WA CROP TECHNOLOGY CENTRE (ESPERANCE)

Thursday 9 September 2021

FAR Australia Crop Technology Centre (Esperance Port Zone) Field Day
Featuring the GRDC's High Rainfall Farming Systems Project

Trial site courtesy of the Whiting family

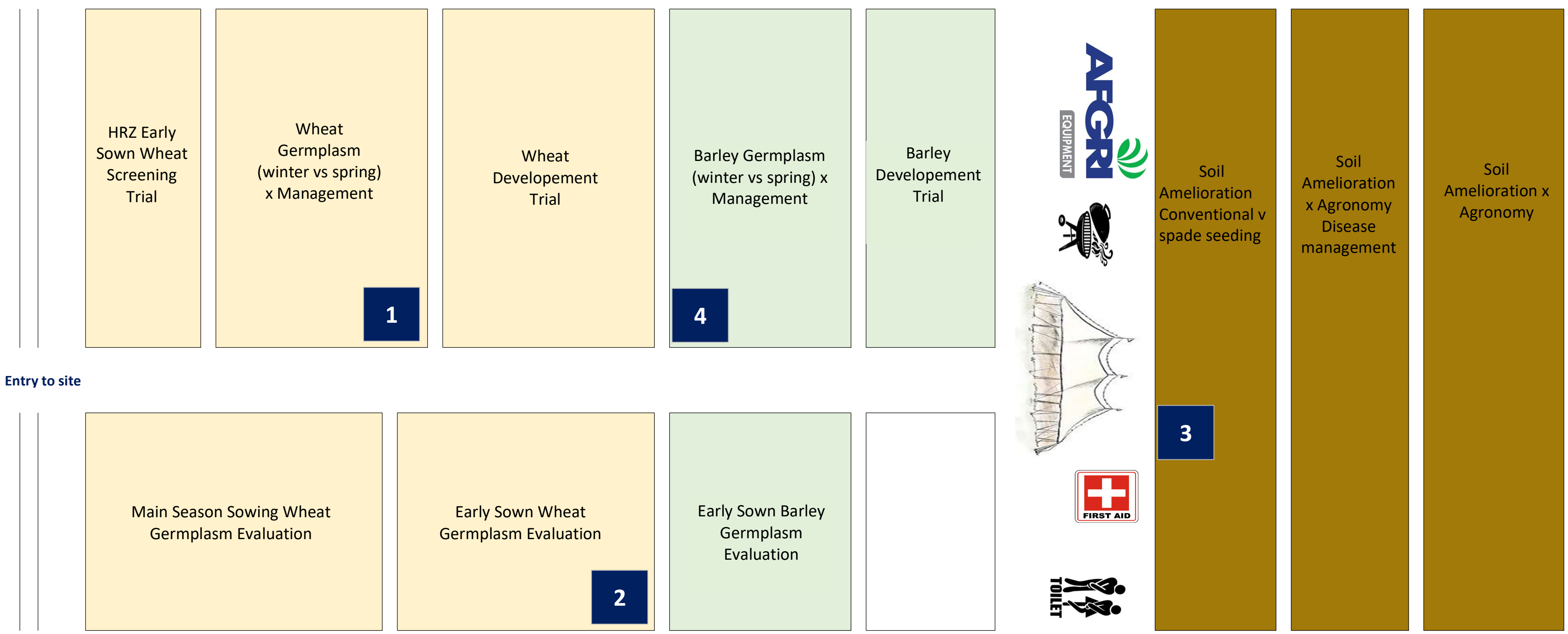
Event sponsor

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

WA CROP TECHNOLOGY CENTRE (ESPERANCE)

SITE MAP: WA CROP TECHNOLOGY CENTRE (ESPERANCE)

Featuring the GRDC's High Ranfall Zone Farming Systems Project



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WA CROP TECHNOLOGY CENTRE (ESPERANCE)

TIMETABLE

WA CROP TECHNOLOGY CENTRE FIELD DAY (ESPERANCE): THURSDAY 9 SEPTEMBER 2021

Featuring the GRDC's High Ranfall Zone Farming Systems Project

In-field presentations	**Station No.**	**11:00-12:15**	**12:30**	**1:15**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**
Jeremy Curry, DPIRD, Jens Berger, CSIRO and Bill Moore, Elders *HRZ Canola research results on nutrition and agronomy*	**Canola research site**		Lunch kindly sponsored by	Welcome and opening address					Closing address including Sam Stubna reporting on the SEPWA HRZ demonstratons followed by refreshments kindly sponsored by
Nick Poole, FAR Australia *Crop disease management - what have we leant so far?*	**1**				1			2	
Jens Berger, CSIRO What does crop modelling tell us about our yield potential in the region?	**2**				2	1			
Quenten Knight, Agronomy Focus, Con Murphy, Warakirri Farming and Michael Whiting, host farmer Where to next with WA HRZ production? A grower and adviser persepctive.	**3**					2	1		
James Rollason, FAR Australia and Jeremy Curry, DPIRD Wheat and barley germplasm for mid-April sowing.	**4**						2	1	
In-field presentations	**Station No.**	**11:00-12:15**	**12:30**	**1:15**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**

3.30pm - 3.45pm:
Closing address including Sam Stubna reporting on the SEPWA HRZ demonstratons.

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**

VISITOR INFORMATION

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

HEALTH & SAFETY

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

FARM BIOSECURITY

- Please be considerate of farm biosecurity. Please do not walk into farm crops without permission. Please consider whether footwear and/or clothing have previously been worn in crops suffering from soil borne or foliar diseases.

FIRST AID

- We have a number of First Aiders on site. Should you require any assistance, please ask a member of FAR Australia staff.

LITTER

- Litter bins are located around the site for your use; we ask that you dispose of all litter considerately.

VEHICLES

- Vehicles will not be permitted outside of the designated car parking areas. Please ensure that your vehicle is parked within the designated area(s).

SMOKING

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

Thank you for your cooperation, enjoy your day.

COVID-19

Help us keep COVID-19 away If you are visiting FAR Australia offices or trial sites by observing the following good hygiene practices to reduce the risk of infection with COVID-19:

- 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 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 (ESPERANCE) FIELD DAY

FEATURING HIGH RAINFALL ZONE FARMING SYSTEMS PROJECT

On behalf of the project team, I am delighted to welcome you to the 2021 WA Crop Technology Centre (Esperance) Field Day. This centre currently hosts the GRDC's High Rainfall Zone (HRZ) Farming Systems 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).

Today you will have an opportunity to look at the following:

- Different levels of nutrition and fungicide management in May sown wheat cv Scepter superimposed on commercial scale soil amelioration (deep ripping and spading).
- A comparison of early sown winter and spring wheat germplasm managed under different levels of management (mid-April sown).
- Screening trial assessing the phenology, standing power and disease resistance of earlier generation winter and spring wheat candidates sown in the early-mid April sowing window.
- Comparisons to wheat sown in the traditional May sowing window (sown 14th May).
- Winter versus spring barley – are there any shorter season winter barley candidates suitable for April sowing?

