Welcome to the GRDC's

HYPER YIELDING CROPS: RESULTS AND AWARDS (WA)

What did we learn in year one?
Which award paddocks came out on top and why?

Regional Project Partner:

STIRLINGS TO COAST FARMERS

SOWING THE SEED FOR A BRIGHTER FUTURE

HYPER YIELDING CROPS (FAR2004-0025AX)

A national initiative striving to push crop yield boundaries in high yield potential grain growing environments.

- A GRDC Investment (over 4 years) – 2020 to 2024
- Applied research, development and extension project co-ordinated and led by Field Applied Research (FAR) Australia.
- Collaborating with the following project partners:

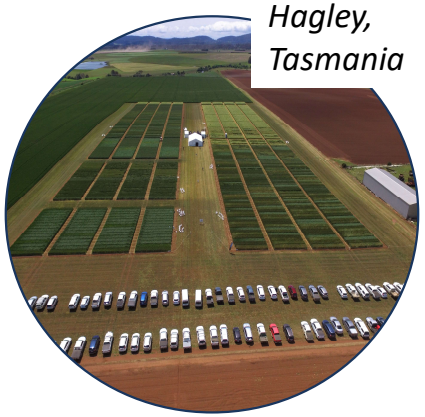
SOWING THE SEED FOR A BRIGHTER FUTURE

Project investment

- To screen for high yield potential cultivars suited to local environments.
- Appropriate agronomic management tactics – including paddock selection and preparation, canopy management, disease, weed and pest control, and crop nutrition strategies – will be explored to assist grower and adviser decision making.
- Focus farms and HYC awards programme to encourage growers to become involved and enable a seeing-is-believing participatory approach.

HYPER YIELDING CROPS

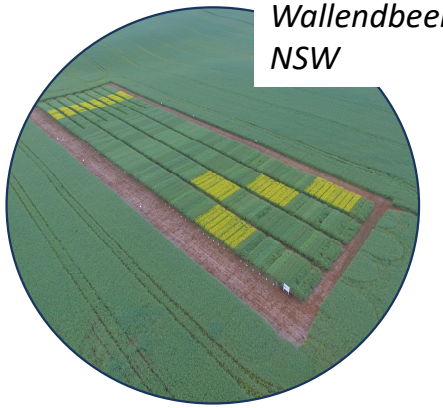
5 HYC Research Centres



Hagley, Tasmania

Millicent, South Australia

Green Range, WA (2020) & Frankland 2021



Wallendbeen, NSW

Gnarwarre, Victoria

SOWING THE SEED FOR A BRIGHTER FUTURE

2020 Season Re-cap

14th July 2021

FAR Australia Albany Crop Technology Centre 2020 Location for Hyper Yielding Crops Project 2020 (courtesy of Scott Smith)

Photo: James Rollason (FAR)

Albany Crop Technology Centre

Albany CTC Pre sowing, 20th April 2020

Albany CTC 29th July 2020

2020 FAR Albany Crop Technology Centre

Rotation Position: 1st Cereal after canola
Soil type: Shallow duplex sand over gravel over clay. “Smudged” 2019/20, clayed 2017.
Sown: 1,2 May
Seeding Rate: 200 seeds/m2
Basal Fertiliser: 90kg/ha MAP
Harvested: 25th November and 17th December
2020 GSR (Apr-Nov): 476mm

Green Range – 2020 Meteorological Data

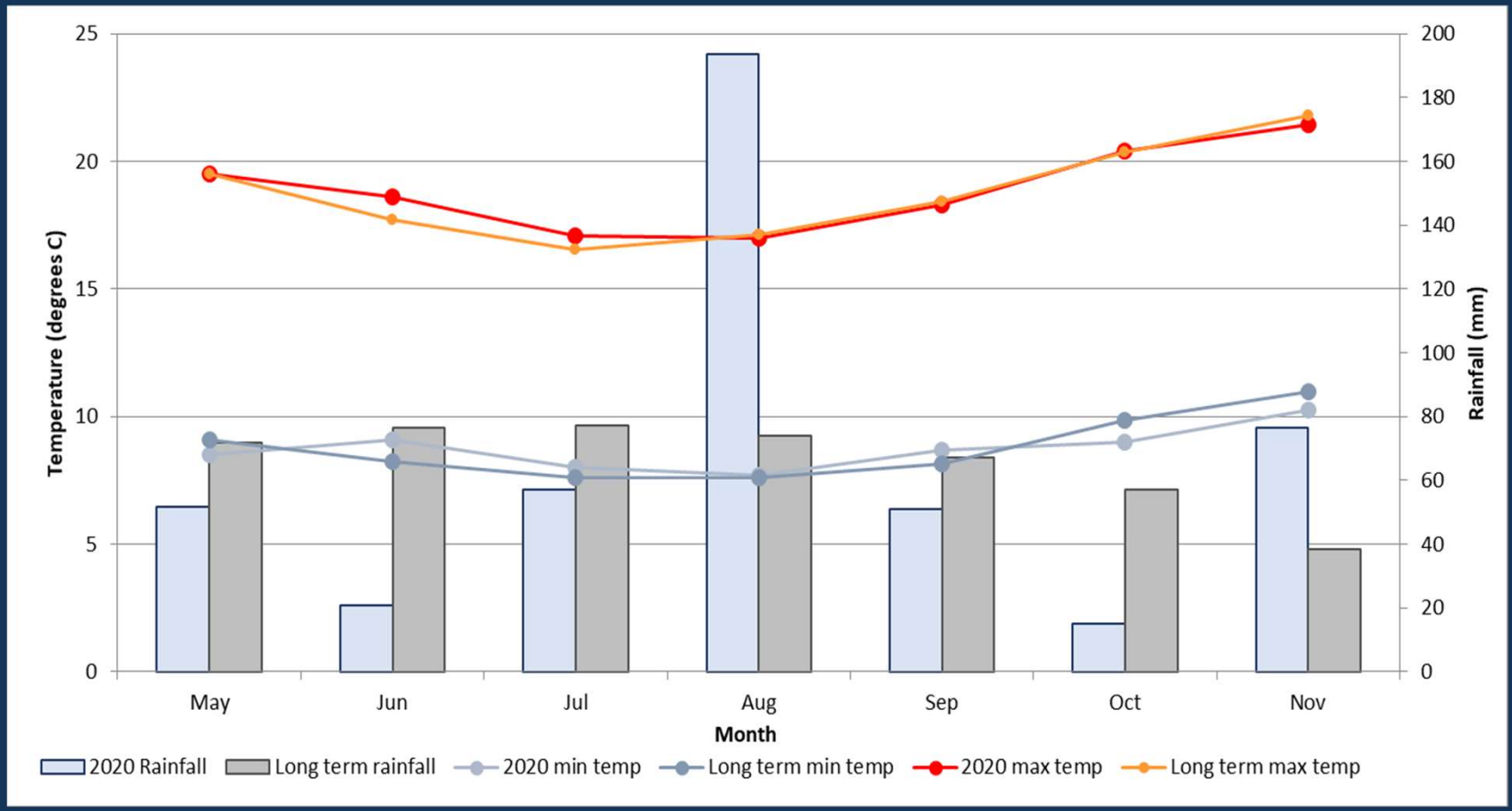


Figure 1. Monthly 2020 and long-term (1919-2020) average growing season rainfall, average minimum and average maximum temperatures for the growing season (April to October) recorded at BOM's Warriup weather station, approximately 17km south-east of the trial site. 2020 GSR (Apr-Nov): 476mm

Warriup, WA – July 2020 Daily Rainfall

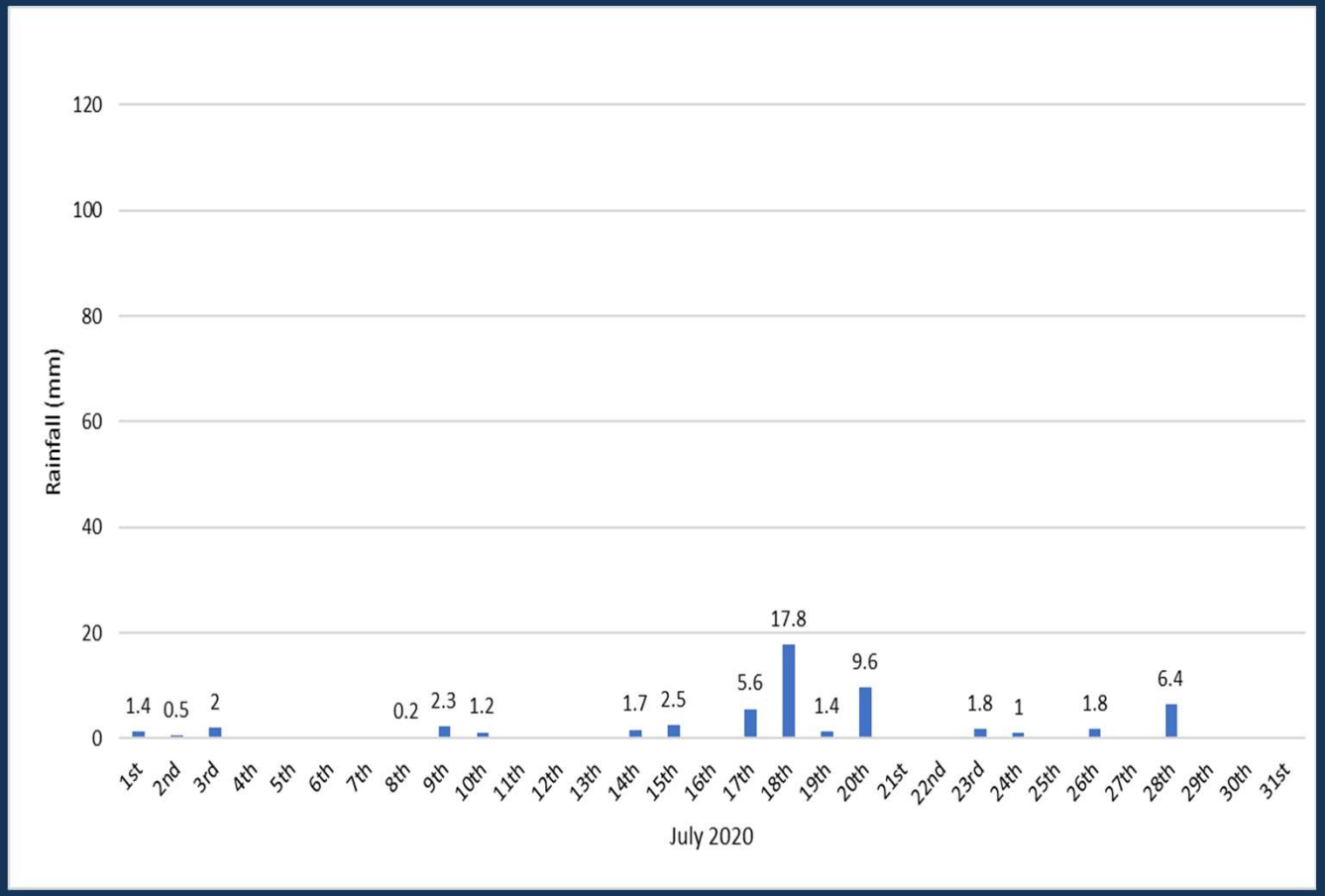


Figure 2. Daily Rainfall recorded at Warriup, WA in July 2020.
Note: Zero figures not displayed

July

2020: 57.2mm

Long-term (1919-2020) Mean: 77.3mm

10th %ile: 44.8mm

90th %ile: 114.1mm

Warriup, WA – August 2020 Daily Rainfall

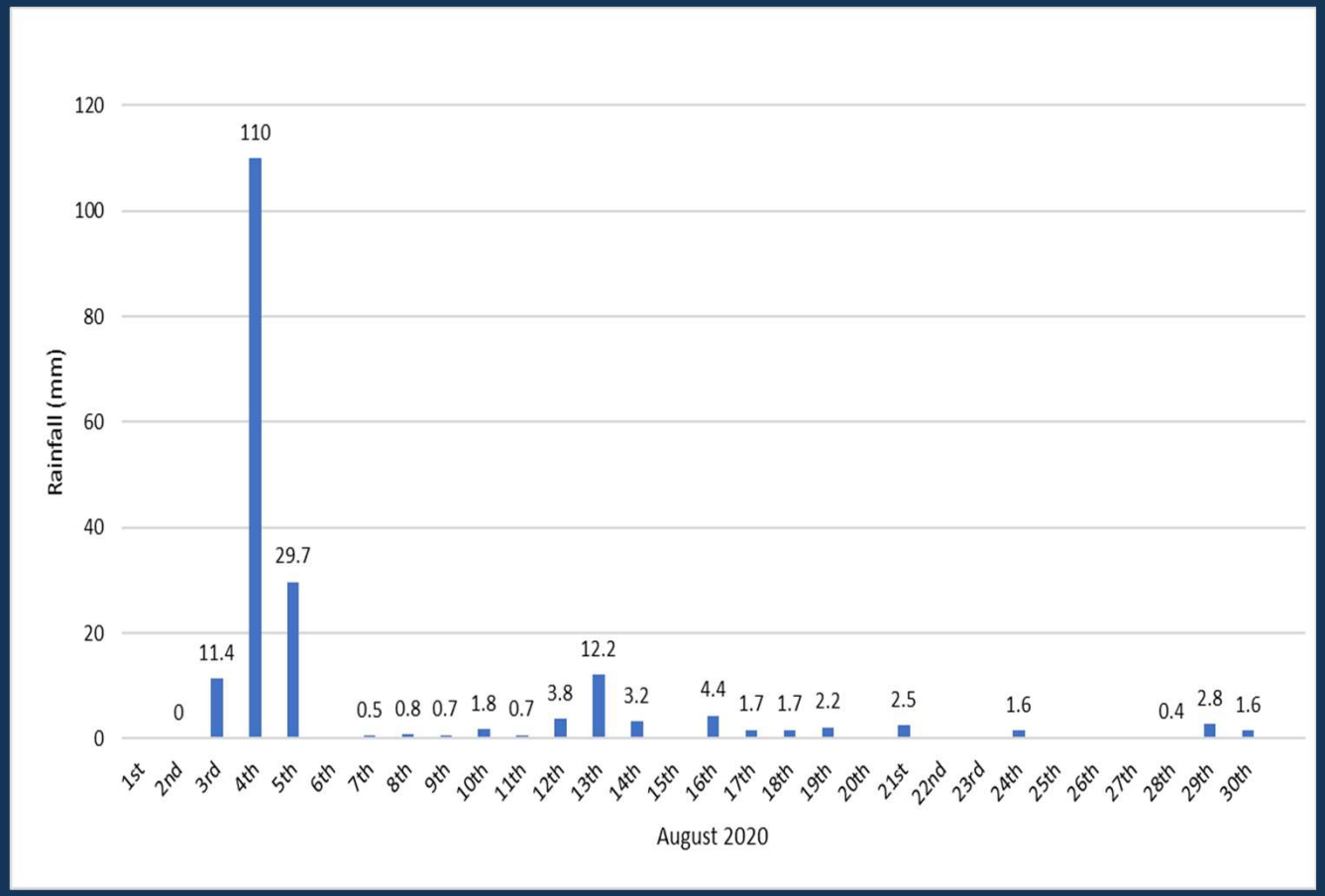


Figure 3. Daily Rainfall recorded at Warriup, WA in August 2020.
Note: Zero figures not displayed

