WA CROP TECHNOLOGY CENTRE (ALBANY)

FAR AUSTRALIA

Industry Innovations
leading the way to a brighter grains industry

FIELD DAY

INCREASING PRODUCTIVITY & PROFITABILITY IN THE ALBANY PORT ZONE

Thursday 19th September 2024

Thanks to the GRDC for investing in some of the research we will be discussing today

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Thanks to the following event sponsors:

DELTA AGRIBUSINESS

FRANKLAND Rural

SOWING THE SEED FOR A BRIGHTER FUTURE

Thanks to our host farmers: Kellie Shields, Terry Scott and the Gunwarrie team

VISITOR INFORMATION

We trust that you will enjoy your day with us at our WA 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 Australia staff.

FARM BIOSECURITY

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

FIRST AID

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

LITTER

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

VEHICLES

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

SMOKING

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

Thank you for your cooperation, enjoy your day.

INCREASING PRODUCTIVITY AND PROFITABILITY IN THE ALBANY PORT ZONE

FEATURING INDUSTRY INNOVATIONS

On behalf of myself and the FAR Australia team, I am delighted to welcome you to our 2024 WA Crop Technology Centre (Albany Port Zone) Field Day featuring Industry Innovations.

Industry Innovations (II) is a FAR Australia initiative which continues to engage with industry to provide innovative research solutions which are helping to create a more productive, profitable and sustainable future for the Australian grains industry. With our Crop Technology Centres (CTCs) operating nationally across the more productive growing regions of Australia, we provide the perfect platform to showcase new industry innovations, whether it be new crops, cultivars, agrichemicals, fertilisers or Ag technologies. More information on our Industry Innovations initiatives is available in the booklet.

Today will provide you with a unique 'seeing is believing' opportunity to experience the latest innovations in cereal germplasm, agronomy, and agrichemical usage. You will witness first-hand the impact of innovative treatments and techniques on enhancing crop performance and profitability.

Event Highlights:

- Cereal Trials: Explore a range of cereal trials featuring crops sown at different times, showcasing how timing can influence crop yields.
- Expert Presentations: Hear from industry leaders, who will share insights into the latest research and trends shaping the Australian grains industry.
- Interactive Discussions: Engage in group discussions on crucial topics such as fungicide management strategies and the future of crop profitability, particularly in light of the new GRDC Hyper Profitable Crops project.
- Innovative Research: Learn from the latest findings of the GRDC's Hyper Yielding Crops high rainfall zone project, and explore opportunities to enhance the use of winter germplasm in the lower to medium rainfall zones.

To make the programme as diverse as possible, I would like to thank all our speakers who have helped to put today's programme together; in particular our keynote speaker Rohan Brill who has made the trip over from NSW to join us today. Rohan is an agronomy researcher with Brill Ag, and without doubt one of the industry's most influential canola research agronomists.

Finally I would like to thank the GRDC for investing in some of the research that may be featured in today's programme, and also a big thanks to our host farmers Kellie Shields and Terry Scott, along with their team at Gunwarrie for their tremendous practical support given to our team, and to today's sponsors Delta Agribusiness and Frankland Rural.

Should you require any assistance today, please don't hesitate to contact a FAR Australia staff member. We hope you find the day informative, and as a result, take away new ideas which can be implemented in your own farming business.

Nick Poole Managing Director
FAR Australia

TIMETABLE

WA CROP TECHNOLOGY CENTRE FIELD DAY (ALBANY PORT ZONE)
THURSDAY 19 SEPTEMBER 2024

WA CROP TECHNOLOGY CENTRE (ALBANY)

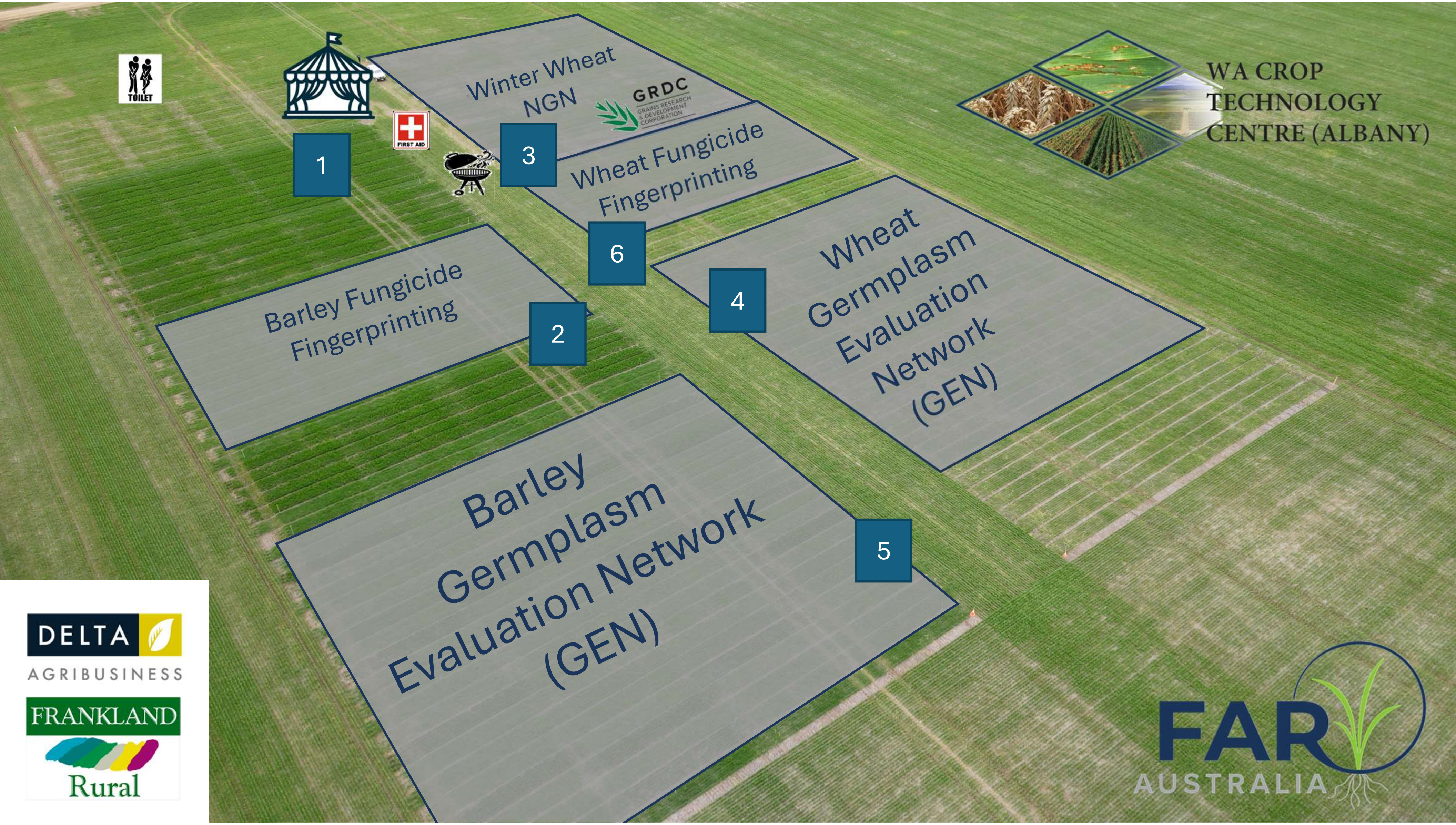
FAR AUSTRALIA

In-field presentations	Station #	12:30	1:15	1:30	2:00	2:30	3:00	3:30	4:00	4:30
Rohan Brill, Brill Ag (kindly sponsored by Frankland Rural) *Rohan answers the questions around what we have learned Hyper Yielding Crops in canola crops in WA, and do we reconsider the legacy effects of grain legumes in* FRANKLAND Rural	1	Lunch kindly sponsored by DELTA AGRIBUSINESS	Opening address by Nick Poole, FAR Australia's Managing Director followed by an introduction to the cereal research programme.	1	2					Closing address followed by refreshments kindly sponsored by DELTA AGRIBUSINESS
Ayalsew Zerihun *DMI* *and SDHI resistance in the net blotch pathogens of barley in WA. A guide for adjusting treatment programmes when resistance is increasing.*	2				1	2				
Nick Poole and Deep Das, FAR Australia *Given a wetter autumn what would early sown winter wheats have looked like sown in late March?* GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION	3					1	2			
Dr Ben Jones, FAR Australia *The physiology of winter germplasm – are there opportunities to make more use of this germplasm in the L-MRZ as well as the high rainfall zone?*	4						1	2		
Darcy Warren and Daniel Bosveld, FAR Australia *What did we learn in wheat and barley from WA cereal trials as part of the Hyper Yielding Crops project?* GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION	5							1	2	
Dan Fay, Stirlings to Coast Farmers and Nick Poole, Rachel Hamilton, FAR Australia *As the nation's economy moves to ways to reduce emissions, where do we stand with crop profitability in the port zone with our new GRDC Hyper Profitable Crops project?* GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION	6			2					1	
In-field presentations	Station #	12:30	1:15	1:30	2:00	2:30	3:00	3:30	4:00	4:30

For the in field presentations, we would be obliged if you could remain within your designated group number.

Thank you for your cooperation.

Group
1
2


Winter Wheat NGN
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
TOILET
FIRST AID
1
3
Wheat Fungicide Fingerprinting
6
Barley Fungicide Fingerprinting
2
4
Wheat Germplasm Evaluation Network (GEN)
Barley Germplasm Evaluation Network (GEN)
5
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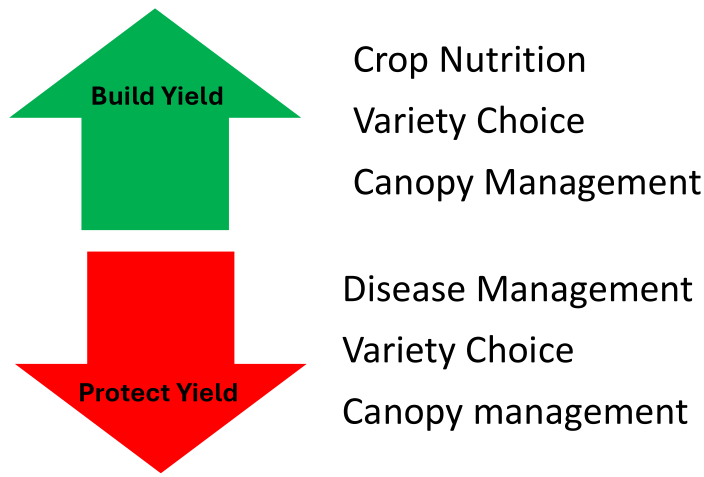
Management Factors for Hyper Yielding Canola

Rohan Brill, Brill Ag

Hyper Yielding canola research from 2020 to 2023 focussed on two aspects:

- Research and development to increase crop yield potential
- Research and development to protect crop yield potential



To increase crop yield potential, we focussed research and development on:

- Crop nutrition
    - Nitrogen rate and timing
    - Organic fertiliser input (e.g. chicken litter)
- Variety choice
    - Understanding the best varieties with the highest yield potential and the physiology behind these varieties
- Canopy management
    - Effects of plant population

To protect crop yield potential, we focussed research and development on:

- Disease management
    - Fungicide choice and timing
- Variety choice
    - Disease resistance
    - Standability
- Canopy management
    - Effect of plant populations on lodging.

The biggest achievement in the canola component of the project was showing that with strong fertility and the use of elite commercial canola cultivars, we could increase yield potential that growers can achieve. The trials showed that 6 t/ha of grain yield is possible in the Hyper Yielding Crops environments of Australia, with this being achieved at two sites in 2021 (Table 1). To achieve highest yield at individual trial sites over the four project years, there was consistency in the variety choice and nutrition required, for example:

- The highest yielding variety at 13/15 sites was a mid-season Pioneer Seeds hybrid. This included 45Y28 RR (Roundup Ready) in six instances and 45Y95 CL (Clearfield) in six instances.
- In two of the four seasons at Millicent in South Australia, the winter canola variety Captain CL was the highest yielding variety at the site, highlighting the difference in type of variety required in the long season Millicent environment.
- At 11/15 sites, the highest yielding treatments had animal manure (poultry or pig) or its inorganic fertiliser (N, P, K & S) equivalent applied.

The benefit of choosing the best variety and providing sufficient nutrition was evident by the difference between the highest and lowest yielding treatments at each site. This ranged from 1.0 to 3.7 t/ha.

Table 1: *Yield of the highest yielding treatment (predicted mean from 3 or 4 replicates) at each HYC canola site from 2020 to 2023; the variety grown and whether manure was applied to achieve this yield. The lowest yield from each site is also shown.*

Site	Season	Highest Yield (t/ha)	Variety	Manure Applied	Lowest Yield (t/ha)
Gnarwarre	2020	4.8	45Y28 RR	Yes	1.1
Millicent		4.5	45Y93 CL	Yes	2.6
Wallendbeen		5.4	45Y28 RR	No	3.6
Gnarwarre	2021	5.9	45Y28 RR	Yes	3.5
Kojonup		4.7	45Y28 RR	Yes	1.8
Millicent		6.5	45Y95 CL	Yes	3.3
Wallendbeen		6.4	45Y95 CL	Yes	3.5
Gnarwarre	2022	5.1	45Y28 RR	Inorganic Equivalent[1]	1.9
Kojonup		4.3	45Y95 CL	Yes	1.8
Millicent		4.6	Captain CL	No	2.0
Wallendbeen		4.8	45Y28 RR	No	2.9
Gnarwarre	2023	5.1	45Y95 CL	Yes	2.8
Kojonup		3.4	45Y95 CL	Yes	2.4
Millicent		5.7	Captain CL	No	2.5
Wallendbeen		4.3	45Y95 CL	Yes[2]	2.7

[1]Inorganic Equivalent had the same Nitrogen, Phosphorus, Sulfur and Potassium applied as synthetic fertiliser as what was contained in the animal manure treatment.
[2]Inorganic fertiliser equivalent yielded the same as the manure application.

Evolution of crop nutrition findings

The benefit shown by the application of animal manure (or its inorganic equivalent) highlights the need to fund a body of work over several seasons as new hypotheses can be developed and tested thoroughly. The use of animal manure in trials evolved over the course of the project and is in no way finalised.