Speakers at today's event
The event will feature a range of research trial demonstrations in canola, barley and wheat and a line-up of speakers who will discuss various aspects of the climate effect on HRZ farming systems in WA, soil amelioration, 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, FAR Australia
Quenten Knight, Agronomy Focus
Con Murphy, Warakirri Farming
Jens Berger, CSIRO

Michael Whiting, Host Farmer
Bill Moore, Elder
James Rollason, FAR Australia
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 the GRDC's High Rainfall Zone Farming Systems Project, 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 project team would like to place on record their grateful thanks to the Grains Research & Development Corporation (GRDC) for their funding support for this event and featured project.

Other Acknowledgements

Thank you to our host farmers the Whitings for all their support throughout the season and to Brad Forrester and the team at AFGRI for sponsoring today's event.

What is the High Rainfall Zone Farming Systems project aiming to achieve and how did this project originate?

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 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

With regards to canola contact
Jens Berger from CSIRO (jens.berger@csiro.au) or
Jeremy Curry from DPIRD (jeremy.curry@agric.wa.gov.au).

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

2021 WA Cereal Research Programme

Gibson (Esperance Port Zone)

"Yonga", Lot 1427 Campbell Road, Gibson 6448 (GPS location of paddock -33.634943^0, 121.870484^0)

Courtesy of the Whiting family

The Esperance research site at Yonga, near Gibson presents a combination of small plot research and larger block research based on commercially established crops. This Esperance Port Zone location is the larger of two research sites, the other being near Frankland on a forest gravel soil type in the Albany Port Zone. At this site, replicated blocks of soil ameliorated soils have been over sown with commercial crop in the mid May sowing window. These commercial replicated blocks of crop are also being used to pursue superimposed small plot agronomy experiments looking at disease management, nutrition and herbicide strategy.

The trial site in Esperance is conducted on a sandy soil over clay into the canola stubble of the previous crop. The soil in the paddock was deep ripped to a depth of 800mm in summer 2019.

Trial 1. Wheat nutrition on ameliorated soils

Cultivar: Catapult

Objectives: To examine the influence of different soil amelioration treatments and establishment methods on the performance of mid-May sown wheat.

Individual objectives specific to the trial are:

- Assessing the establishment, yield and profitability of autumn 2021 deep ripping on a soil that was ripped in summer 2019.
- Comparing the establishment, yield and profitability of wheat when established with a tyne based seeder versus a spade seeder.
- Influence of spade seeding versus conventional tyne seeding on dry matter production, yield and harvest index.
- To examine the influence of additional nutrition (N, P & K) on the dry matter, yield and profitability of wheat established using three methods of establishment.

Trial 2. Wheat disease management on ameliorated soils

Cultivar: Catapult

Objectives: To examine the influence of different soil amelioration and establishment methods on the requirement for fungicide input in mid-May sown wheat.

Individual objectives specific to the trial are:

- Assessing whether different soil amelioration and establishment combinations have any influence on responsiveness of the crop canopy to disease management.
- To examine whether amelioration makes the use of more expensive QoI (Group 11) and SDHI (Group 7) more profitable than standard triazole (Group 3) chemistry.
- Does more regularly deep ripping and or spading increase green leaf retention and is this influence enhanced by the addition of so called stay green fungicides such as QoIs and SDHIs?

Trial 3. Early sown germplasm (winter v 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 (mid-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 mid-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 early.

Trial 4. Wheat early sowing germplasm screening trial – winter and spring (not taken to yield).

Objectives: To assess elite breeders' lines for early - mid April sowing opportunities.

Individual objectives specific to the trial are:

- Assessing the phenology, standing power and disease resistance of earlier generation winter and spring wheat candidates sown in the early-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 sown early.

Trial 5. Early season sowing wheat elite germplasm evaluation

Objectives: To assess the performance of wheat sown in the mid-April sowing window.

Individual objectives specific to the trial are:

- Assessing the phenology, standing power, disease resistance of commercially available spring wheat candidates sown in the mid-April sowing window.
- Although not statistically comparable to the late sown wheat blocks (10^{th} – 20^{th} May) the trial would compare the yield and profitability of mid-April sown crops grown alongside the later sowing.
- To compare the performance of feed and milling winter wheats sown early.

Trial 6. Main season sowing wheat elite germplasm evaluation

Objectives: To assess the performance of wheat sown in the traditional May sowing window (10^{th} – 20^{th} May).

Individual objectives specific to the trial are:

- Assessing the phenology, standing power, disease resistance of commercially available spring wheat candidates sown in the mid-May sowing window.
- Although not statistically comparable to the early sown wheat blocks (April 6^{th} – 16^{th}), the trial would compare the yield and profitability of May sown crops grown alongside the main blocks.
- To compare the performance of feed and milling winter wheats sown early.

Trial 7. Early sown barley germplasm (winter v spring) x management interaction trial

Cultivar: various

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

Individual objectives specific to the trial are:

- Assessing the phenology, dry matter production, yield and profitability of winter versus spring barley sown in mid-April.
- To examine the effect of defoliation in winter and spring barley on dry matter removed, final dry matter, phenology, grain yield and profitability.

Trial 10. Early season sowing barley elite germplasm evaluation

Objectives: To assess the performance of barley sown in the mid-April sowing window

Individual objectives specific to the trial are:

- Assessing the phenology, standing power, disease resistance of commercially available spring barely candidates sown in the mid-April sowing window.

Frankland (Albany Port Zone)

"Gunwarrie", 411 Gunwarrie road, Frankland River 6396, WA
(GPS location of paddock -- 34.330454°, 117.240896°)

Courtesy of Kellie Shields and Terry Scott
The trial site is conducted on a forest gravel into a canola stubble.

The research programme at this site repeats some of the research proposed for Esperance but with the focus on late April sowing. Two trials have been pursued that allow the research team to compare the economics of winter and spring germplasm sown in the traditional ANZAC day sowing window.

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

Cultivar: various
Objectives: To assess a comparison of late April sown winter and spring wheat germplasm managed under different levels of management.

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 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.


