes.
- A fourth site will be run at Kojonup, Western Australia in 2021.

Yield targets and yields achieved in 2020

The aim of the canola component of the Hyper Yielding 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.

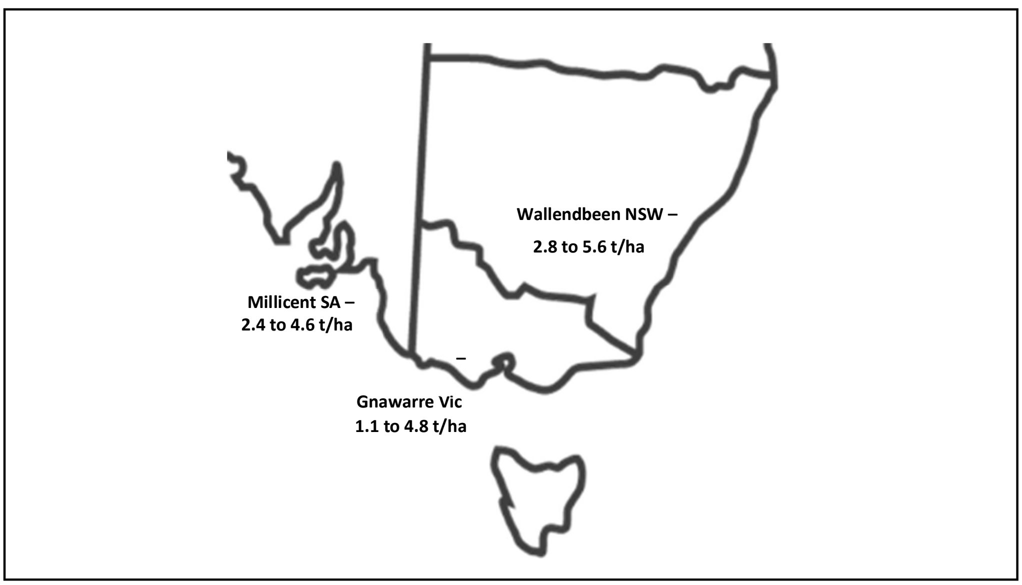


Figure 1 – *Yield of the highest and lowest yielding treatments at three Hyper Yielding canola sites in 2020.*

2021 Research
A fourth site has been included in 2021, Kojonup in Western Australia. Similar factors will again be examined in 2021, including:

- Variety choice - including differences between phenology, herbicide tolerance, disease resistance and yield response to inputs.
- Nutrition management - especially focussing on nitrogen management and the use of manure as a 'slow release' source of nutrition to maximise growth in the critical period for yield development.
- Disease management - two contrasting cultivars, 45Y28 RR and HyTTec Trifecta with different blackleg resistance, with a range of seed, early foliar and flowering fungicide applications.
- Seeding rate - response of winter and spring cultivars to plant populations from 15 to 75 plants/m².

Table 1. *Start of flowering date of four varieties in Canola G * E * M trial at Kojonup 2021, sown 20 April 2021*

Variety	***Start of flowering date***
Xseed Condor (Truflex)	*3 August*
45Y28 RR (Roundup Ready)	*5 August*
HyTTec Trifecta (Triazine Tolerant)	*7 August*
ATR Wahoo (Triazine Tolerant)	*11 August*

Four varieties were sown in a genotype * environment * management trial at Kojonup. Each variety has a low input, medium input and high input treatment applied, which are combinations of nitrogen rate and fungicide. Xseed Condor was the quickest to flower and ATR Wahoo the slowest to flower. Biomass at the start of flowering was 4.2 t/ha for the two glyphosate tolerant varieties compared with 2.5 t/ha for the triazine tolerant varieties. Biomass will again be measured at maturity to determine which varieties and input treatments grow the most through the crop critical period and which have the best conversion of biomass to grain. Disease will also be assessed at maturity, with a focus on sclerotinia stem rot and blackleg.

More detailed trials will be conducted on one to two varieties at each site to better understand the nitrogen and fungicide responses in the G * E * M trial. A manure treatment has been added into the nutrition trial with the application of manure pre-sowing at Kojonup resulting in a 30% increase in biomass compared to where no manure was applied (with 225kg/ha N applied on both treatments).

Hyper Yielding 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.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NEW!
NEW!
X-citing news!
Our family of EPR listed Canolas has x-panded with 2 new arrivals.
Seed Force
SF Spark TT
Hybrid TT Canola
RGT Nizza CL
Hybrid CL Canola
RGT Capacity TT
Hybrid TT Canola
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Hybrid TT Canola
HANDLE WITH CARE
Now available at your local reseller
Seed Force

James Rollason[1], Nick Poole[1,], Jeremy Curry[2] and Tracey Wylie[1]
[1]Field Applied Research (FAR) Australia, [2]DPIRD Esperance

Pushing the productivity of wheat in the high rainfall zone (Albany Port Zone 2020 results)

GRDC project code: DAW1903-008RMX, FAR00003

Objectives: To assess a comparison of winter and spring wheat germplasm managed under different levels of management sown on 1 May on soil that was **clayed**.

The following trial was conducted at Green Range in 2020 (sandy soil duplex over clay) on land that was clayed in 2017 and smudged 2019/20 prior to sowing. With decile 1 start seven wheats (3 spring wheats – DS Pascal, Scepter, Cutlass & 4 winter wheats – Anapurna, RGT Accroc, Illabo and LPB 19-14343) were grown under three levels of management (outlined below).

Key Messages:

- Despite differences in dry matter at flowering there was no significant yield difference due to management input, however higher N input did significantly increase protein (11 to 12%).
- There were statistically significant differences in yield due to cultivar (p=0.001) with Scepter (spring) and LPB19 -14343 (winter) being significantly higher yielding than other wheats tested except Cutlass.
- Winter wheat germplasm produced significantly more tillers per unit area as a result of a longer vegetative period (sowing – GS30).
- The consequence of a longer vegetative period was greater dry matter production by the time the crop reached GS30 (longer period of potential grazing in a mixed cropping system).
- Short season winter wheats LPB 19-14343 and Illabo flowered in the period 25-30 September compared to the long winter wheats (Anapurna and RGT Accroc) in the period 10-15 October.
- Stem elongation of the spring wheat cultivars took place prior to heavy rainfall in early August and significantly reduced the dry matter recorded at the flowering stage in these cultivars, growth post flowering during grain fill showed considerable compensation.
- This contrasted with the winter wheats where stem elongation occurred after heavy rains in early August and flowering dry matter was significantly higher but post flowering growth was reduced relative to the spring wheats.

- With higher N input (136N) there was significantly greater dry matter production at flowering compared with standard management (86N) but this did not translate into more grain yield.
- Barley yields on the research site were significantly higher on equivalent clayed soils.

Winter wheats spend more time in the vegetative period before stem elongating in the spring compared to spring wheats. The length of this period depends on whether it's a short season winter or long season winter wheat. Consequently, winter wheats produce more tillers per unit area, more dry matter for potential grazing and flower later in generally less frost prone periods of spring (Table 1 & 2). Although the flowering period is more stable and less influenced by sowing unfortunately later development can result in key growth periods pre and post flowering into warmer months which reduces yield potential. In this trial decile 1 rainfall conditions significantly affected the accumulation of dry matter in the spring wheats up to flowering, compared to the winter wheats which stem elongated after heavy rain fell in early August 2020 (Table 4). However, by harvest there was no significant difference in harvest dry matters amongst cultivars as the spring wheats compensated with higher growth rates during grain fill compared to winter wheats. In this trial conducted on clayed ground the spring wheat Scepter significantly out yielded the majority of winter wheats except the earliest flowering coded winter wheat (Figure 2 & 3).

Table 1. *Influence of cultivar on plants and tillers under standard management.*

	Canopy structure			
Cultivar (Type)	Plants/m2		Tillers/m2	
Illabo (Winter)	113	-	314	bc
DS Pascal (Spring)	147	-	270	c
LPB19-14343 (Winter)	137	-	400	ab
Cutlass (Spring)	168	-	262	c
Anapurna (Winter)	150	-	441	a
RGT Accroc (Winter)	142	-	418	a
Scepter (Spring)	124	-	234	c
Mean	140		334	
LSD	43		95	
P Value	0.204		0.001	

Table 2. *Growth Stage (GS) that each cultivar was at on 13 July; 30 July; 25 August and 15 October.*

Cultivar (Type)	**13 July**	**30 July**	**25 Aug**	**29 Sept**	**15 Oct**
Scepter (Spring)	31	39	69	75	77
Cutlass (Spring)	30	37-39	57	71	73
DS Pascal (Spring)	30	39	59	73	77
Illabo (Winter)	Vegetative	30	32-33	65	69
LPB19-14343 (Winter)	Vegetative	30	37-39	65-69	73
Anapurna (Winter)	Vegetative	Vegetative	30-31	39-41	65
RGT Accroc (Winter)	Vegetative	Vegetative	30	37	61

Table 3. *Dry matter (t/ha) removed with simulated grazing (mechanical defoliation) at GS30 and total above ground dry matter at GS30 – Standard Management with defoliation.*

	Dry Matter (t/ha)			
Cultivar (Type)	Removed		Total	
Illabo (Winter)	1.00	a	2.06	a
DS Pascal (Spring)	0.31	b	0.78	b
LPB19-14343 (Winter)	0.96	a	1.85	a
Cutlass (Spring)	0.38	b	0.96	b
Anapurna (Winter)	1.03	a	2.05	a
RGT Accroc (Winter)	0.93	a	1.91	a
Scepter (Spring)	0.35	b	0.87	b
Mean	0.71		1.50	
LSD	0.18		0.29	
P Value	<0.001		<0.001	

Residual dry matter after defoliation ranged from 0.47-1.07t/ha depending on the cultivar and how prostrate the canopy it was when mechanically defoliated.

Table 4. *Influence of cultivar on dry matter at GS65 during full flowering (t/ha) under different canopy management regimes.*

	Canopy Management (Dry matter t/ha)							
	Standard Input		**"Grazed" Standard***		**High Input**		**Mean**	
Cultivar (Type)	t/ha		t/ha		t/ha		t/ha	
Illabo (Winter)	9.84	-	9.28	-	10.99	-	10.03	ab
DS Pascal (Spring)	3.66	-	3.47	-	4.25	-	3.79	d
LPB19-14343 (Winter)	10.36	-	9.57	-	12.09	-	10.67	a
Cutlass (Spring)	4.44	-	3.74	-	4.26	-	4.14	d
Anapurna (Winter)	7.92	-	8.47	-	9.90	-	8.76	c
RGT Accroc (Winter)	9.89	-	9.03	-	9.25	-	9.39	bc
Scepter (Spring)	3.97	-	3.56	-	4.17	-	3.90	d
Mean	**7.15**	**b**	**6.73**	**b**	**7.84**	**a**		
LSD Cultivar p = 0.05			0.776		**P Value**	<0.001		
LSD Management p=0.05			0.678		**P Value**	0.019		
LSD Cultivar x Management P=0.05			1.344		**P Value**	0.208		

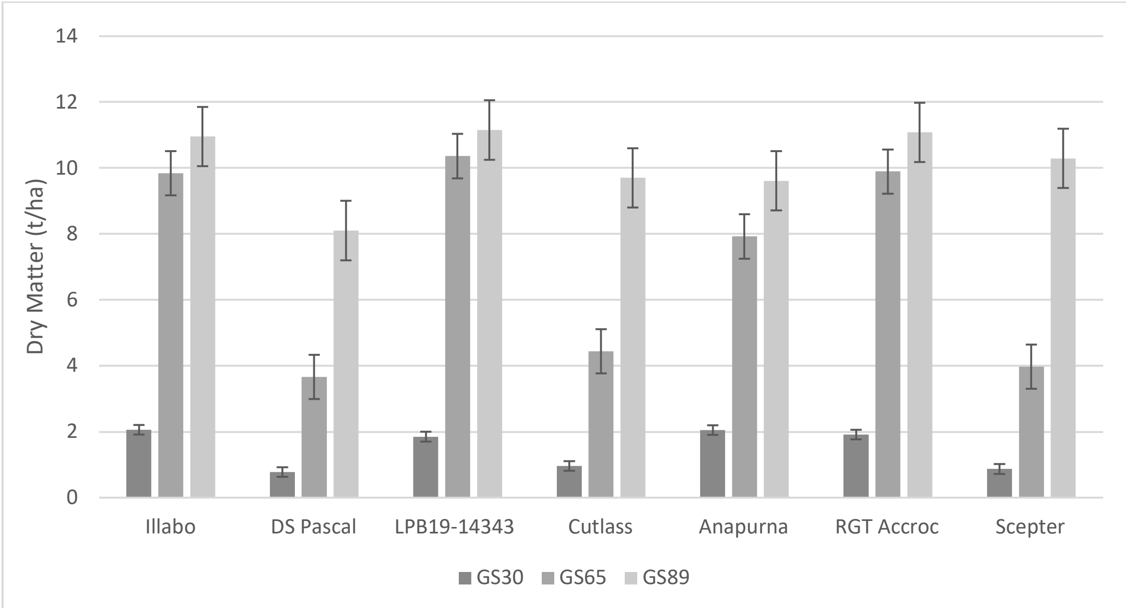


Figure 1. *Influence of cultivar on dry matter accumulation under standard management.*