The evolution included:

1. In 2020 and 2021 animal manure was used as a treatment to mimic a soil with high background fertility. In 2021 animal manure increased grain yield by 0.5 to 1.2 t/ha at all sites, over and above yields achieved where high rates of phosphorus and nitrogen were applied. Was the manure yield response due simply to its nutrient content or a more complex biological effect?
2. In 2022 the application of animal manure increased grain yield above where a high rate of N (300 kg/ha) was applied at Gnarwarre (Vic), Kojonup (WA) and Wallendbeen (NSW). Where the nutrient equivalent of manure was applied as inorganic fertiliser (including MAP, Urea, potash) yield increased even further at both Gnarwarre and Wallendbeen. This showed that the manure response is likely a nutrition response rather than a more complex biological response. But which nutrients were responsible for driving the yield response from manure?
3. In 2023 extra treatments were included at Wallendbeen to determine the nutrients responsible for the manure benefit. Manure and its inorganic equivalent yielded more than where 300 kg N/ha was applied (with 45 kg /ha P at sowing). When the phosphorus was subtracted from the inorganic equivalent treatment, grain yield dropped back to the same as where no manure was applied, suggesting at this site that the manure nutrition response was driven by phosphorus (Table 2).

Table 2: *Grain yield, oil, and protein concentration of 45Y95 CL canola with twelve different nutrition levels at Wallendbeen NSW, 2023.*

Treatment	Grain yield (t/ha)	Oil (%)	Protein (%)
Nil N	3.1	47.7	16.5
75 kg N/ha	3.5	46.8	17.5
150 kg N/ha	3.7	45.8	18.8
225 kg N/ha	3.8	45.5	19.5
300 kg N/ha	3.8	44.9	20.2
Nil N + 3 t/ha Chicken Manure*	3.2	47.7	16.5
225 kg N/ha + 3 t/ha Chicken Manure*	4.2	45.2	19.8
225 kg N/ha + Inorganic Nutrients	4.2	44.8	20.6
225 kg N/ha + Inorganic Nutrients – K	4.1	45.6	19.4
225 kg N/ha + Inorganic Nutrients – N	4.2	45.2	19.8
225 kg N/ha + Inorganic Nutrients – P	3.8	44.6	20.6
225 kg N/ha + Inorganic Nutrients – S	4.3	44.7	20.6
l.s.d. p=0.05	*0.22*	*0.60*	*0.80*
p value	*<0.001*	*0.002*	*<0.001*

*Dry basis. See Table 3 for detailed nutrient analysis of chicken manure.
Inorganic Nutrients: Application of inorganic fertiliser (Urea, single super, potash, MAP) to the equivalent NPKS rates supplied by 3 t/ha chicken manure.

Other aspects of crop nutrition

There was a focus on determining the nitrogen requirement of Hyper Yielding canola crops. From 2021 to 2023 consistent rates of N were tested (12 site year combinations). Key findings were:

- Response to nitrogen plateaued at an N rate of 75 kg/ha at eight of the 12 site year combinations.
- At the Gnarwarre sites, N response plateaued at 150 kg/ha in 2021 and 300 kg/ha in 2022 and 2023.

Apart from the Gnarwarre site (where N response was possibly amplified due to waterlogging in 2022 especially), overall nitrogen input required for high yield was lower than expected. The trials were often sown in soils with a high level of nutrition which meant that more nitrogen came from background fertility than from added fertiliser. Importantly, the average canola protein throughout the project was less than 19%, which means that, on average, there was ~29 kg N removed per tonne of grain removed. This is much less than industry 'rules of thumb' for N removal of 40 kg N per tonne of grain.

What are the characteristics of a Hyper Yielding variety?

The yield results showed consistent high yields from the Pioneer mid-season hybrid varieties. At Wallendbeen across 2021 and 2022 there was a close relationship between seeds/m^2 and grain yield but little relationship between seed size (thousand grain weight) and grain yield. This is common in grains across Australia. Of the yield components seeds/pod and pods/m^2, neither appeared to be a major driver of grain yield and these two components were often negatively correlated (seeds/pod reduced as pods/m^2 increased). High yielding varieties were ranked above average for both seeds/pod and pods/m^2. In fact, in 2021 at Wallendbeen when 45Y95 CL yielded 6.4 t/ha, it had 8422 pods/m^2 and 21 seeds per pod. Comparing to high yielding canola from the UK, this is approximately 30% more seeds/pod than would be expected for the high number of pods/m^2.

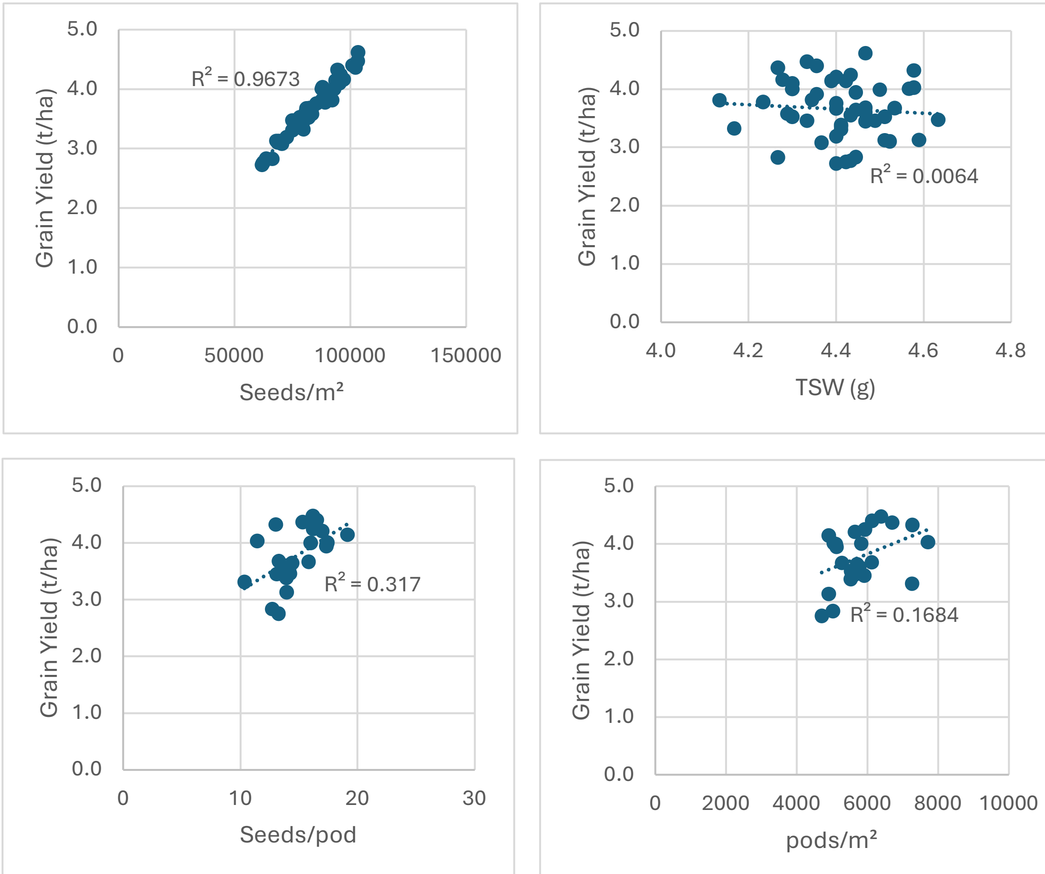


Figure 1: Relationship between seeds/m², thousand grain weight (g), seeds/pod, pods/m² and grain yield across two seasons at Wallendbeen, NSW.

More rain = more disease = more fungicide?

When comparing nil fungicide (including bare seed) to a complete fungicide program (fungicide applied to seed, at crop 4 leaf stage and during reproductive growth) there was an average grain yield response of 0.28 t/ha (6% of grain yield) in 10 trials on spring canola from 2020 to 2022. Canola has in the past had a bad reputation for its susceptibility to disease, but our findings show that the risk may be overstated and the response to fungicide input was much less than was observed in certain varieties in nearby cereal trials.

Nitrogen balance of pulse species in central and southern NSW

Rohan Brill[1], Liz Farquharson[2], Graeme Sandral[3], Michael Moodie[4], Maurie Street[5], Ben O'Brien[5], Tom Price[6], Barry Haskins[7], Rachael Whitworth[7]

[1] Brill Ag
[2] SARDI
[3] GRDC
[4] Frontier Farming
[5] Grain Orana Alliance
[6] FAR Australia
[7] AgGrow Agronomy

Key words
faba bean, chickpea, vetch, field pea, lupin, lentil, nitrogen fixation, grain nitrogen, pulse

GRDC code
BRA2105-001RTX

Take home message

- In 2021 and 2022 trials, for each tonne of above ground biomass (greater than ~1.2 t/ha), nitrogen fixation averaged 31 kg/ha
- Nitrogen fixation differences between species were largely driven by differences in biomass
- Faba beans and (where well drained) lupins had the highest biomass and hence the highest nitrogen fixation
- Grain nitrogen concentration ranged from about 6% in albus lupin, down to 3.2% in chickpea. Nitrogen removal per tonne of grain harvested (or hay cut for vetch) was ranked from albus lupin > narrow-leaf lupin > vetch > lentil = faba bean = field pea > chickpea > vetch hay.

Introduction

In 2021 GRDC initiated a project focused on 'Best Practice Pulse Agronomy' that brought together a unique group of organisations including Frontier Farming, Grain Orana Alliance, FAR Australia and AgGrow Agronomy. Led by Brill Ag it established two major themes of research activity:

1. Maximising economic yield and nitrogen (N) fixation in regional environments.
2. Developing locally relevant research knowledge on limitations to pulse production and productivity. Research to date has focused on plant density, disease management, nutrition management, inoculation strategy, phenological development, and herbicide tolerance.

This paper reports on the findings from Theme 1 above for the 2021 and 2022 seasons.

Materials and methods

Trials were conducted at seven sites across southern and central NSW in 2021 and five sites in 2022 (Table 1). Sites were selected to be regionally relevant with challenges (both perceived and real e.g., low pH, sodic and/or poorly drained soils) that may restrict the use and production of pulses in the rotation. The research is not designed to compare the performance of pulses in a benign situation but is focused more on determining the performance of pulse species for yield and N fixation performance in the local environment where adapted species may thrive, but less adapted species may struggle. This paper is reporting on ten of these twelve sites where N fixation analysis has been completed.

Table 1. *Site description of ten pulse agronomy research sites from 2021 & 2022*

Site	Sowing date	Rain (mm) Jan-Mar	Rain (mm) Apr-Nov	pH (Ca) 0-10 cm	Available N (kg/ha)	Site description
Barellan	13 May	270	435	4.5	63 (0–60 cm)	Acidic sandy loam soil with 3.3% Al.
Canowindra	3 May + 20 May[1]	290	490	4.8	192 (0–120 cm)	Moderately acidic, well drained red loam soil
Caragabal	29 April + 18 May[1]	280	480	5.0	53 (0–60 cm)	Slightly acidic loam (chromosol) with sub-soil sodicity
Buraja	7 May	180	450	4.6	54 (0–10 cm)	Moderately acidic silty loam soil
Ganmain	28 April + 18 May[1]	220	360	5.3	82 (0–60 cm)	Slightly acidic loam soil with sub-soil sodicity
Parkes	31 May	290	485	5.7	126 (0–90 cm)	Neutral pH, moderately heavy soil type with sub-soil sodicity
Barellan	6 May	255	537	5.2	76 (0–60 cm)	Well drained sandy loam soil
Ganmain	9 May	185	572	5.5	115 (0–80 cm)	Well drained loam soil (until flooded in late October from overland water)
Trundle	28 June	155	705	5.6	103 (0–90 cm)	Fairly well drained loam soil but site was very wet in 2022.
Wellington	23 May	235	780	5.4	120 (0–60 cm)	Grey basalt soil, wet in 2022.

[1]*Faba beans, vetch and lupins sown at earlier sowing date; field peas, lentils and chickpeas sown at later sowing date.*

N fixation was determined by collecting biomass samples at peak biomass (i.e., mid-podding stage and before leaf drop) and analysed using the ^{15}N natural abundance technique (Unkovich *et al*., 2008) to determine what proportion of the N in the biomass was derived from the atmosphere (NDFA). Once the quantity of NDFA in above ground biomass was calculated (peak biomass * N content of biomass * NDFA%), total N fixation (N-fix) was calculated by multiplying a co-efficient that estimates the root contribution which was 1.5 for faba beans, field peas, lentils, lupins and vetch; and by 2.0 for chickpeas. These figures (1.5 and 2.0) are known as 'root factors' and are described by Swan *et al.* (2022). The root factor calculation makes an allowance for below ground N (e.g. in roots and nodules) so an improved estimate of total N fixed can be provided. Finally, the N balance is calculated by subtracting the N removed in grain from total N fixed.

Results

Total nitrogen fixation

Total N fixed by the pulse species across the ten sites in 2021 and 2022 was closely related to crop biomass. For each tonne of biomass >1.2 t/ha, total N fixation was ~31 kg N/ha (Figure 1). Some crop biomass figures were very high in 2021 and 2022 due to high rainfall. The species most consistently able to achieve these very high biomass levels was faba bean as it handled intermittent waterlogging relatively well. Lupins had very high biomass in some trials (e.g. Canowindra 2021 & Barellan 2022) but had low biomass where waterlogging was an issue (e.g. Parkes 2021, Trundle 2022). Overall lentils had the lowest biomass and the lowest N fixation.