GROWING WITH
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Esperance Crop Technology Centre

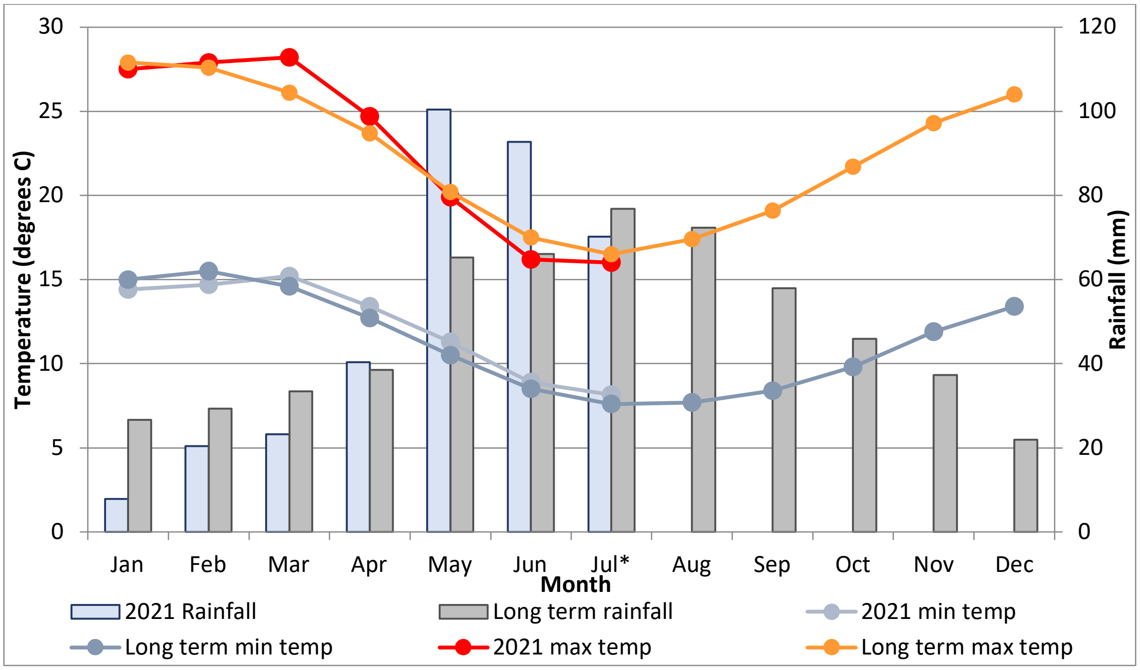


Figure 1. 2021 yearly rainfall so far (as of 27 July) and long-term rainfall (1950-2021) (recorded at Esperance Aero), 2021 min and max temperatures and long-term min and max temperatures (1950-2021) (recorded at Esperance Aero). *Rainfall April to July 28th= 303.8.0mm (Decile 9).*

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

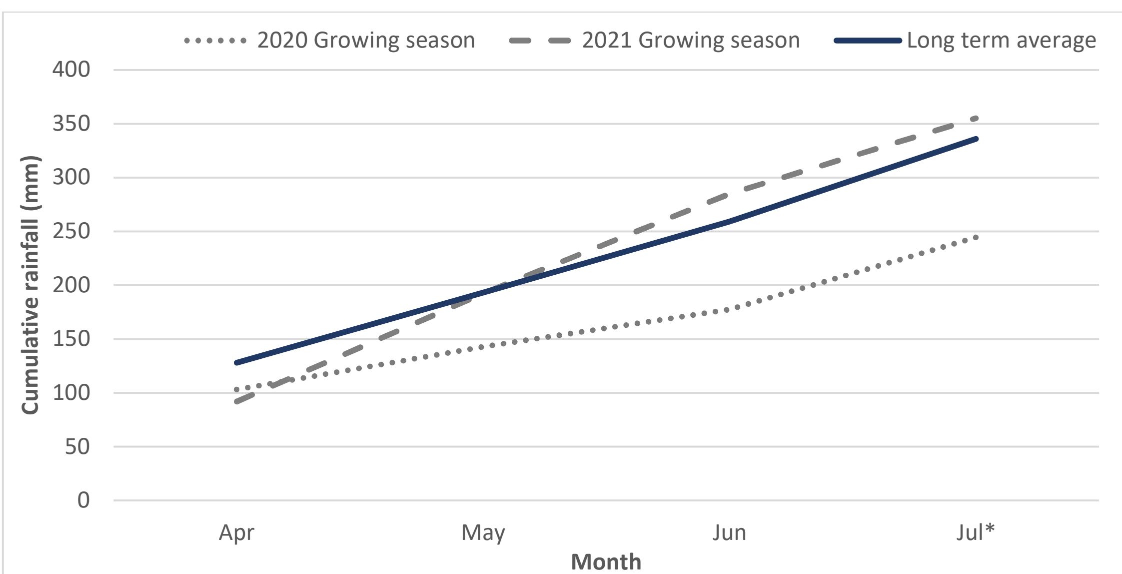


Figure 2. Cumulative growing season rainfall for 2020, 2021 and the long-term average for the growing season.

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):

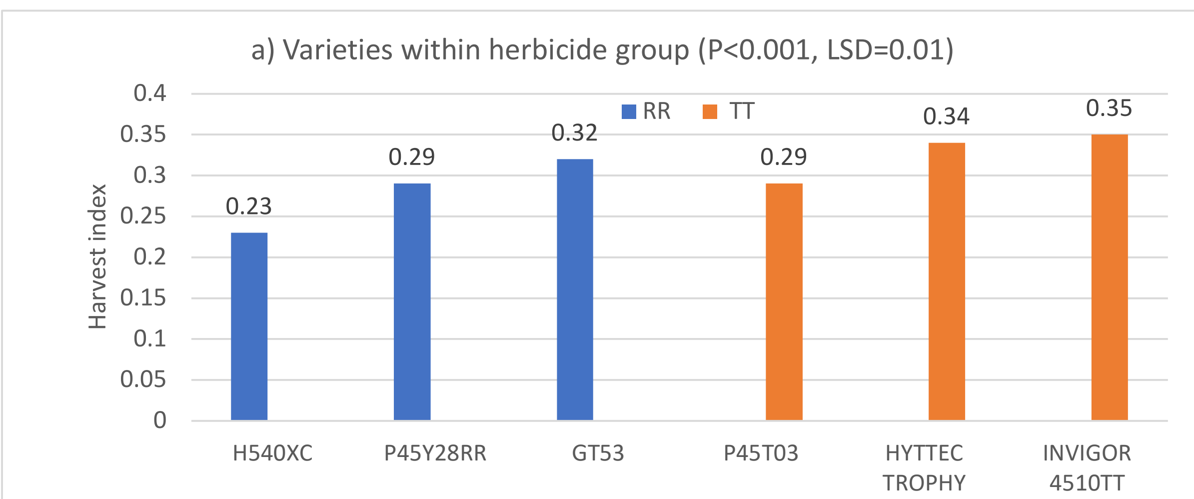
- High yield: GT 53RR, P45Y28RR, Invigor 450TT, Hytech Trophy TT (3.5-3.9 t/ha, averaged across all treatments-individual treatment means in Table 1)
- Low low yield: H540XC RR, P45T03 TT (2.7-2.9 t/ha)