August

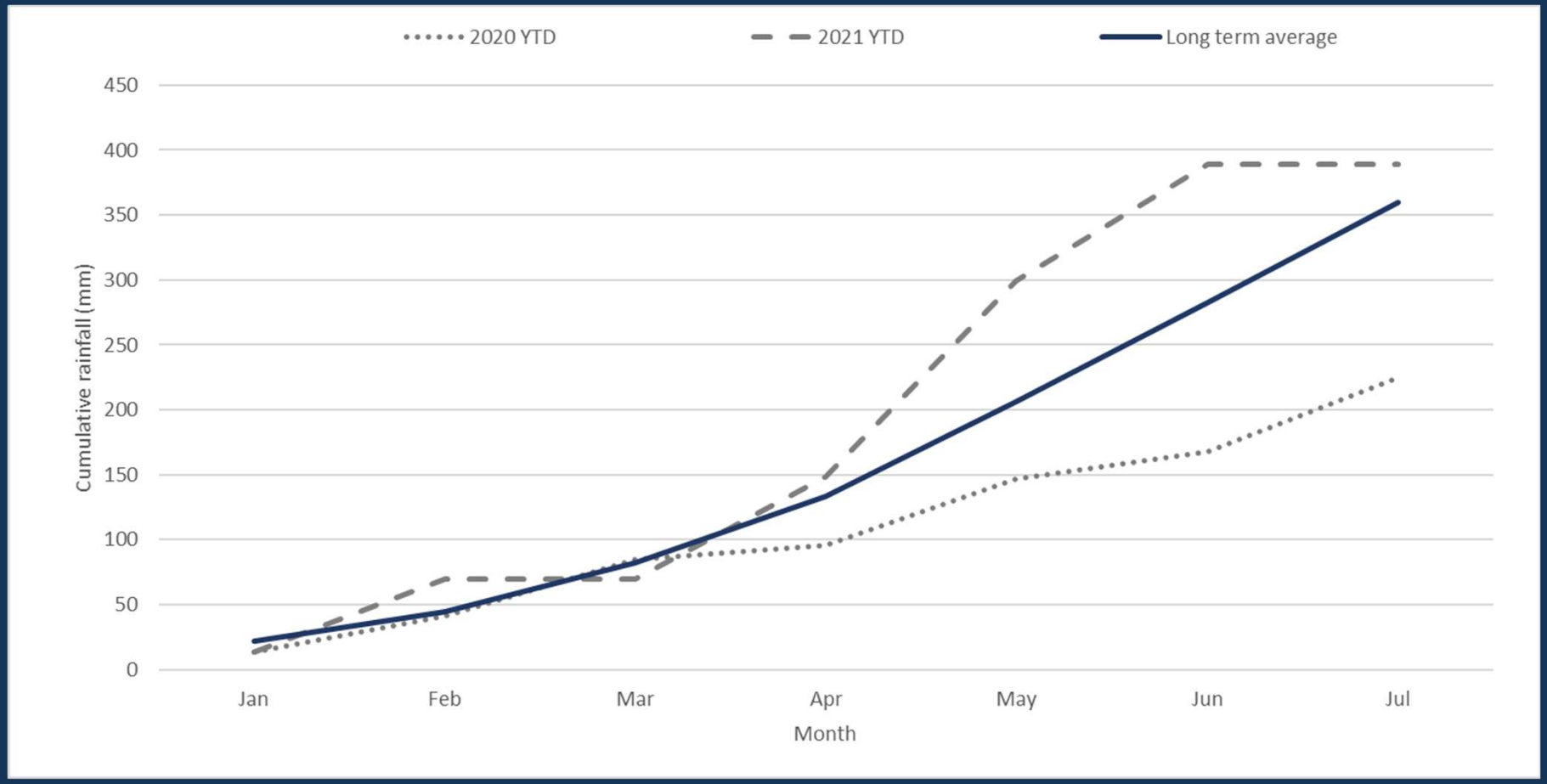
2020: 194mm

Long-term (1919-2020) Mean: 74.1mm

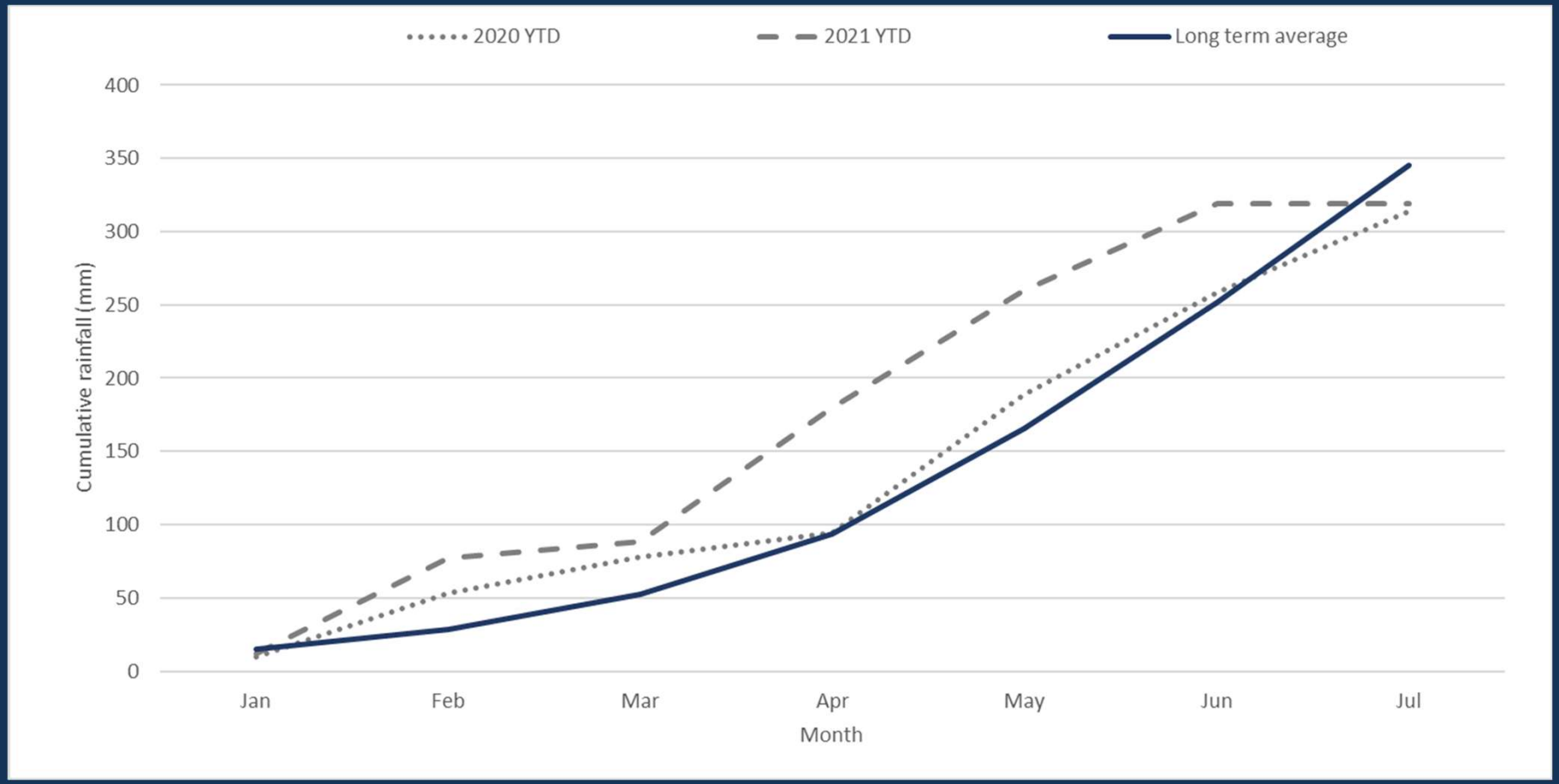
10th %ile: 42.9mm

90th %ile: 111.3mm

Green Range – 2020, 2021 Cumulative Rainfall Year to date (YTD)



Frankland – 2020, 2021 Cumulative Rainfall Year to date (YTD)



South Stirlings – June 2021

Photo: Phil Honey (Stirlings to Coast Farmers)

2021 FAR Albany Crop Technology Centre

Photo: James Rollason (FAR)

Generating Hyper Yielding Barley – What does a Hyper Yielding crop look like

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

HYC Results and Awards Evening

14th July, 2021

What does a hyper-yielding barley crop look like?

	Grain Yield (t/ha)	Harvest Index (%)	Dry Matter t/ha	Heads/ m^2	Grains per spike	Grain Weight (mg)
WA HRZ	**8**	**>50**	**14.5**	**650**	**26**	**48**
SE Australian	10	>50	18	600	32	50
TAS Spring	12	>50	22	800	28	55

What's different about these environments?
Is it different enough to change management?
How can we hit these numbers?

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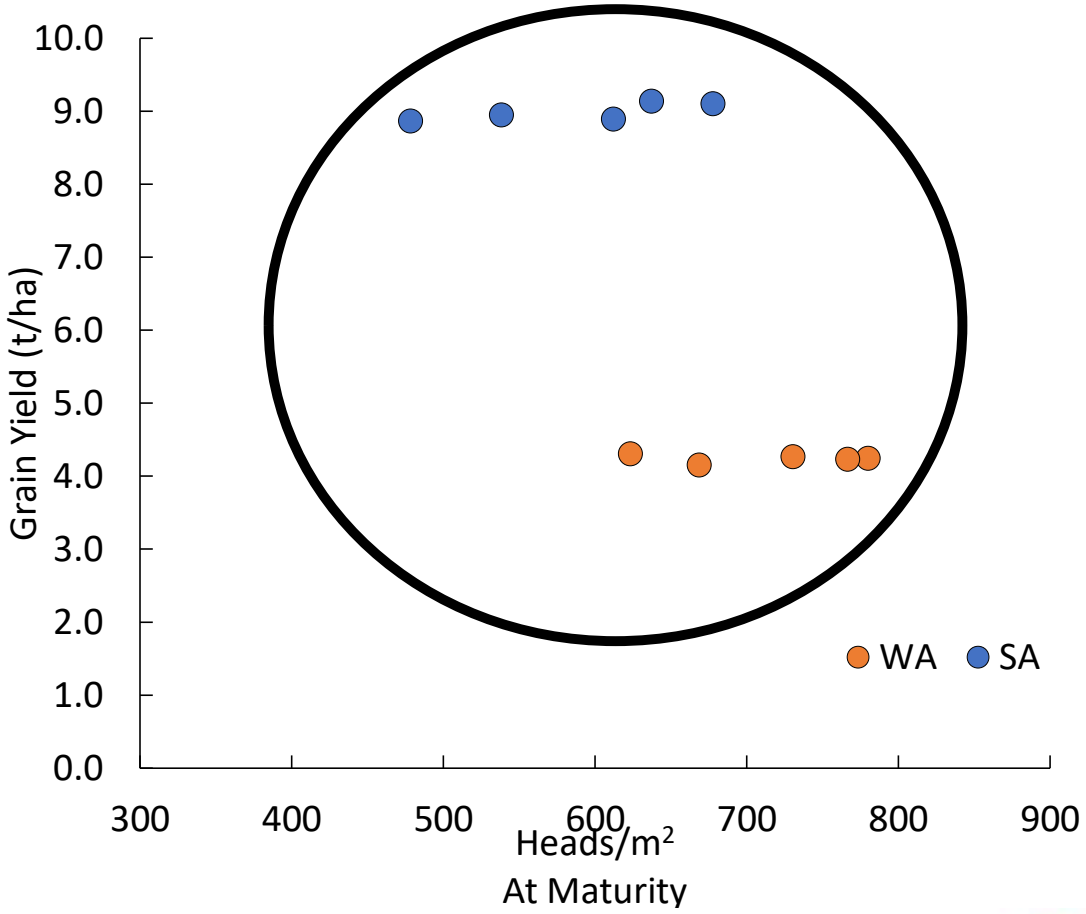
GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

What does a hyper-yielding barley crop look like?

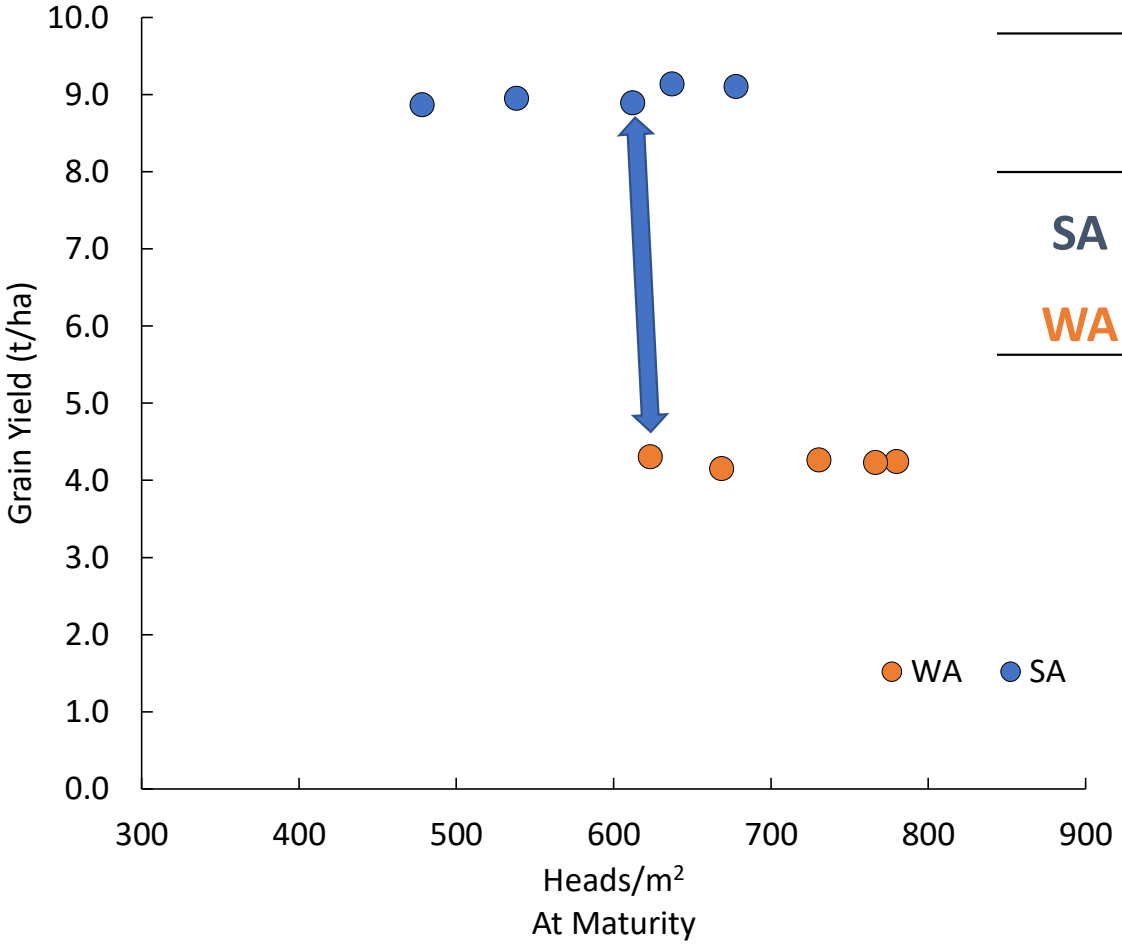
RGT Planet in 2020



Head number difference relates to environment and management prior to growth stage 30

What does a hyper-yielding barley crop look like?

RGT Planet in 2020



	Grain Yield (t/ha)	Heads/ m²	Grains/ spike	Grain Weight	Harvest Index (%)
SA	9.1	637	28.1	51.0	54.0
WA	4.3	623	18.8	36.7	34.7

The business end: Relates to environment and management during the critical period

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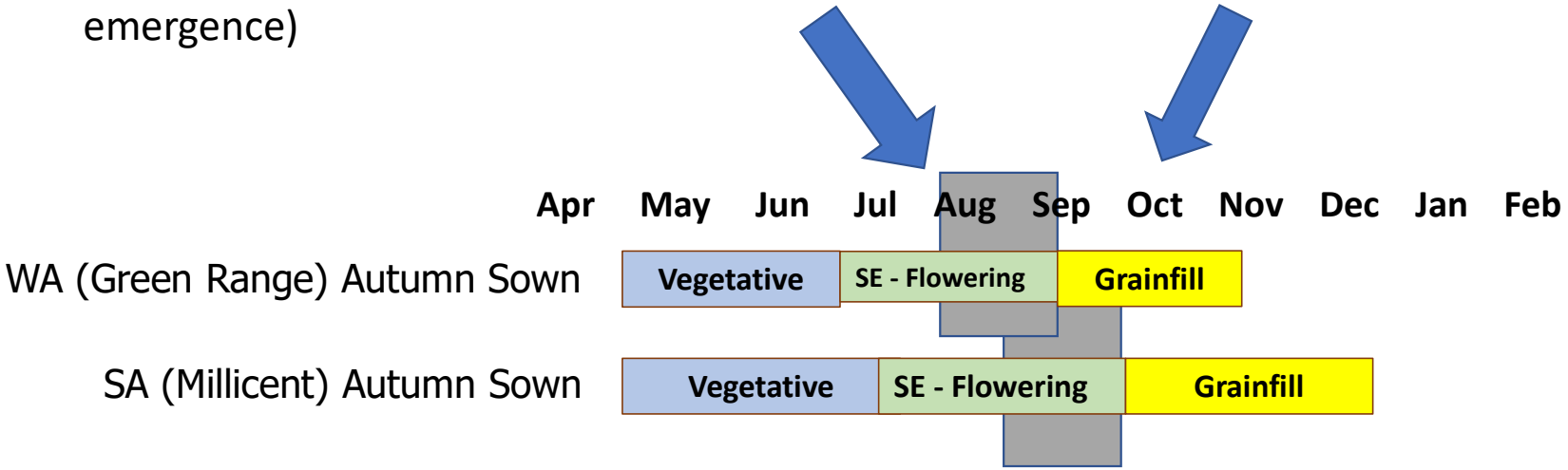
Crop Physiology rules for the High Rainfall Zone

2. Manage your crop so that it is intercepting 90 – 95% radiation with green leaves by the start of the critical period (before flag leaf emergence)