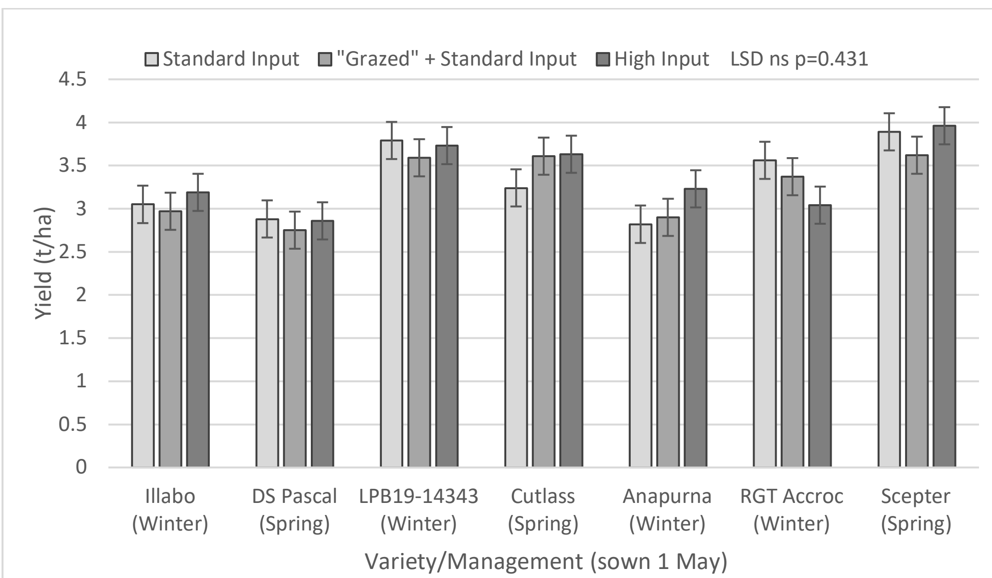


Figure 2. *Influence of variety and management package on grain yield (t/ha).*

Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement in this case).
**"Grazed standard" – simulated grazing using mechanical defoliation*

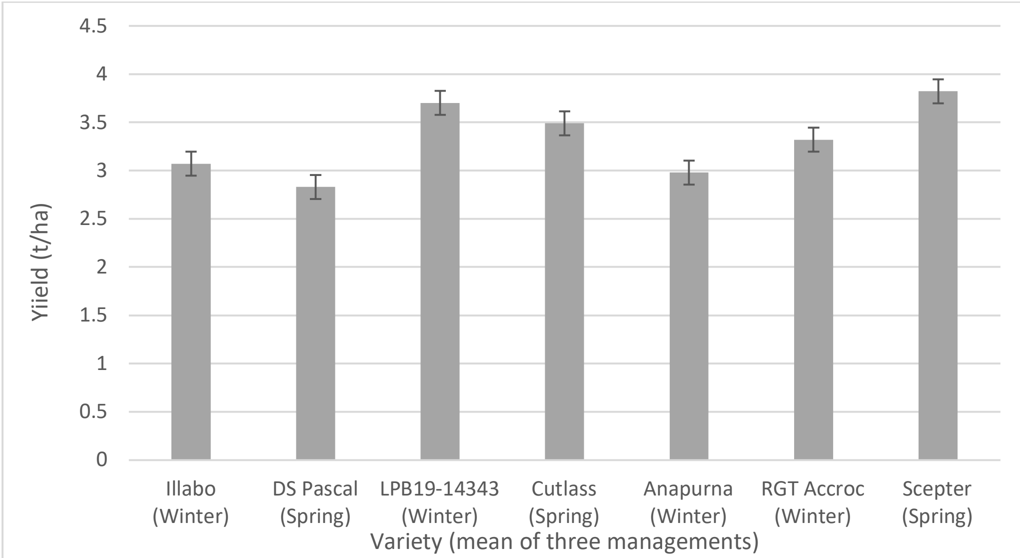


Figure 3. *Influence of cultivar on yield (mean of three management levels).*

Table 5. *Influence of cultivar on grain yield (t/ha) and quality (%, kg/hL) (mean of canopy management strategies).*

	Yield		**Protein**		**Test weight**		**Screenings (<2mm)**	
	t/ha		%		Kg/hL		%	
Cultivar (Type)								
Illabo (Winter)	3.07	d	10.7	c	72.4	d	1.8	a
DS Pascal (Spring)	2.83	d	11.6	b	74.5	c	1.4	bc
LPB19-14343 (Winter)	3.70	ab	10.7	c	77.0	b	1.7	ab
Cutlass (Spring)	3.49	bc	11.0	c	76.3	b	1.1	c
Anapurna (Winter)	2.98	d	12.4	a	78.6	a	2.0	a
RGT Accroc (Winter)	3.32	c	11.4	b	78.2	a	1.2	c
Scepter (Spring)	3.82	a	10.7	c	78.8	a	1.2	c
Mean	3.37		11.5		78.5		1.5	
LSD	0.25		0.4		1.2		0.3	
P Value	<0.001		<0.001		<0.001		<0.001	
CV	9.16							

Table 6. *Influence of management level on grain yield (t/ha) and quality (%, kg/hL) (mean of canopy management strategies).*

	Yield		**Protein**		**Test weight**		**Screenings (<2mm)**	
	t/ha		%		Kg/hL		%	
Standard Management	3.32	-	11.0	b	76.6	-	1.6	-
Grazed Management	3.26	-	10.6	b	77.3	-	1.3	-
High Input Management	3.38	-	12.0	a	75.7	-	1.6	-
Mean	3.37		11.5		78.5		1.5	
LSD	0.28		0.44		1.72		0.34	
P Value	0.593		0.001		0.165		0.182	

Table 7. *Details of the three management levels (kg, g, L, ml/ha).*

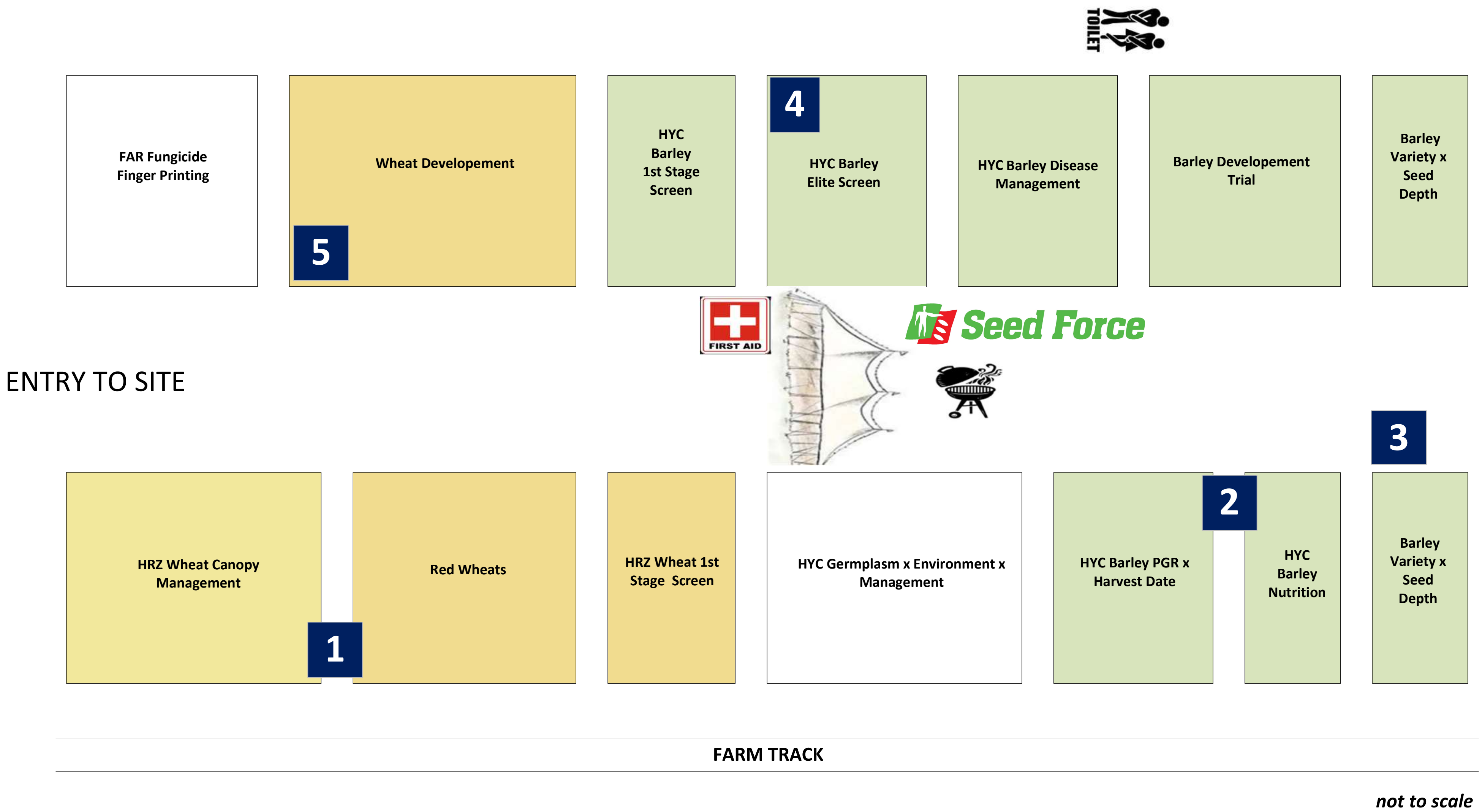
Plant pop'n:		180 seeds/m^2 (150 plants/m^2 target)		
		Standard	**Standard Grazed**	**High Input**
Grazed:		----	✓	----
Seed treatment:		Vibrance/ Gaucho		
Basal Fertiliser:	1 May	90Kg MAP		
	13 May	50Kg Potash		
Nitrogen:	19 May	33.3 Kg N	33.3 Kg N	33.3 Kg N
	2 August	27.6 Kg N	27.6 Kg N	27.6 Kg N
	11 August	16.6 Kg N	16.6 Kg N	16.6 Kg N
As per variety reaching	GS30	---	---	50.0 Kg N
Total N (With 9 N at sowing)		**86.5 Kg N**	**86.5 Kg N**	**136.5 Kg N**
PGR:	GS31	----	----	Moddus Evo. 100ml Errex. 650mL
Fungicide:	GS00	---	---	Systiva
	GS31	Opus 250mL	Opus 250mL	Radial 840mL
	GS39	Prosaro 300mL	Prosaro 300mL	Aviator Xpro 420mL

All other inputs of insecticides and herbicides were standard across the trial.
**Timings of PGRs and fungicides were adjusted to take account of the differences in spring and winter wheat phenology (development).*

WA CROP TECHNOLOGY CENTRE (ALBANY)

SITE MAP: WA CROP TECHNOLOGY CENTRE (ALBANY)

Featuring the GRDC's High Rainfall Zone Farming Sytems and Hyper Yielding Crops projects



WA CROP TECHNOLOGY CENTRE (ALBANY)

TIMETABLE

WA CROP TECHNOLOGY CENTRE FIELD DAY (ALBANY): FRIDAY 17 SEPTEMBER 2021

Featuring the GRDC's High Ranfall Zone Farming Systems and Hyper Yielding Crops (HYC) Projects

In-field presentations	Station No.	9.30 - 11.30	12:30	1:15	1:30	2:00	2:30	3:00	3:30	4:00
Sam Flottman, CSIRO and Heping Zhang, HYC Canola Researcher Canola agronomy in the high rainfall zone - Sam discusses canola results from WA HRZ project and Heping discusses the Hyper Yielding Crops trials in canola.	Canola research sites		Lunch kindly sponsored by Seed Force	Welcome and opening address, Darrin Lee, GRDC Western Panel Chair and Nick Poole, Managing Director FAR Australia						Closing address and refreshments Seed Force
Nick Poole, FAR Australia Pushing the productivity of wheat in our HRZ farming systems.	1				1			3	2	
James Rollason, FAR Australia and Jeremy Curry, DPIRD What have we leant so far from HYC in terms of barley agronomy for the WA HRZ?	2				2	1			3	
Dan Fay, Nathan Dovey, Stirlings to Coast Farmers and Jon Beasley, Grower Hyper Yielding Crops: Capturing yield potential through innovation and benchmarking.	3				3	2	1			
Mark Lawrence, Farmanco Agronomist, Gunwarrie Where to next with cereal production in the WA high rainfall zone? Bridging the yield gap - an agronomist's view.	4					3	2	1		
Andrew Fletcher, CSIRO What does crop modelling tell us about our yield potential in the region?	5						3	2	1	
In-field presentations	Station No.		12:30	1:15	1:30	2:00	2:30	3:00	3:30	4:00

We would be obliged if you could remain within your designated group number throughout the day.