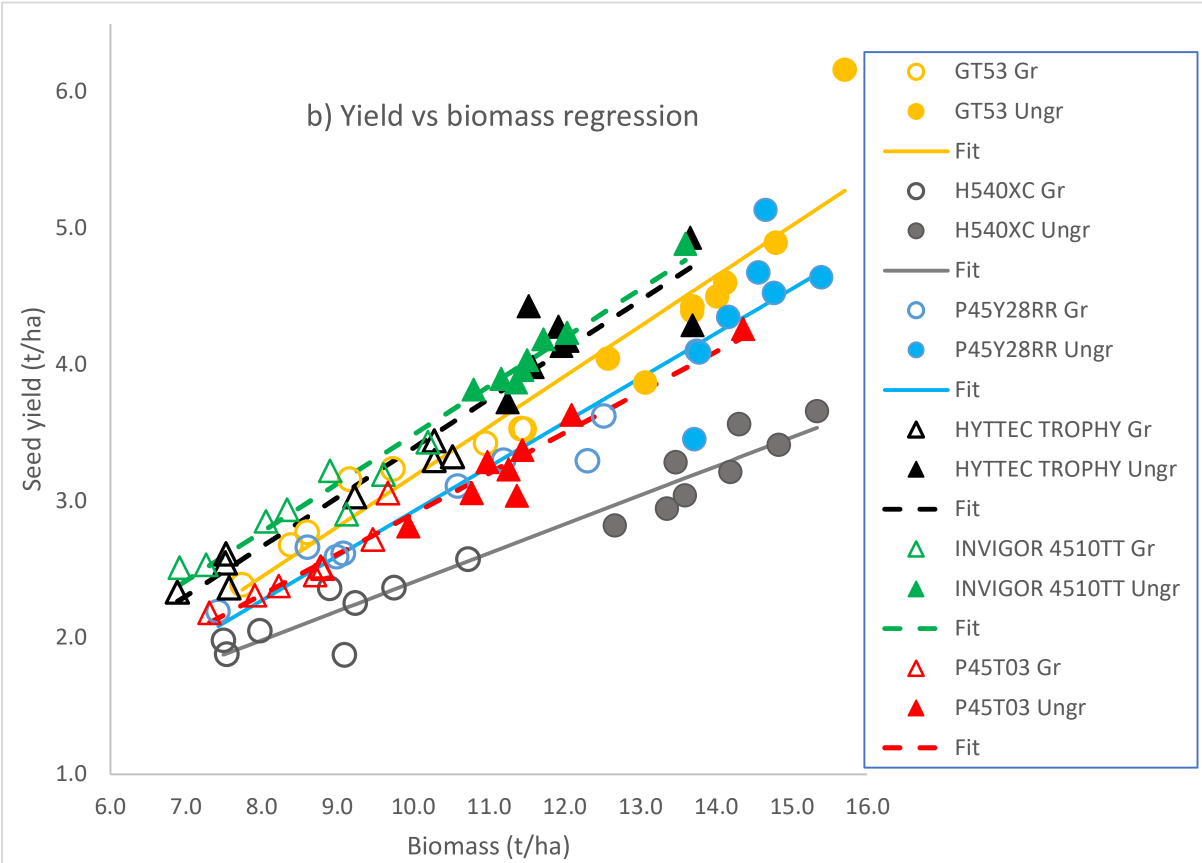
Harvest index differences were dominated by genetics and its interaction with agronomy. Harvest index in Roundup Ready was lower than TT canola (P<0.001) but there were important varietal differences and interactions within these 2 groups (Fig. 1a):

- 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 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:

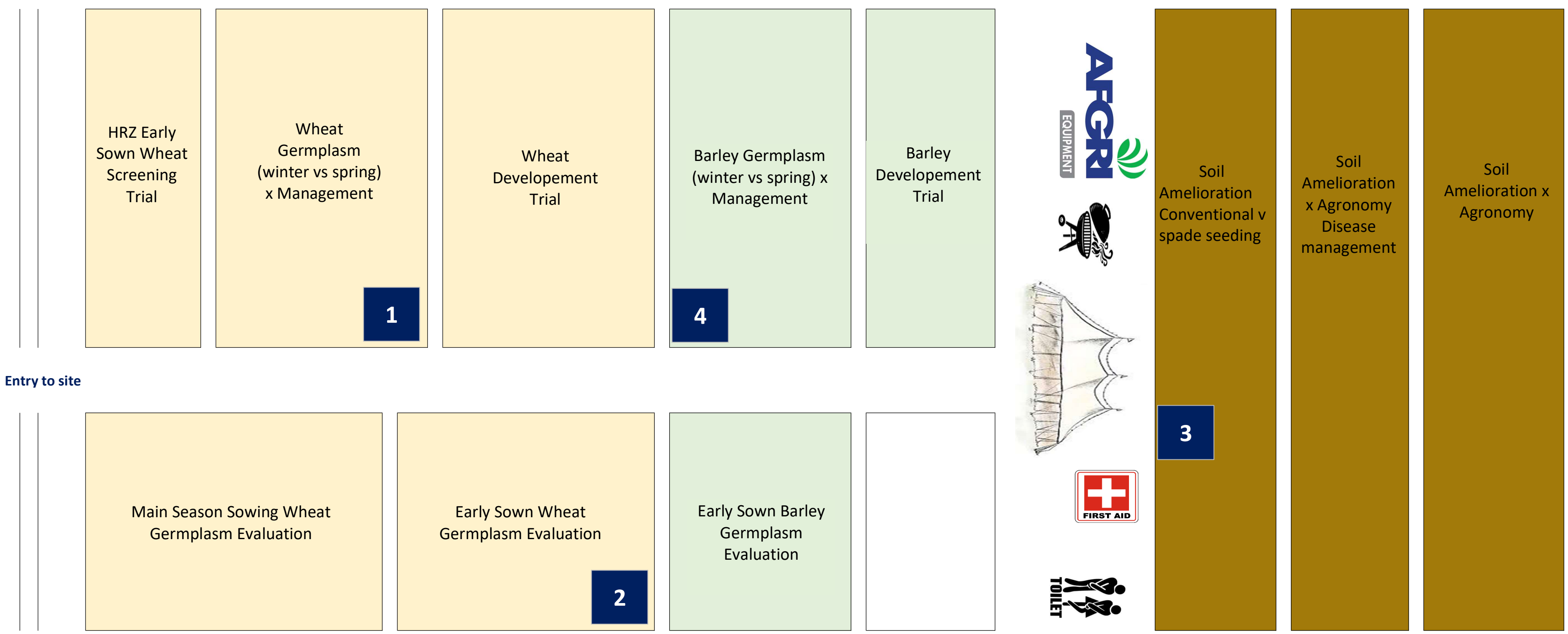
Table 2. *Soil test results taken at seeding at 10cm incremental depths.*

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%

WA CROP TECHNOLOGY CENTRE (ESPERANCE)