1. Flower during the optimum period



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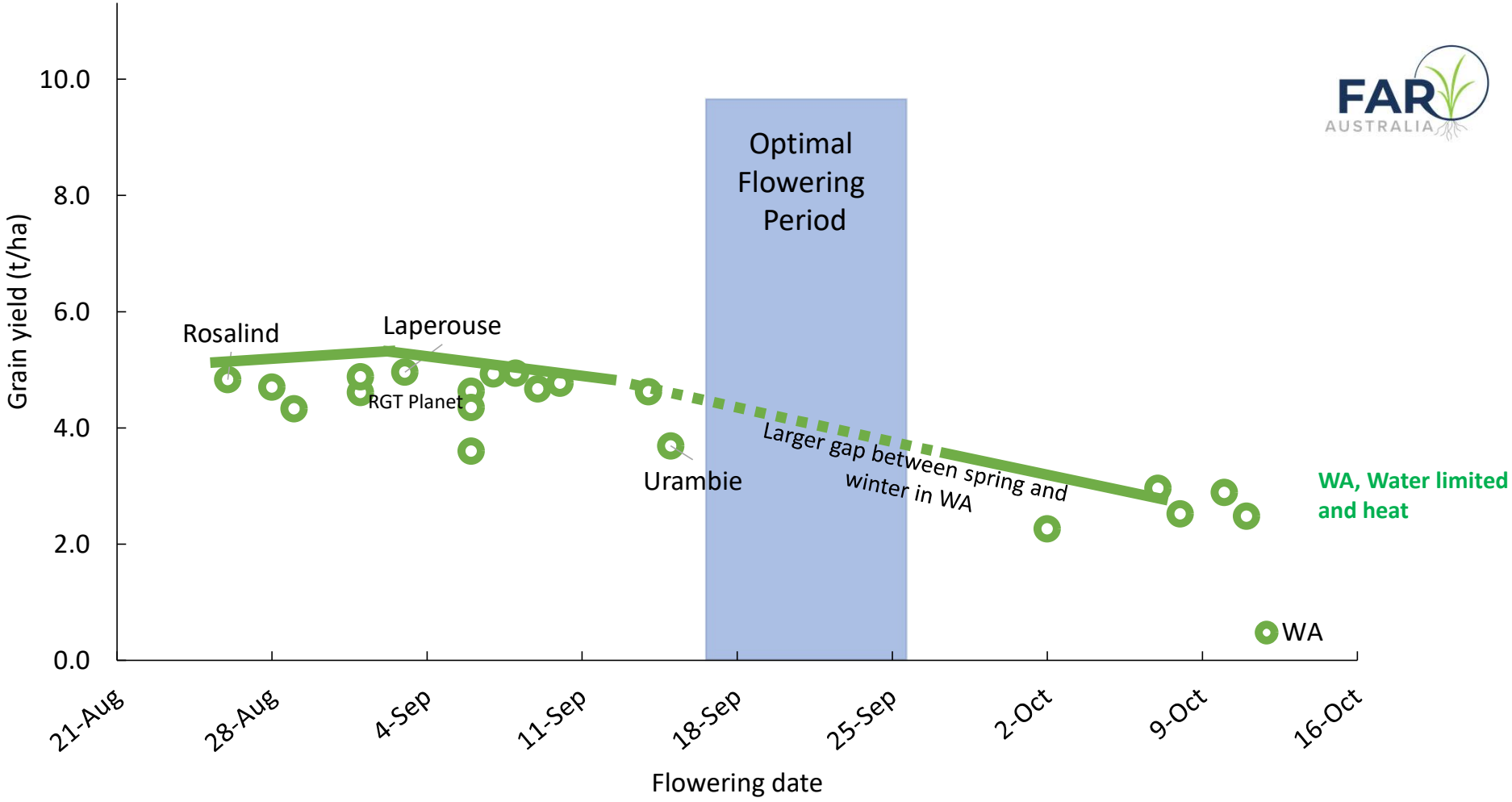
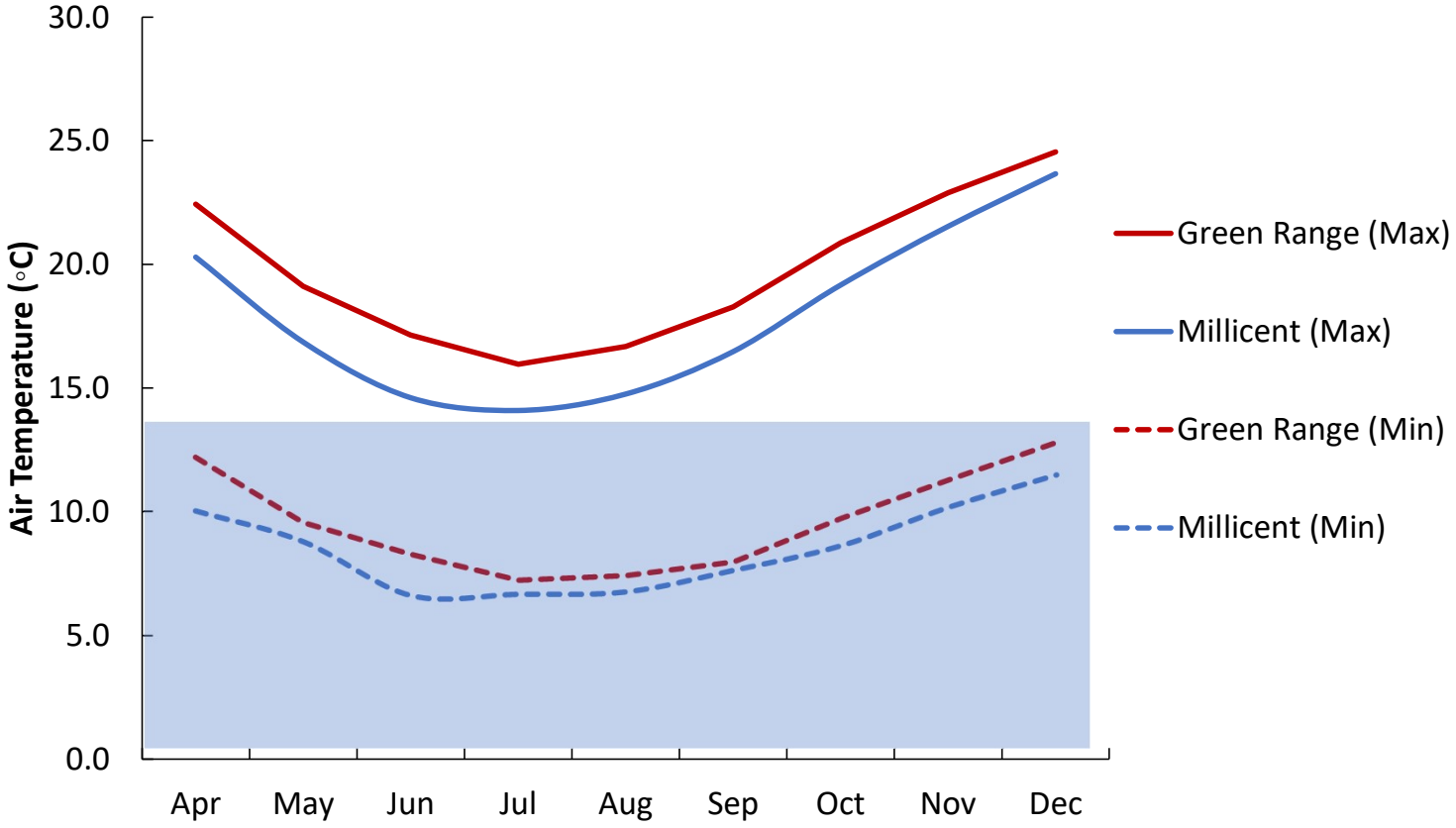
Genotype: Elite series → Yield improvements?? better matching life cycle to environment



Vernal temperatures are similar but mean daily temperatures are higher = faster development in spring germplasm

Day time temperatures

Vernalisation range



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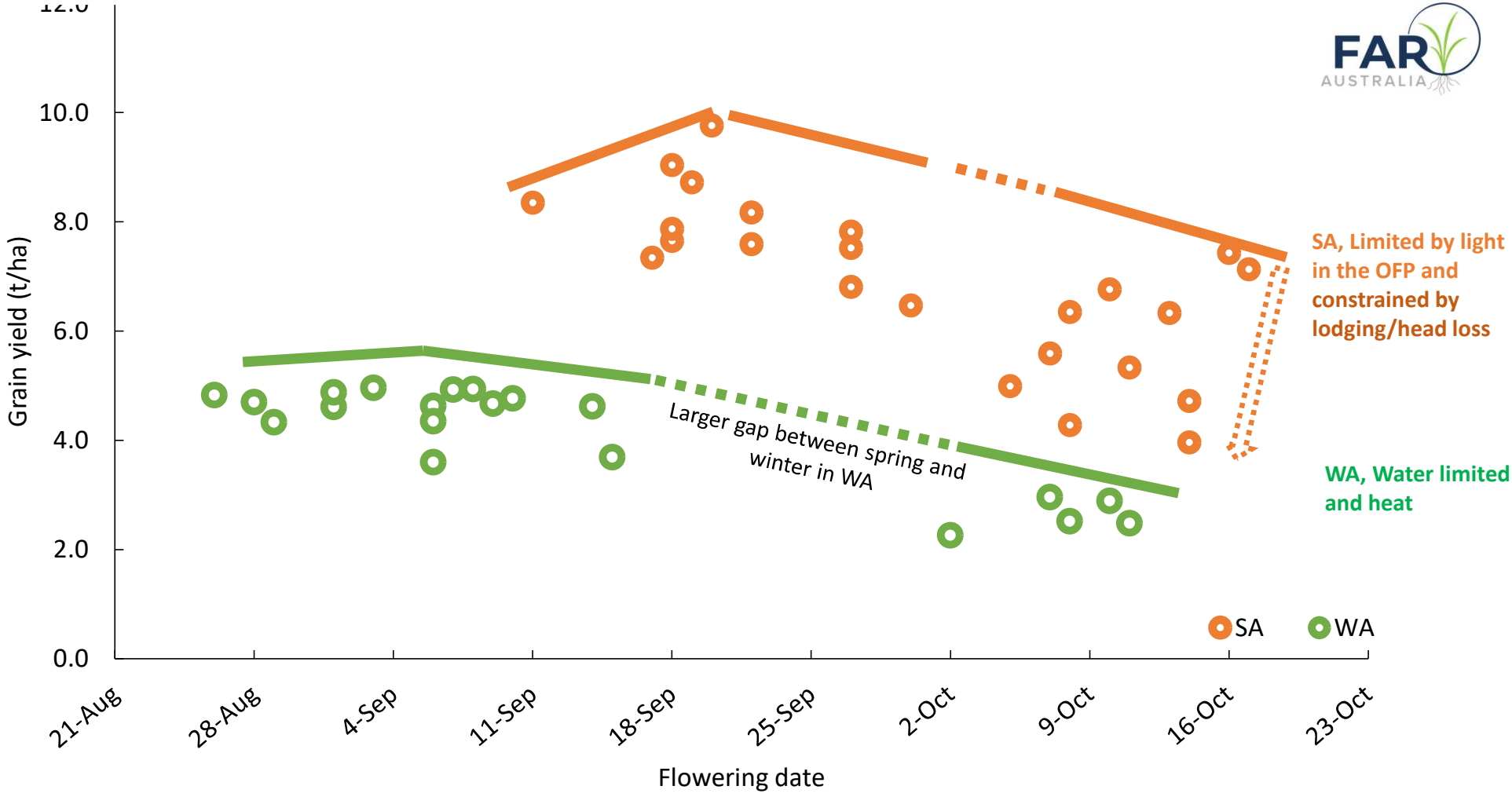
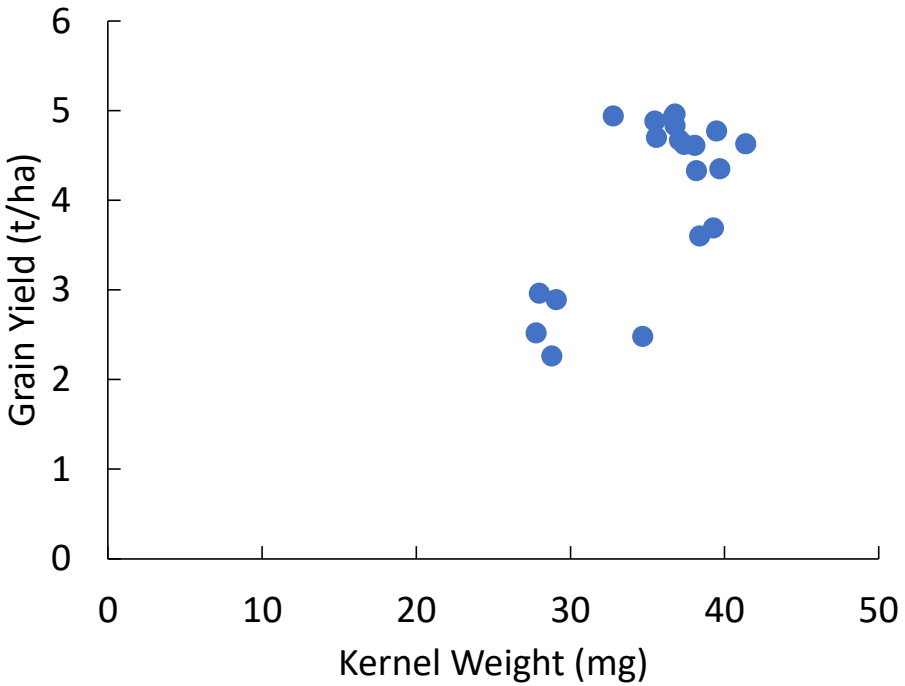
Genotype: Elite series (20 April sowing) → Yield improvements?? better matching life cycle to environment



Quicker winters/slower springs will be required for early sowing in WA

Maintaining grain weight under a more hostile grain filling environment will lead to improved harvest index and yield



Aligning development:
Slowing down fast developing springs:
Turning one cultivar into two: “Reset Strategy”

WA 2020 defoliation responses

	% Yield Penalty	% Grain Weight Reduction
Rosalind	-19	-7
RGT Planet	-11	-10
Urambie	-8	-8

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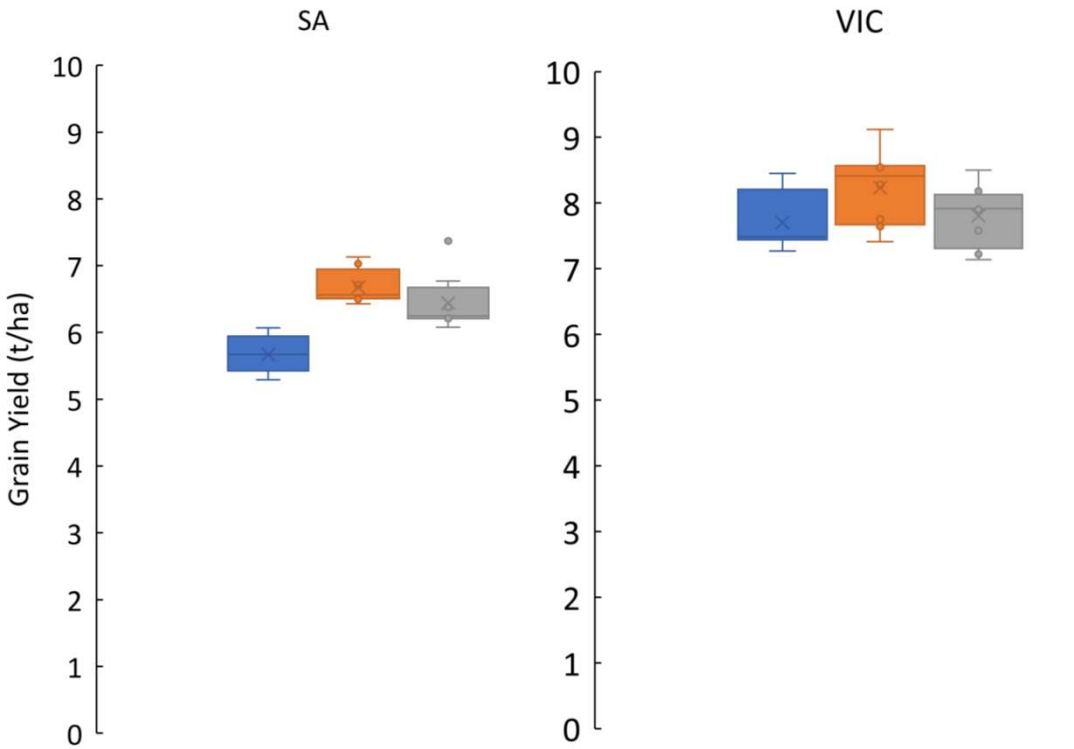
After aligning the critical period (using right genetics and sowing dates) these two factors were the biggest yield constraints in 2020

2020 HYC GxExM Series

What can we achieve with management?



Yields across all management interventions (n= 8 per cultivar per site

Photo credit: Mark Seymour DPIRD Twitter

Cassiopee
WINTER

RGT Planet
Mid-quick spring

Rosalind
Very quick spring

Current HYC national benchmark

Laureate Barley

Sown 1st September (Hagley)

Yield = 11.42t/ha
Protein = 13.3%
TestWeight = 65.9kg/hL
Retention = 98.5%
Screenings = 0.4%

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Thank you to GRDC and collaborating colleagues

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Genetics and management are improving

Genetics and management are improving

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

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

Table 1. Grain yield (t/ha, % site mean) and grain quality results.

	Grain Yield				Grain Quality					
Variety	**Yield**		**Trial Mean**		**Protein**		**Test wt**		**Colour**	
	(t/ha)		**(%)**		**%**		**kg/HL**		**%**	
RGT Planet	4.63	a	113.5	a	10.2	b-g	68.2	ab	58.7	bcd
Rosalind	4.83	a	118.4	a	10.2	b-g	65.9	bcd	57.7	ef
Cassiopee	2.26	f	55.4	f	11.1	b	54.1	f	56.0	g
Urambie	3.69	bcd	90.4	bcd	11.1	b	65.9	bcd	59.0	abc
Westminster	4.61	a	113.0	a	9.5	efg	66.8	abc	58.3	cde
AGTB0213	4.62	a	113.2	a	9.4	fg	68.0	abc	59.7	a
AGTB0245	4.77	a	116.9	a	9.5	efg	63.8	d	59.0	abc
Laperouse	4.96	a	121.6	a	10.4	b-g	68.9	a	59.0	abc
Spartacus CL	4.7	a	115.2	a	10.8	bcd	68.8	a	58.0	def
Traveler	4.35	ab	106.6	ab	10.7	bcd	65.4	cd	59.0	abc
GSP-17-27-B	4.93	a	120.8	a	9.4	g	63.9	d	59.3	ab
GSP-18-44-B	4.94	a	121.1	a	9.8	c-g	61.1	e	59.0	abc
Operette	3.6	cde	88.2	cde	9.7	d-g	67.2	abc	59.7	a
SC27274PH (Madness)	2.52	f	61.8	f	11.1	b	54.4	f	54.3	h
SC21529PH (Newton)	2.48	f	60.8	f	13.1	a	55.1	f	55.0	h
Etencil	2.96	def	72.5	def	10	b-g	56.2	f	57.7	ef
Pixel	2.89	ef	70.8	ef	10.9	bc	54.3	f	56.0	g
HV8 Nitro	4.33	abc	106.1	abc	10.5	b-f	68.3	ab	58.7	bcd
Maximus CL (IGB1705T)	4.88	a	119.6	a	10.8	bcd	67.9	abc	58.0	def
IGB1844	4.67	a	114.5	a	10.6	b-e	67.4	abc	57.3	f
Mean	**4.08**		**100**		**10.5**		**63.6**		**58.0**	
LSD 0.05	**0.74**		**0.74**		**1.2**		**0.8**		**0.8**	
P Val	**<0.001**		**<0.001**		**<0.001**		**<0.001**		**<0.001**	

Generating Hyper Yielding Barley – how do we control disease in the HRZ sustainably?