Thank you for your cooperation.

1	**GROUP 1**
2	**GROUP 2**
3	**GROUP 3**

Nick Poole[1], James Rollason[1], Jeremy Curry[2] and Tracey Wylie[1]
[1]Field Applied Research (FAR) Australia, [2]DPIRD Esperance

Achieving big yields – production systems and N strategies for wheat, barley and canola in the high rainfall zone

GRDC project code: DAW1903-008RMX, FAR00003

Key Points

- Research has been centred at the Esperance Crop Technology Centre, Shepwok Downs on a deep sandy duplex soil type near Gibson.
- The research has combined testing mid-April sown wheat (winter and spring cultivars) with a farming system that is being commercially ameliorated.
- Deep ripping to 800mm in autumn 2020 resulted in a significant yield increase (0.45t/ha) over the control (control was deep ripped in autumn 2019 but not in 2020) when wheat was sown in mid-April, cv Illabo.
- The highest yields from 16th April sowing (5.7 – 5.9 t/ha) came from the spring wheat cultivars Scepter and Cutlass and the shorter season winter wheat cultivars Illabo and LPB19-14343.
- Longer season winter wheats DS Bennett, RGT Accroc and Anapurna were significantly lower yielding (less than 4t/ha) and gave less early competition to a background ryegrass population at the site.
- All cultivars responded positively to a greater input of applied nitrogen (total applied 173kg N/ha), PGR and fungicide (High Input), but protein levels (9.5 - 10.5%) still suggested that yield was not optimised.
- The effect of higher input appears to be primarily associated with additional nutrition since there was no lodging in the trial and disease levels were very low.
- Although not statistically comparable, barley on the same site sown at the same time with the same level of applied nitrogen was more productive than wheat (highest yielding barley plots were 6.82 – 7.23t/ha compared to wheat at 5.7 – 5.9t/ha following canola).

What are the objectives of the research?

The concept of the cereal research programme for DAW1903-008RMX is to explore the productivity and profitability of cereal crops (primarily wheat) sown in mid-April as part of a soil ameliorated farming system. The early sowing date has allowed the research team to explore the suitability of winter versus spring germplasm in a coastal HRZ region of WA (25km or less from the sea) where frost risk is lower. The research programme has included screening wheat and barley germplasm overlaid on commercially ameliorated sand over clay soils. It has also enabled the research team to look at the management of early sown wheat and barley in an ameliorated farming rotation. Soil amelioration is one of the biggest changes currently influencing the farming system in the SE WA coastal region, so the aim was to address how this change in land management will influence the agronomy of earlier sown cereals.

Soil Amelioration combined with early sowing of winter wheat

Key results from the project in 2020 illustrated that there was a significant yield advantage (0.45t/ha) to deep ripping to a depth of 800mm two months prior to establishing winter wheat sown in mid-April (cv. Illabo). The yield advantage was recorded in replicated commercially sown blocks sown with a tine DBS seeder and occurred despite the fact that the entire site had been deep ripped to a depth of 600 mm in autumn 2019. In effect the research indicated that there was a benefit to deep ripping when the paddock had already been deep ripped the year previous. Spade seeding following deep ripping in the same experiment produced better crop establishment that persisted through to better dry matter in early grain fill, however increased competition from ryegrass and lack of herbicide options for spade seeding reduced the benefits observed in crop establishment and it was lower yielding than establishing mid-April sown wheat straight into deep ripped ground using the DBS tyne seeder.

Germplasm for early sowing

2020 cereals trials were established on sand over clay at the Esperance Crop Technology Centre sited on Shepwok Downs, 277 Freebairns Rd Gibson 6448 (GPS location of paddock -33.61989180, 121.97536300) following canola. The land was deep ripped (400 mm) and spaded prior to small plots being established. Seven cultivars were sown on 16th April into good moisture and subsequently farmed under three levels of management input: i) Standard input ii) Standard input with defoliation (GS30) and iii) High input. Yields are presented in Table 1.

Table 1. *Influence of cultivar on grain yield (t/ha) under different canopy management regimes. (Presented in order of fastest to slowest development)*

	Canopy Management (Grain Yield t/ha)							
	Standard Input		**"Grazed" Standard***		**High Input**		**Mean**	
Cultivar (Type)	t/ha		t/ha		t/ha		t/ha	
Scepter (Spring)	4.52	bc	3.97	ef	5.80	a	4.76	a
Cutlass (Spring)	4.72	b	4.15	cde	5.86	a	4.91	a
Illabo (Winter)	4.66	b	4.05	def	5.82	a	4.78	a
LPB19-14343 (Winter)	4.46	bc	3.57	gh	5.74	a	4.75	a
DS Bennett (Winter)	3.85	efg	3.88	efg	4.58	b	4.00	b
Anapurna (Winter)	3.31	hi	3.09	i	4.07	def	3.49	c
RGT Accroc (Winter)	3.89	efg	3.73	fg	4.40	bcd	4.01	b
Mean	**4.20**	**b**	**3.78**	**b**	**5.18**	**a**		
LSD Cultivar p = 0.05		0.23			**P Value**	<0.001		
LSD Management p=0.05		0.54			**P Value**	0.002		
LSD Cultivar x Management P=0.05		0.39			**P Value**	0.001		

(Presented in order of fastest to slowest development)

Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement in this case).

"Grazed standard" – simulated grazing using mechanical defoliation at GS30
High input received higher N input than the standard (173 versus 127 kg N/ha) and higher fungicide input and PGR input

Sown in mid-April the highest yields (5.7 – 5.9 t/ha) came from the spring wheat cultivars Scepter and Cutlass and the shorter season winter wheat cultivars Illabo and LPB19-14343. Longer season winter wheats DS Bennett, RGT Accroc and Anapurna were significantly lower yielding and gave less early competition to a background ryegrass population at the site. Detailed phenology assessments indicated that the spring wheats reached GS30 (start of stem elongation) in early June when sown in mid-April and almost two months before the long season winter wheat RGT Accroc. Scepter had started to flower when RGT Accroc reached GS30 on the 3rd August. The earliest winter wheats to flower were Illabo and the coded line LPB19-14343 on 1 September with the late season winter wheats flowering from 30 September to 15 October. With a shorter vegetative period until GS30 Scepter produced fewer tillers per unit area than longer season spring and winter wheats. This also translated to similar differences in head numbers, although this was not statistically significant ($p=0.08$). Mechanical defoliation simulating grazing had greater negative impact on the highest yielding cultivars with no statistically significant impact on the lower yielding winter types (despite the later defoliation of the winter types). As might be predictable wheats taking longer to reach GS30 produced higher dry matter values, but these came at the expense of grain yield compared to cultivars with shorter vegetative periods.

Influence of Management

Significantly higher yields achieved with higher input was primarily associated with increased N input since there was little disease pressure in the trial and no significant lodging. The indications were that N levels could have been increased further since protein levels were between 9.2 - 10.5% for the highest yielding cultivars. Based on a simple budget of 40-50kg N/ha supplied for every tonne of wheat/barley produced, a 6t/ha potential would require 240-300kg N/ha supplied. Taking account of 57kg N/ha available in the soil (0 – 80cm) prior to sowing, this would have required 183-243 kg N/ha applied. However, increasing N fertiliser levels above 200kg N/ha has frequently failed to give high grain yields in other research conducted in 2020 as part of the Hyper Yielding Crops project, indicating that there will be a limit to just how much yield can be generated by routinely applying more than 200kg N/ha. In both wheat and barley trials (Table 2) sown at the same time on ameliorated soil (deep ripped) it was illustrated that 170-175kg N/ha was associated with significantly higher yields than 127kg N/ha. Interestingly, although not statistically comparable, barley on the same site sown at the same time with the same level of applied nitrogen was more productive than wheat (highest yielding barley plots were 6.82 – 7.23 compared to wheat at 5.7 – 5.9t/ha following canola).

Table 2. *Influence of barley cultivar on grain yield (t/ha) under different canopy management regimes – sown on ameliorated land on 16 April.*

	Canopy Management (Grain Yield t/ha)					
	Standard Input		**"Grazed" Standard***		**High Input**	
Cultivar (Type)	t/ha		t/ha		t/ha	
Cassiopee (Winter)	4.33	e	4.37	e	4.31	e
Urambie (Winter)	5.55	d	5.47	d	6.33	b
RGT Planet (Spring)	5.78	cd	6.19	bc	6.86	a
HV8 Nitro (Spring)	6.17	bc	6.33	b	7.23	a
Rosalind (Spring)	5.85	cd	5.93	bcd	6.82	a
Mean	**5.53**	**b**	**5.36**	**b**	**6.31**	**a**
LSD Cultivar p = 0.05		0.27			**P Value**	<0.001
LSD Management p=0.05		0.46			**P Value**	0.012
LSD Cultivar x Management P=0.05		0.48			**P Value**	0.030

Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement in this case).
"Grazed standard" – simulated grazing using mechanical defoliation.

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Disease management in an era of fungicide resistance and reduced sensitivity in cereals

GRDC project code: FAR2004-002SAX, FAR00003, AFREN project (Australian Fungicide Resistance Extension Network) CUR1905-001SAX

Keywords: Disease Management Strategies, Integrated Disease Management (IDM), Fungicide Resistance, Septoria Tritici Blotch (STB), Net Form of Net Blotch (NFNB), Group 11 Quinone Outside Inhibitors - QoI (Strobilurins) and Group 7 Succinate Dehydrogenase Inhibitors (SDHIs), Fungicide resistance.

Take home messages

- In seasons that favour higher yield potential, 2020 Hyper Yielding Crops (HYC) research has indicated that one of the most important components in growing high yielding cereal crops is disease management.
- However, fungicide resistance and reduced sensitivity needs to be minimised through integrated management approaches which allow us to successfully and profitably use less fungicide.
- The number of fungicide applications over time is a key driver fuelling the shift (the selection of more resistant strains) in pathogen populations towards fungicide resistance.
- To ‘slow the train’, growers and advisers need to adopt anti resistance measures when using fungicides that avoid repeating the same active ingredients, and wherever possible, in an integrated disease management (IDM) approach.
- Integrated management strategies include rotating chemistries, using less disease susceptible cultivars and cultural practices to minimise disease.
- A key part of HYC research has been to see if we can use genetic resistance to delay disease progression and fungicide intervention. The aim of this is to encourage less use of fungicide with applications only at key timings to protect the most important leaves.
- Where genetic resistance in wheat cultivars is not sufficient to delay fungicide decisions until later in stem elongation, 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.
- In barley, two timings are essential in order to maximise returns with an option for seed treatment in high disease pressure scenarios. These timings were identified as GS31 and awn tipping GS49.

- 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.

So how can we maximise productivity and minimise fungicide resistance development in seasons of high disease pressure?

Firstly, we need to know which are the most problematic pathogens for resistance development, since whilst it's advisable to adopt integrated disease management IDM principles for all diseases, some pathogens are more problematic than others. In Australia it's powdery mildew in wheat (WPM) and barley (BPM), net blotches in barley (both spot and net form) and Septoria tritici blotch (STB) in wheat that are currently the main pathogens affected (Table 1). In addition, the risk of resistance development in these pathogens varies with fungicide mode of action.