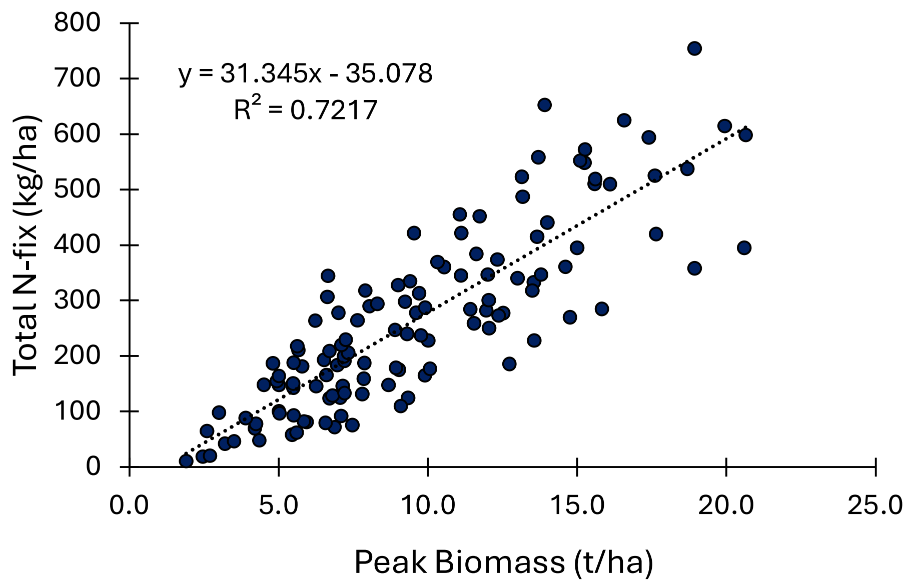


Figure 1. *Relationship between peak biomass of pulses and total N fixed (N-fix) across 10 trials in 2021 and 2022.*

Nitrogen removal

Nitrogen concentration in the grain was highest in albus lupin and lowest in chickpea, with albus lupins having approximately double the grain N concentration of chickpeas (60 kg N/tonne for albus lupins versus 33 kg N/tonne for chickpeas). Narrow-leaf lupins had the second highest grain N concentration (52 kg N/ tonne) with faba beans, field peas and lentils all within 40–45 kg N/tonne of grain (Figure 2). Vetch hay (from nearby trials) had an average N removal of 27 kg N/tonne of hay (data not shown). Site variation for grain N concentration was less significant than the differences between species.

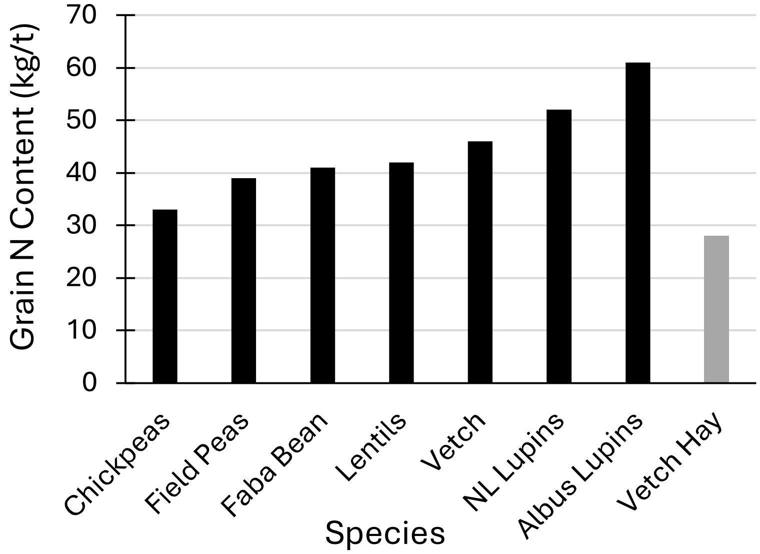


Figure 2. *Average Grain (and hay) N concentration of pulse species in 2021 and 2022 in trials in southern and central NSW.*

Nitrogen balance

N balance is simply a measure of how much N is harvested in grain (or removed in hay) subtracted from total N fixation. With >50 species*site combinations assessed in 2021 and 2022, the N balance was always positive ranging from 2 kg/ha to 402 kg/ha. Due to their low biomass production, the N balance of lentils was <100 kg N/ha in eight of nine trials where lentils were included. In contrast, faba beans had an N balance >100 kg N/ha in eight of ten trials where they were included (Tables 2 & 3). In general, higher biomass crops had higher grain yield and higher nitrogen balance. Pulse agronomy (for example sowing date, species selections, seeding rate) should focus on maximising biomass to increase both crop biomass (and N fixation) and grain yield.

Table 2. *Peak biomass, total N fixed (N-fix), grain yield, N removed in grain and N balance of pulse species at research sites in NSW in 2021.*

Site	**Species**	**Cultivar**	**Peak biomass (t/ha)**	**N fix (kg/ha*)**	**Grain yield (t/ha)**	**N removed (kg/ha)**	**N balance (kg/ha)**
Barellan	*Chickpea*	*CBA Captain*ⓓ	5.0	148	2.2	72	76
	Faba bean	*PBA Samira*ⓓ	9.4	335	4.4	171	164
	Field pea	*PBA Wharton*ⓓ	9.9	287	3.9	146	141
	Lentil	*PBA Hallmark XT*ⓓ	6.8	129	2.6	105	24
	Lupin	*Luxor*ⓓ	5.5	188	3.0	174	14
	Vetch	*Timok*ⓓ	9.3	240	3.5	162	78
Buraja	*Chickpea*	*CBA Captain*ⓓ	7.1	220	2.3	74	146
	Faba bean	*PBA Samira*ⓓ	6.7	209	2.9	123	86
	Vetch	*RM4*ⓓ	4.8	187	1	51	136
Canowindra	*Chickpea*	*CBA Captain*ⓓ	8.9	247	2.2	89	158
	Faba bean	*PBA Samira*ⓓ	15.0	395	5.8	230	165
	Lentil	*PBA Hallmark XT*ⓓ	6.7	124	1.4	58	66
	Lupin	*Murringo*ⓓ	17.6	525	4.3	263	262
	Lupin	*PBA Bateman*ⓓ	15.6	519	3.4	179	340
Caragabal	*Chickpea*	*CBA Captain*ⓓ	9.6	278	2.1	72	206
	Faba bean	*PBA Samira*ⓓ	17.4	594	5.7	251	343
	Field pea	*PBA Taylor*ⓓ	7.0	278	3.4	134	144
	Lentil	*PBA Hallmark XT*ⓓ	7.2	133	1.7	71	62
	Lupin	*PBA Bateman*ⓓ	9.7	313	2.1	112	201
	Vetch	*Timok*ⓓ	11.1	345	1.6	92	253
Ganmain	*Chickpea*	*CBA Captain*ⓓ	5.0	164	Not harvested due to hail		
	Faba bean	*PBA Samira*ⓓ	12.0	347	5.2	211	136
	Field pea	*PBA Wharton*ⓓ	8.3	294	2.7	104	190
	Lentil	*PBA Hallmark XT*ⓓ	5.5	93	2.1	91	2
	Vetch	*Timok*ⓓ	6.6	166	2.7	127	39
Parkes	*Chickpea*	*CBA Captain*ⓓ	9.0	328	2.6	89	239
	Faba bean	*PBA Samira*ⓓ	15.1	552	6.3	282	270
	Lentil	*PBA Hallmark XT*ⓓ	3.9	88	0.7	29	59
	Lupin	*Murringo*ⓓ	3.0	98	0.8	47	51
	Lupin	*PBA Bateman*ⓓ	7.9	318	2.6	132	186

Table 3. *Peak biomass, total N fixed (N-fix), grain yield, N removed in grain and overall N balance of pulse species at research sites in NSW in 2022.*

Site	Species	Cultivar	Peak biomass (t/ha)	N fix (kg/ha*)	Grain yield (t/ha)	N removed (kg/ha)	N balance (kg/ha)
Barellan	*Chickpea*	*CBA Captain*Ⓟ	12.4	428	1.8	59	369
	Faba bean	*PBA Samira*Ⓟ	13.0	195	4.6	185	10
	Field pea	*PBA Butler*Ⓟ	11.3	268	2.3	96	172
	Lentil	*PBA Hallmark XT*Ⓟ	7.7	175	2.6	105	70
	Lupin	*Luxor*Ⓟ	15.0	425	5.3	312	113
	Lupin	*PBA Bateman*Ⓟ	15.0	427	3.8	209	118
	Vetch	*Timok*Ⓟ	10.7	307	4.7	220	87
Ganmain	*Chickpea*	*CBA Captain*Ⓟ	9.5	282	0.5	18	264
	Faba bean	*PBA Samira*Ⓟ	17.8	570	5.7	235	335
	Field pea	*PBA Butler*Ⓟ	8.7	261	2.9	126	135
	Lentil	*PBA Hallmark XT*Ⓟ	7.5	84	1.1	46	38
	Vetch	*Timok*Ⓟ	12.1	251	2.4	120	131
Trundle	*Chickpea*	*CBA Captain*Ⓟ	4.4	63	1.5	48	15
	Faba bean	*PBA Samira*Ⓟ	15.3	595	4.1	192	402
	Field pea	*PBA Butler*Ⓟ	5.4	63	1.6	52	11
	Lentil	*PBA Hallmark XT*Ⓟ	3.0	31	0.4	17	14
	Lupin	*PBA Bateman*Ⓟ	8.0	273	1.3	72	201
	Vetch	*Studenica*Ⓟ	7.2	223	2.2	107	115
Wellington	*Chickpea*	*CBA Captain*Ⓟ	5.9	111	1.1	37	74
	Faba bean	*PBA Samira*Ⓟ	12.7	431	5.9	267	163
	Field pea	*PBA Butler*Ⓟ	16.3	369	3.8	136	232
	Lentil	*PBA Hallmark XT*Ⓟ	8.0	160	0.5	17	143
	Lupin	*Luxor*Ⓟ	5.7	168	2.1	100	68
	Lupin	*PBA Bateman*Ⓟ	7.1	243	2.7	138	105
	Vetch	*Studenica*Ⓟ	7.6	241	1.7	80	161

Discussion and conclusion

The above average rainfall in 2021 and 2022 led to some very high biomass and grain yields being achieved across the project region, most consistently with faba bean. Other pulses such as lupin, lentil and chickpea had more variable yield responses. Field pea and vetch (for grain) performed consistently across sites and seasons, only occasionally being the best performer but also rarely being the poorest performer. This trait of lowish but stable yield may be appealing to some growers that wish to manage potential downside risks in pulse production. In addition to their excellent grain yield performance, faba bean had an average N balance of 180 kg N/ha.

The work from this project on pulse crop suitability to local environments and tactical agronomy couples well with GRDC Farming Systems research to gain a full understanding of the role of pulses in regional farming systems.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the author would like to thank them for their continued support.

Thanks to grower co-operators Jeff Savage (Barellan), Dennis Tomlinson (Buraja), Daybreak Farming (Caragabal), Stephen Cooper (Caragabal), Chris Berry (Trundle), Viridis Ag (Canowindra), Angus Maurice (Wellington), Trentham Estate (Gol Gol), Nathan Border (Parkes).

Further reading

NSW Pulse Agronomy Development and Extension Project – 2021 summary of field trial results. https://grdc.com.au/resources-and-publications/all-publications/publications/2022/nsw-pulse-agronomy-development-and-extension-project

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Swan T, Dunn M, Kirkegaard J, Goward L, Leighton E, Sandral G, Hunt J, Bullock M, Pumpa R, Fiske K, Woodford-Smith A, Reardon D, Barry M and Burns H (2022) What is the N legacy following pulses for subsequent crops and what management options are important to optimise N fixation? 2022 Wagga Wagga GRDC Update. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2022/02/what-is-the-n-legacy-following-pulses-for-subsequent-crops-and-what-management-options-are-important-to-optimise-n-fixation2

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Date published

August 2024

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DELTA AGRIBUSINESS

Delta Agribusiness are a leading force in independent rural inputs and advisory services in regional Australia. With a strategic footprint across NSW, QLD, VIC, WA and SA.

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In a highly competitive marketplace, it is the integrity of our people that make the difference. We are committed to being innovative and making smart decisions to add value to our clients. With a culture of empowering staff and branches, we are passionate about rural communities, the profitability of our clients and the sustainability of agriculture at all levels.

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Fungicide resistance and management strategies – are we using too much fungicide in WA crops?

Fran Lopez, Centre for Crop and Disease Management, Curtin University, Perth

Since the introduction of the first commercial fungicide class in the decade of 1940, fungicides have continuously gained importance in the control of crop diseases and today they remain a basic component of existing integrated disease management (IDM) strategies in developed countries for most crops. With a protection benefit comparable to that of genetic resistance, fungicides have contributed to the steady yield increases seen over the last few decades and are considered to be an integral part of any strategies aimed at ensuring worldwide food security in the medium term.

Unfortunately, the high effectivity of fungicides in controlling diseases has led to their widespread application and the generalised relaxation of IDM practices. As a result of this, resistance to fungicides has quickly emerged in some cases challenging IDM programs while increasing pressure over other disease management tools. To date resistance to one or more key fungicide groups has been reported in most relevant broadacre diseases in Australia (https://afren.com.au/understanding/#fungicide-map).

When fungicide resistance develops, management strategies need to be rapidly adjusted to avoid fungicide control failure. In recent years, WA has acquired international relevance due to the rapid onset of fungicide resistance. The repeated application of fungicides from the same group and the use of crop varieties with low disease tolerance have been key drivers of the fast selection and spread of fungicide resistance in the state.

Data collected from 326 paddocks across the south-west WA grainbelt between 2020-2022 indicates an increment in applications of group 3 fungicides for the control of net blotch diseases over the years (Figure 1). In addition to this, multiple applications from fungicide groups 7 and 11, which have a higher risk of resistance selection, was common. During this period, 39-44% of the paddocks had a one-year rotation strategy and susceptible varieties dominated the programs. Lastly, 78% of the paddocks had been sown with farm retained seed, increasing the risk of net blotch seed transmission. These conditions have likely contributed to the rapid selection of resistance to fungicide groups 3 and 7 in net blotch pathogens.

To counteract this problem, The Australian Fungicide Resistance Extension Network (AFREN, https://afren.com.au/) was established with GRDC investment in 2019 to develop and deliver fungicide management resistance resources for growers and advisers across the country. It brings together regional plant pathologists, fungicide resistance experts and communications and extension specialists.

In this presentation, I will use WA examples to discuss relevant strategies aimed at slowing down the emergence of fungicide resistance.