James Rollason, Dr Kenton Porker, Nick Poole (FAR Australia) and Jeremy Curry (DPIRD)

HYC Results and Awards Evening

14th July, 2021

FAR Australia Albany Crop Technology Centre 2020
Location for GRDC HRZ Farming Systems Project & Hyper Yielding Crops (courtesy of Scott Smith)

Disease management for Hyper Yielding Crops (HYC)

Objectives of HYC disease management studies

1. Can we identify germplasm for long and short season HRZ regions that is sufficiently resistant to allow us to delay or remove (therefore reduce) fungicide applications?

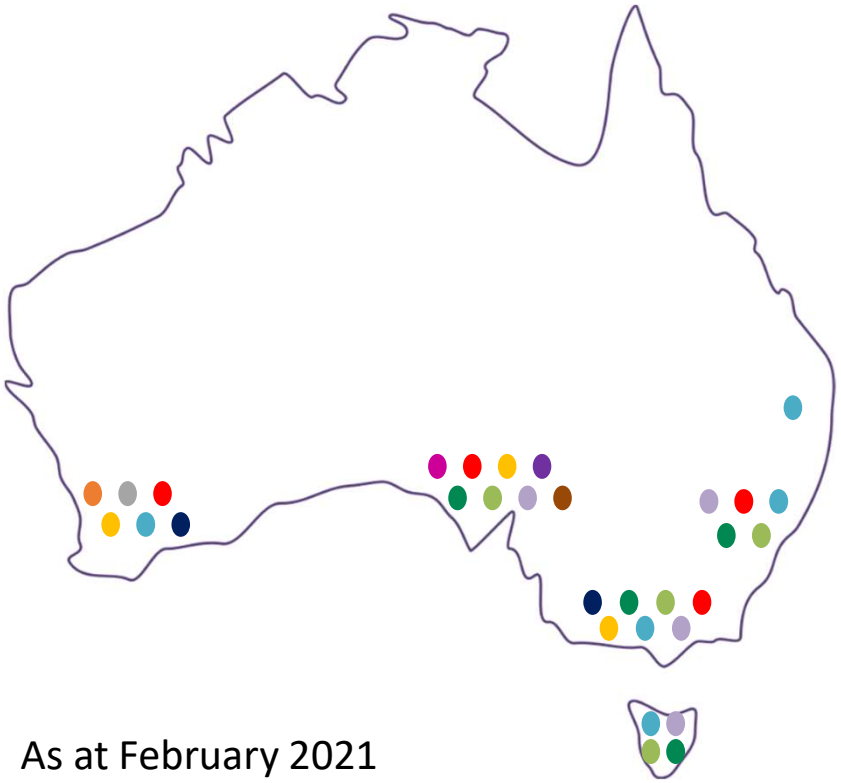
2. If we can't what are the most profitable and sustainable disease management strategies for barley and wheat in the HRZ?

3. Are there any new fungicide actives that can assist in disease management strategies?

Hyper Yield Crops Project wheat research – NSW Crop Technology Centre, Wallendbeen, NSW, October 2020

Fungicide resistance in Australian grain crops

Centre for Crop and Disease Management
GRDC | Curtin University



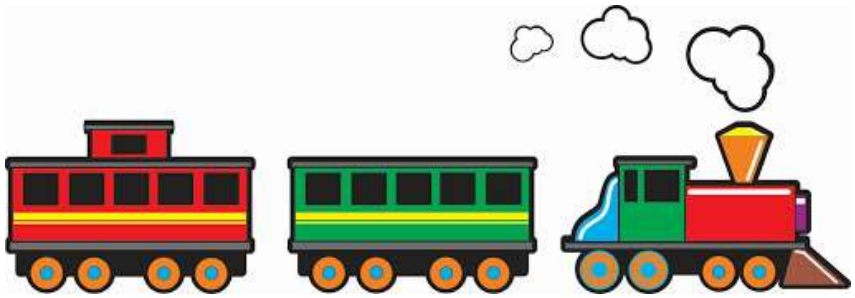
As at February 2021

NB. Dots point to state only, not area where resistance was discovered.

	Disease and fungicide group
L, RS, R	Barley Powdery Mildew – Group 3 (DMI)
L, RS, R	Barley Net Form Net Blotch – Group 3
L, R	Barley Net Form Net Blotch – Group 7 (SDHIs)
RS, R	Barley Spot Form of Net Blotch – Group 3
RS, R	Barley Spot Form of Net Blotch – Group 7
L, R	Wheat Powdery Mildew – Group 3
L, R	Wheat Powdery Mildew – Group 11 (strobilurins)
RS	Wheat Septoria tritici blotch – Group 3
L	Canola Blackleg – Group 2 (MAP-kinase)
RS	Canola Blackleg – Group 3
L	Ascochyta Blight of Lentil – Group 1 (MBC)
L	Botrytis Grey Mould of Chickpea – Group 1

L = Lab detection RS = Reduced sensitivity R = Resistant

We are all heading towards Station Resistance – You decide the speed!



Station - Susceptible Station – "Resistanceinthelab" Station – Reduced Sensitivity Station – Resistance

QoI Group 11 (Strobilurin) – High speed train for particular pathogens (high risk 1-3 years for resistance to develop)
SDHI's Group 7 – High to intermediate risk
DMI's (triazoles) – low to moderate risk can be decades (high risk for net blotch in barley)

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AUSTRALIAN FUNGICIDE RESISTANCE EXTENSION NETWORK

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Generating Hyper Yielding Barley –

1st stage of the process is screening germplasm under high disease pressure (no Fungicide or PGR applied)

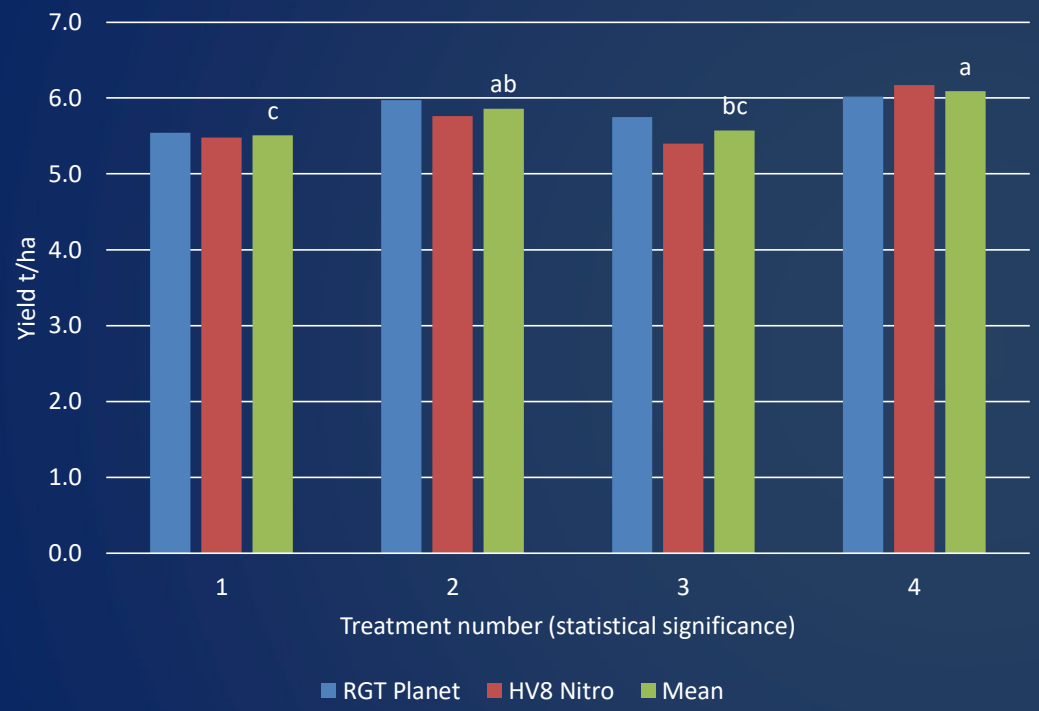
Variety	NFNB	SFNB	Scald	Ramularia	Leaf Rust
RGT Planet	90	0	0	0	3
Rosalind	5	15	0	5	2
Cassiopee	8	6	0	12	0
Surge	4	4	10	15	0
AGTB0213	0	0	95	0	0
AGTB0245	0	0	95	0	0
HV8 Nitro	0	0	85	0	0
Laperouse	0	0	100	0	0
Laureate	2	4	35	10	20
Sanette	20	3	0	0	60
Traveler	10	4	0	30	25
GSP-17-27-B	30	12	0	0	25
GSP-18-44-B	60	0	35	0	0
Operette	10	0	85	0	0
SC27274PH(Madness)	20	3	2	20	0
SC21529PH (Newton)	3	6	8	12	0
Etencil	10	6	3	12	0
Pixel	8	8	3	12	0
Memento	0	4	0	8	0
SC56325QH	5	8	0	14	3
SC15643QH	4	2	0	6	2
IDILIC	3	2	6	8	0
943PH (Pulco)	3	2	0	22	0
COCCINEL	3	8	0	12	0
Visual	20	5	0	4	0

HYC Research in Victoria 2020

Lower levels of disease in WA at Green Range did not allow screening under high pressure

Disease Management in RGT Planet

WA trial - decile 1 start and low levels of scald



Hyper Yield Crops Project barley – Green range, WA 2020 (sown 1st May) cv RGT Planet

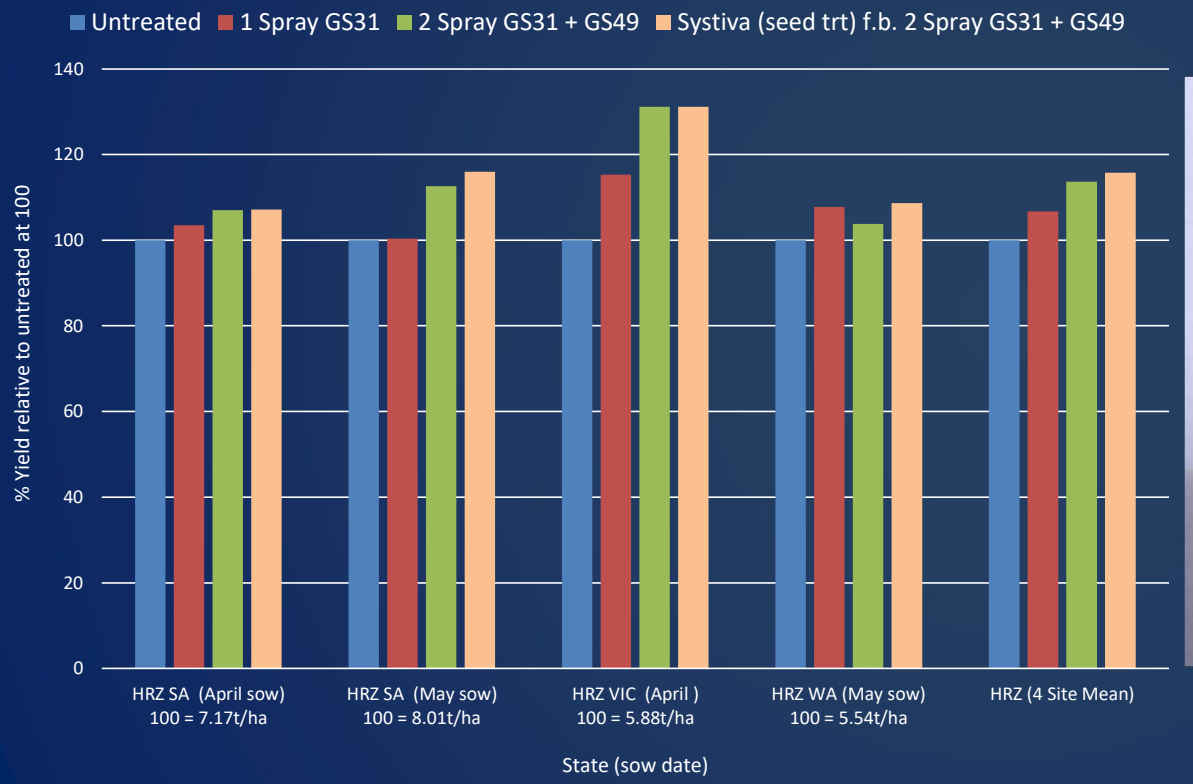
Trt.	GS00	GS31	GS39-49	RGT Planet % Scald	HV8 Nitro % Scald
1	---	---	---	16.3	3.8
2	---	Folicur 290ml/ha	---	5.3	1.3
3	---	Folicur 290ml/ha	Opus 500ml/ha	5	0
4	Systiva	Folicur 290ml/ha	Radial 840ml/ha	0	0

In WA a single spray at GS31 was more cost effective than an expensive three input programme, despite evidence of better disease control.

This was not the case in other HYC trials in 2020

N.B. The GS31 spray has been typically based on Prosaro (tebuconazole/prothioconazole)

Nationwide % Fungicide Response in RGT Planet – 4 Sites and Mean - HYC trials 2020



Impact of a second foliar spray apparent across all sites except WA

Where do we use our SDHIs that offer foliar disease control?

1. As a seed treatment (Systiva)?
Or
2. In crop

New Kids on the block!

New & old fungicide active ingredients result in new fungicide product mixtures

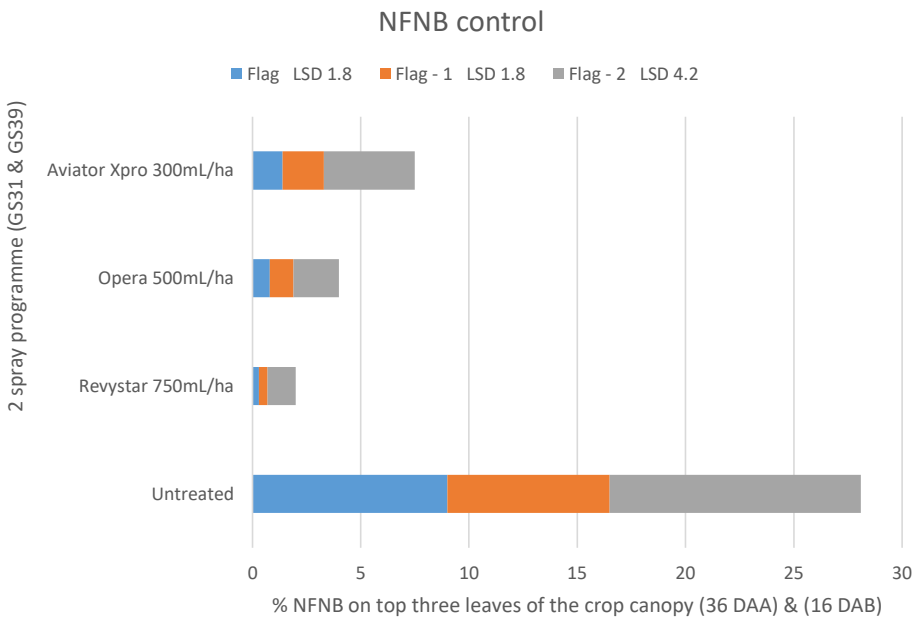
Focus on actives & MOA– not brands!	FRAC MOA Group
Systiva seed treatment – 333g/L Fluxapyroxad (150ml/100kg)	Group 7
Top notch - (200g/L Azoxystrobin and 200g/L Propiconazole)	Group 11 & 3
Maxentis – (133g/L Azoxystrobin and 100g/L Prothioconazole)	Group 11 & 3
Elatus ace – (40g/L Benzovindiflupyr and 250g/L Propiconazole)	Group 7 & 3
Aviator Xpro – (75g/L Bixafen and 150g/L Prothioconazole)	Group 7 & 3
Revystar* – (50g/L Fluxapyroxad and100g/L Mefentrifulconazole)	Group 7 & 3

*To be commercialised

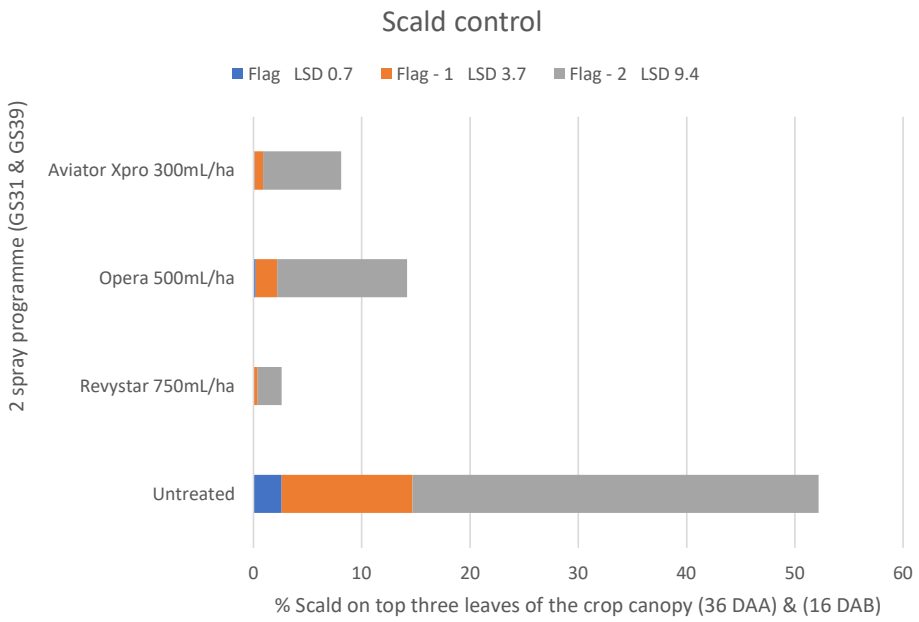
New mixture - NFNB and Scald control – FAR

SA Crop Technology Centre 2019 – cv Baudin

*Effect of **Mefentrifulconazole** plus fluxapyroxad on NFNB*



*Effect of **Mefentrifulconazole** plus fluxapyroxad on Scald*



Independent research conducted by FAR on behalf of BASF in 2019

- Good disease management is essential in all regions when yield potential is higher due to spring rainfall!