- Group 11 QoIs (strobilurins) are at the highest risk of pathogen resistance development, particularly the pathogens responsible for Septoria tritici blotch (STB) in wheat and powdery mildew. Both these pathogens have now overcome strobilurins in different regions of Australia, but so far it is not an issue in WA. Note that the newly discovered barley disease *Ramularia* has overcome Group 11 in Europe and New Zealand.
- Group 7 SDHIs are at moderate to high risk of resistance development in the pathogen with evidence in New Zealand and Europe of pathogen shifts in sensitivity to Ramularia leaf spot in barley and net blotch and STB in Europe. Net blotch pathogens are currently our biggest issue in Australia with reduced sensitivity identified in spot form of NB in WA and net form in regions of SA and Victoria.
- Group 3 DMIs Demethylase Inhibitors (DMIs – triazoles) are generally considered at low to moderate risk, however recent developments in WA in the net blotch pathogen have challenged this view.

Table 1. *Fungicide resistance and reduced sensitivity cases identified in Australian broad acre grains crops.*

Disease	Pathogen	Fungicide Group	Compounds affected	Region	Industry implications
Barley powdery mildew	*Blumeria graminis* f.sp. *hordei*	3 (DMI)	Tebuconazole, propiconazole, flutriafol	Qld, NSW, Vic, Tas, WA	Field resistance to some Group 3 DMI fungicides
Wheat powdery mildew	*Blumeria graminis* f.sp. *tritici*	3 (DMI)	None	NSW, Vic, Tas, NSW	This is a gateway mutation. It does not reduce the efficacy of the fungicide but is the first step towards resistance evolving.
		11 (QoI)	All group 11	Vic, Tas, SA, NSW	Field resistance to all Group 11 fungicides

Barley net-form of net blotch	*Pyrenophora teres* f.sp. *teres*	3 (DMI)	Tebuconazole, propiconazole, prothioconazole	WA	Reduced sensitivity that does not cause field failure
		7 (SDHI)	Fluxapyroxad Bixafen	SA (Yorke Peninsula)	Reduced sensitivity or resistance depending on the frequency population.
Barley spot-form of net blotch	*Pyrenophora teres* f.sp. *maculata*	3 (DMI)	Tebuconazole, epoxiconazole Propiconazole	WA	Field resistance to old generation Group 3 fungicides
		7 (SDHI)	Fluxapyroxad Bixafen	WA (Cunderdin region)	Reduced sensitivity identified in 2020
Wheat Septoria tritici blotch (STB)	*Zymoseptoria tritici*	3 (DMI)	Tebuconazole, flutriafol, propiconazole, cyproconazole, triadimenol	NSW, Vic, SA, Tas	Reduced sensitivity that does not cause complete field failure
Wheat Septoria tritici blotch	*Zymoseptoria tritici*	11 (QoI)	Azoxystrobin Pyraclostrobin	SA	Identified in 2021. Unknown at this stage but if mutation affects performance as Europe then QoIs will decline in their effectiveness

Table 1 definitions

Reduced sensitivity*: Fungi are considered as having reduced sensitivity to a fungicide when a fungicide application does not work optimally, but does not completely fail. In most cases, this would be related to small reductions in product performance which may not be noticeable at the field level. In some cases, growers may find that they need to use increased rates of the fungicide to obtain the previous level of control. Reduced sensitivity needs to be confirmed through specialised laboratory testing.*

Resistant*: Resistance occurs when the fungicide fails to provide an acceptable level of control of the target pathogen in the field at full label rates. Resistance needs to be confirmed with laboratory testing and be clearly linked with an unacceptable loss of disease control when using the fungicide in the field at full label rates.*

Where the cultivar's susceptibility to disease prevents delaying fungicide application until flag leaf (or later in stem elongation) and earlier fungicide intervention is needed (e.g. GS31) to secure the higher yield potential, it's important that we adhere to sound anti resistance measures. These include avoiding repeated use of the same active ingredients/products and in the case of the newer Group 11 QoI (strobilurins) and Group 7 SDHIs, also avoid repeating the same mode of action. This is frequently easier said than done in longer season scenarios since many of the fungicides with better efficacy are also important co-formulation partners in fungicide mixtures carrying two modes of action. However, focussing on the key physiological timings that protect the upper canopy leaves will ensure that the number of applications is not excessive, usually no more than two applications or three at most is sufficient with the most susceptible scenarios.

Anti-resistance measures when using fungicides as part of an Integrated Disease Management (IDM) strategy

- With wheat and barley crops where two to three applications of fungicide are applied, avoid repeat applications of the same product/active ingredient and where possible also avoid the same mode of action in the same crop. This is

particularly important when using Group 11 QoI (strobilurins) and Group 7 SDHIs, which preferably would only be used once in a growing season.
- Avoid using the seed treatment fluxapyroxad (Systiva®) year after year in barley without rotating with foliar fungicides of a different mode of action during the season or directly following Systiva with a fungicide containing an SDHI.
- Avoid applying the same DMI (triazole) Group 3 fungicide twice in a row, irrespective of whether the DMI is applied alone or as a mixture with another mode of action.
- Group 3 DMIs (for example; triazoles e.g. epoxiconazole (Opus®) or triazole mixtures (e.g. prothioconazole and tebuconazole (Prosaro®)) used alone are best reserved for less important spray timings, or in situations where disease pressure is low in higher yielding scenarios.
- With SDHI seed treatments such as fluxapyroxad (Systiva®) or QoI fungicides used in-furrow such as Uniform® containing azoxystrobin, consider foliar fungicide follow ups which have a different mode of action, and therefore, avoiding if possible, a second application of SDHI or QoI fungicides.

Influence of fungicide rate

Growers and agronomists frequently ask the question whether dose rates have an impact on how likely fungicide resistance is to evolve. Resistance comes in many forms and trying to manipulate rates with fungicides should not be seen as the core resistance management strategy. The reality is that using the most appropriate rate for effective disease control is the best strategy for managing resistance. Label rates have been developed to provide robust and reliable control of the target disease.

In many cases the full label rate is the most appropriate rate for control. However, for some diseases, the lower rate from the label range of a fungicide can be used in conjunction with a crop variety that has a good disease resistance rating because disease pressure will be lower. Contrary to what might be the case with other agrichemicals, there is evidence that by using a higher rate than necessary increases the risk of resistance, as removing all of the sensitive individuals provides more opportunity for these resistant individuals to dominate the population and hence be the strain colonising the plant. This is particularly the case with Group 11 QoIs and Group 7 SDHIs fungicides.

Clearly, the best way to avoid fungicide resistance is not to use fungicides! However, in high disease pressure regions, this would be an unprofitable decision. When a cultivar’s genetic resistance breaks down or is incomplete, it is imperative that growers and advisers have access to a diverse range of effective fungicides (in terms of mode of action) for controlling the disease. Hence, we need to protect their longevity. In order to protect them, one of the most effective measures is to minimise the number of fungicide applications applied during the season. Therefore, consider all aspects of an Integrated Disease Management (IDM) strategy when putting your cropping plans together at the start of the season.

Principle components of IDM

Rotations – where possible avoid high risk rotations for disease, for example, barley on barley or wheat on wheat.

Seed hygiene – minimise the use of seed from paddocks where there were high levels of disease that could be seedborne (e.g. Ramularia, net form net blotch).

Use less disease susceptible cultivars, particularly when sowing early. Where this is not possible delay the sowing of the most susceptible cultivars to reduce disease pressure where the phenology of the cultivar is adapted to the later development window.

Cultural control such as stubble management, where disease risks are high and the penalties for stubble removal are not as high.

Grazing early sown cereal crops up to GS30 to reduce disease pressure.

AFREN (Australian Fungicide Resistance Extension Network)

The Australian Fungicide Resistance Extension Network (AFREN) was established to develop and deliver fungicide resistance resources for grains growers and advisers across the country. It brings together regional plant pathologists, fungicide resistance experts and communications and extension specialists.

AFREN wants to equip growers with the knowledge and understanding that they need to reduce the emergence and manage the impacts of fungicide resistance in Australian grains crops.

As members of AFREN, the authors of this paper are keen for you to report any fungicide resistance instances to your local DPIRD regional pathologist if you believe you are encountering reduced sensitivity or resistance in your broad acre crops.

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Achieving hyper yielding barley crops in Southern WA HRZ, is it different to the Eastern states?

Background

The GRDC and FAR Australia led barley Hyper Yielding Crops program has a national framework incorporating genetics x environment x management (GxExM) field experiments to increase yield in the higher rainfall zones. We have an aspirational target to reliably achieve 10t/ha grain yield in all regions of the High Rainfall Zone and remain competitive with wheat. However, the big question is whether the management and germplasm required across the regions is different to achieve this goal of 10t/ha?

After the first year of results there are distinctive differences between regions and particularly in WA results that help us to dissect the management and genetics required for each high rainfall zone. The most important factor that spreads across all high rainfall zones is that:

The fundamental principles of high productivity do not change across rainfall zones, but the timing of aligning critical yield forming periods and intensity of management intervention changes with environment.

The first factor is ensuring crops flower on time and are matched to environment, this is earlier in WA than eastern high rainfall zones.

Flowering date is determined by sowing date, variety selection, and to some extent grazing intensity and timing. The reason this is so important is that flowering time aligns the critical period for grain number accumulation. This period is typically 28 days before awn emergence in barley. Across all hyper yield environments an elite screen was conducted in 2020 with the objective to examine the yield potential of new winter and spring germplasm grown under hyper yielding management packages against spring and winter controls in the traditional late April/early May sowing window. One of the most important differences between WA and other HRZs is that the required flowering dates are earlier in WA. Flowering time responses to yield depended on environment and early flowering was favoured in WA.

Some key observations from 2020 are included below.

- Six row winter barley was introduced to Australia and evaluated in yield plots for the first-time and flowered during the optimum period in the SA and Vic crop technology centre but were too late in WA.
- The yields achieved by the highest yielding 2 and 6 row winter barley were comparable with the spring barley control RGT Planet in Vic but not at any other

sites due to head loss and lodging in SA, and flowering too late and thus heat and drought in WA (table 2).

- The 6-row winter Pixel was the most consistent performer and has been progressed to management trials in WA for 2021.
- RGT Planet and Rosalind remain among the highest yielding cultivars across all centres and are broadly adapted despite flowering earlier than most other cultivars and remain the benchmarks in adaptation and yield performance.
- Yields greater than 10t/ha were achieved in spring sown barley in Tasmania and the cultivar Laureate was the highest yielding at 11.4 t/ha. This becomes the benchmark yield for the remainder of the project.

Table 1. *Grain yield (t/ha) of the relevant spring controls and best performing introduced or alternate spring, 2 row winter and 6 row winter at each crop technology centre. Shaded treatments within a site are statistically the highest yielding treatments for the site.*

CTC	Rosalind (Fast Spring Control)	RGT Planet (spring control)	Best Spring Alternative		Best 2 Row Winter		Best 6 Row Winter	
SA TOS1[1]	8.3	8.7	9.7	AGTB0245	7.4	Newton	7.1	Pixel
SA TOS2[1]	8.9	9.6	9.8	Laureate	7.3	Cassiopee	---	
Vic[2]	8.3	7.8	8.2	GSP1727-B	8.4	Madness	8.5	Pixel
WA[1]	4.8	4.6	4.9	Laperouse	3.9	Urambie	2.9	Pixel
Tas (spring)[1]	9.2	10.4	11.4	Laureate	---		---	

[1] sites received one PGR, [2] sites received 2 PGR.

One of the starkest differences between environments is the fact that winter cultivars flowered much later than the spring cultivars in WA relative to other environments and there is a significant gap between the flowering time of spring germplasm compared to winter types in WA and this is reflected in the yield responses (figure 1). The other noticeable feature from the data is that the spring types develop too quickly in WA from April sowing dates, and leave crops vulnerable to frost damage, and or insufficient biomass accumulation. The spring germplasm also flowered much earlier in WA compared to the Eastern states (data not presented).