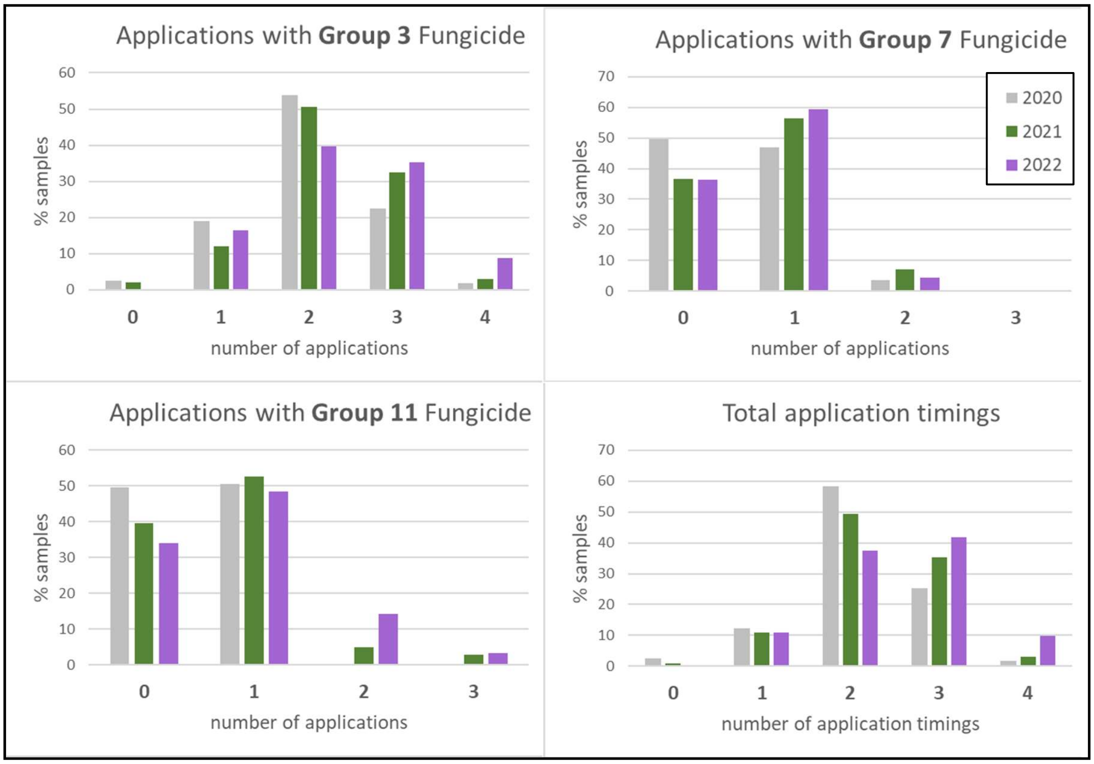

Figure 1. *Frequency of net form and spot form net blotch samples collected in the south-west WA grainbelt between 2020 and 2022 from paddocks receiving 0-4 applications of different fungicide groups.*

The vast majority of practical fungicide resistance detections derive from field observations. Typically, growers and agronomists are the first ones alerting when abnormal fungicide performance is observed in the field. Unfortunately, when this occurs growers are already having difficulties in controlling diseases and this often translates into yield or quality losses.

One of the key elements required in any sound IDM strategy is the ability to monitor pathogen populations so that disease control methods can be tailored to suit emerging management requirements. Fungicide resistance management is not an exception to this, and large efforts have been devoted to the monitoring of fungicide resistance populations in many different crops and countries (R4P network, 2021).

Key Learnings: Albany Crop Technology Centre 2020 – 2023 & where to next? – Frankland River, WA

Nick Poole & Deep Das – FAR Australia

Winter wheat NGN study - 2024

Over four years (2020 – 23) FAR Australia has run a series of wheat trials investigating the performance of winter wheat versus spring wheat sown here in the HRZ of the Albany port zone (Green Range in 2020 and Frankland River 2021 – 2023). A summary of the results of that study is featured in this article. This research in the absence of frost delivered no yield benefit of winter wheat over longer season spring wheats. However, the research did not investigate winter wheat sowing dates earlier than the second half of April (21st – 30th April) at Frankland River 2021-2023 and 1st May 2020 at Green Range.

In this year's 2024 evaluation (a GRDC one year NGN investment) the objective was to look at sowing dates earlier than late April. As a result, four trials have been set up with two in the Esperance port zone and two in the Albany port zone. The HRZ site here at Frankland River was sown on the following dates with six varieties of wheat and two varieties of barley. However, autumn 24 was anything, but high rainfall and the first sow dates were irrigated in order to get emergence.

Time of sowing 1: 3rd April (Irrigated 15mm at sowing) – emergence mid-April
Time of sowing 2: 29th April (no irrigation) – emergence 15 – 20 May following rainfall 10th May

The second sowing dates emerged following rainfall and were much less stressed following emergence.

A second satellite site was established at South Stirling with very similar sowing dates (2nd April irrigated with & 29th April).

The objectives of this one-year research programme are:

- To examine the role of winter wheat in rotations along the south coast of WA in the Esperance and Albany Port Zones.
- To explore this possible role in relation to sowing date and spring wheat germplasm with different phenology at the different sow dates covering late March/early April to early comparing profitability and performance to spring barley germplasm.
- To evaluate the different management needs of winter wheat in relation to the other cereal groups being tested (two varieties per cereal classification).

Clearly there are no results from this project at this stage, however, there have been a number of significant observations regarding phenology. Scepter planted 2nd April was in head and flowering on 3rd July whilst spring wheats Rockstar and Denison were at earlier stage of head emergence, Mowhawk and Illabo were at GS31 and the long season winter wheat RGT Waugh had just finished tillering.

The previous research conducted 2020 – 22 on this farm courtesy of the Kellie Shields, Terry Scott and the Gunwarrie team looked at mid-late April sowing. The main results of that study are as follows.

Spring versus winter wheat germplasm sown mid-late April

Key point summary 2020-23
In 2020 the research took place on a Sandplain at Green Range northeast of Albany with below average growing season rainfall. The Frankland River research has been conducted on a forest gravel with above average rainfall in 2021 and slightly above average rainfall in 2022 and 2023, particularly September rainfall was 50% down on average rainfall.

Key point summary

- Despite slightly later April sowing dates (ranging from 21st April to 1st May) winter wheat germplasm has been higher yielding in the southern western WA environment than was the case in the Esperance port zone.
- The longer season red wheat RGT Accroc performed well over this period in relation to Scepter, except in the 2023 season when it was 10% lower yielding than Scepter.
- The later flowering date of mid-October for RGT Accroc is later than is regarded optimal for the Frankland River region but the yield disadvantage was only recorded in 2023.
- Rainfall distribution, particularly in September and October as the later flowering winter wheats are flowering may be a key reason for the inconsistency of the long season winter wheats such as RGT Accroc.
- Mowhawk a shorter season winter wheat has been more consistent than RGT Accroc and has AH quality. It has been superior to Illabo the other short season wheat control.
- Over the last three years at Frankland River the long season spring wheats Rockstar and Dennison have outperformed Scepter and given performances similar to the short season winter wheats such as Mowhawk.
- Increased inputs, particularly nutrition have been the key to cost effective yield increases in wheat trials in three of the four season.
- An additional 25, 50 or 90kg N/ha on top of a standard N dose (125kg N/ha) provided profitable increases in productivity in 2021 and 2022 based on yield increases of 0.71 and 0.66t/ha (urea at $600/t & grain price at $375/t) and associated protein lifts (mean of seven cultivars). In 2023 there was no yield advantage but quality paid for the extra input.
- RGT Accroc was the least responsive variety to higher input management, despite generally producing higher harvest dry matters, although grain proteins have been lower.

- In contrast, the spring milling wheats have shown good responses to a higher input management strategy (additional N, PGRs and greater fungicide input), which from observations of disease, lodging and crop structure is most associated with additional N fertiliser input.
- As was the case at the Esperance site, increasing fungicide input in wheat has not given rise to better crops with little evidence of disease to warrant spending more than a standard two spray strategy based on DMI chemistry.
- Defoliation simulating grazing had variable effects on grain yields and margins but was most negative in the highest yielding season, depending on the value attributed to grazing.

Grain Yields 2020 – 2023
At the Albany Crop Technology Centre, the grain yields have been more variable in comparison to Esperance, in part due to a change of site and soil type between 2020 and 2021 (Figure 1). Over the four project years the notable difference between Esperance and Frankland River has been better performance of winter germplasm relative to spring germplasm. This was not only apparent with the shorter season winter wheats Mowhawk and Illabo, but also the long season red wheat RGT Accroc, which despite later flowering has performed better.

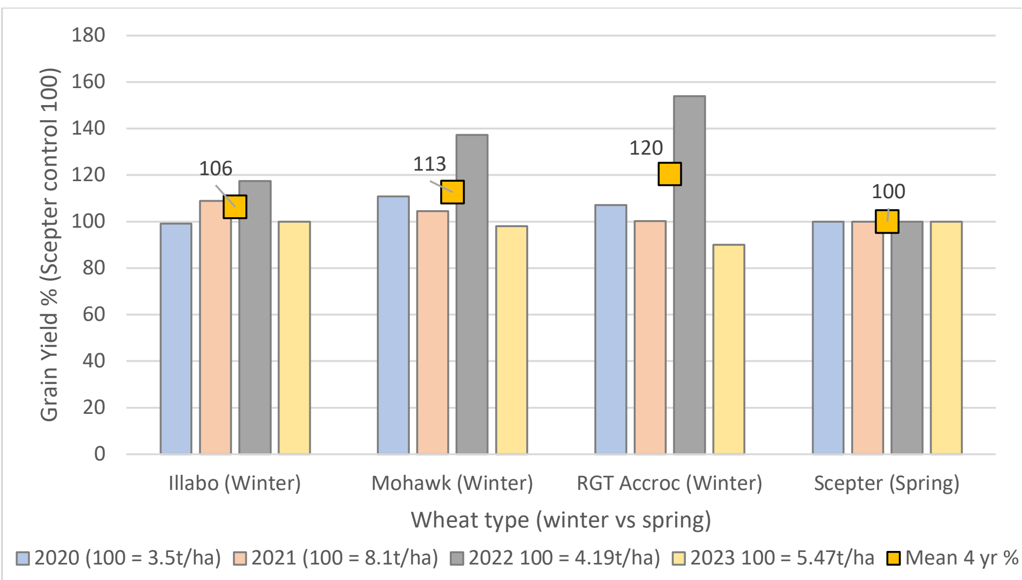

Figure 1. *Winter vs. spring wheat germplasm grain yield (%) under high input management over four seasons – 2020 - 2023.*

However, the performance of winter wheat germplasm has been matched by longer season spring wheats experimented upon between 2021 – 2023 at Frankland River. Using RockStar and then also Denison in 2022 and 2023 long season spring wheat planted in the second half of April has been higher yielding than Scepter (short spring) and Illabo (short winter) under a range of management approaches. In general, the yields RockStar and Denison have been similar to the newer shorter season winter wheat Mowhawk with similar flowering dates (Figure 2).

WA CROP TECHNOLOGY CENTRE (ALBANY)

FAR AUSTRALIA

TIMETABLE

WA CROP TECHNOLOGY CENTRE FIELD DAY (ALBANY PORT ZONE)
THURSDAY 19 SEPTEMBER 2024

In-field presentations	Station #	12:30	1:15	1:30	2:00	2:30	3:00	3:30	4:00	4:30
Rohan Brill, Brill Ag (kindly sponsored by Frankland Rural) *Rohan answers the questions around what we have learned Hyper Yielding Crops in canola crops in WA, and do we reconsider the legacy effects of grain legumes in* FRANKLAND Rural	1	Lunch kindly sponsored by DELTA AGRIBUSINESS	Opening address by Nick Poole, FAR Australia's Managing Director followed by an introduction to the cereal research programme.	1	2					Closing address followed by refreshments kindly sponsored by DELTA AGRIBUSINESS
Ayalsew Zerihun *DMI* *and SDHI resistance in the net blotch pathogens of barley in WA. A guide for adjusting treatment programmes when resistance is increasing.*	2				1	2				
Nick Poole and Deep Das, FAR Australia *Given a wetter autumn what would early sown winter wheats have looked like sown in late March?* GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION	3					1	2			
Dr Ben Jones, FAR Australia *The physiology of winter germplasm – are there opportunities to make more use of this germplasm in the L-MRZ as well as the high rainfall zone?*	4						1	2		
Darcy Warren and Daniel Bosveld, FAR Australia *What did we learn in wheat and barley from WA cereal trials as part of the Hyper Yielding Crops project?* GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION	5							1	2	
Dan Fay, Stirlings to Coast Farmers and Nick Poole, Rachel Hamilton, FAR Australia *As the nation's economy moves to ways to reduce emissions, where do we stand with crop profitability in the port zone with our new GRDC Hyper Profitable Crops project?* GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION	6			2					1	
In-field presentations	**Station #**	**12:30**	**1:15**	**1:30**	**2:00**	**2:30**	**3:00**	**3:30**	**4:00**	**4:30**

For the in field presentations, we would be obliged if you could remain within your designated group number.

Thank you for your cooperation.