- Screening for high yielding germplasm with good genetic resistance (and standing power) is central to HYC research.

- Key foliar fungicide timings for barley disease control to protect the top four leaves are GS31 (1st node), GS39-49 (flag leaf – 1st awns emerging). Flag-1 is the most important leaf to protect in barley.

- New (yet to be released) fungicide mixture Revystar based on a completely novel Group 3 DMI (Mefentrifulconazole) will strengthen our "in crop" armory of SDHI/DMI mixtures'

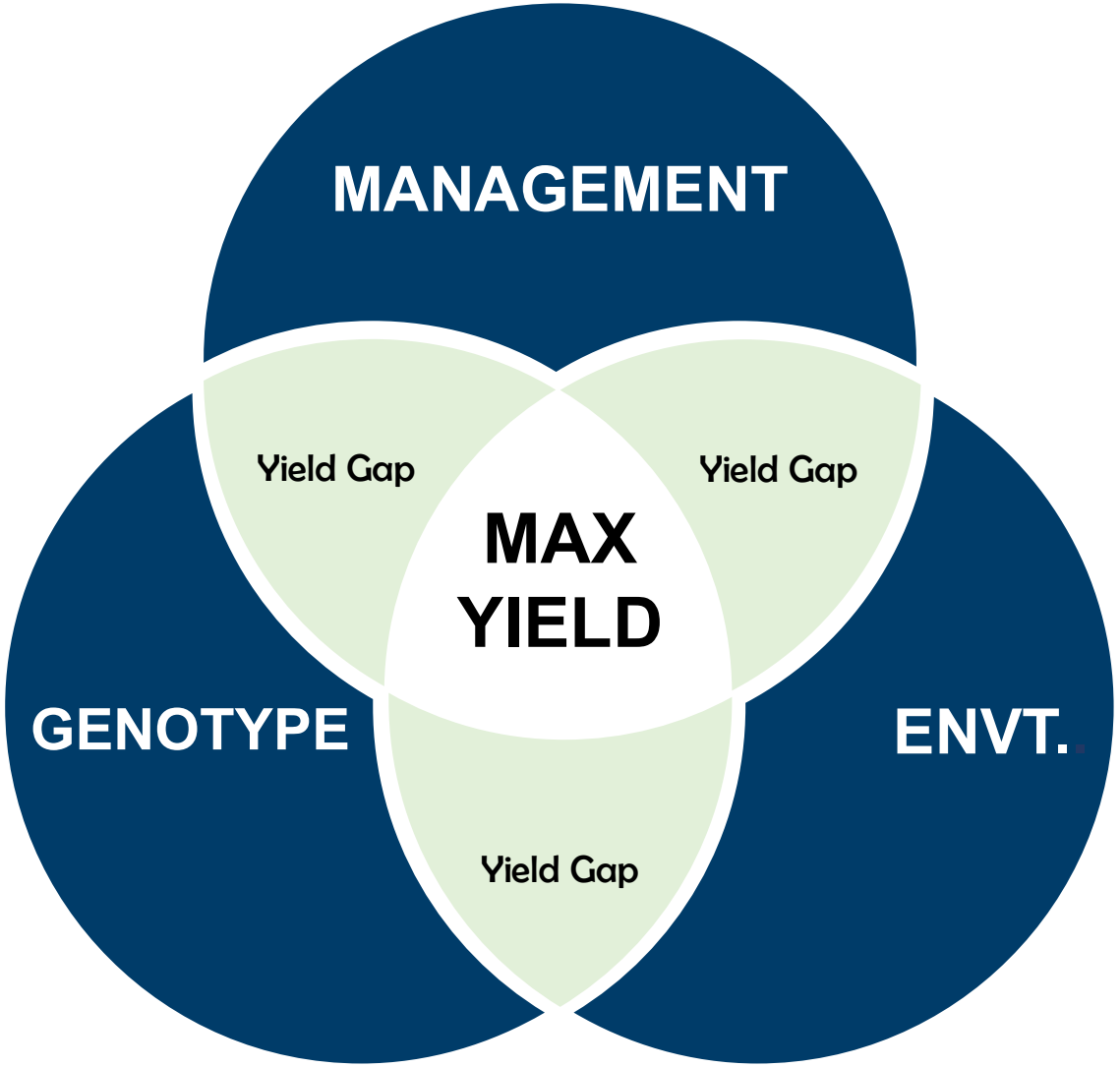
- Where possible look to minimize the use of fungicide application and where possible minimize the use of QoI (Group 11) and SDHI (Group 7) applications to one per season.

Synergising GxExM

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

Genotype
Environment
Management

GxExM

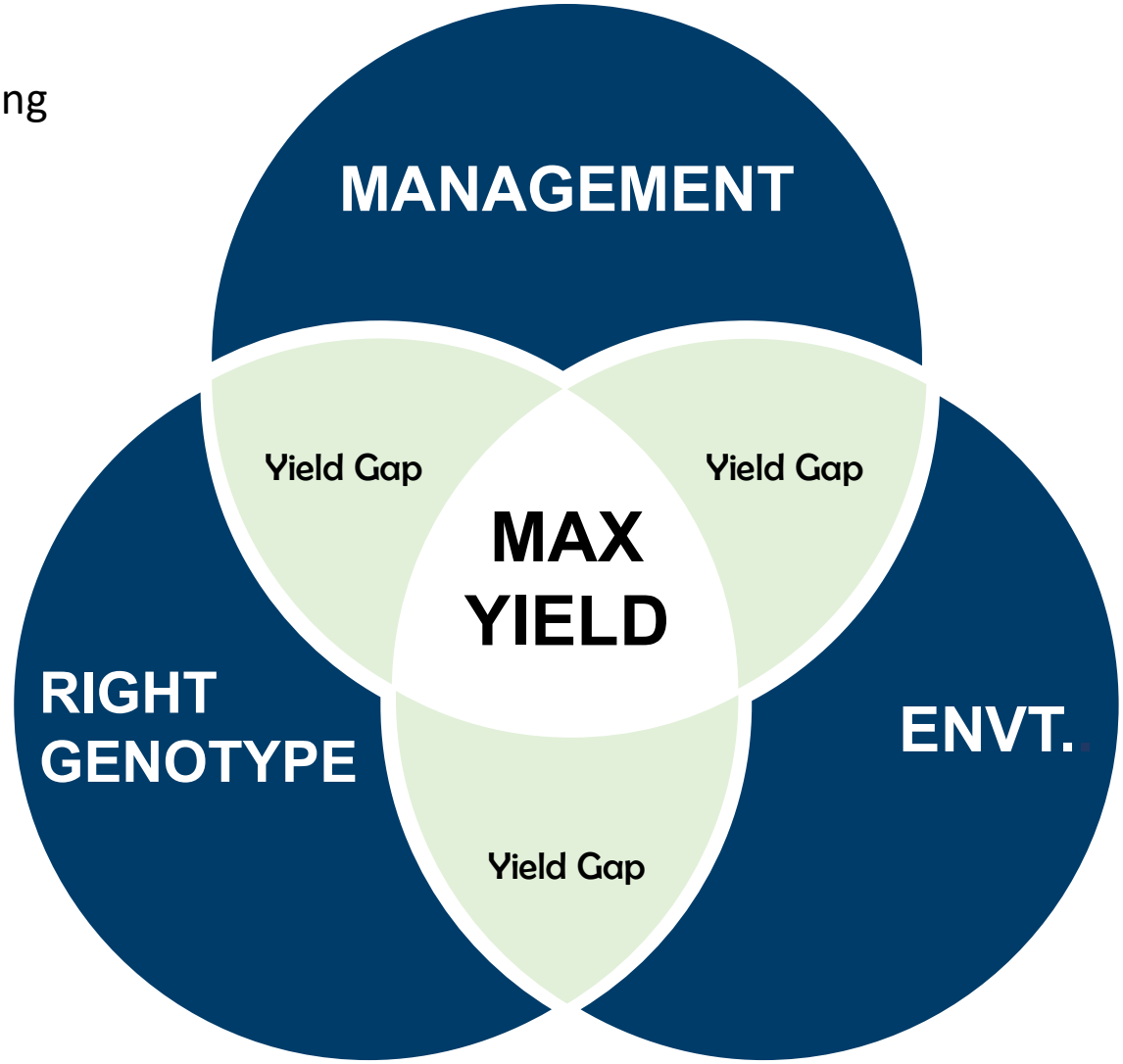

MANAGEMENT
Yield Gap
Yield Gap
MAX YIELD
GENOTYPE
ENVT.
Yield Gap

GxExM

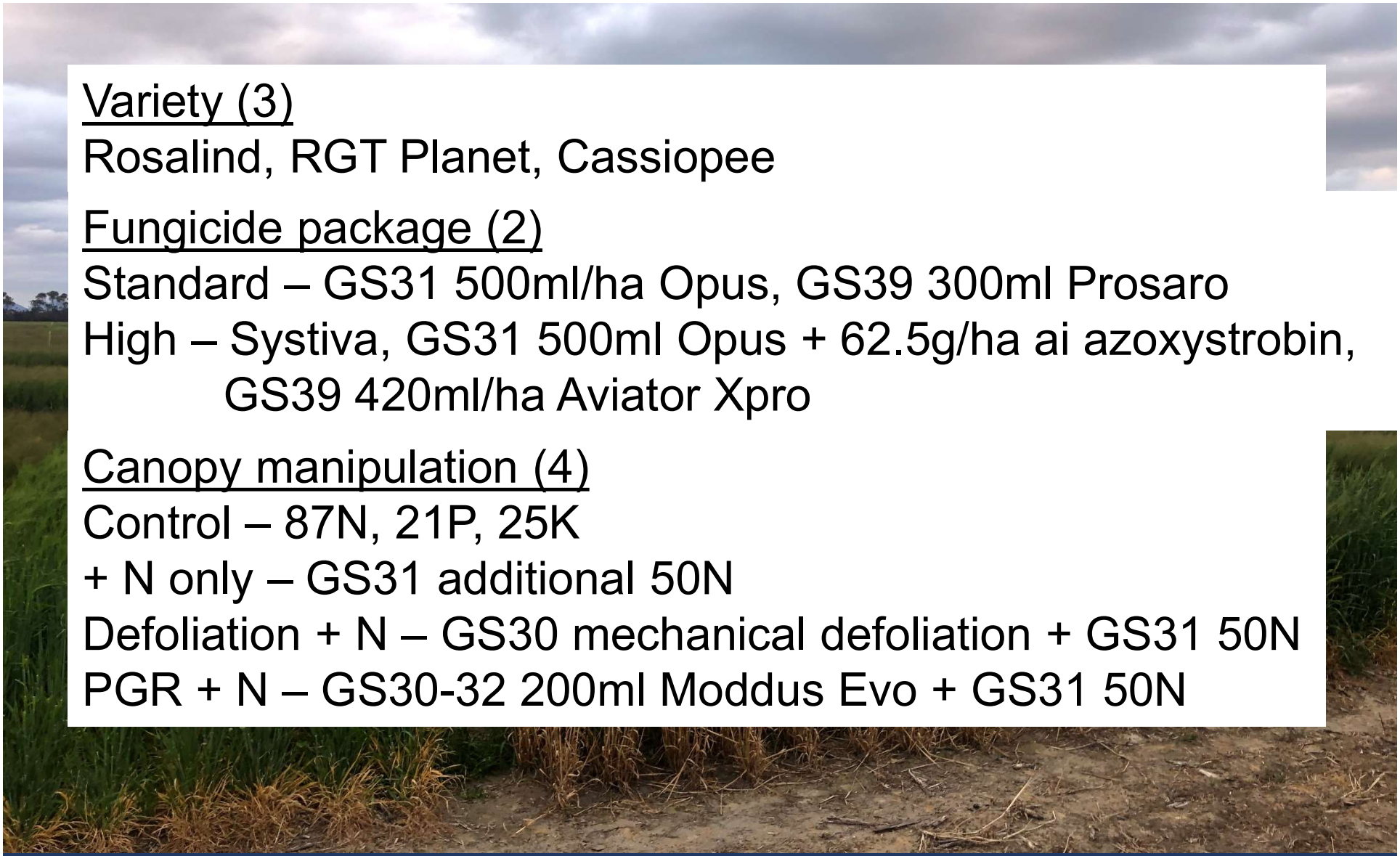
WA HRZ
- cooler, wetter grain filling

(comparative to WA)
- high disease pressure
- bulkier crops

Category	2023
Imi-tolerant	Maximus CL Spartacus CL
Low-med rainfall	Maximus CL Rosalind Beast?
Med-high rainfall	RGT Planet Rosalind Laperouse?



Treatment details



Variety (3)

Rosalind, RGT Planet, Cassiopee

Fungicide package (2)

Standard – GS31 500ml/ha Opus, GS39 300ml Prosaro

High – Systiva, GS31 500ml Opus + 62.5g/ha ai azoxystrobin, GS39 420ml/ha Aviator Xpro

Canopy manipulation (4)