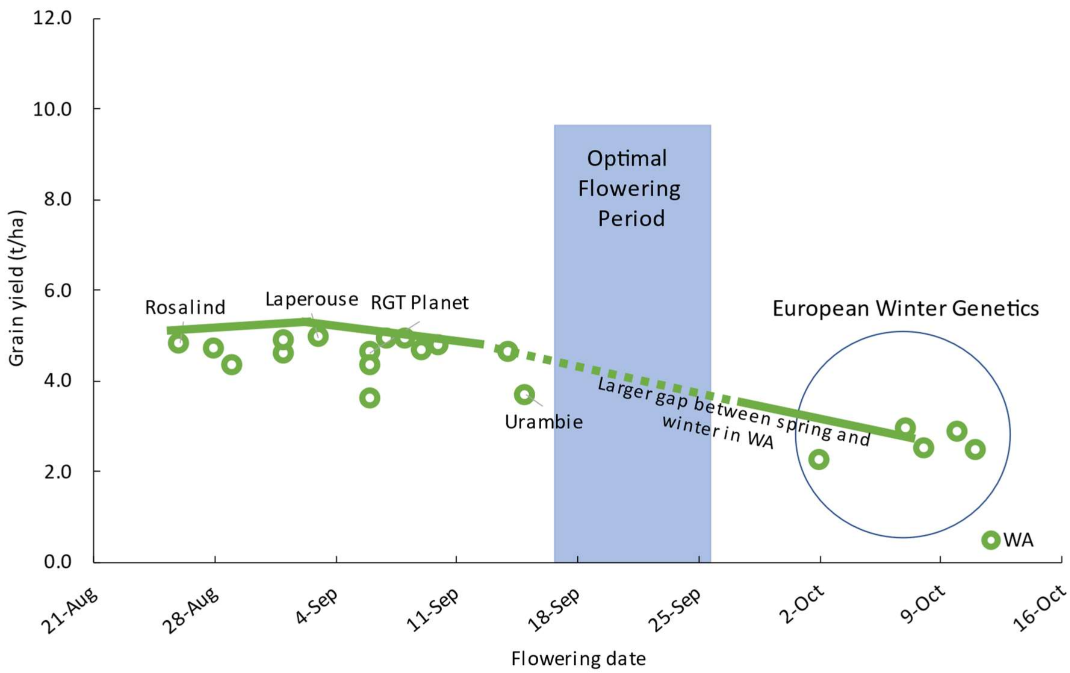


***Figure 1**. Grain yield response to flowering date at the WA Green Range Crop Technology centre 2020.*

What these findings mean that if winter or slower developing cultivars are to be successful in WA from earlier sowing it is unlikely that current Australian varieties or introduced germplasm from Europe will be sufficient, and there will need to be a targeted breeding effort to develop germplasm with a development pattern suited to early sowing. The alternative solution is to sow slightly later (25 April – 5 May) to optimise the flowering time of high performing spring cultivars. This is what has been achieved in 2021 at Frankland.

The reason for the difference in WA compared to other states, is environmental. Not because a lack of vernalising (or cold) temperatures in WA but due to the fact that day time daily maximum temperatures are much warmer in WA compared to the eastern states. For example in the graph below daily minimum temperature in July and August are similar at Green Range WA, and Millicent South Australia, but there is a much bigger gap in daily maximum temperatures. Warmer temperatures will accelerate development in spring types during this period, where as winter types will still be accumulating their cold requirement and thus less affected creating a large gap between germplasm types.

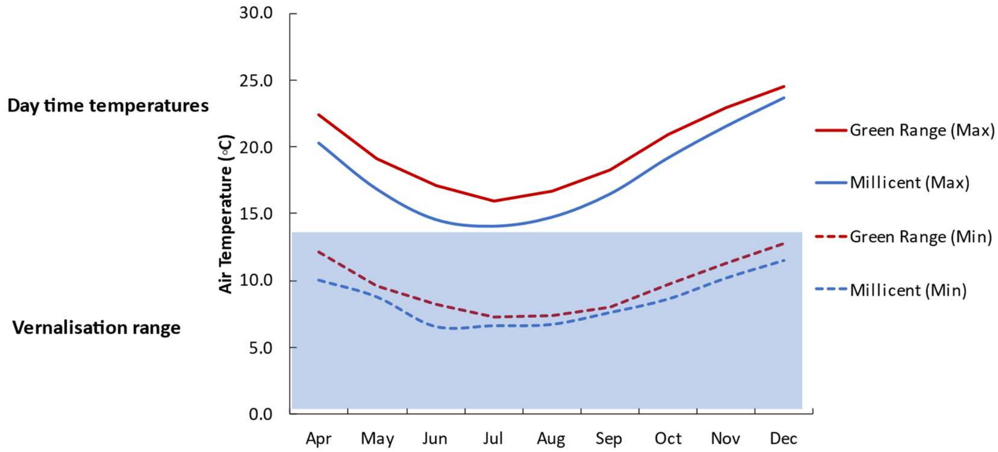


Figure 2. *Mean Min and maximum temperature differences between Millicent SA, and Green Range WA (Bom Data 1990 – 2020).*

The other important reason quicker winters/slower springs will be required for early sowing in WA is the fact that grain fill conditions are more hostile, drier and warmer compared to eastern high rainfall zones. Varieties or management that maintains grain weight under a more hostile grain filling environment will lead to improved harvest index and yield. Often grain number is the focus at cooler sites, however maintaining grain weight was more important for yield in WA in 2020 (figure 3).

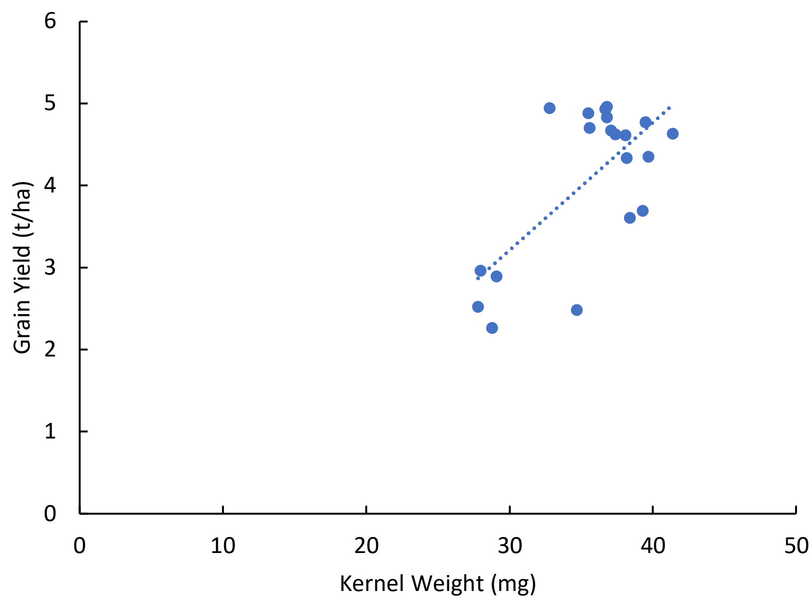


Figure 3. *Relationship between grain weight and grain yield at Green Range 2020 WA.*

What else can we achieve with crop management? Exploiting management to better match genetics to environments

The objective of the Genotype x Environment x Management (GEM) trial series was to assess the performance of winter and spring barley germplasm managed under four different management intensities (mid-April to early May sown) at two levels of fungicides. Other management factors included canopy intervention such as the addition a PGR, defoliation and additional Nitrogen.

The data from the GEM confirms findings above for WA and highlights the effect of cultivar compared to management across environments. The spread between box plots in the visual demonstration below (figure 4) highlights the effect of cultivar, and the spread within the box plot represents the difference in management. Within each boxplot all levels of management are included. At SA, WA, and TAS the effect of cultivar was greater or equal to the variation possible with management, whereas at Victoria management was more important than cultivar. None the less in Planet the effect of management could influence grain yield by + or – 0.5 t/ha, and a 1 tonne difference between best and worst management in WA in Planet.

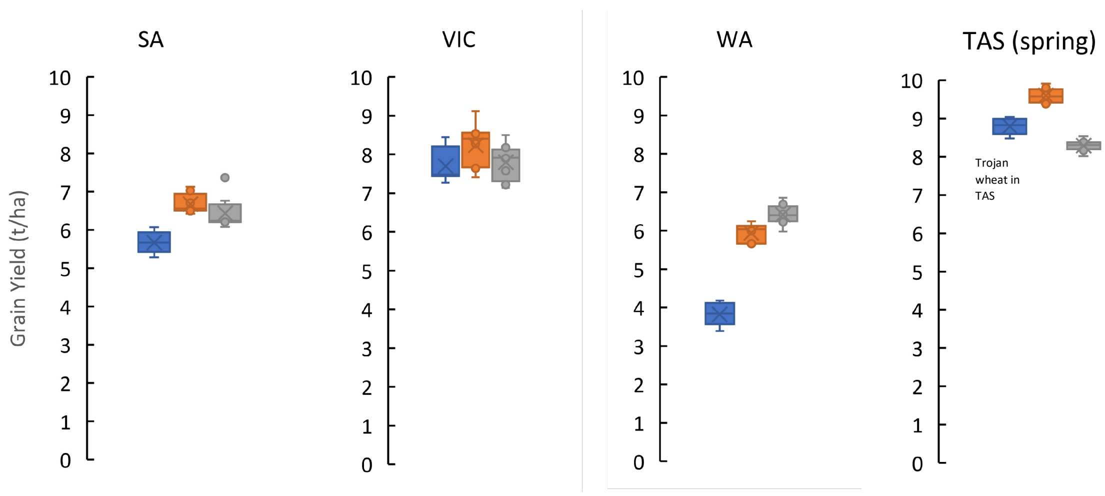


Figure 4. *Boxplot representation blue (•Cassiopee winter barley (Trojan in Wheat in TAS), •RGT Planet, and •Rosalind) grain yields across all management combinations (n = 8 per box plot) and environments (blue = trojan wheat in TAS spring sown).*

Jeremy Curry (DPIRD), Kenton Porker (FAR Australia), James Rollason (FAR Australia)

2021 Barley germplasm screening - Frankland

Aim

To assess a wide range of barley varieties for their suitability to the Western HRZ. Specifically, varieties are assessed for phenology, disease resistance and standing power and promising candidates will be included in future yield trials.

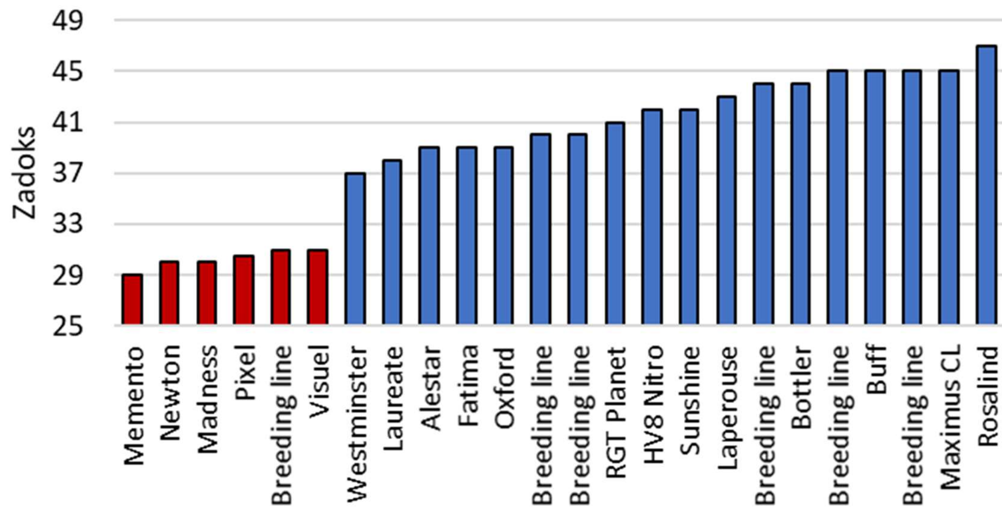


Figure 1. *Zadoks scores of barley varieties within the screening trial at Frankland in 2021. Data as of 16 August. Red – winter types, blue – spring types.*

Figure 2. *Severe NFNB formation in a breeding line (photo taken 16 August 2021).*

Jeremy Curry (DPIRD), Kenton Porker (FAR Australia), James Rollason (FAR Australia)

2020 WA HYC Project Barley Results: Barley GEM trial Green Range

Aim

To assess the performance of winter and spring barley varieties managed under different management and fungicide regimes.

More specifically, this trial series aims to:

- Better understand the physiological constraints to higher production of alternative spring and winter barley genotypes through assessment of phenology, dry matter production and yield conversion.
- Determine whether alternative spring and winter barley genotypes require specific management to optimise their production.
- Determine the relative importance of management levers available to growers.

Treatments:

Table 1. *Treatments applied within the trial. Two levels of fungicide input were applied with four levels of canopy intervention to three barley varieties in a factorial design.*

Cultivar	
Rosalind	Spring, feed barley.
RGT Planet	Spring, malt barley.
Cassiopee	Winter, feed barley.