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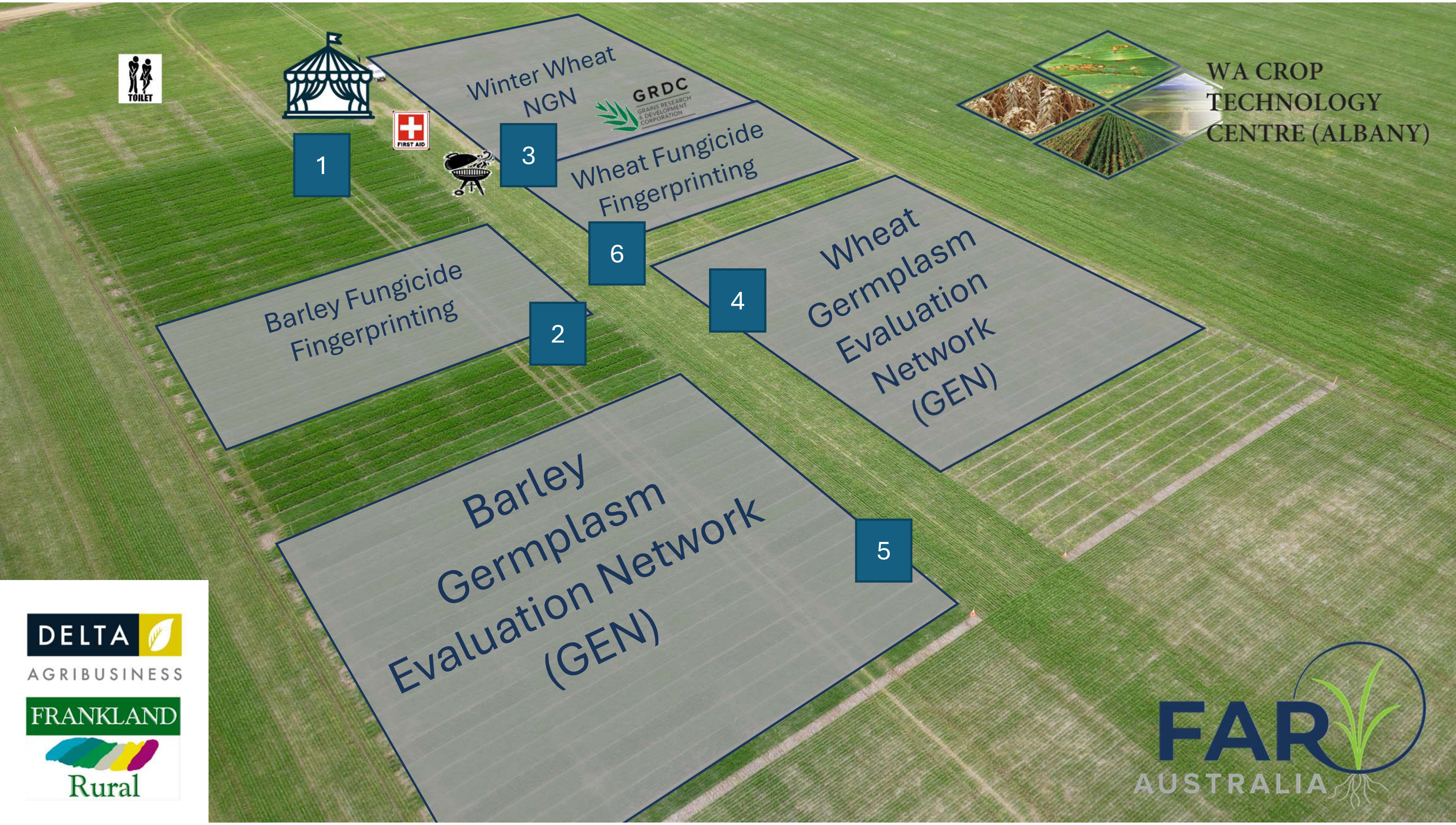
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Winter Wheat NGN
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
Wheat Fungicide Fingerprinting
Barley Fungicide Fingerprinting
Wheat Germplasm Evaluation Network (GEN)
Barley Germplasm Evaluation Network (GEN)
WA CROP TECHNOLOGY CENTRE (ALBANY)
DELTA AGRIBUSINESS
FRANKLAND Rural
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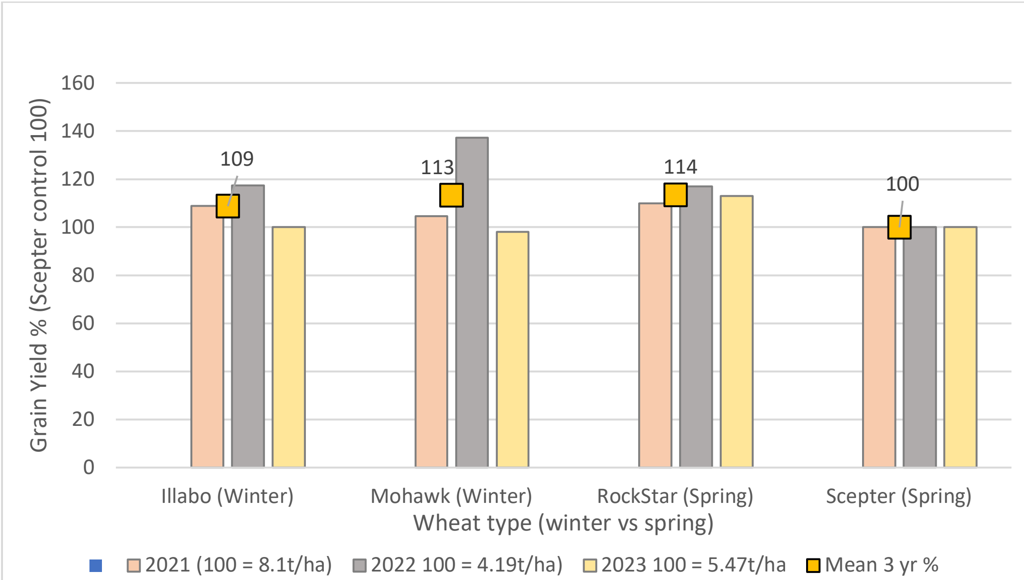


Figure 2. *Winter vs. spring germplasm grain yield (%) under high input management over four seasons – 2020 - 2023.*

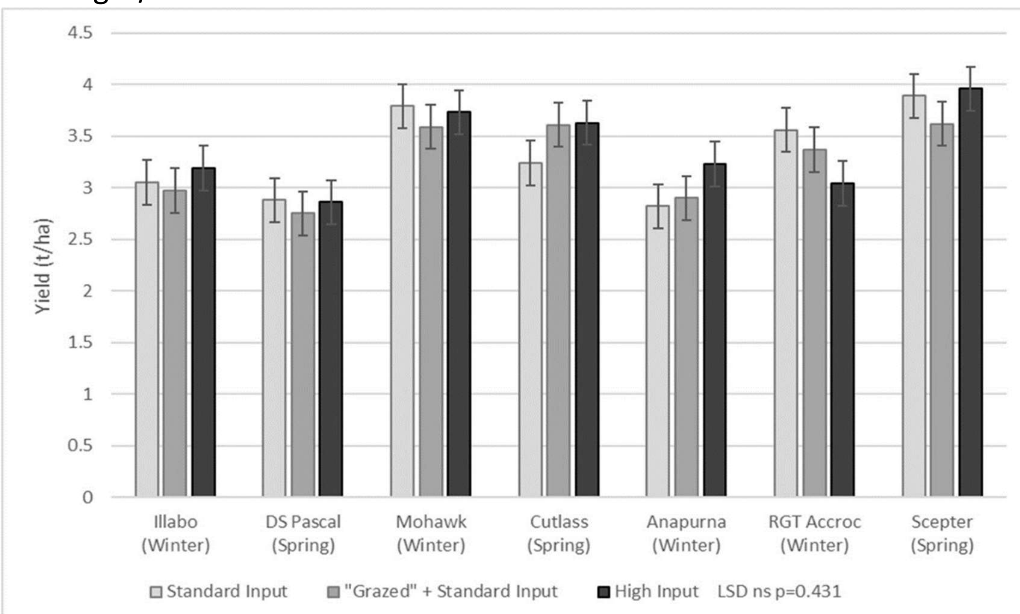
When did crops flower at the Frankland River trial?
Following a 21st April sowing date in 2022, Table 1 shows the diversity in flowering dates of the winter and spring cultivars established at the Frankland River site, with almost 2 months difference between Scepter and RGT Accroc. From modelling studies, the optimum flowering period for the region is regarded as late September, slightly later than mid-September for Esperance. As might be expected, those spring wheats that flowered first had significantly lower harvest dry matters than the winter wheats. However, the surprise has been the good grain yield performance of RGT Accroc winter wheat despite them flowering much later than the optimum period. Further assessment in future seasons is necessary to determine whether this is an artefact of two mild springs or a lift in productivity from European germplasm not previously tested in southwest WA.

***Table 1**. Approximate calendar date that each cultivar reached stem elongation (GS30) and the beginning of flowering (GS61) – 21 April sown 2022.*

Cultivar (type)	Date GS30	Date GS61
Illabo (Winter)	1 July	26 September
Rockstar (Spring)	16 June	30 August
Mowhawk (Winter)	1 July	12 September
Kinsei (Spring)	16 June	30 August
RGT Accroc (Winter)	16 June	14 October
Scepter (Spring)	2 Aug	19 August
Denison (Spring)	16 June	9 September

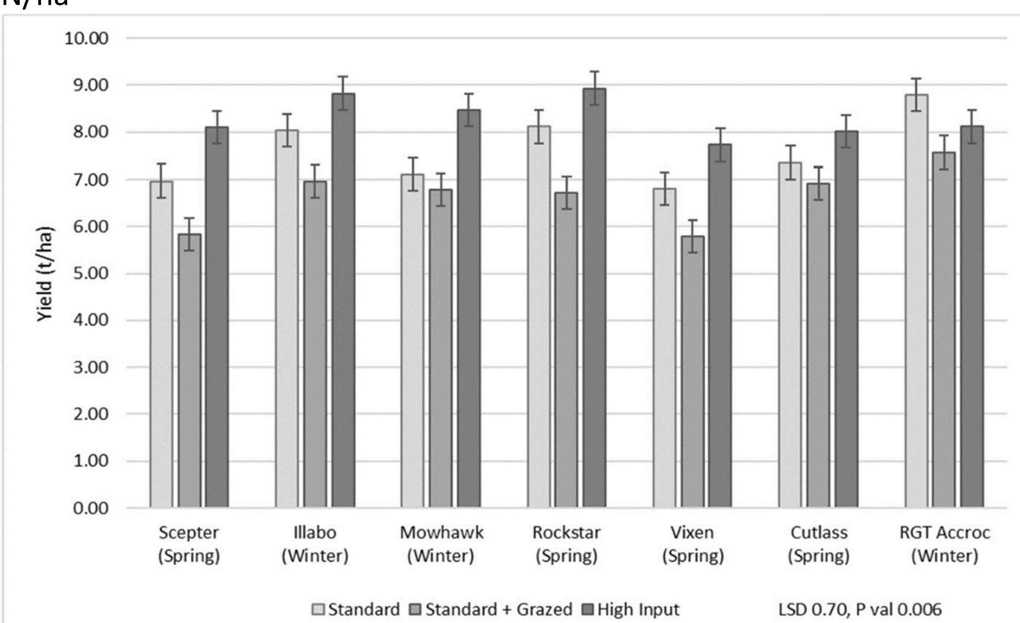
In terms of low to high input management approaches, high input (higher N input, higher F input and PGR) in the spring wheat has increased yields in 2021, 2022 but not 2023, however grain classification in 2023 still indicated an economic benefit to high input associated with higher nutrition and grain proteins (175kg/ha N versus 125kg N/ha).

2020 Green Range, WA - Standard Input N – total 86.5kg N/ha, High Input N – total 136.5kg N/ha



2021

Frankland River, WA Standard Input N – total 116kg N/ha, High Input N – total 209kg N/ha



2022

Frankland River, WA Standard Input N – total 100kg N/ha, High Input N – total 125kg N/ha

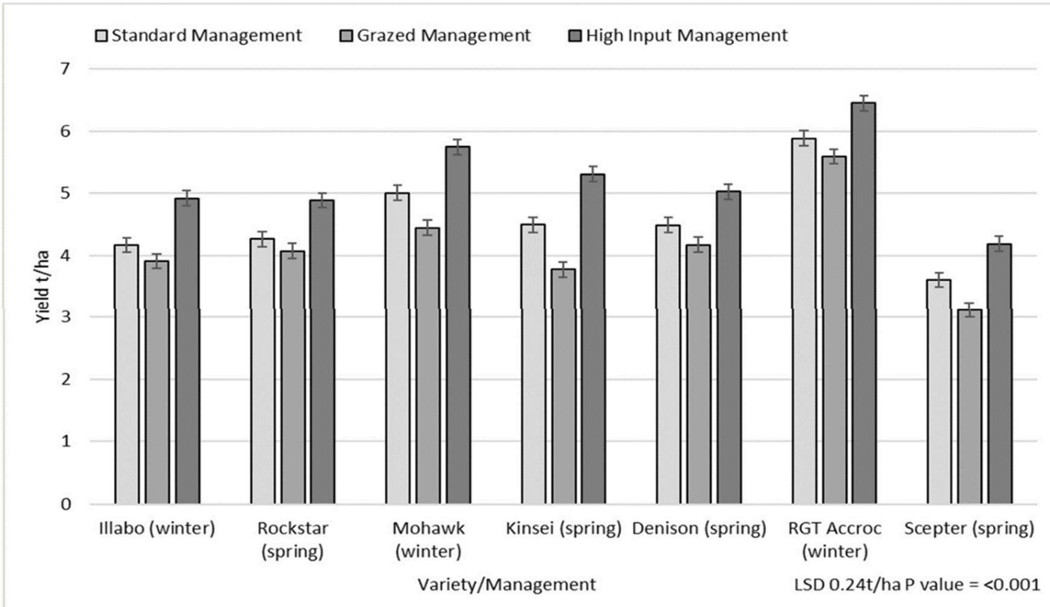


Figure 2. *Influence of management approach on wheat variety performance*

Economic analysis of 2023 data

Despite 2023 yields in wheat showing no yield differences because of management strategy, there were economic benefits as a result of grain quality/classification (results not shown). While costing less on average, the low and tactical inputs showed lower partial net margins (taking into account the variable costs in each strategy) when compared to high and strategic inputs in the wheat Germplasm * Environment * Management (GEM) trial (Figure 3). The upside potential of achieving higher grain classifications offset the additional costs involved. For example, under low input Mowhawk, Illabo and RockStar only achieved feed standard to receive a price of $350/t (averaging a partial net margin of $1,737/ha) compared to high input where the same three varieties achieved AUH2/H3 classification at $402/t (and an average partial net margin of $1,950/ha). See 2023 national results for HYC project for further details.