SITE MAP: WA CROP TECHNOLOGY CENTRE (ESPERANCE)

Featuring the GRDC's High Ranfall Zone Farming Systems Project



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WA CROP TECHNOLOGY CENTRE (ESPERANCE)

TIMETABLE

WA CROP TECHNOLOGY CENTRE FIELD DAY (ESPERANCE): THURSDAY 9 SEPTEMBER 2021

Featuring the GRDC's High Ranfall Zone Farming Systems Project

In-field presentations	**Station No.**	**11:00-12:15**	**12:30**	**1:15**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**
Jeremy Curry, DPIRD, Jens Berger, CSIRO and Bill Moore, Elders *HRZ Canola research results on nutrition and agronomy*	**Canola research site**		Lunch kindly sponsored by AFGRI Equipment	Welcome and opening address					Closing address including Sam Stubna reporting on the SEPWA HRZ demonstratons followed by refreshments kindly sponsored by AFGRI Equipment
Nick Poole, FAR Australia *Crop disease management - what have we leant so far?*	**1**				1			2	
Jens Berger, CSIRO What does crop modelling tell us about our yield potential in the region?	**2**				2	1			
Quenten Knight, Agronomy Focus, Con Murphy, Warakirri Farming and Michael Whiting, host farmer Where to next with WA HRZ production? A grower and adviser persepctive.	**3**					2	1		
James Rollason, FAR Australia and Jeremy Curry, DPIRD Wheat and barley germplasm for mid-April sowing.	**4**						2	1	
In-field presentations	**Station No.**	**11:00-12:15**	**12:30**	**1:15**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**

3.30pm - 3.45pm:
Closing address including Sam Stubna reporting on the SEPWA HRZ demonstratons.

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**

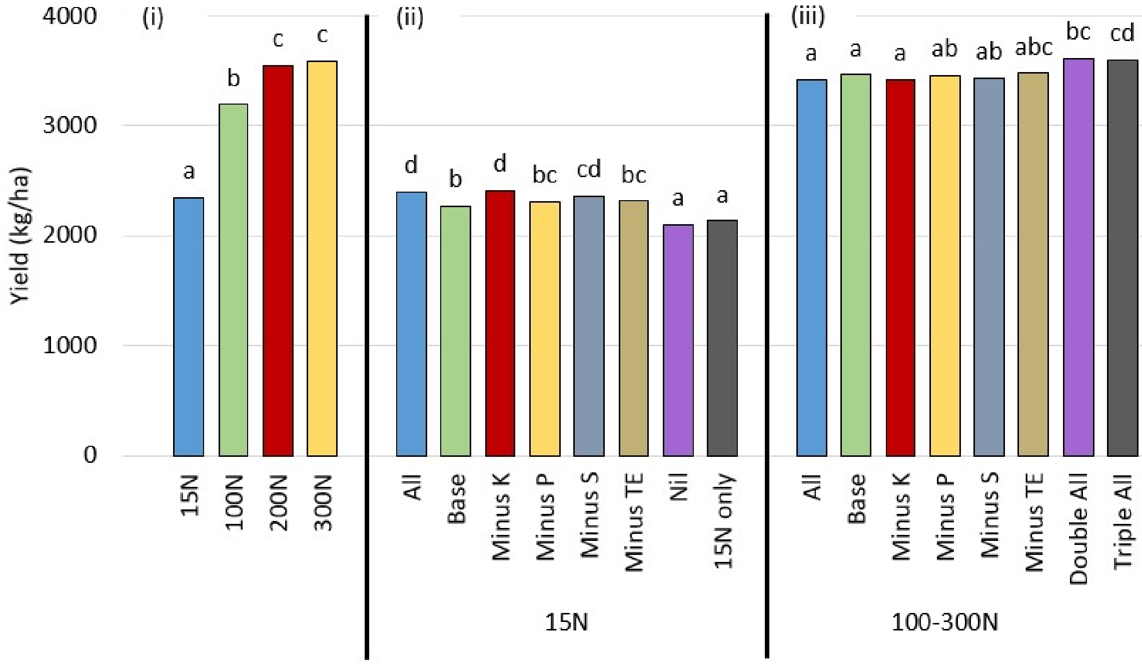

Figure 1. *Grain yield (i) averaged across N rates, (ii) at eight nutrition treatments at the 15N rate, and (iii) at eight nutrition treatments averaged across the 100-300N rates. Different letters denote values are significantly different.*

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.

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:

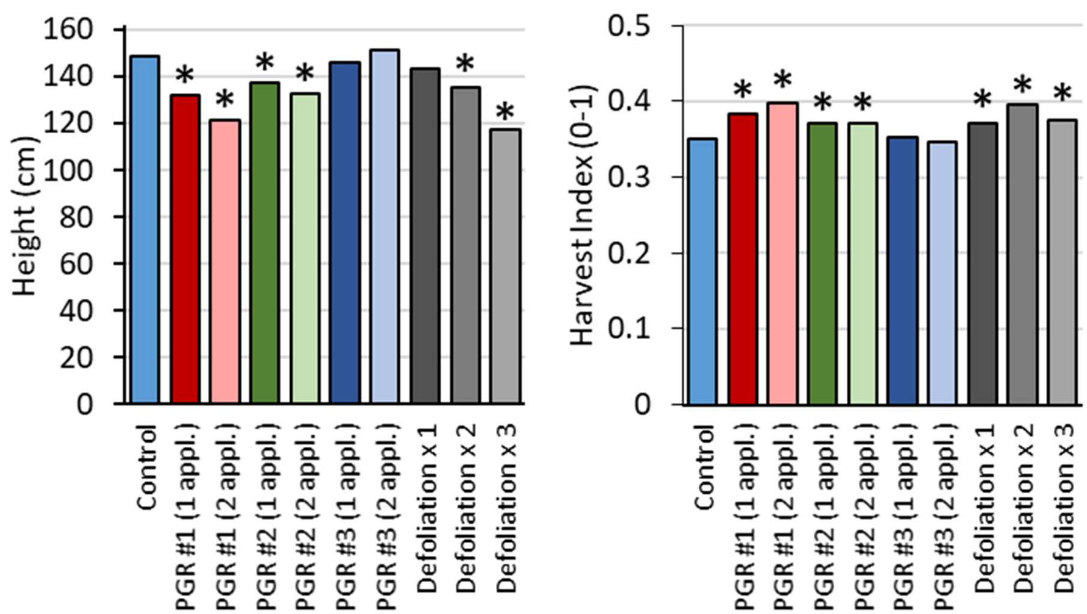

***Figure 1**. Height (cm) and harvest index (ratio of yield to total biomass produced) at maturity. Asterisk indicates value is significantly different to the control.*