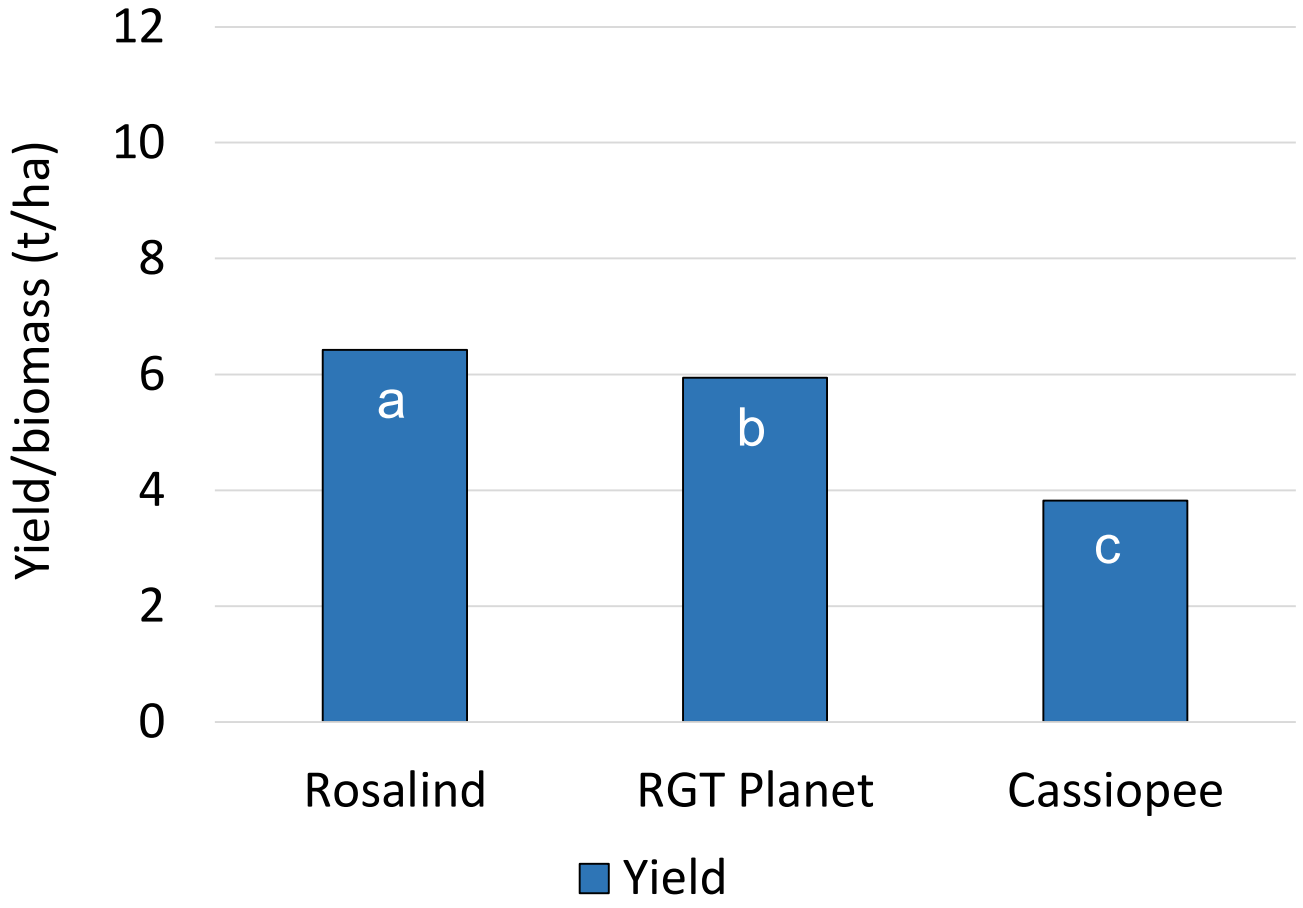
Control – 87N, 21P, 25K

+ N only – GS31 additional 50N

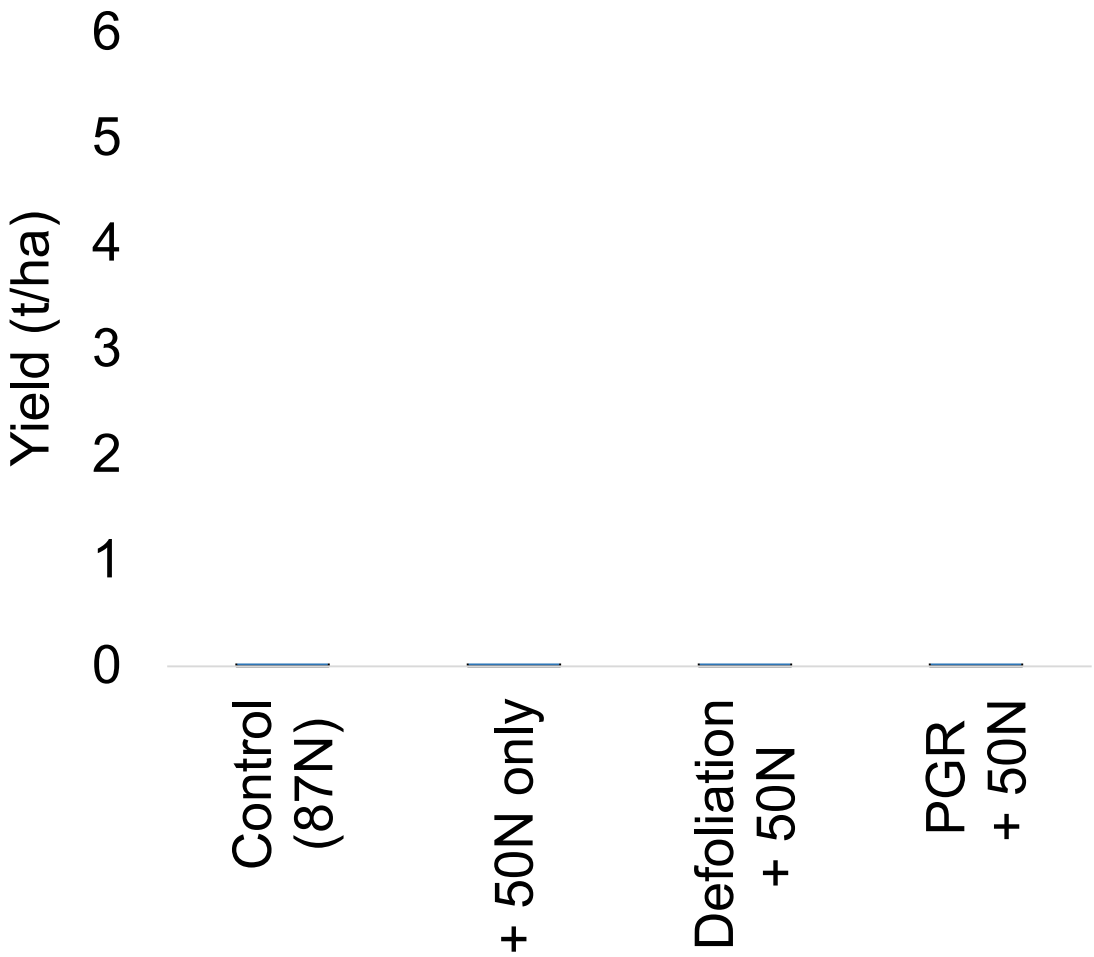
Defoliation + N – GS30 mechanical defoliation + GS31 50N

PGR + N – GS30-32 200ml Moddus Evo + GS31 50N

Genotype


12
10
8
6
4
2
0
Yield/biomass (t/ha)
a
b
c
Rosalind
RGT Planet
Cassiopee
Yield

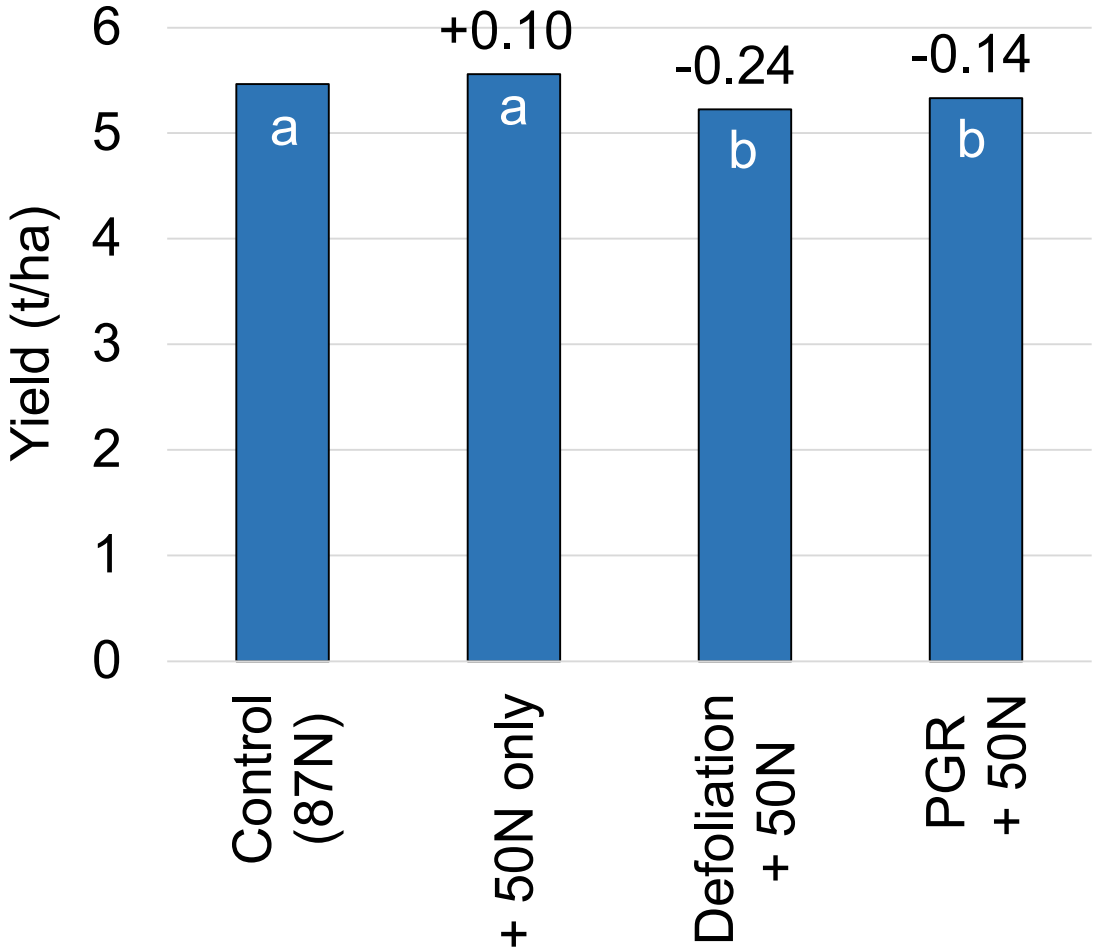
Canopy management



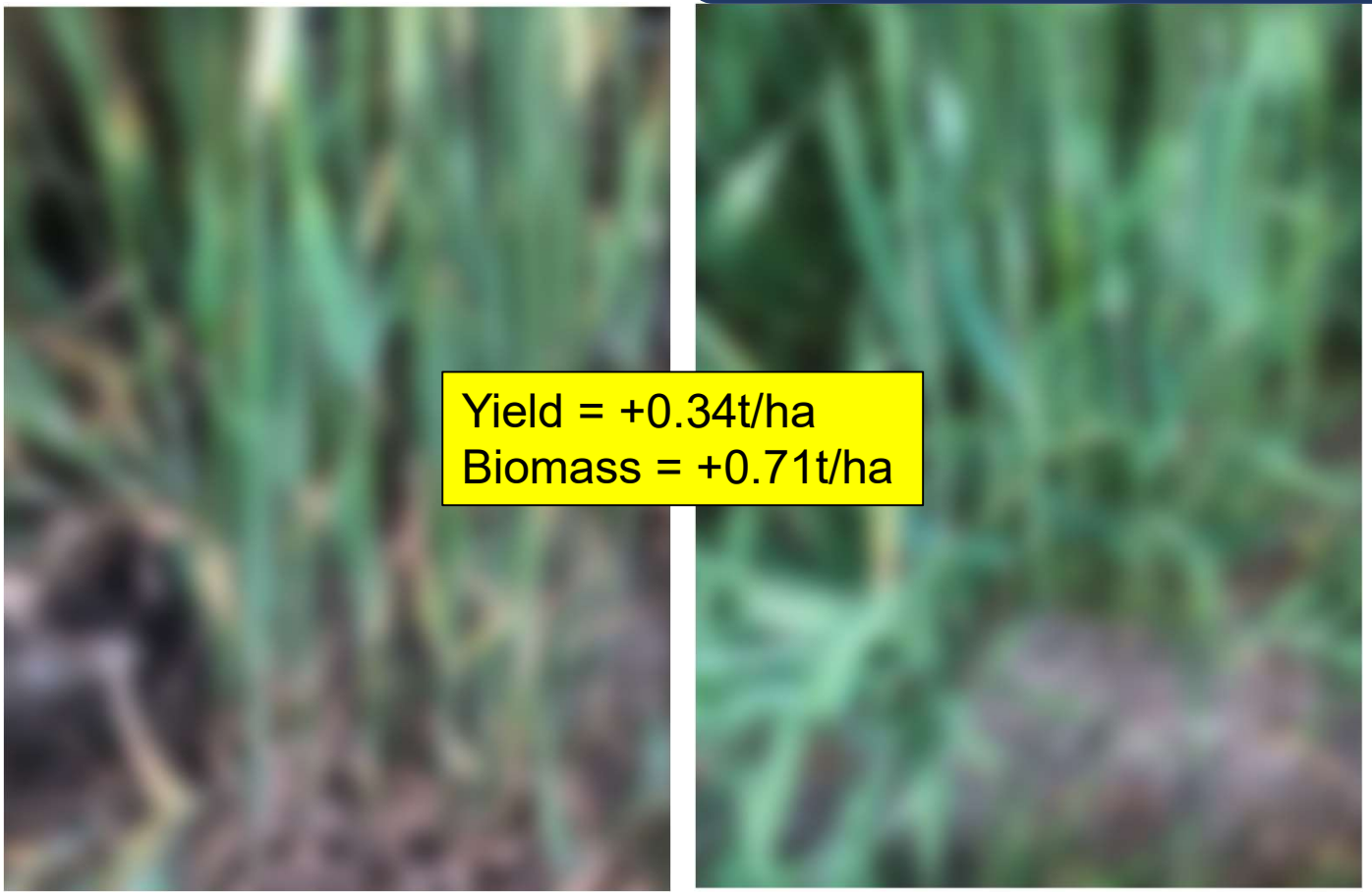
Canopy management

No impact on biomass.

Small and inconsistent impact on height.



Fungicide



Standard Package

GS31 500ml/ha Opus
GS39 300ml Prosaro

High Input Package

Systiva
GS31 500ml Opus + 62.5g/ha ai azoxystrobin,
GS39 420ml/ha Aviator Xpro

Fungicide

Standard Package

GS31 500ml/ha Opus
GS39 300ml Prosaro

High Input Package

Systiva
GS31 500ml Opus + 62.5g/ha ai azoxystrobin,
GS39 420ml/ha Aviator Xpro

GxExM

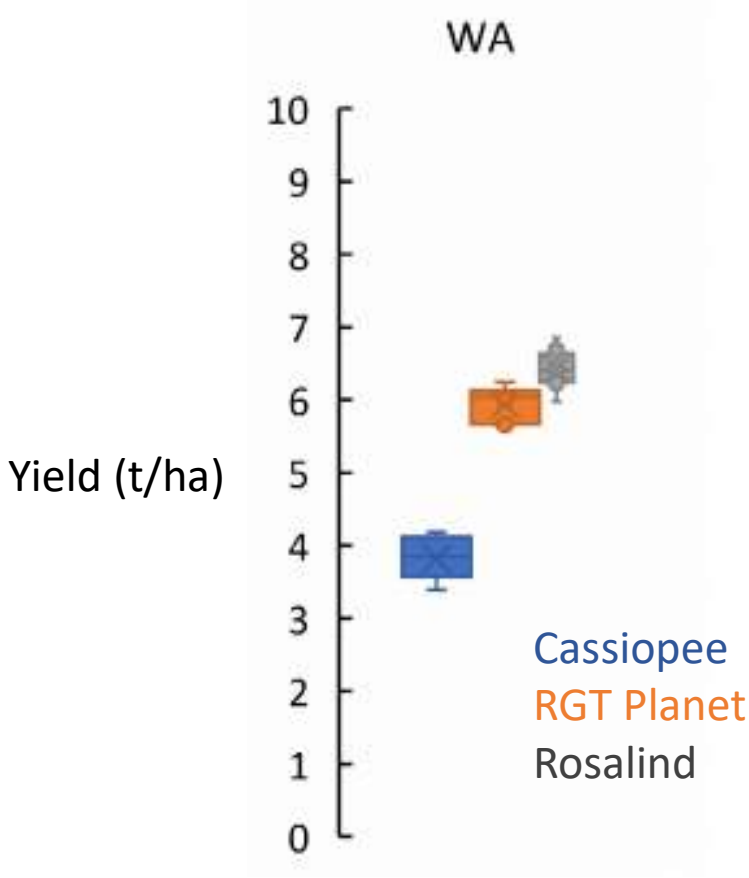
2020

Tougher season so minimal gains by management interventions (very much limited by envt).

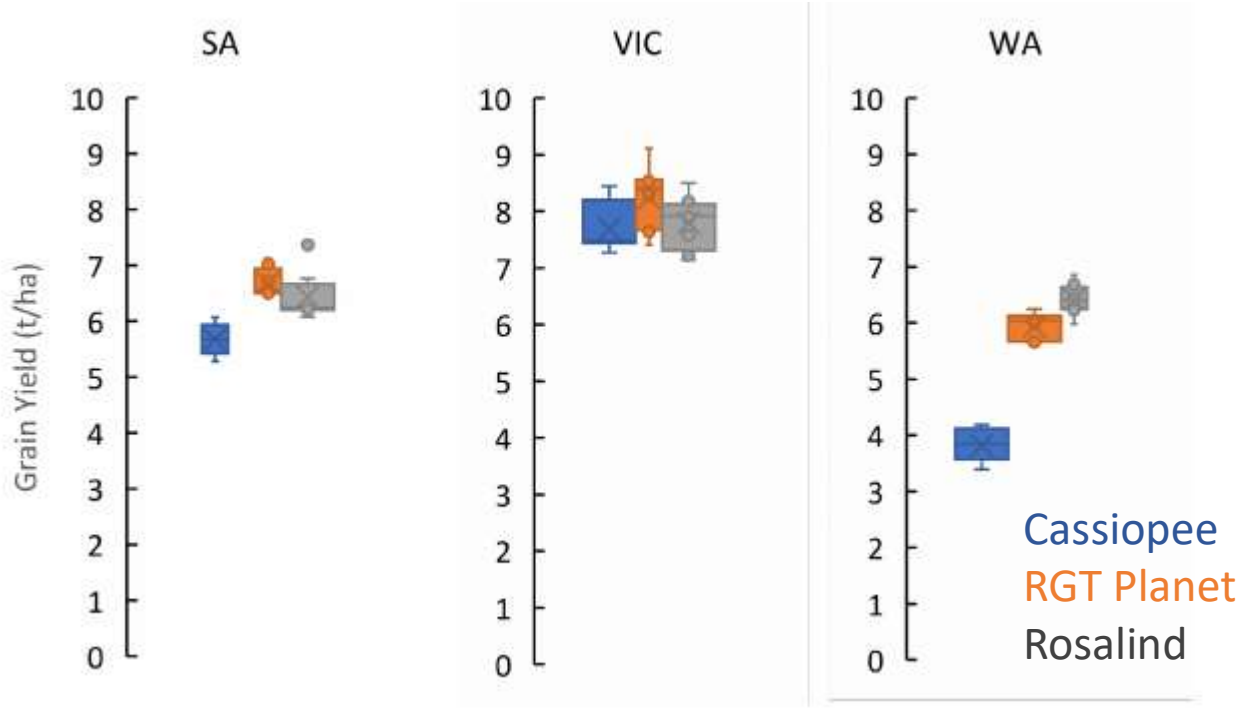
Low disease pressure so typically expect low fung. response