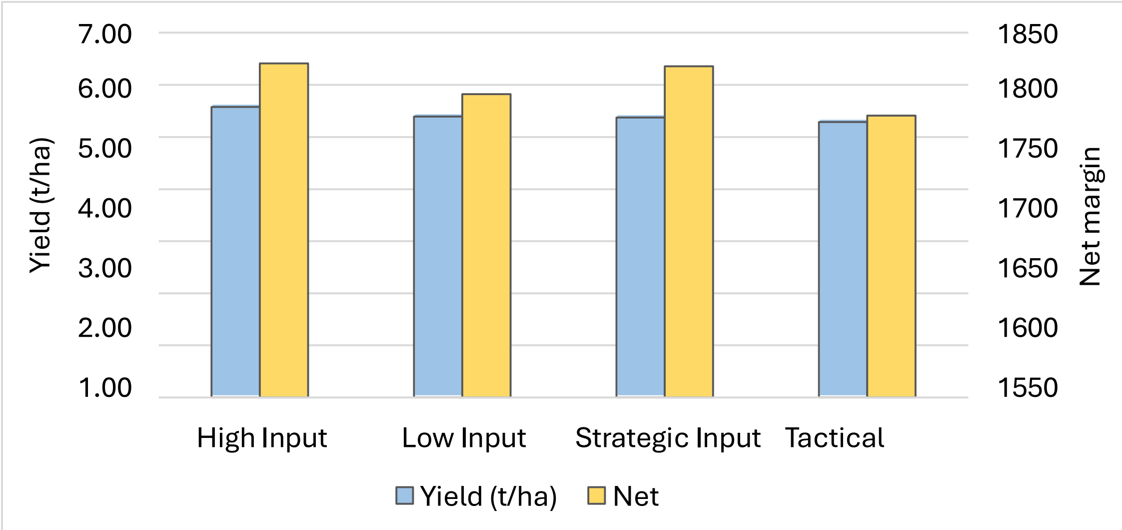


Figure 3. *Influence of management strategy on wheat yield (t/ha) and net margin (margin after the application of N, PGR & F was taken into account ($/ha).*

Prices based on AUH2/H3 $402/t, APW1 $407/t, SFW1 $350/t, CT spraying $16.2/ha, CT spreading $9.2/ha, high input cost average - $473.2/ha, low input cost - $338.7/ha, strategic input average - $402.3/ha and tactical input average - $404.2/ha. Includes cost of seed treatment, foliar fungicides, PGR, nutrition and grain.

Scan the QR code to access 2023 HYC Results

GERMPLASM

evaluation network (GEN)

your trusted research partner for germplasm evaluation

FAR AUSTRALIA

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

An Industry Innovations (II) initiative

Industry Innovations
leading the way to a brighter grains industry

SOWING THE SEED FOR A BRIGHTER FUTURE

GERMPLASM EVALUATION NETWORK (GEN)

Background:

FAR Australia has been working with breeders to bring new products to the Australian Grains industry since its inception in 2012. It is a trusted development partner for many breeders, assisting with bringing in new germplasm to the marketplace, whilst ensuring the correct management to fulfil the genetic yield potential.

Industry Collaborations:

FAR Australia is partnering with industry to independently showcase ***germplasm*** performance in a series of high productivity ***evaluation*** trials across the country as part of its Industry Innovations (II) initiative.

FAR Australia has been delivering extremely successful germplasm evaluation network (GEN) pilot programmes across an established series of trial sites in order to test different germplasm in wheat and barley. The five Crop Technology Centres that test GEN are located in WA, SA, Vic, NSW and Tas.

What is Proposed:

Once again, the 2025 programme will focus on genetic yield potential and disease resistance. The trials, in wheat barley and canola, will be managed ‘plus and minus’ fungicide using FAR Australia’s expertise in disease management.

This independent initiative delivers a coordinated and independent network of high productivity trials in wheat and barley. The trials will be managed ‘plus and minus’ fungicide with control varieties provided by FAR Australia.

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

The breeders and FAR Australia will jointly own the results produced. Pre commercialisation breeding lines can be identified by the breeders or a FAR Australia code.

GERMPLASM
evaluation network
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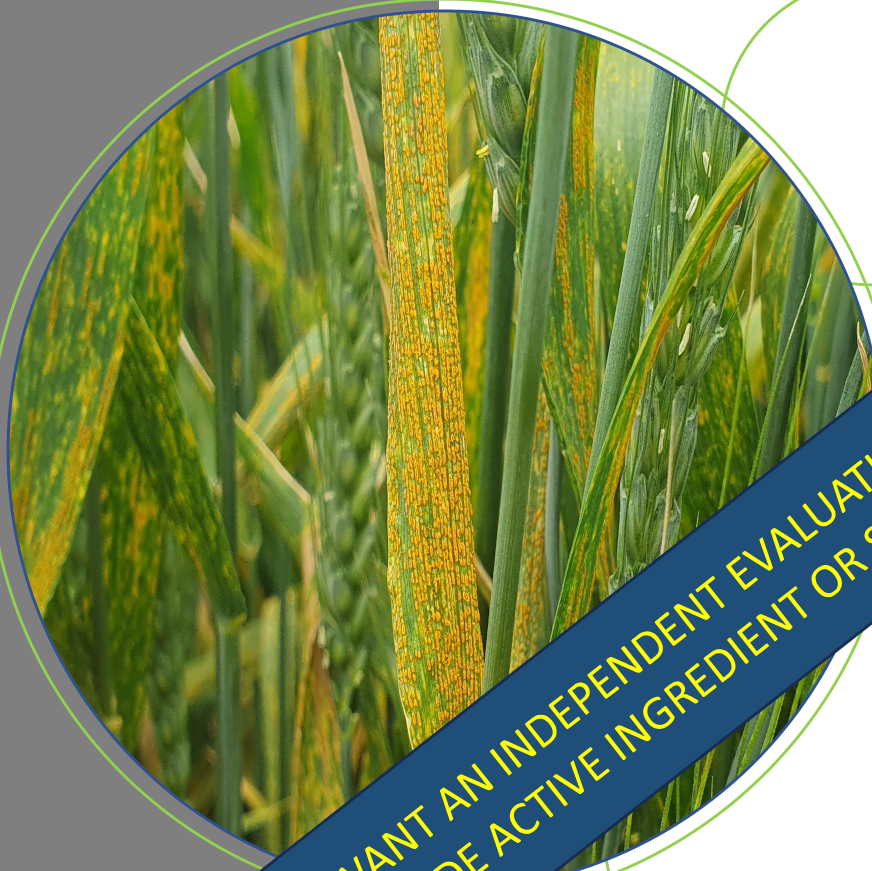
FUNGICIDE FINGERPRINTING

an independent fungicide evaluation network



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

FAR AUSTRALIA

SOWING THE SEED FOR A BRIGHTER FUTURE

An Industry Innovations (II) initiative

Industry Innovations

leading the way to a brighter grains industry

FUNGICIDE FINGERPRINTING - FIRST IN ITS FIELD

Fungicide Fingerprinting, developed by FAR Australia, was launched in 2021 and is the first coordinated and independent fungicide evaluation network in Australia. This initiative aims to generate an independent evaluation of existing and newly developed fungicide strategies to help growers and advisers make better decisions when managing disease. It is:

- Independent
- accurate
- consistent in the approach to disease assessment
- within the label stipulations and AFREN compliant control framework

Collaborating Industry Stakeholders

This industry initiative is of benefit to agrichemical manufacturers involved in both new active and generic, fungicide resellers with agronomists in the field, private advisers and regional farming groups.

Overall Objective:

Individual objectives specific to the trial are:

- To assess the efficacy of different fungicide strategies and active ingredients against foliar pathogens prevalent in the HRZ of Australia.
- To assess the most cost-effective fungicide strategies in different HRZ regions of Australia (long season and short season) using less expensive generic chemistry alongside the latest development material.
- To evaluate whether newer generation fungicide chemistry is more effective than DMI based standard controls.
- To determine the impact of introducing Group 7 and QoI Group 11 chemistry SDHI into two spray programmes.
- To allow development material to be entered under a FAR code (where it is pre commercial) which is revealed when the new active is commercialised.

The Fungicide Fingerprinting initiative is conducted at FAR Australia's Crop Technology Centres in the HRZ regions of Australia where disease is more prevalent, thus an important component of cereal crop agronomy.

Costs:

Should you wish to invest in entries into FAR Australia's Fungicide Fingerprinting Evaluation Network or Germplasm Evaluation Network (GEN), please contact Rachel Hamilton on 0428 843 456 or email rachel.hamilton@faraustralia.com.au

FUNGICIDE FINGERPRINTING
an independent fungicide evaluation network

Physiology of Winter Germplasm - are there opportunities to make more use of this germplasm in the L-MRZ as well as the HRZ?

Dr Ben Jones, Senior Research Manager, Field Applied Research (FAR) Australia

Take-home:

- Winter wheats have yielded better than spring wheats over a yield range from 4 to 15 t/ha in southern Australia, even with sowing times that better favoured spring wheat
- The same advantage has not been seen in Western Australia to date, and may relate to soil or nutrition
- Continue to consider winter wheat for early sowing opportunities. New projects in 2024 should help to better understand where winter wheat works and why in WA.

Introduction

Winter wheats require exposure to cool temperatures (range -2 to 15C) before they transition from the vegetative (tillering) to reproductive (spike growth and grain set) stages. In contrast to 'spring' wheats (which are less sensitive to cool temperatures), winter wheats can be sown early with less risk of early flowering and frost damage. The result is a longer vegetative period leading to several potential advantages:

- Deeper root growth (and access to nitrogen and water if there)
- More water used by the crop; less evaporated (or drained)
- Greater associated nutrient uptake, light interception and biomass accumulation
- Potential to graze excess biomass, or set more grains
- Less prone to waterlogging/better recovery
- Weed competition earlier in the season

There are also potential disadvantages, among which the tendency for winter wheats to be feed quality is a significant one. This requires higher yields, or at least equivalent yields with some systems-related advantages (for example, grazing, or lengthening the sowing window).

Recent developments

Interest in winter wheats increased considerably in the low- and medium-rainfall zone with interest in early sowing and dual-purpose crops following the millenium drought. James Hunt (2017) made an excellent review of the history of winter wheats in Australia and potential adaptations to these areas (as seen at the time).

Subsequently with interest in 'hyper-yielding' cereal crops in high rainfall zones, and the testing and subsequent introduction of a wide range of European winter germplasm, winter wheats have been widely tested in higher rainfall areas.
In 2024 FAR Australia are now part of two related GRDC projects: the first (with University of Melbourne) examines winter vs spring wheat growth in greater detail,

with a particular focus on understanding the poor harvest index when sown early in low- and medium-rainfall environments (Porker et al., 2020), and also on whether there are intrinsic differences that might be related to European vs Australian breeding priorities. The second (a one-year NGN project) tests a range of winter wheats with early sowing in the Western Australian high rainfall zone. It is timely to review what has been learnt since then.

Winter vs spring wheat yield comparisons

Between 2016 and 2023, FAR Australia have grown winter and spring wheats together in 37 different comparisons across southern Australia (Figure 1). In 14 of these the sowing times have been relatively early (ie. before April 25; notionally better suiting winter wheats), but the remainder have been neutral (April 25 – May 2; 10 comparisons), or combined neutral or winter-suited sowing times with sowing times that would better suit spring wheat (>May 2; 12 comparisons).

Generally where winter and spring wheats have been sown early, winter wheats yield higher (Figure 1). This is not surprising, partly because early sowing forces the 'critical period' of the spring wheat into a less favourable light environment. There have, however, been enough comparisons where timing might have better favoured the spring wheats, and winters have still significantly out-yielded springs. This has happened across a yield range, with one notable exception: most comparisons sown in Western Australia, even with sowing times favouring winter wheats.

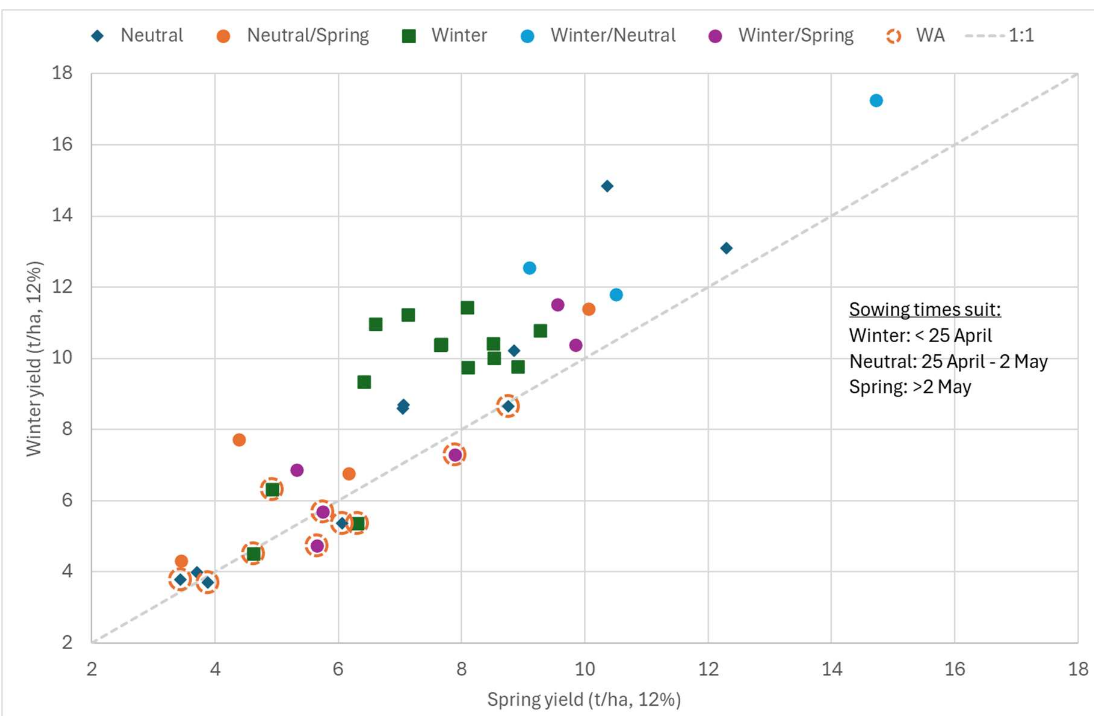


Figure 1. *Highest winter vs spring yield in comparisons in FAR Australia experiments, southern Australia 2016-2023. Points are coloured according to whether sowing times in the comparison favoured winter wheat, spring wheat, were neutral, or a combination. Points from Western Australian crops are circled in orange.*

Differences in WA

There could be many reasons for winter wheats (even with early sowing) not out-yielding spring wheats in Western Australia; hopefully more can be said about the FAR comparisons at the time of the field days.

One thing that is conspicuous is that Western Australian winter wheat crops have also tended to have less favourable nitrogen nutrition. In other states, winter wheats are more likely to have more nitrogen harvested in grain (Figure 2), and by implication, have been able to access more nitrogen in soil.

It is possible that limited soil depth or inadequate nitrogen nutrition is the reason for this. There is no advantage to growing a deeper root system if the root depth is limited anyway, or there is little additional resource to access at depth. There still should be advantages to increasing water use by sowing early (given an appropriate break) in a winter-dominant rainfall environment like Western Australia; perhaps closer attention needs to be given to the nutrition requirements that go with it?