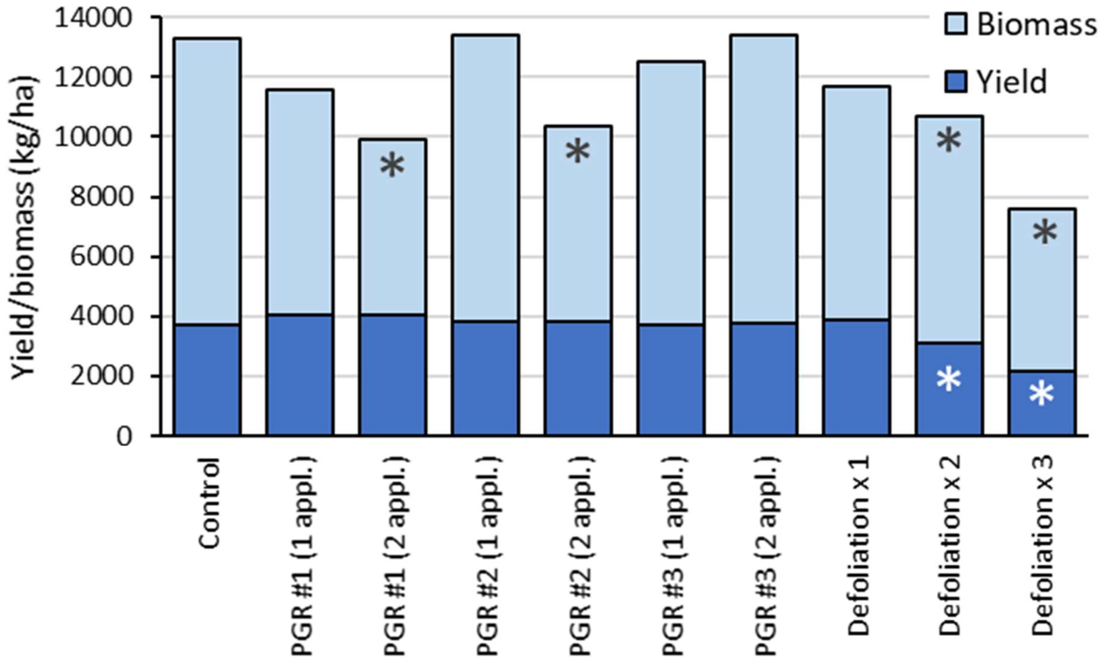

Figure 2. *Yield (dark blue, kg/ha) and biomass (light blue, kg/ha) of the canopy manipulation treatments at Gibson in 2020. Asterisk indicates value is significantly different to the control.*

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).

***Nick Poole*[1]*, Tracey Wylie*[1]*, Darcy Warren*[1]*, Kat Fuhrmann*[1]*, Aaron Vague*[1]*, Ben Morris*[1]*, Tom Price*[1]*, Kenton Porker*[1]*, Greta Duff*[2]*, Rohan Brill*[3]** *and* ***Kylie Ireland*[4]**
[1]Field Applied Research (FAR) Australia, [2]Southern Farming Systems (SFS), [3]Brill Ag.
[4]Australian Fungicide Resistance Extension Network (AFREN)

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.

Investment Acknowledgement: *FAR Australia gratefully acknowledges the investment of the Grains Research and Development Corporation (GRDC) for the AFREN and Hyper Yielding Crops Project which are both national initiatives.*

Collaborating Partners Acknowledgement
FAR Australia gratefully acknowledges the support of all of its research and extension partners in Hyper Yielding Crops project. These are CSIRO, the Department of Primary Industries and Regional Development (DPIRD) in WA, SA Research and Development Institute (SARDI), Brill Ag, Southern Farming Systems (SFS), Techcrop, the Centre for eResearch and Digital Innovation (CeRDI) at Federation University Australia, MacKillop Farm Management Group (MFMG), Riverine Plains Inc and Stirling to Coast Farmers.

We would also like to acknowledge the work of our co-workers and collaborators in AFREN, in particular Dr Fran Lopez from the Centre for Crop and Disease Management (CCDM).
For more information on AFREN and fungicide resistance – Contact:
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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

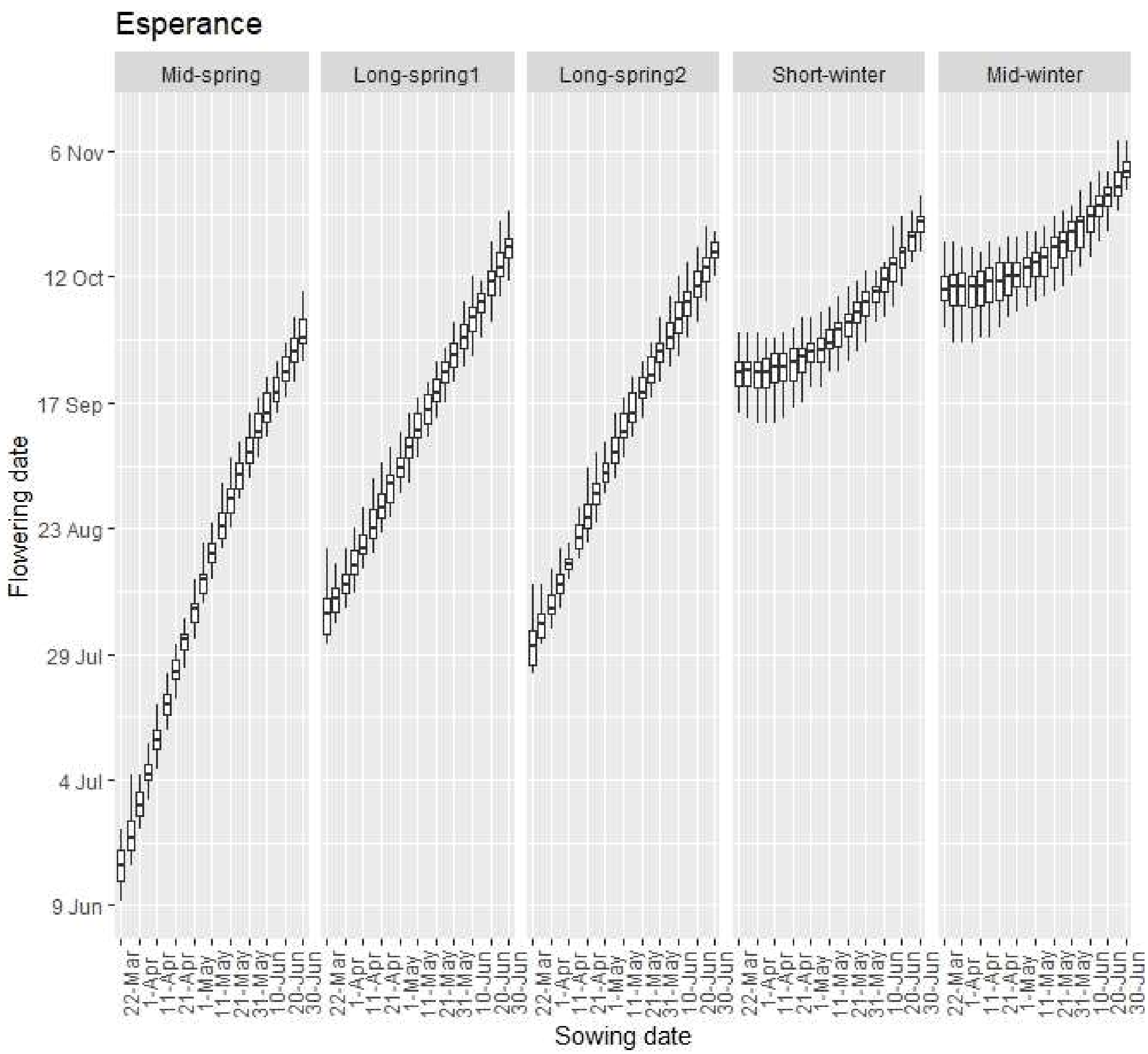
Simulations were set up so that N was not a limiting factor. Therefore, the simulations represented yield potential. APSIM does not explicitly account for the impact of frost and heat. Therefore, we applied correction factors to the simulated yields to account for these events. For each simulation we 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.