Fungicide management	
Standard Input	500ml/ha Opus (125g/L epoxiconazole) at GS31, 300ml/ha Prosaro (210g/L prothioconazole + 210g/L tebuconazole) at GS39.
High Input	1.5ml/kg Systiva (333g/L fluxapyroxad) seed treatment, 500ml/ha Opus (125g/L epoxiconazole) + 62.5 g/ha a.i. azoxystrobin at GS31, 420ml/ha Aviator Xpro (75g/L bixafen + 150g/L prothioconazole) at GS39.

Canopy intervention	
Control	No additional intervention.
Nitrogen (N) only	Additional 50N at GS31.
Defoliation + N	Mechanical defoliation defoliation at GS30 and additional 50N at GS31.
PGR + N	200ml Moddus Evo (350g/L trinexapac-ethyl) at GS30-32 and additional 50N at GS31.

Key Results:

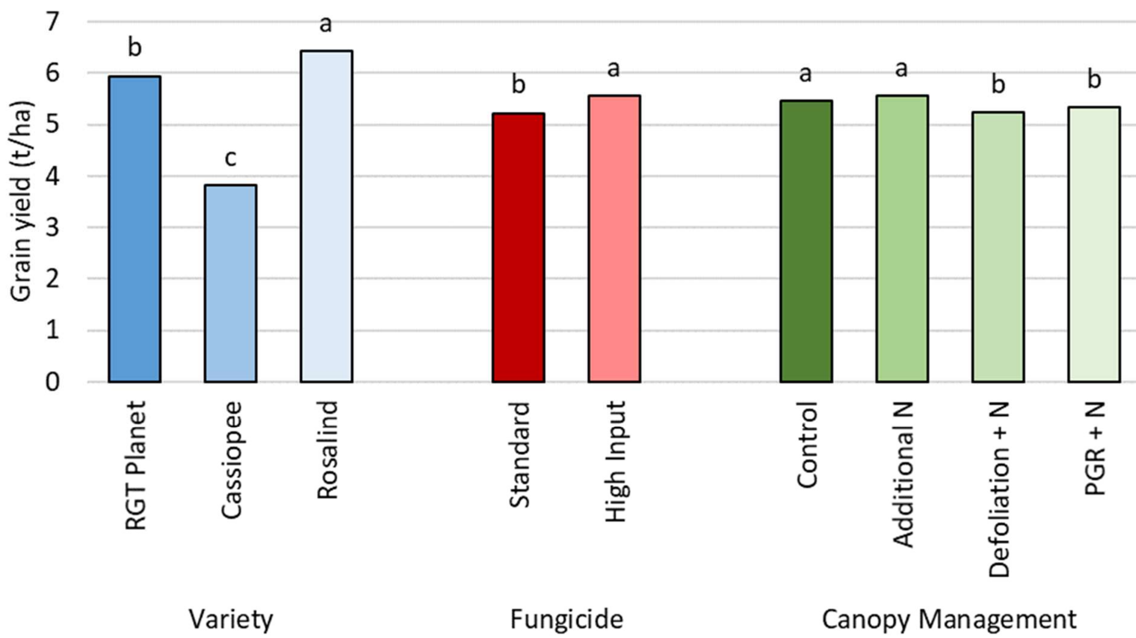


Figure 1. *The grain yield (t/ha) of the three main treatment factors of variety, fungicide and canopy management at Green Range in 2020. Different letters indicate values are significantly different (within same treatment factor).*

Summary

- Rosalind was higher yielding than RGT Planet (+0.48t/ha), producing slightly more biomass and maintaining a similar harvest index (yield to biomass ratio) from this start of May sowing date.
- The winter barley, Cassiopee, was significantly lower yielding than either of the spring varieties, due to its development being too slow for WA resulting in a poor harvest index.
- Despite low levels of disease at the site, the high input fungicide package increased yield by 0.32t/ha and resulted in slightly more biomass and plumper grain, a result that is expected to have resulted from delayed leaf senescence.
- Canopy interventions including increased N, defoliation or plant growth regulator applications had minimal impact on growth. These treatments are more likely to be applicable in seasons with high biomass production that can lead to associated issues including lodging and intra-crop shading.
- Given the minimal impacts of management in 2020, genotype by management interactions were rare across the site.

2020 HRZ Project Barley GEM Trial - Esperance

A genotype x environment x management (GEM) trial was established at Esperance in 2020 from a 16 April sowing date as part of the GRDC investment, DAW1903-008RMX (*Optimising high rainfall zone cropping for profit in the Western and Southern Regions*). This trial saw five genotypes (Rosalind, RGT Planet and Cassiopee as per Green Range 2020 plus the inclusion of HV8 Nitro and Urambie) tested at three management levels.

The three spring varieties (Rosalind, RGT Planet and HV8 Nitro) were the equal highest yielding varieties at the site, topping out at around 6.8-7.2t/ha under the high input management treatment. As per the Green Range trial, Cassiopee was 2-3t/ha lower yielding than the other varieties, while Urambie yielded 0.5-1t/ha less than the spring varieties.

Defoliation at the onset of stem elongation had minimal impact on yields at the site, potentially due to the early sowing date (and hence, longer period to compensate for removed biomass). The high input management package improved grain yield (except for Cassiopee), a result that is expected to be linked to additional nitrogen (rather than additional fungicide or plant growth regulator applications).

For more information on the Esperance results, see the FAR Australia website.

2021 Trial - Frankland

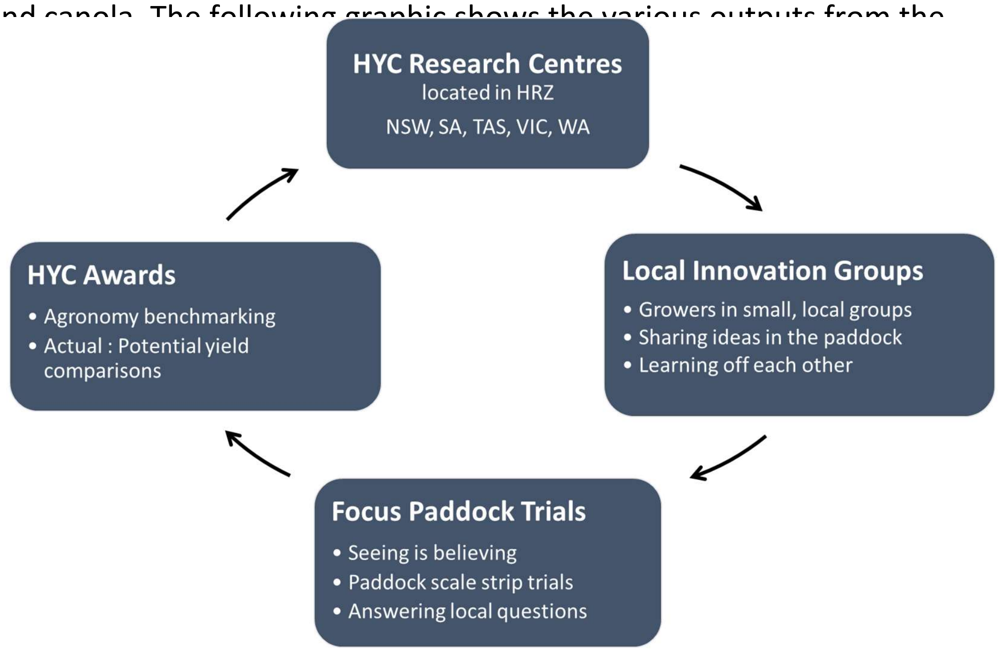
Given its comparatively poor performance in 2020, Cassiopee has been replaced in the 2021 trial with the 2-row winter barley, Madness, and the 6-row winter barley, Pixel. In addition to RGT Planet and Rosalind, the spring barley Laperouse has been included. There are a total of six management treatments being applied to all varieties, including combinations of improved fungicide regimes, plant growth regulator applications, defoliation and increased nitrogen applications.

As of mid-August 2021, Rosalind had reached awn peep, RGT Planet and Laperouse were booting, and Madness and Pixel were in early stem elongation.

Jon Midwood, TechCrop

GRDC Hyper Yielding Crops WA

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



In combination with the research centres there is a large emphasis on local grower involvement in the project and so in the HRZ of WA, Stirlings to Coast Farmers (SCF) 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 SCF set up two innovation groups in the southern HRZ region. Both 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 SCF 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. ***South Stirling Focus paddock trial 2020***

Research question: Could an additional urea application of 100kg/ha at GS37 (end August) in a crop of Devil wheat increase grain yield? Is the grain protein influenced by this application late in the season?

Paddock details

Crop	Wheat
Variety	Devil (AH)
Sow Rate	120.00 kg/ha
Sow Date	26-05-20
Harvest Date	20-12-20
Harvest Yield	4.6 T/ha
Stubble Management	Retained Pasture
Fallow Management	Grazed (Sheep)
Seeder type	Tyne (Knife Point)

Fertiliser

Date	Product	Rate	Units	N	P	K	S
26-05-20	Starter	90	kg/ha	9	18	0	3
26-05-20	MOP	20	kg/ha	0	0	10	0
01-07-20	NS51	90	kg/ha	33	0	0	8
19-08-20	Flexi-N	80	L/ha	34	0	0	0
Total				**76**	**18**	**10**	**11**

Extra treatment								
30-08-20	Urea	100	Kg/ha	**122**	**18**	**10**	**11**	

Results

Measurement type	Control	Extra N	Sig Diff
Dry Matter (T DM/ha)	13.52	13.92	None
Yield (t/ha)	4.64	5.01	Yes
Protein (%)	11.2	11.0	None
Screenings (%)	1.5	1.3	None
Test weight (kg/hL)	78	76	None

Conclusion

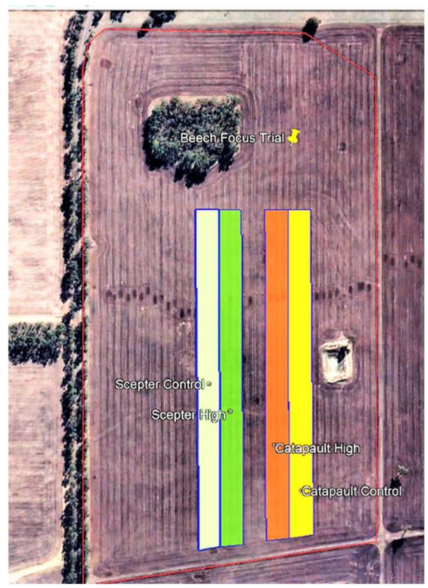
The additional application of 100 kg/ha of urea (46N) at the very end of August (GS37), on top of the 76kg N/ha already applied, gave a significant yield increase of 0.37t/ha and only slightly diluted the protein content. The above average rainfall in August would have meant there was sufficient soil moisture to utilize this extra N and convert it into yield.

2. *Frankland River Focus paddock trial – 2020*

Research question: What is the yield difference between Scepter and Catapult sown on 15 May and can I achieve a higher yield by adding an additional 44 kg/ha urea on 14th August?

Paddock details

Crop	Wheat
Variety 1	Scepter (AH)
Variety 2	Catapult (AH)
Sow Rate	120.00 kg/ha
Sow Date	15-05-20
Harvest Date	14-12-20
Harvest Yield	6.4 T/ha
Stubble Management	Chaff cart
Fallow Management	Grazed (Sheep)
Seeder type	Tyne (Knife Point)



Fertiliser

Date	Product	Rate	Units	N	P	K	S
15-05-20	Starter	140	kg/ha	18	25	0	8
15-05-20	MOP	20	kg/ha	0	0	10	0
01-06-20	Urea	80	kg/ha	37	0	0	0

01-06-20	MOP	40	L/ha	0	0	20	1
07-07-20	Urea	80	Kg/ha	37	0	0	0
Total				**92**	**25**	**30**	**9**
Extra treatment							
14-08-20	Urea	44	Kg/ha	**112**	**25**	**30**	**9**

Results

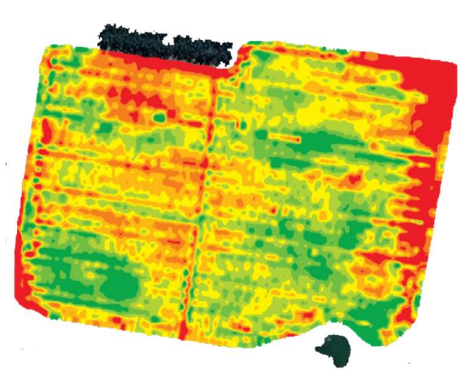
Measurement type	Scepter	Scepter **extra N**	Catapult	Catapult **extra N**	**Sig Diff**
Dry Matter (T DM/ha)	15.86	15.66	15.83	16.39	None
Yield (t/ha)	6.38	6.20	6.74	6.38	None
Protein (%)	11.0	9.5	11.0	10.0	None
Screenings (%)	0.3	0.5	0.6	0.7	None
Test weight (kg/hL)	80.5	81.3	80.0	80.1	None

Conclusion

Catapult yielded more than Scepter, but this was not statistically significant. The additional application of 44kg/ha of urea (20N) in mid August (GS37), on top of the 92kg N/ha already applied, gave a non-significant yield and protein reduction in both Scepter and Catapult, suggesting the optimum nitrogen had already been applied to these varieties, for this season.