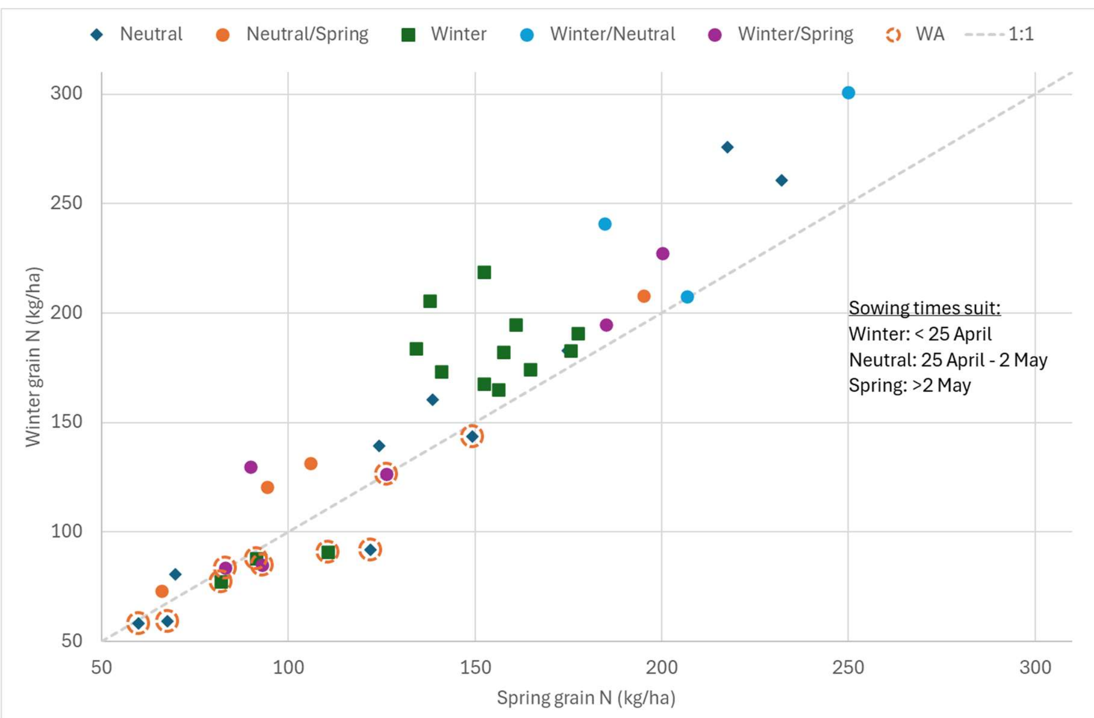


Figure 2. *Nitrogen harvested in grain in highest yielding winter and spring wheats (comparisons in FAR Australia experiments, southern Australia 2016-2023). Points are coloured according to whether sowing times in the comparison favoured winter wheat, spring wheat, were neutral, or a combination. Points from Western Australian crops are circled in orange.*

Recommendations

Keep an eye on the possibilities offered by winter wheats and early sowing, particularly as adapted cultivars are tested in Western Australia. They have shown potential at a range of yields in other parts of Australia, and should have at least some of the same potential in seasons where there are early sowing opportunities, and system-related advantages such as spreading sowing time, or grazing.

References

Hunt, J.R., 2017. Winter wheat cultivars in Australian farming systems: a review. Crop Pasture Sci. 68, 501. https://doi.org/10.1071/CP17173

Porker, K., Straight, M., Hunt, J.R., 2020. Evaluation of G × E × M Interactions to Increase Harvest Index and Yield of Early Sown Wheat. Front. Plant Sci. 11, 994. https://doi.org/10.3389/fpls.2020.00994

Hyper Yielding Crops project – update on lessons for WA High Rainfall Zone

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[1] Field Applied Research (FAR) Australia

Key point summary

- *Drier conditions in September and October reduce yield potential and grain quality particularly in crops flowering later in the season, this was the case in 2023.*
- *In 2023 earlier sown crops (29 April) on average yielded more than those sown later (17 May) and spring varieties out yielded slower developing winter types.*
- *Grain yields of the highest yielding wheats (5t/ha) were almost 1t/ha* ***lower*** *than highest yielding barleys (approx. 6t/ha) sown at the same time, on the same site.*
- *Economic analysis of the Germplasm x Environment x Management (GEM) trials in HYC showed that the 2023 season on average better suited a strategic or tactical management approach in barley, but higher input costs in wheat paid off where higher classification of the grain was achieved.*

Yield

The 2023 Frankland River Crop Technology Centre (CTC) was host to two Germplasm x Environment x Management (GEM) trials, part of a national HYC trial series. These trials, in wheat and barley, looked at the interaction between five cultivars across four management regimes – low input (minimalist approach), high input (no expenses spared), strategic input (tailored approach based on pre-season forecasts/expectations) and tactical (tailored approach based on strategic with in-season adjustment guided by climate and in-season triggers).

Yield in the wheat trial indicated there was no strong influence of management on results (Table 1). There was no interaction between management and cultivar and no significant differences between management means, likely driven by the lack of disease and lodging in the trial and drier weather during stem elongation and grain fill. There was however a significant impact of variety choice on yield with Rockstar and Denison yielding significantly higher than all other cultivars, while the long season winter red wheat RGT Accroc yielded significantly less.

Table 1. *Influence of management strategy and cultivar on wheat grain yield (t/ha) in the GEM trial.*

	Yield (t/ha)									
	Low Input		High Input		Strategic		Tactical		Mean	
Scepter	5.29	-	5.47	-	5.28	-	5.02	-	**5.26**	**b**
RGT Accroc	4.61	-	4.94	-	4.76	-	4.74	-	**4.76**	**c**
Mowhawk	5.40	-	5.36	-	5.24	-	4.97	-	**5.24**	**b**
Illabo	5.49	-	5.47	-	5.21	-	5.28	-	**5.36**	**b**
Rockstar	5.70	-	6.19	-	6.03	-	5.88	-	**5.95**	**a**
Denison	5.87	-	6.01	-	5.72	-	5.82	-	**5.86**	**a**

Mean	**5.39**	**-**	**5.57**	**-**	**5.37**	**-**	**5.29**	**-**	**5.41**	
LSD Cultivar p = 0.05		0.18				**P val**		<0.001		
LSD Management p = 0.05		ns				**P val**		0.227		
LSD Cultivar x Man. p = 0.05		ns				**P val**		0.526		

In contrast, barley results showed significant interaction between management and cultivar (Table 2). Disease susceptible cultivars such as RGT Planet (SVS to NFNB and S to SFNB) and Rosalind (S to SFNB) showed greater response to more robust fungicide input. Inversely, the more disease resistant Laureate showed little response to changes in management. Overall the quick spring variety Rosalind and mid spring variety Neo CL yielded highest, both averaging 6.66 t/ha.

Table 2. *Influence of management strategy and cultivar on barley grain yield (t/ha) in the 2023 HYC GEM trial.*

	Yield (t/ha)									
	Low Input		**High Input**		**HYC Strategic**		**HYC Tactical**		**Mean**	
RGT Planet	5.75	k	6.13	ghi	6.25	f-i	6.21	ghi	**6.09**	**c**
Rosalind	6.31	e-h	6.76	abc	6.63	bcd	6.92	a	**6.66**	**a**
Laureate	5.83	jk	6.08	hij	5.99	ijk	5.74	k	**5.91**	**d**
Minotaur	6.39	d-g	6.05	hij	6.89	ab	6.54	cde	**6.47**	**b**
Neo	6.52	c-f	6.77	abc	6.83	ab	6.51	c-f	**6.66**	**a**
Mean	**6.16**	**b**	**6.36**	**ab**	**6.52**	**a**	**6.38**	**a**	**6.35**	
LSD Cultivar p = 0.05			0.14			**P value**		<0.001		
LSD Management p = 0.05			0.22			**P value**		0.030		
LSD Cultivar x Man. p = 0.05			0.27			**P value**		<0.001		

Economic analysis

Despite yields in wheat being similar across management strategies, that was not the case with grain classification (results not shown). While costing less on average, the low and tactical inputs which cut back on N nutrition and saw no PGR application showed lower partial net margins (taking into account the variable costs in each strategy) when compared to high and strategic inputs in the wheat GEM trial (Figure 1). The upside potential of achieving higher grain classifications offset the additional input costs involved. For example under low input Mowhawk, Illabo and Rockstar only achieved feed standard to receive a price of $350/t (averaging a partial net margin of $1,593/ha) compared to high input where the same three varieties achieved AUH2/H3 classification at $402/t (and an average partial net margin of $1,799/ha).

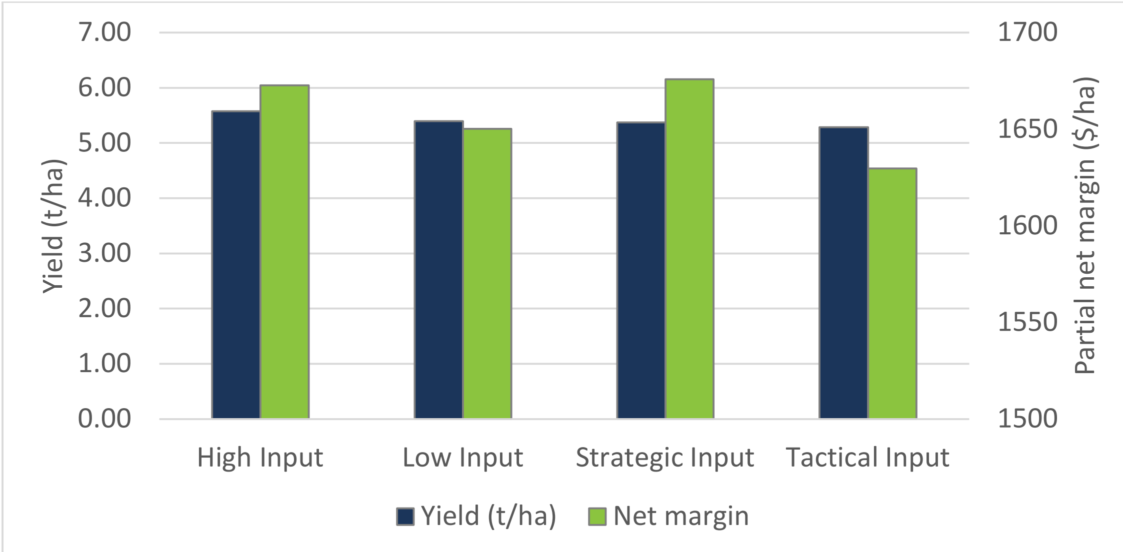

Figure 1. *Influence of management strategy on wheat yield (t/ha) and partial net margin ($/ha).*

Prices based on AUH2/H3 $402/t, APW1 $407/t, SFW1 $350/t, CT spraying $16.2/ha, CT spreading $9.2/ha, high input cost average - $473.2/ha, low input cost - $338.7/ha, strategic input average - $402.3/ha and tactical input average - $404.2/ha. Includes cost of seed treatment, foliar fungicides, PGR, nutrition, freight and grain.

Inversely barley varieties struggled to achieve proteins low enough to reach malt standards. Therefore the cost of the strategies had a larger effect on the partial net margins. In this case Rosalind, which was significantly lower yielding under 'low' management, the net partial net margins were improved by adopting a strategic or tactical approach. The variety Laurate, which gave little yield response to different management scenarios meant that the cheaper managements (low and strategic) gave better partial net margins.

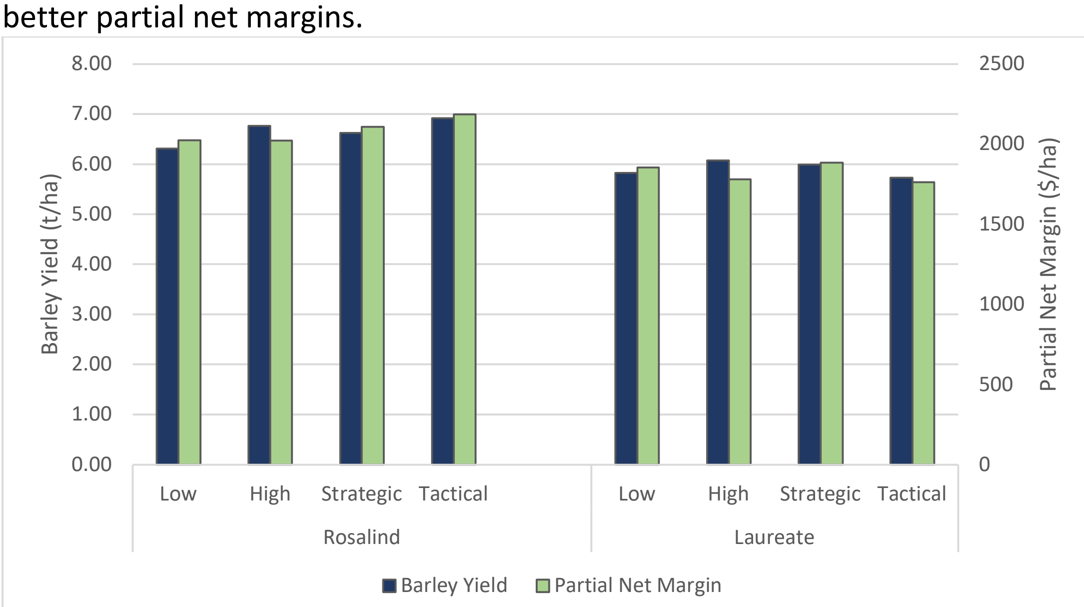

Figure 2. *Influence of management strategy on barley yield (t/ha) and net margin ($).*

Prices based on Malt $376/t, Feed $351/t, CT spraying $16.2/ha, CT spreading $9.2/ha, high input cost average - $517.7/ha, low input cost - $351.0/ha, strategic input average - $386.9/ha and tactical input average - $404.6/ha. Includes cost of seed treatment, foliar fungicides, PGR, nutrition, freight and grain.