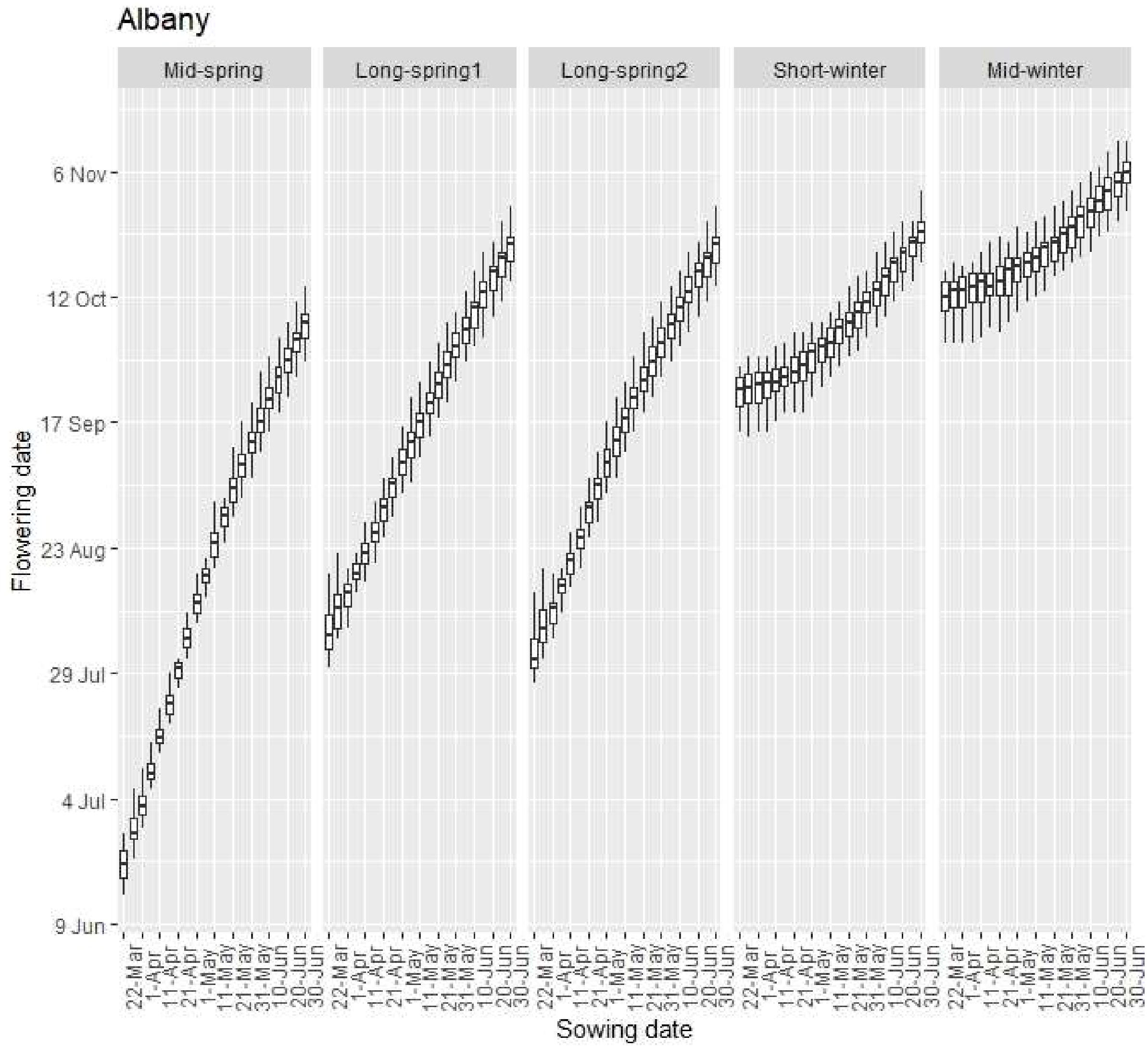


Figure 1. *Simulated flowering dates for wheat in response to sowing date at both Esperance and Albany.*