Not bulky crops so no lodging

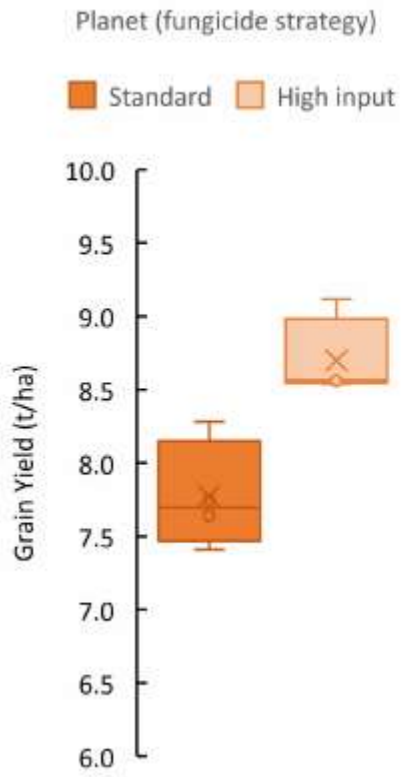
Not N deficient



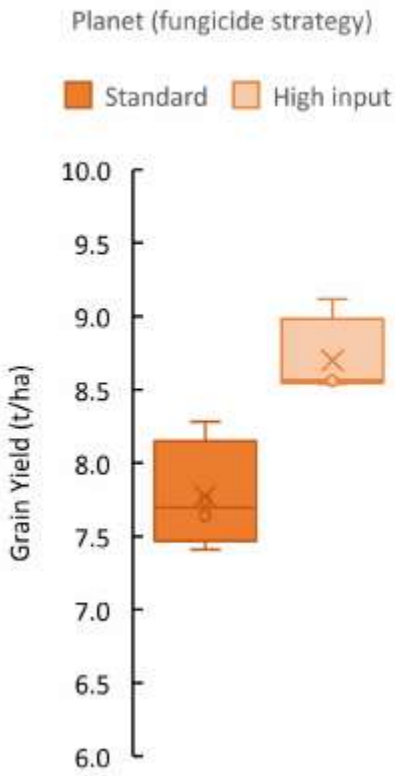
GxExM

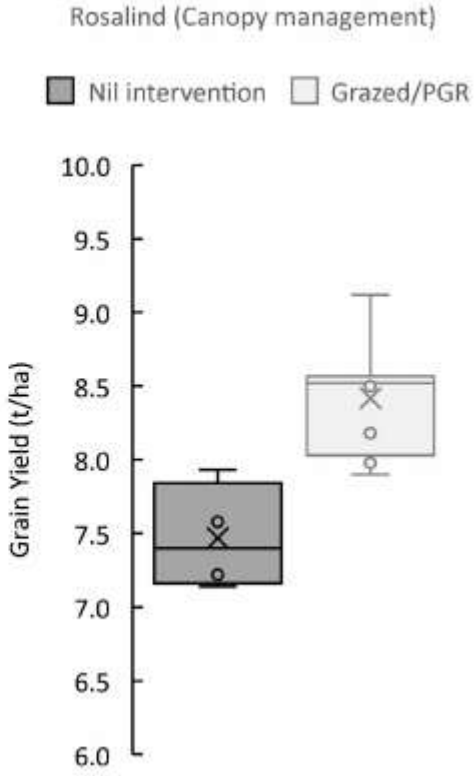

SA
VIC
WA
Grain Yield (t/ha)
0
1
2
3
4
5
6
7
8
9
10
Cassiopee
RGT Planet
Rosalind

GxExM

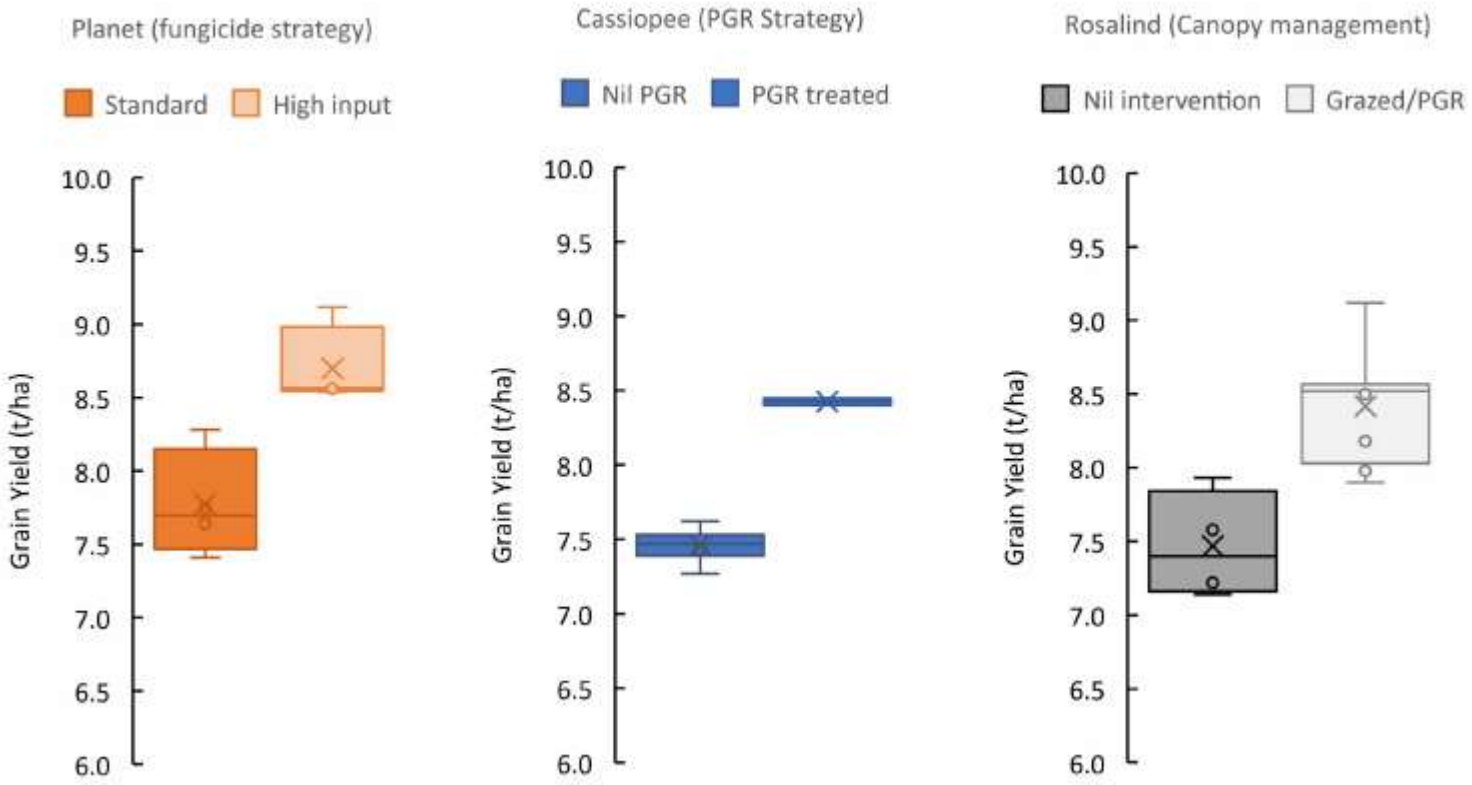

Planet (fungicide strategy)
Standard
High input
Grain Yield (t/ha)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0

GxExM

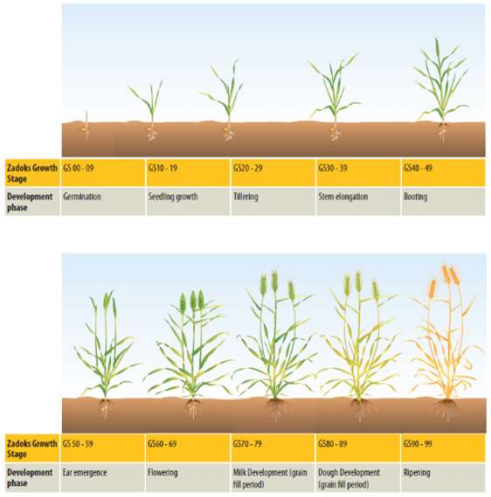

Planet (fungicide strategy)
Standard
High input
Grain Yield (t/ha)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0

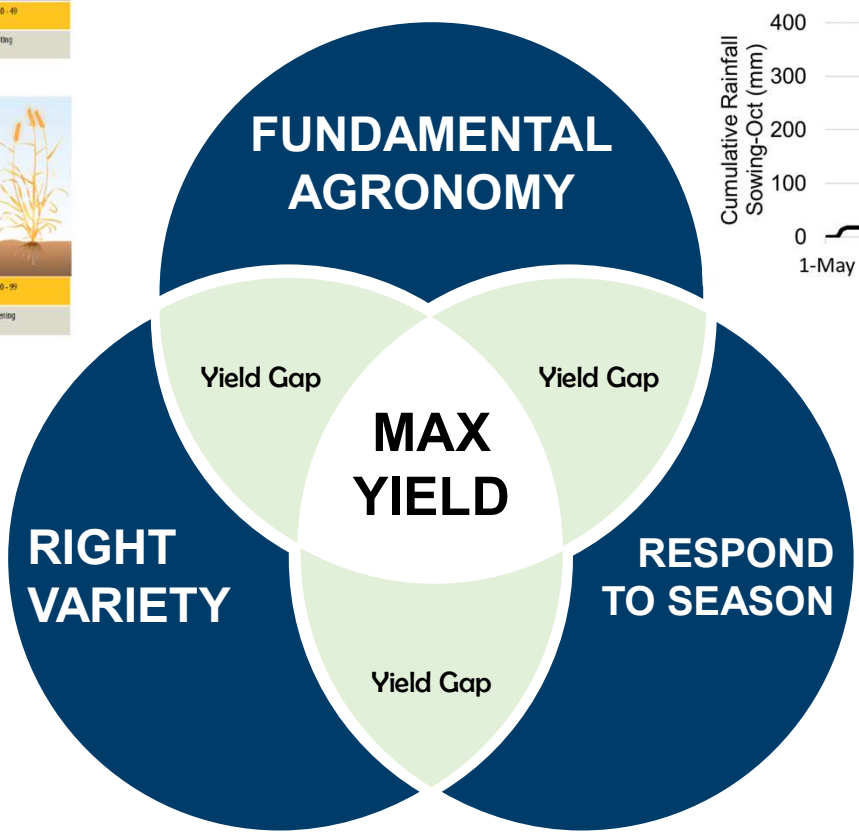

Rosalind (Canopy management)
Nil intervention
Grazed/PGR
Grain Yield (t/ha)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0

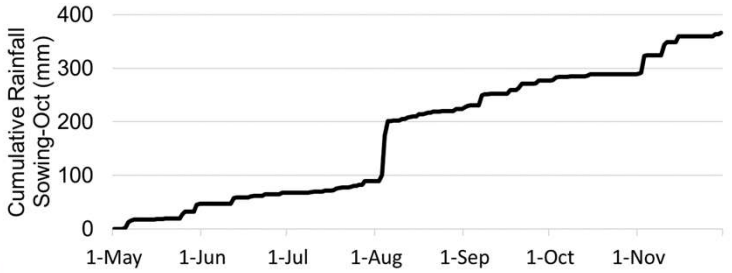
GxExM


Planet (fungicide strategy)
Standard
High input
Grain Yield (t/ha)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Cassiopee (PGR Strategy)
Nil PGR
PGR treated
Grain Yield (t/ha)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Rosalind (Canopy management)
Nil intervention
Grazed/PGR
Grain Yield (t/ha)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0

Key messages







Category	2023
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Low-med rainfall	Maximus CL Rosalind Beast?
Med-high rainfall	RGT Planet Rosalind Laperouse?

Jeremy Curry | WA HYC Awards | 14 July 2021

Thank you!

Jeremy Curry
Jeremy.curry@dpird.wa.gov.au
DPIRD Esperance

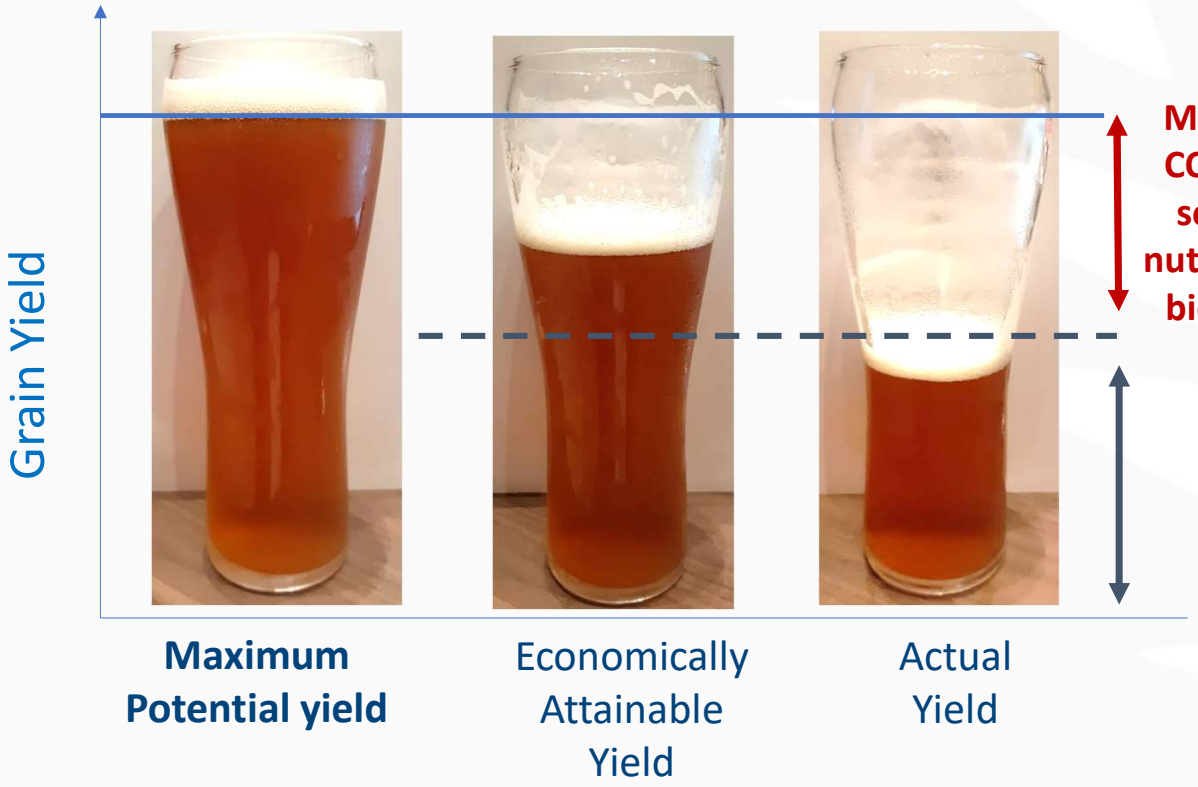
Defining Grain Yield

HYC Awards WA

John Kirkegaard (CSIRO), **Kenton Porker (FAR),** Nick Poole (FAR), Jon Midwood (TechCrop)

How should we think about yield?

Potential Yield - Under best practice water and climate are the only factors limiting crop growth.



Award 2:
% of potential
= exploitable yield gap

Award 1:
Actual Farm Yield

The HYC Awards Community

Lets **close the yield gap**

and **raise the yield frontier** together

(get closer to 100% of potential yield)

HYC Yield Potential Calculation - Built on the fundamental principles of crop growth

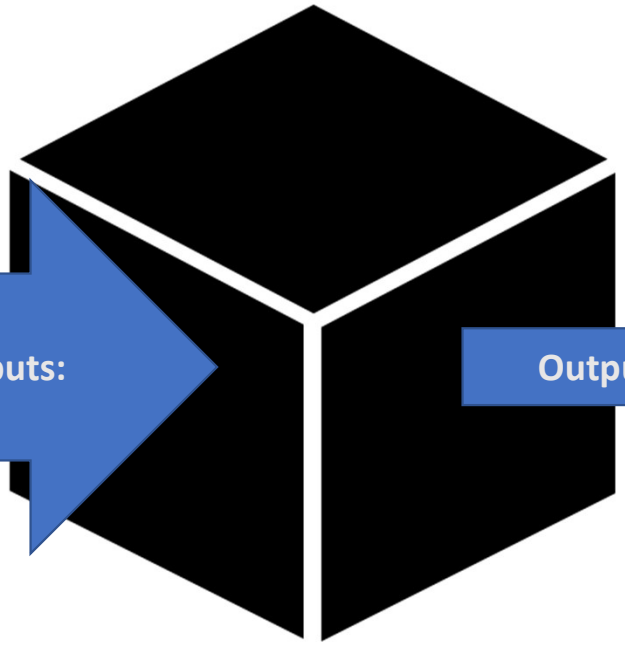
1. Temperature and solar radiation light during the critical period

2. Water use efficiency model

3. Solar radiation and conversion to yield (Harvest Index)

4. Soil water holding capacity

Inputs:



Output

The HYC Yield Potential (PyHYC)