Cereal phenology

It was noted in 2021 research that barley yields were 2t/ha higher in HYC trials than in 2022. Through investigation into photothermal quotient (PTQ) the 2022 earlier sowing (April 21st) resulted in crops flowering in early August as opposed to late August/early September when conditions for growth in the "*critical period*" were far better, as was the case in 2021 (crops in 2021 were sown on April 30th). It is now known through the work of HYC over the last four seasons that good solar radiation and cooler temperatures during the critical period are essential to maximise grain number in both wheat and barley (Porker et al. 2024, in review). Grain number is determined in the period of approximately 3 weeks before flowering. Maximising growth of the crop in this window is associated with higher yield potential (as a result of higher grain number per unit area) provided the crop is not subject to other stresses such as frost, heat stress or moisture stress.

In contrast to 2022, wheat and barley varieties in 2023 that developed quicker were the ones that eventually went on to yield higher. With higher-than-average maximum temperatures in August, September and October and higher-than average minimum temperatures in September and October, PTQ yield potential was reduced.

Furthermore, the drier than average conditions throughout spring made for a more hostile critical period for many varieties (Figure 5). When assessing the phenology stages of the varieties tested in FAR Australia's Industry Innovation Germplasm Evaluation Network (GEN) trial, the wheat varieties that had developed further on the 22nd September were amongst those that ended up being the highest yielding (Figure 3).

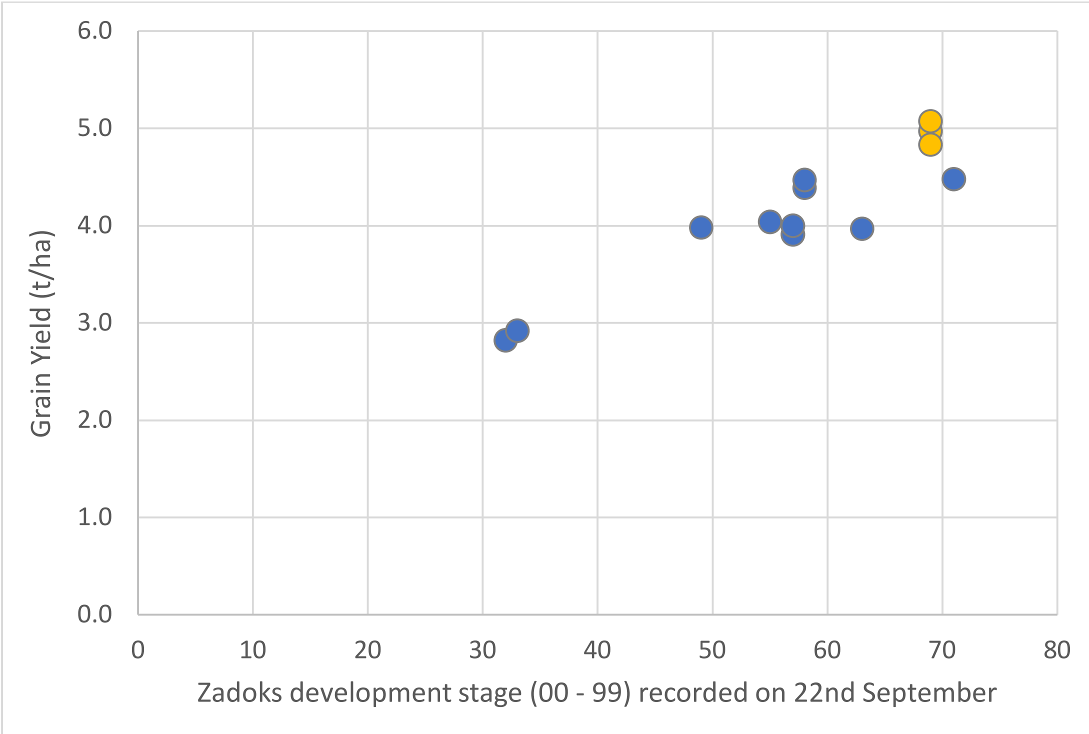

Figure 3. *Influence of development stage in 2023 (recorded on 22nd September) on final grain yield (t/ha). (three orange markers – Denison, Kinsei and Genie (tested as IGW6754) the three highest yielding varieties).*

Cereal disease

With wheat disease only found at very low levels across the 2023 site, much of the disease story developed in the barley trials at the Frankland River CTC. With increased areas of the high yielding barley RGT Planet being sown in the region, so has the prevalence of Net Form Net Blotch (NFNB). RGT Planet is rated SVS to the Oxford virulent, S to the Beecher virulent and MS to the Beecher avirulent pathotypes of the disease. Therefore NFNB has shifted from being an uncommon barley disease in WA to very prevalent. This disease, which is now widespread in both the west and eastern states, has reduced sensitivity and resistance to DMI chemistry in WA and increasing reports of resistance issues to SDHI chemistry in the east of Australia as well as WA. With the risk of resistance to fungicide on the rise, it is vitally important to consider integrated disease management (IDM) approaches, and being a stubble and seed borne disease, seed and paddock hygiene as well as variety selection are imperative.

On site the most dominant disease was NFNB in barley. Despite the susceptibility of RGT Planet, the dry spring kept levels of the disease to a minimum with 10% of untreated Flag-2 showing infection when tested on the 20th September at early grain fill (Figure 4). Most two, three and four fungicide unit programs were sufficient in controlling the disease with between 60% and 70% control. Single applications of fungicides showed less control, especially in the case of a single application of propiconazole (Tilt 500) which showed no significant difference in severity or incidence when compared to the untreated. Due to the low levels of disease experienced and drier conditions than average reducing yields, there was no response to fungicides on final grain yields (Figure 5).

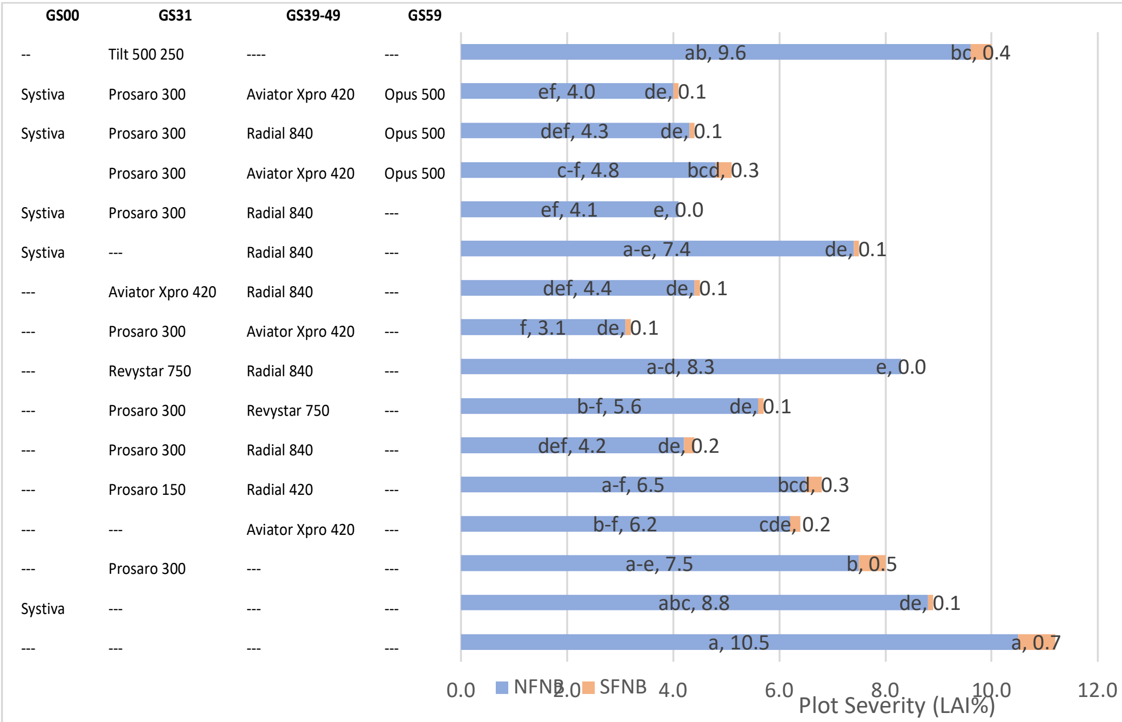

Figure 4. *Net Form Net Blotch (NFNB) and Spot Form Net Blotch (SFNB) severity on Flag-2 tested on 20 September, Z73. Fungicide rates expressed at mL/ha.*

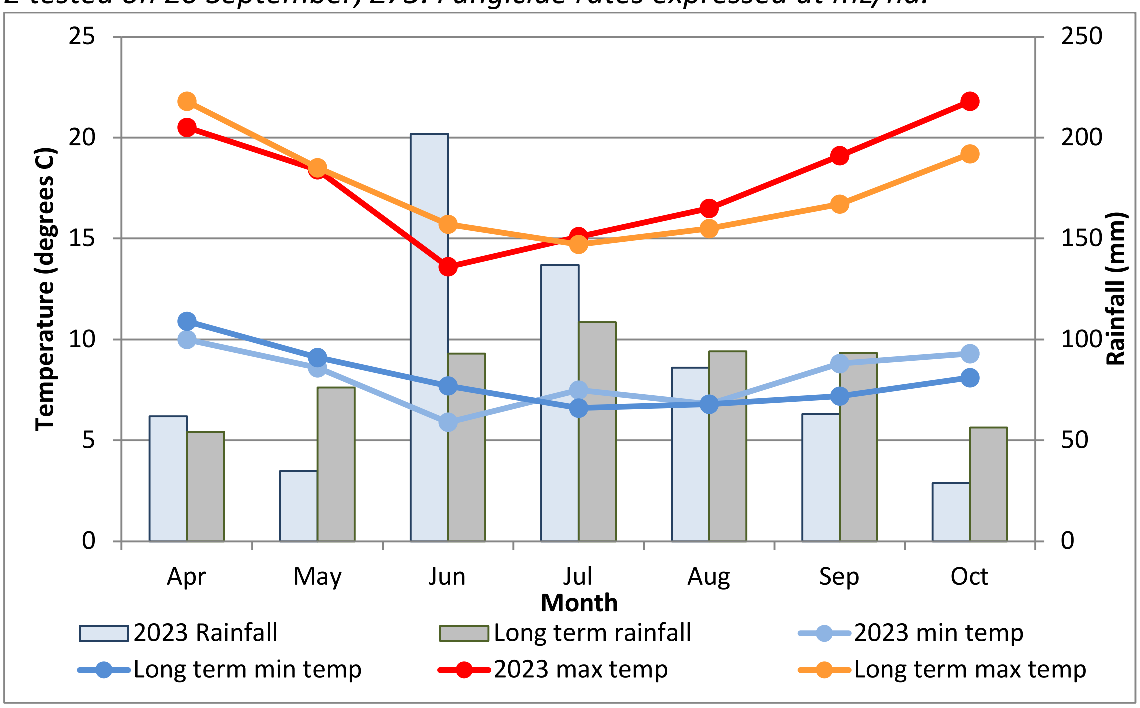

Figure 5. *2023 growing season rainfall and long-term rainfall and long-term min and max temperatures recorded at Rock Gully (1995 to 2023) for the growing season (April to October). Rainfall April to October= 613.4mm.*

‘Growers Leading Change’
Hyper Profitable Crops

Rachel Hamilton and Nick Poole, FAR Australia and Dan Fay, Stirlings to Coast Farmers

Overview:
the Hyper Profitable Crops (HPC) initiative is a new GRDC investment aimed at significantly boosting on-farm profitability for wheat and barley growers in Australia's high rainfall zones. Despite the progress made by previous research initiatives, a considerable gap remains between actual crop yields and the potential profitability in these regions. The HPC initiative seeks to bridge this gap by putting cutting-edge research into practice on the farm, enabling a wide range of growers to enhance their profitability.

Project Goals:
Building on the success of earlier GRDC Hyper Yielding Crops investment, which demonstrated improved crop water use efficiency and higher yields through informed decisions on variety, sowing date, fertiliser, and disease management, the HPC initiative will focus on translating this knowledge into actionable strategies for growers. The ultimate goal is to equip wheat and barley growers in high rainfall environments with the motivation, agronomic support, and expertise needed to close the yield gap while maximising profit by April 30, 2027.

Innovation and Benchmarking Hubs:

Central to the initiative are seven innovation and benchmarking hubs strategically located across key high rainfall zones, including the South Coast of Western Australia, South-eastern South Australia, Southern Victoria, Tasmania, and Southern New South Wales. These hubs will act as centres for knowledge exchange, facilitated discussions, and hands-on crop inspections. They will enable growers to learn from each other and explore and implement innovative agronomic practices that can lead to increased on-farm profitability.

Discussion Groups and On-Farm Benchmarking:
As part of the HPC initiative, 17 discussion groups have been established across the high rainfall zones. These groups aim to not only boost on-farm profitability but also build confidence among Generation Y growers and advisors, who will play a pivotal role in leading change within their regions. Through on-farm benchmarking of paddock performance and smaller HPC-specific trial programs, growers will have the opportunity to refine their management practices, optimise crop yields, and achieve more profitable outcomes.

Collaboration and Support:
FAR Australia has partnered with regional farming systems groups to provide dedicated project officers in each region. These officers will work closely with farmers and agronomists to collect input and operational data, which will be costed generically per region using the Agworld data platform. Importantly, no individual financial data will be requested from participating growers. In addition to this support, the initiative will produce a comprehensive high rainfall zone cropping manual, offering valuable insights and case studies to guide future decision-making.

How to get Involved:
To become involved in the Hyper Profitable Crops initiative, growers can contact the HPC Project Officer in their respective region:

- Stirlings to Coast Farmers: Dan Fay (dan.fay@scfarmers.org.au)
- South East Premium Wheat Growers Association (SEPWA): David Cook (david@sepwa.org.au)
- Farmlink: Caroline Keeton (caroline@farmlink.com.au)
- Riverine Plains Inc: Kate Coffey (kate@riverineplains.org.au)
- Southern Farming Systems:
    - (VIC) Ashley Amourgis (aamourgis@sfs.org.au) or Greta Duff (gduff@sfs.org.au)
    - (TAS) Brett Davey (bdavey@sfs.org.au)
- Mackillop Farm Management Group: Gina Kreeck (research@mackillopgroup.com.au)

Project Leadership:
The HPC initiative is led by Rachel Hamilton of FAR Australia, supported by a technical team including Dr. Ben Jones, Darcy Warren, Tom Price, and Nick Poole.

For further information, please contact Rachel Hamilton at rachel.hamilton@faraustralia.com.au.

FAR Australia has collaborated with the following organisations:

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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