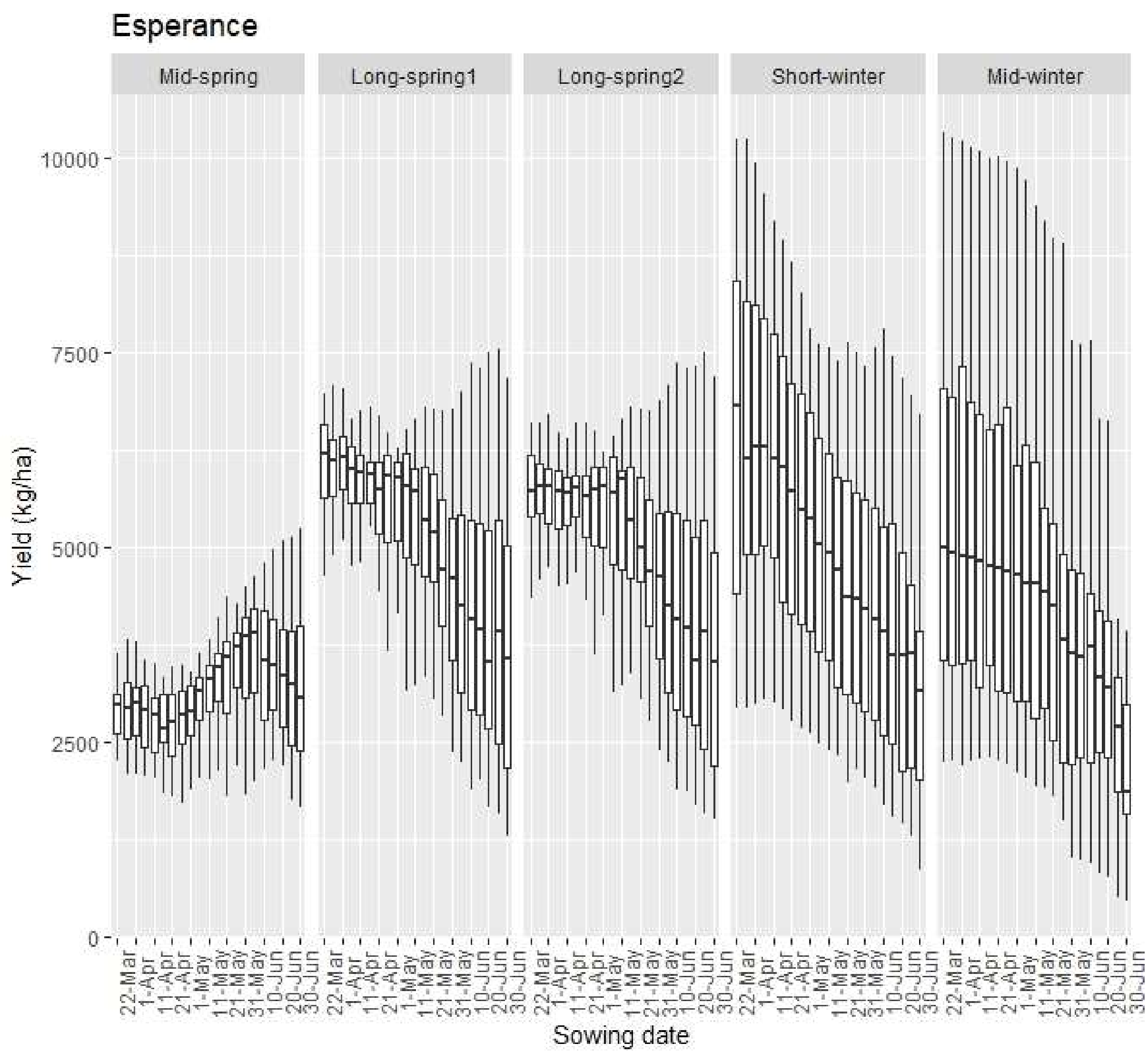
Yield in response to sowing date

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.



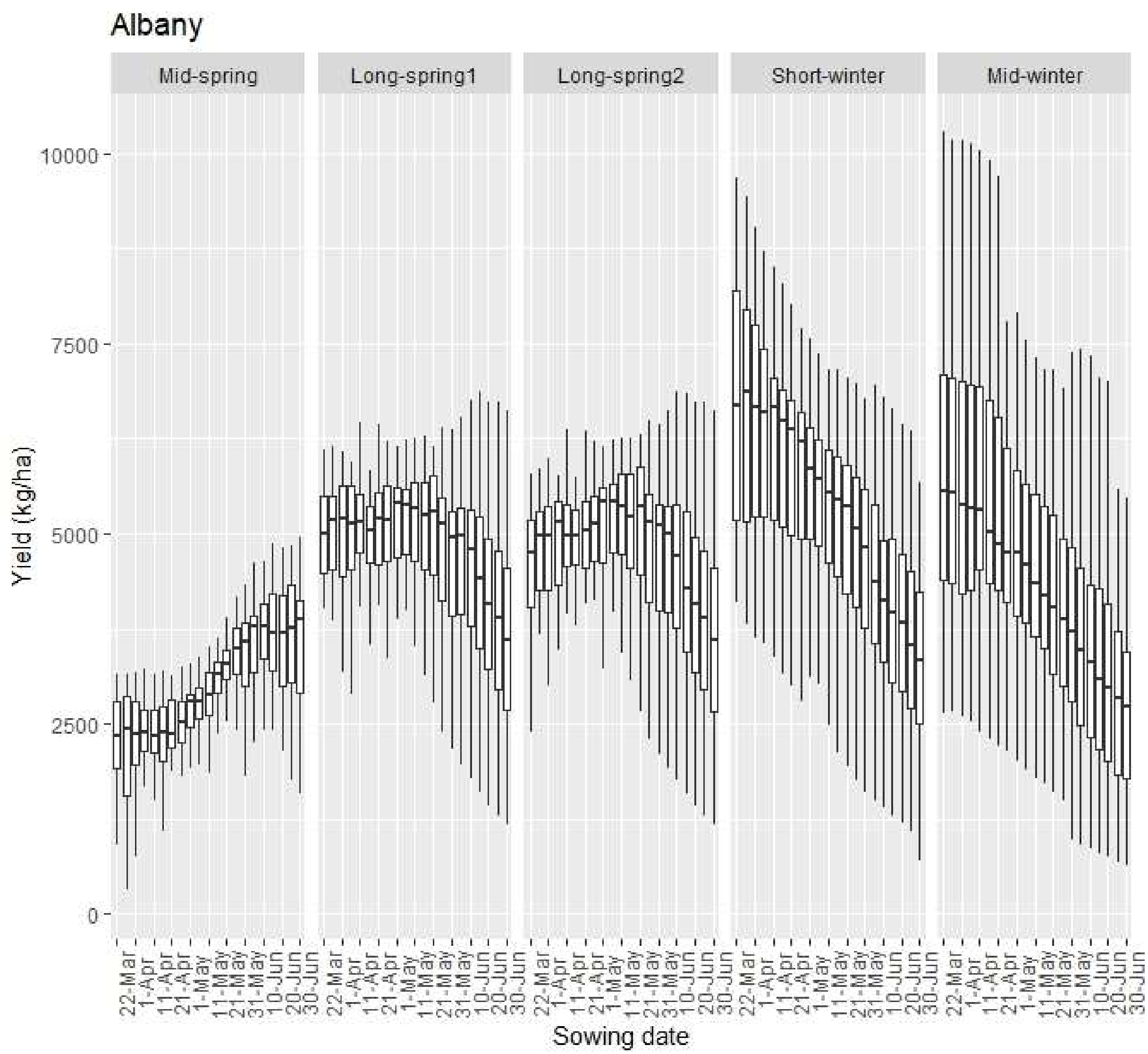


Figure 2. *Simulated grain yields for wheat in response to sowing date at both Esperance and Albany.*

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.

Quenten Knight[1], Con Murphy[2], Michael Whiting[3]
[1]Agonomy Focus, [2]Warakirri Farming, [3]Host Farmer

Where to next with WA HRZ Production> A grower and adviser perspective.

Notes:

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.

Acknowledgement

FAR Australia gratefully acknowledges the support of its research partners in the WA HRZ farming systems project. These are CSIRO and the Department of Primary Industries and Regional Development (DPIRD) that lead the project.

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