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

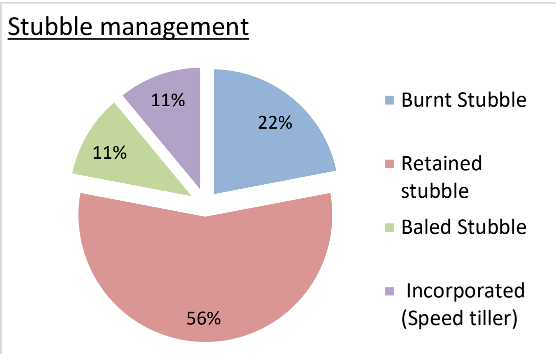


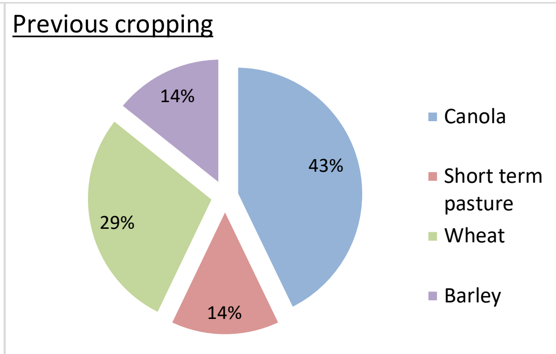
factors and compare it to other growers in their region.

The winner for the highest yield in WA in 2020 was Jon Beasley from Frankland River with a 6.2t/ha crop of Zen noodle wheat, sown after canola in May on a fertile paddock with grass/clover in the recent rotation.

Jon also won the award for the highest yield as a percentage of the potential yield. His crop of Zen wheat produced 70.3% of the 8.82 t/ha potential yield.

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





Agronomic Factor	Top 25% Award paddocks	Remaining 75%
Yield (t/ha)	5.8	4.2
N applied (kg N/ha)	129	107
Cost of N / tonne yield	$46/t	$57/t
Fungicides ($/ha)	$29	$18
Fungicides ($/t)	$4.8/t	$4/t
Number of applications	2	1
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 Dan Fay from SCF (0498 278177) for information about being part of this exciting project or to enter a wheat crop as a HYC award paddock in 2021.

Mark Lawrence, Farmanco Agronomist, Gunwarrie

Where to next with cereal production in the WA high rainfall zone? Bridging the yield gap - an agronomist's view

Notes:

Andrew Fletcher, Chao Chen, Jens Berger
(CSIRO)

What does crop modelling tell us about yield potential in this region of the HRZ?

Key Points

- We simulated the impact of sowing long-season wheat varieties early in the HRZ of WA.
- We used APSIM and carried out simulations over 30 years at both Albany and Esperance.
- Current mid-spring varieties had maximum yields of ~ 4t/ha when sown in late May and June.
- If long-spring and winter wheat varieties were sown early median yields could be increased to 7 t/ha and 6t/ha at Albany and Esperance, respectively.

Introduction

One of the key research priorities identified by farmers in the HRZ is how to utilise early break opportunities. In particular the growers wanted to evaluate the potential for sowing long-season cereal varieties early to utilise the available growing season. Recent modelling and experimental research have demonstrated that early sowing systems could lift wheat yields across Australia by approximately 0.5t/ha. Furthermore, the HRZ of WA was where the predicted yield increases were greatest (1.5 to 2t/ha). In order to achieve these benefits matching sowing time with appropriate phenology so that flowering occurs at about the same time during a broad optimum is required. In the HRZ of WA the optimum flowering period is between mid-September to mid-October. It is impossible to discuss early sowing without also discussing cultivar duration and flowering time, because of the associated frost risk if flowering occurs before the optimal window and terminal drought and heat risk if it is too late. Therefore, we present the results for both flowering time and yield in response to cultivar choice and sowing date. In most parts of the wheatbelt cereal yield potential is related to seasonal rainfall. We therefore relate observed yields to seasonal rainfall.

Simulations are a vital tool to explore these issues that compliment the field trials. **Field trials are of course the best test of what is realistically possible.** However, they can only test a small number of treatments and are limited to the rainfall patterns experienced in that season. Thus, the simulations here allow us to test the outcomes of a wider range of possible sowing time/ variety combinations and explore the implications of a wider range of seasons.

Although sowing early with long-season wheat varieties is a likely option to improve cereal yields, early sowing opportunities do not always occur. Therefore, we have also done a climatological analysis to investigate the likelihood of an early sowing opportunity in the HRZ. Our analysis focuses on the two sites where field experiments were grown in 2020 (Albany and Esperance).

So what did we do?

Simulations of wheat yield potential in response to sowing date and variety

APSIM wheat simulations were run for two sites: Albany and Esperance. These represented the two sites used in 2020 for the cereals field experiments. Soils were chosen based on an estimate of the local soil at each site.

Simulations were run for 30 years (1990-2019) using sowing dates at five-day intervals from 22nd March to 30th June in each year. At each sowing date we applied 5mm of irrigation to ensure that germination occurred on that date in the simulation. Apart from ensuring germination in the model, this 5mm of water was unlikely to have affected final yield.

We used five different wheat genotypes in the simulation (Table 1). These represented typical WA wheat phenology and explored the use of winter wheat genotypes which are not currently widely used. We did not have cultivar parameter for all the current wheat varieties. So, we used analogue varieties already available in APSIM that had similar flowering times (vernalisation and photoperiod responses) as surrogates (Table 1).

Table 1. Wheat variety parametrisations used in simulations and the varieties they represent.

Type	Varieties	Variety used in simulations to represent these
Mid-Spring	Mace, Scepter	Wyalkatchem
Long spring	Catapult	Trojan
Long Spring	Pascal	Gregory
Short winter	Illabo	Wedgetail
Mid winter	Accroc, Anapurna	Revenue

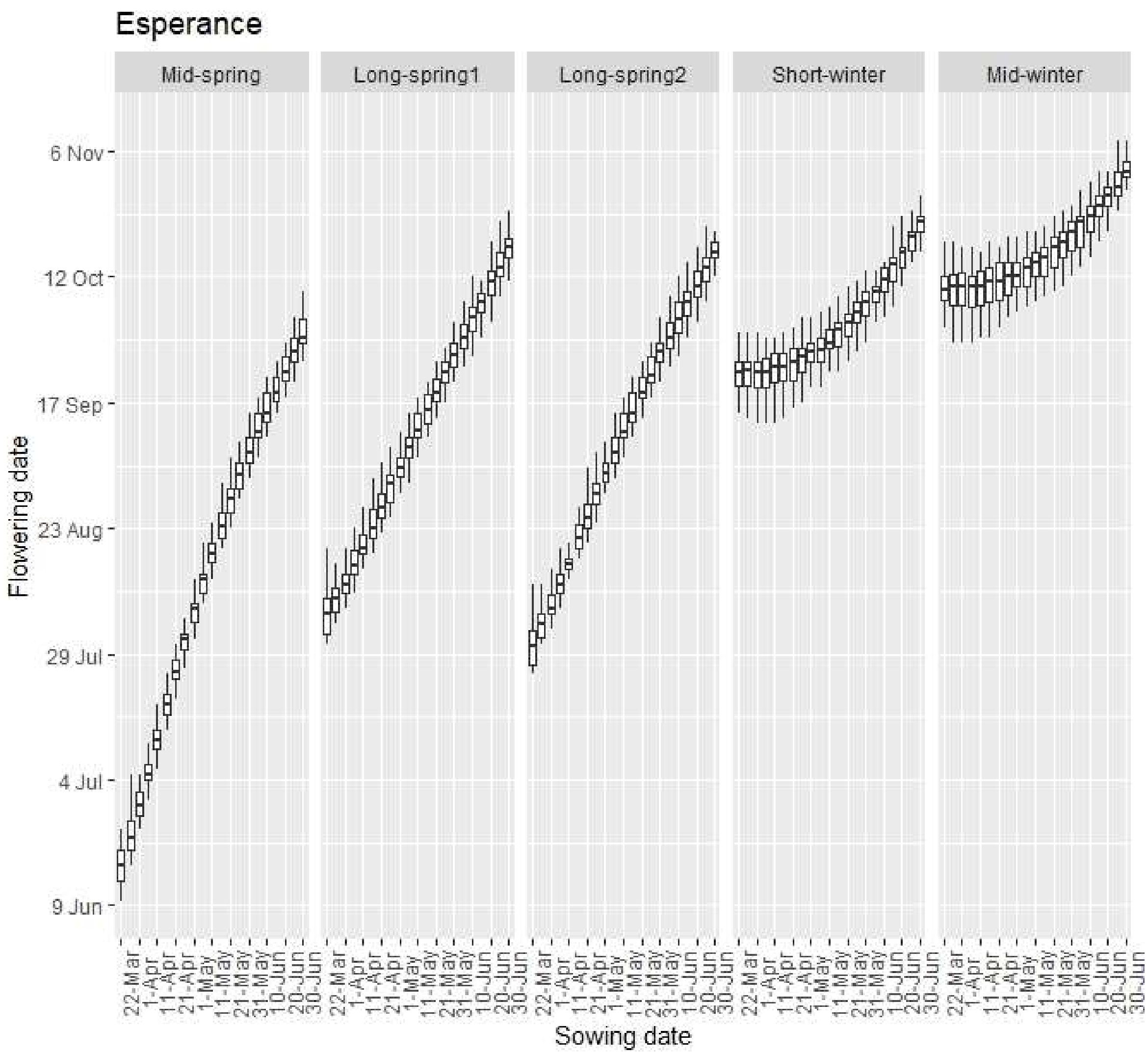
Simulations were set up so that N was not a limiting factor. Therefore, the simulations represented yield potential. APSIM does not explicitly account for the impact of frost and heat. Therefore, we applied correction factors to the simulated yields to account for these events. For each simulation we recorded yield (frost/heat adjusted), biomass, flowering date, harvest date, and plant available soil water at sowing and harvest.

Results & discussion

Flowering time in response to sowing time

At both sites as sowing time was delayed flowering time was also delayed. However, the extent of flowering delay was conditional on variety choice: as variety phenology becomes later, their flowering responsiveness reduces. Thus, when the mid-spring variety was sown in late March flowering occurred at approximately 16-18 Jun. This was far too early to flower due to frost and also an inability to use the full season. This explains the low yield of this genotype when sown early (Figure 1). As sowing was delayed there was a delay in flowering date, such that when sown in June flowering date was mid-September to early October.

In contrast, the flowering time of the two winter varieties was later and far less responsive to sowing date. When sown in late March the median flowering date was 21 September for the short winter wheat and 8-11 October for the midwinter wheat, respectively. This helps to explain the higher yields of these two varieties when sown early. Flowering occurred somewhere near the optimum time and the crop was able to make full use of the growing season. When sowing was delayed until June median flowering date was delayed until late October to early November for the two winter wheats which were too late for high yields as the effects of drought and heat became limiting.



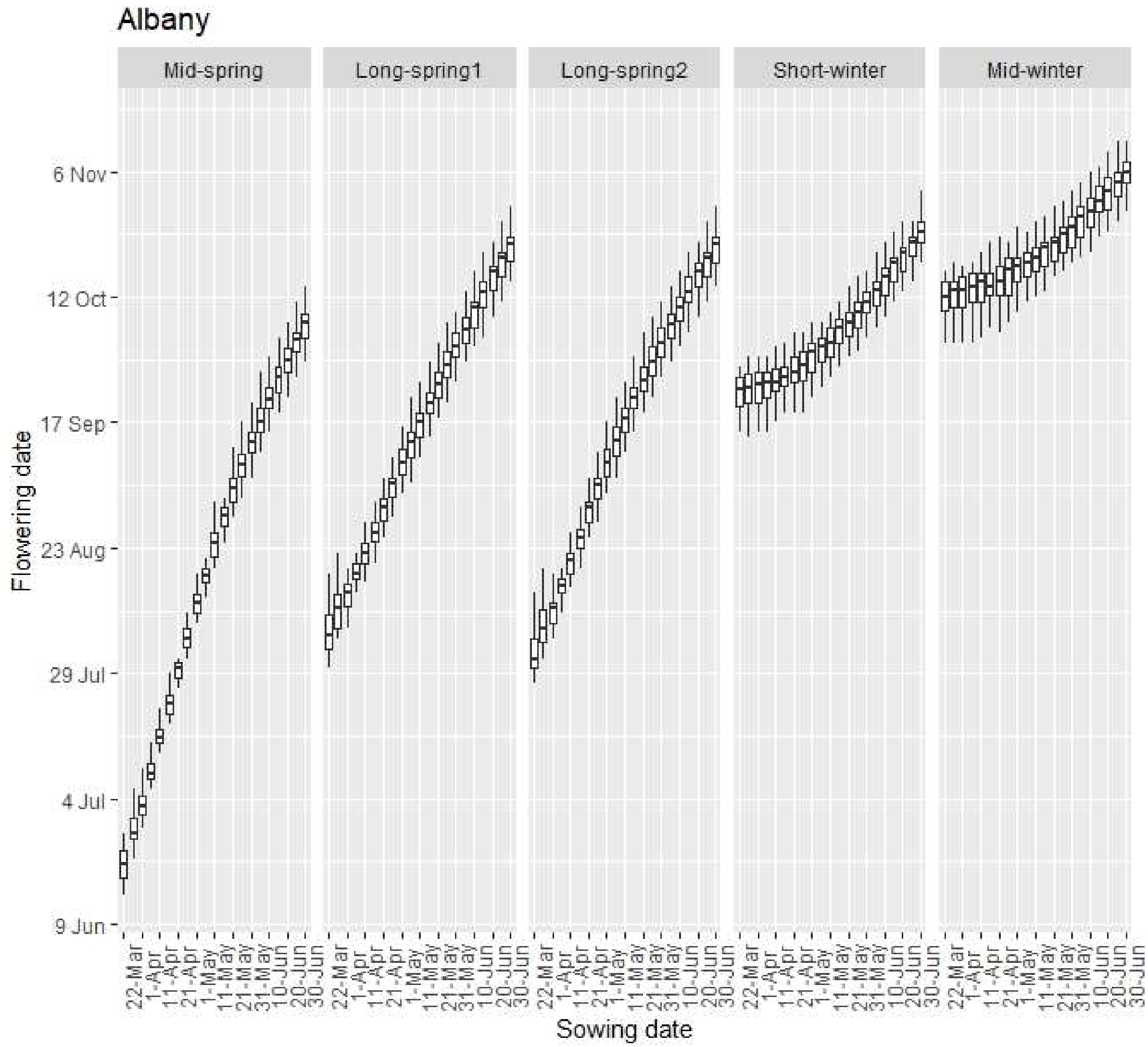


Figure 1. *Simulated flowering dates for wheat in response to sowing date at both Esperance and Albany.*

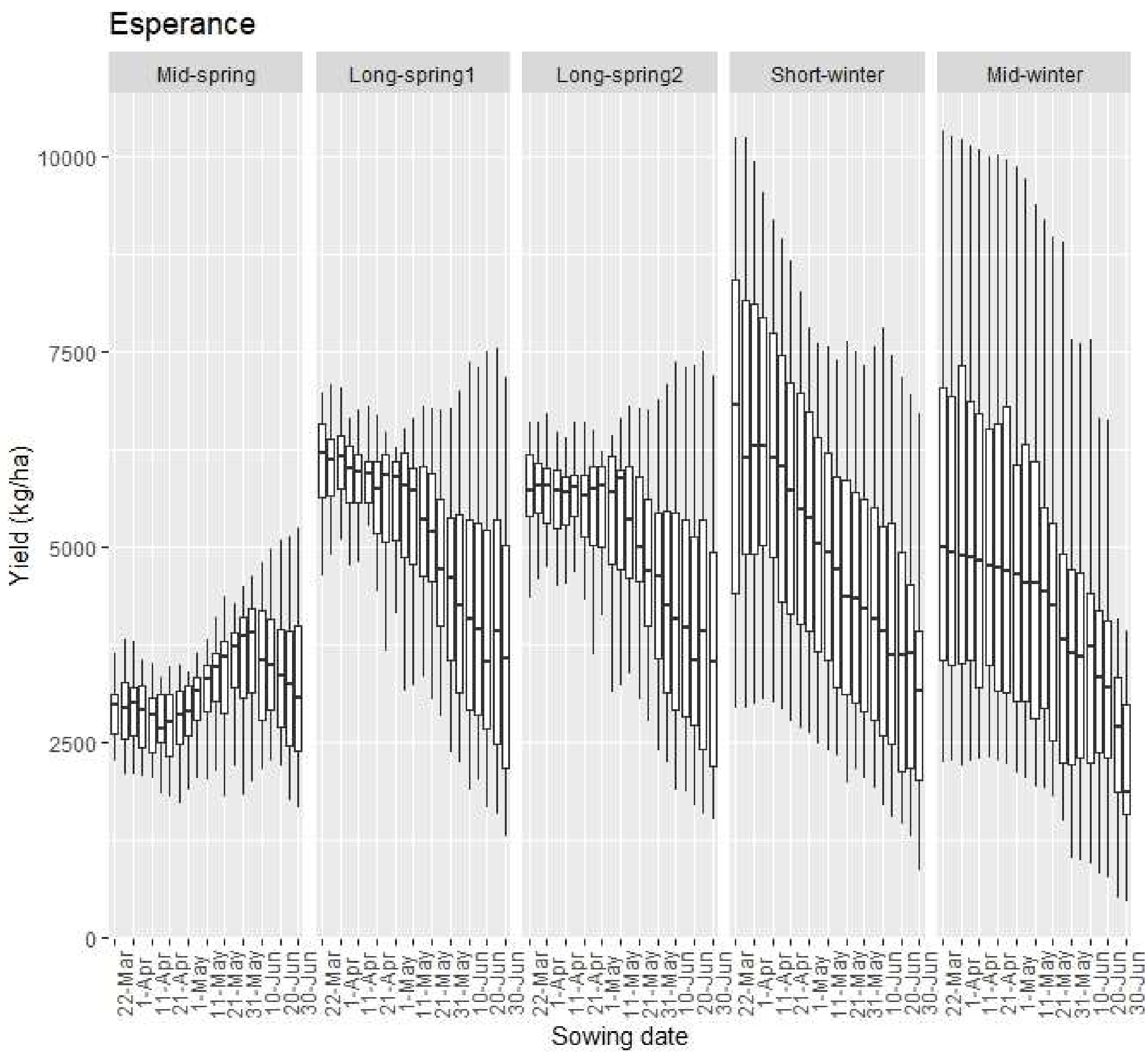
Yield in response to sowing date

The flowering-sowing response curves drive completely different yield responses in early and late wheat cultivars (Fig. 2). Thus, early spring varieties tend to have a more stable, lower yield potential with different sowing optima than the later varieties. At the Albany site, when the mid-spring variety was sown early the median yield was approximately 2.5 – 3 t/ha. As sowing was delayed past late April-early May the simulated yield steadily increased to an optimum of approximately 4 t/ha when sown on the 31st of May. Further delays did not increase yield further.

The yield of the long-spring varieties was 5 t/ha when sown anytime between late March and 16 May at Albany; and 6 t/ha when sown anytime between late March and 6 May at Esperance. Further delays in sowing lead to progressive declines in simulated yield.

In contrast, the yields of the winter wheat varieties were much higher when sown in late March and April at Albany. Median yields of the short winter wheat were nearly 7 t/ha when sown in late March and median yield of the mid-winter variety was 5.5t/ha. However, in the best years yields as high as 9 t/ha were achieved with the winter wheat varieties.

In contrast, at Esperance the median yields of the winter wheat varieties were no greater than the long-spring varieties when sown early. However, they were much more variable which meant that they were able to capture the higher yielding seasons better, but this occurred at the cost of lower yield in the poor seasons. Yields as high as 10t/ha were possible in the best years with winter types sown early.



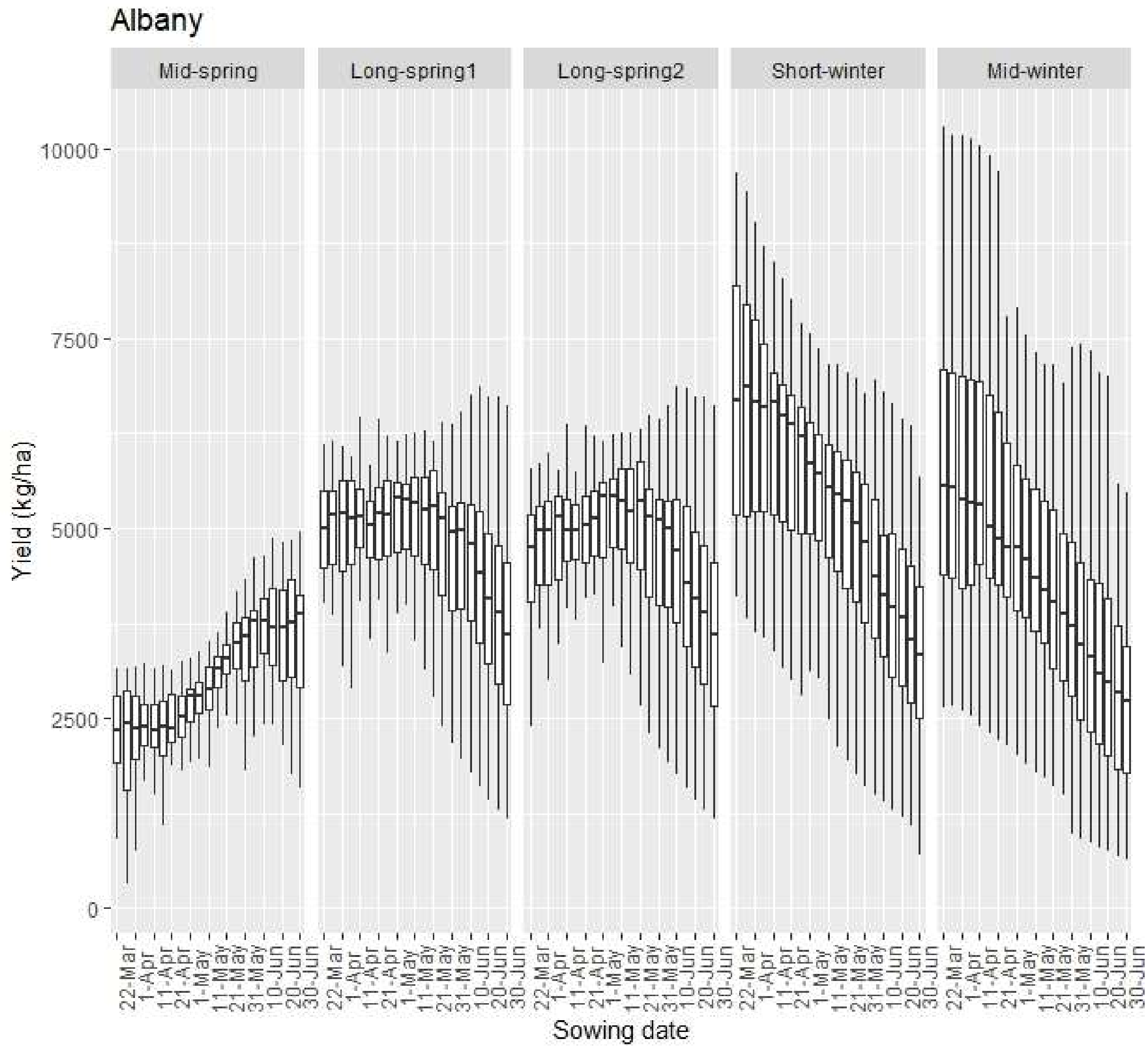


Figure 2. *Simulated grain yields for wheat in response to sowing date at both Esperance and Albany.*

The results of these simulation highlight the potential to dramatically increase wheat yield potential in the HRZ by combining early sowing with long-duration cultivars. However, an early sowing opportunity will not occur every year and farmers will need to be prepared with multiple cultivars to suit each season. These simulation results are all unlimited by weeds, diseases, pests and nutrition. We will need to pay particular attention to agronomy to reach these high yield potentials.

SOWING THE SEED FOR A BRIGHTER FUTURE

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