Black Box assumptions published methods

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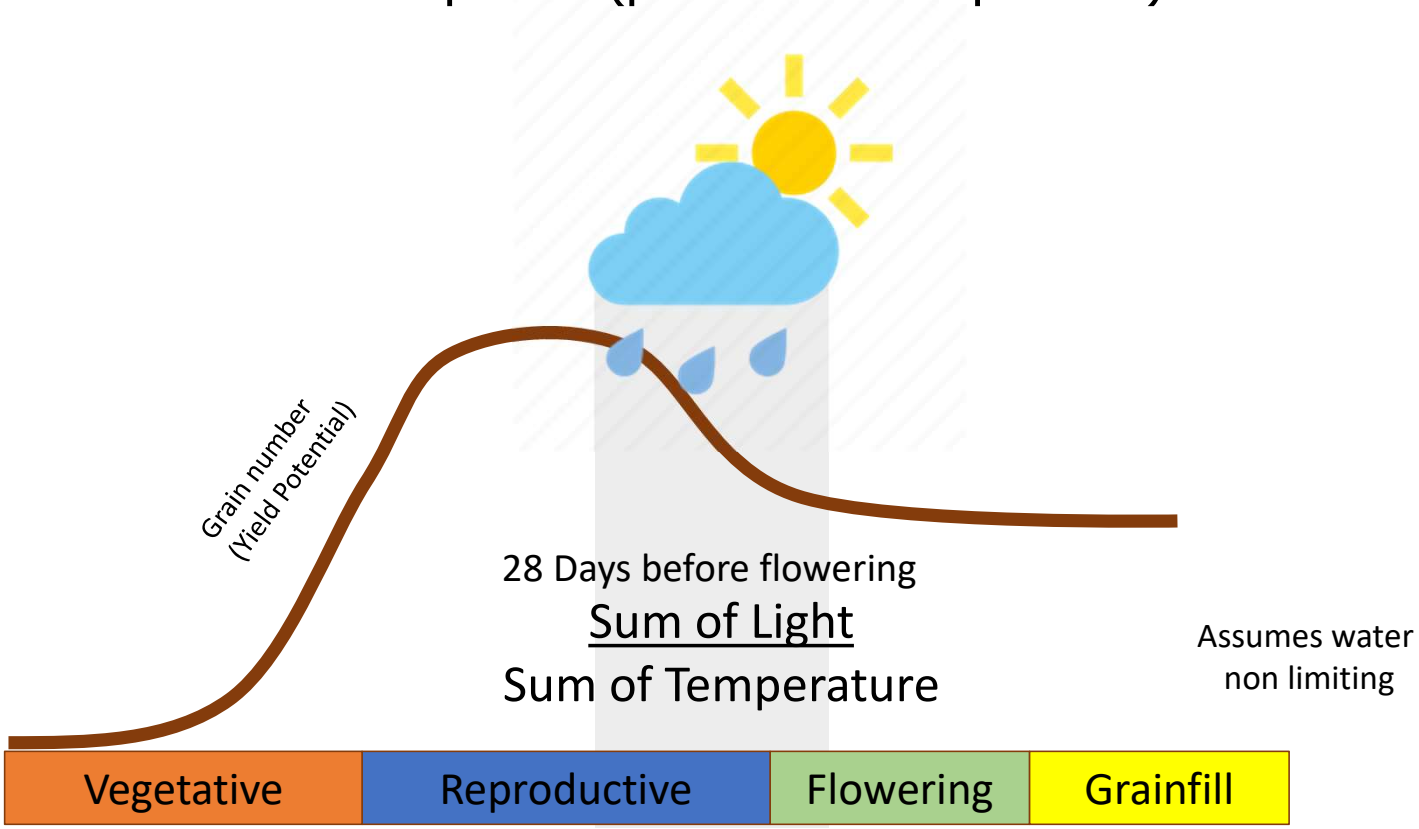
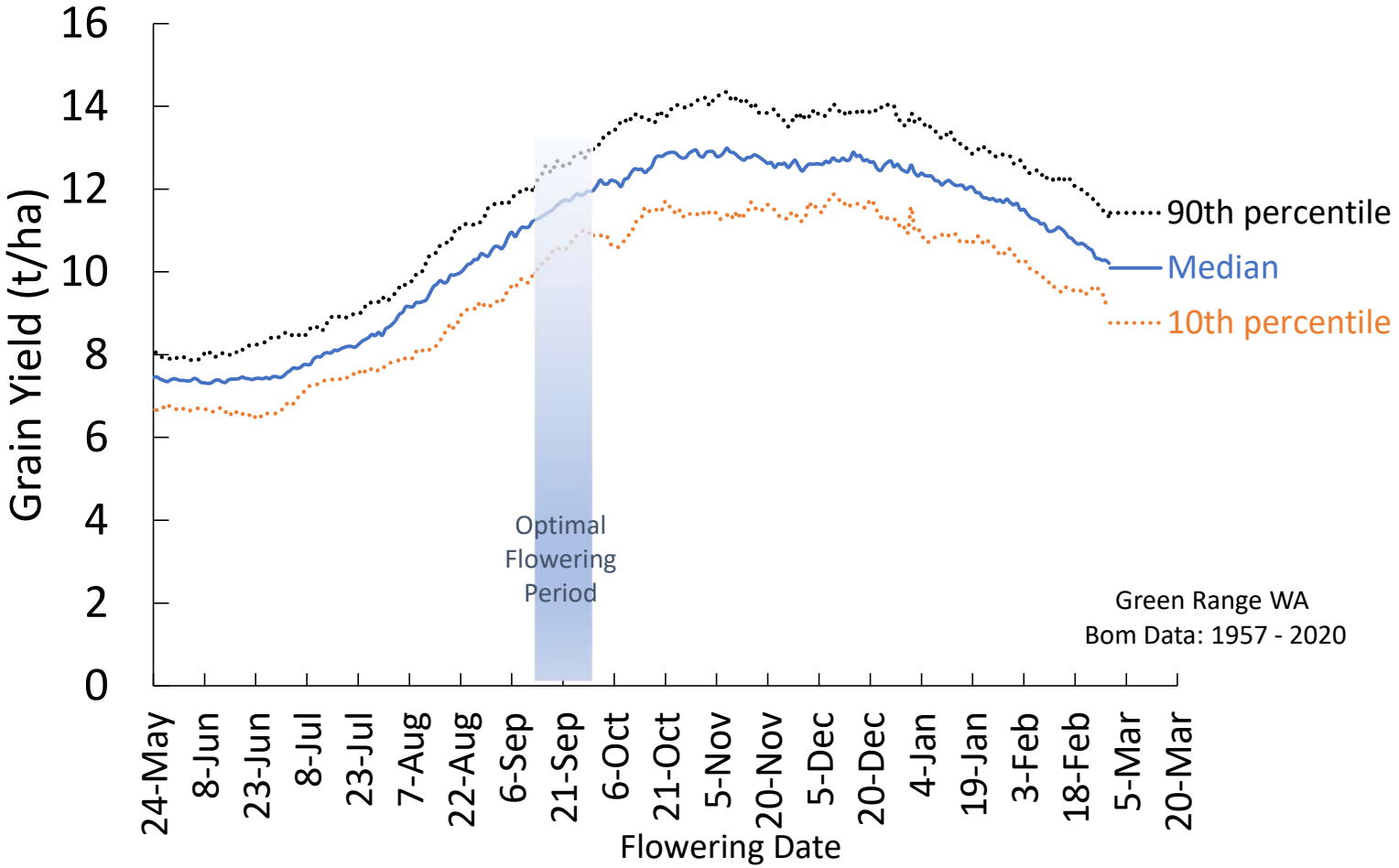
Potential yield is primarily determined by growth during the critical period (photothermal quotient)



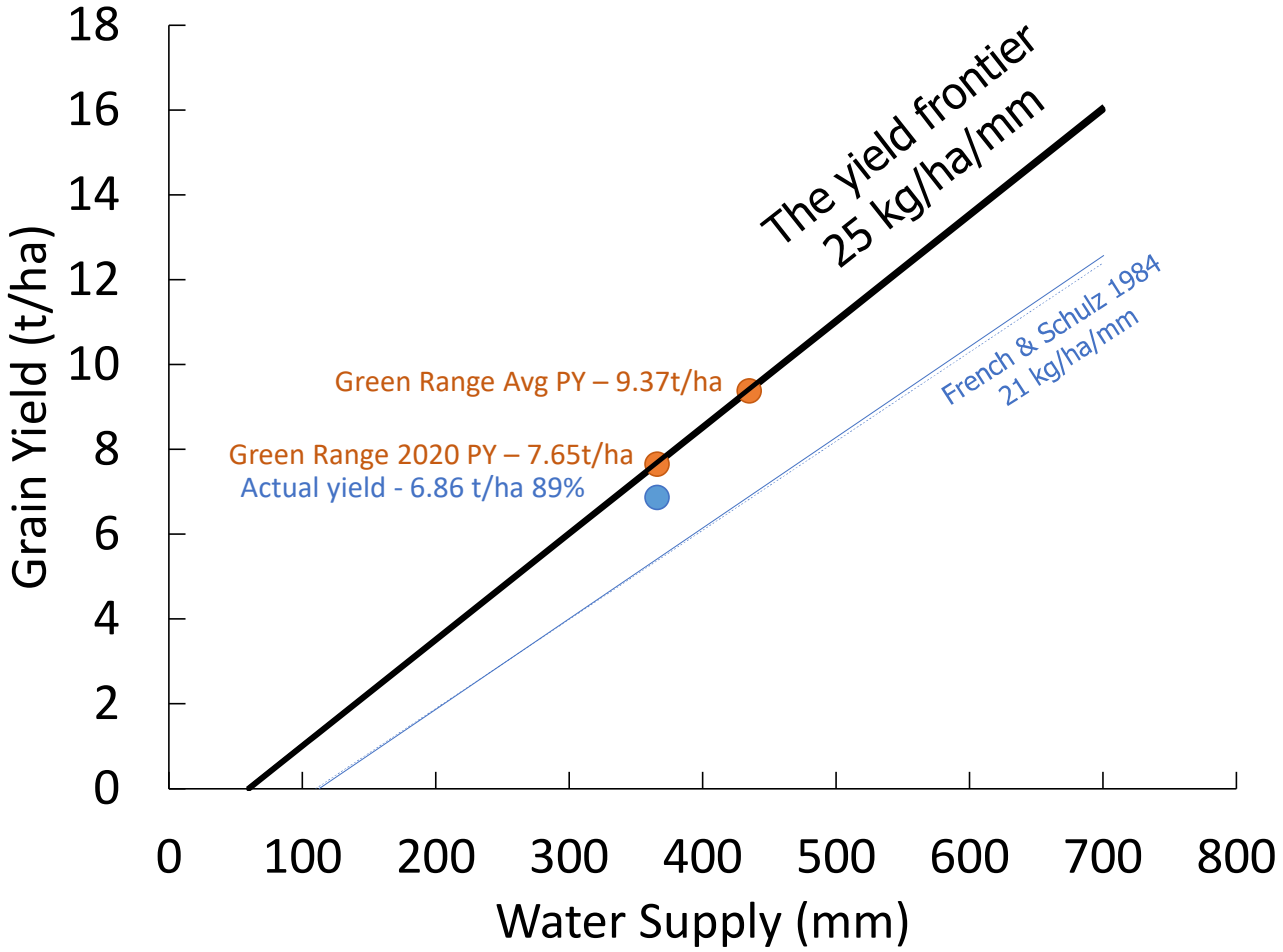
*3 weeks before anthesis (Rawson et al., (1988))

In high rainfall zones the PTQ may limit yield potential as often as water supply to the crop (coastal, cloudy areas) – **This is not as likely in WA**



FAR AUSTRALIA

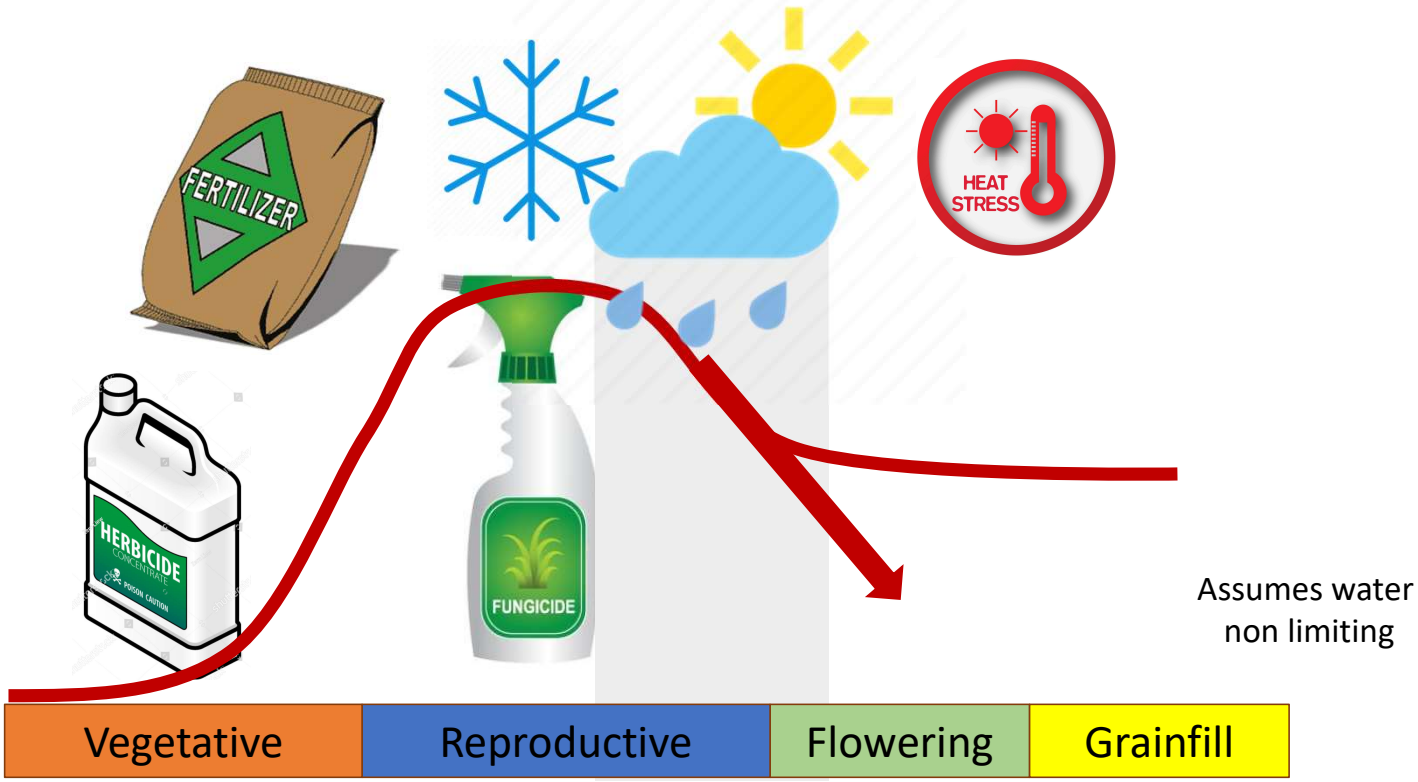
Water limited yield frontier (WUE)



Other factors considered in HYC Yield Potential

- **Soil water holding capacity** – soil type/rooting depth/incident rainfall
- **Growing season solar radiation and harvest Index –** conversion of dry matter to grain yield (Harvest Index of 55%)

Other **manageable factors** (including heat and frost stress) **lower actual yield** not yield potential



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The HYC Community

Lets **close the yield gap**

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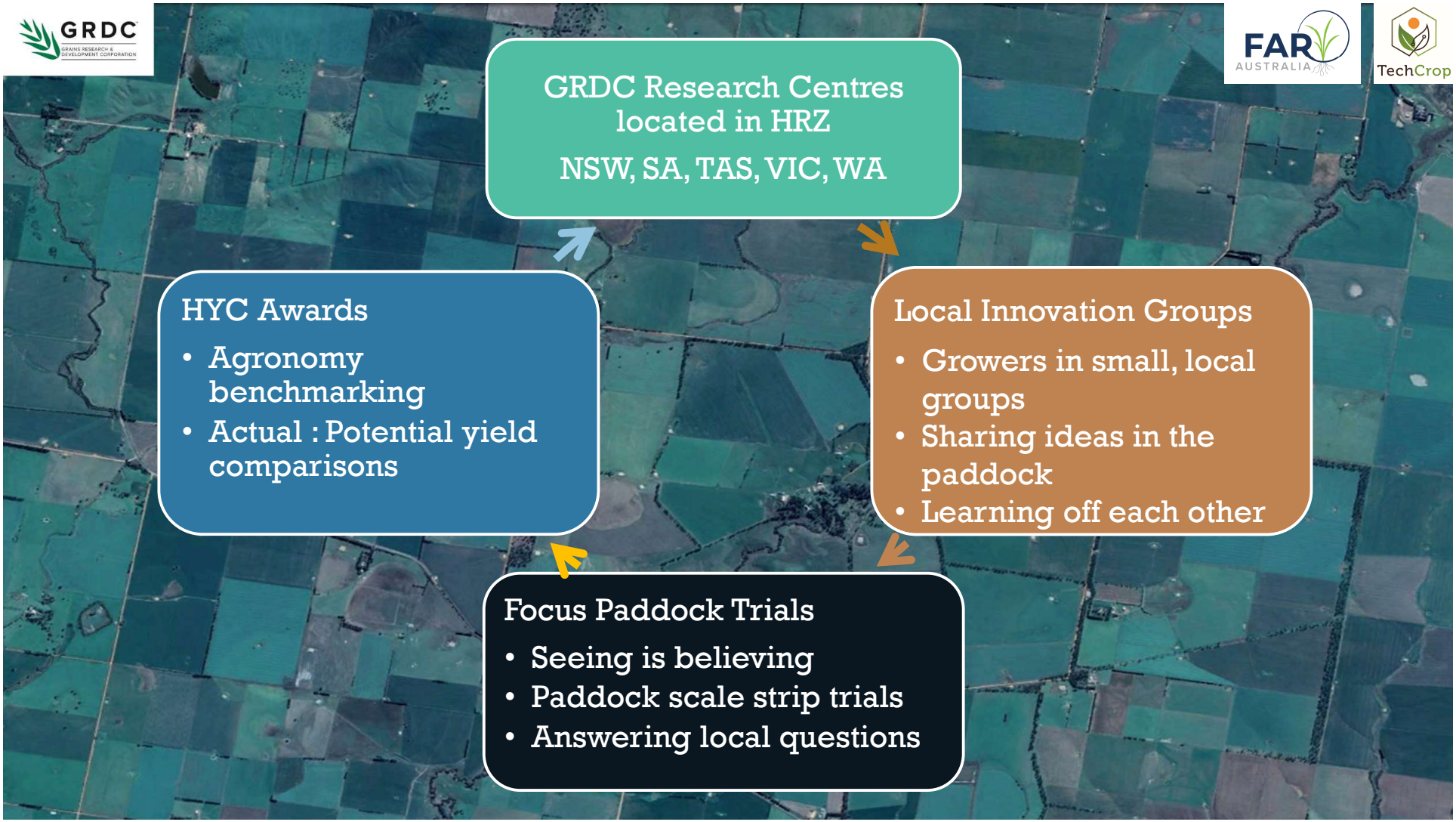
(get closer to 100% of potential yield)

HYPER YIELDING CROPS – RESULTS AND AWARDS


GRDC Research Centres located in HRZ
NSW, SA, TAS, VIC, WA
Local Innovation Groups
• Growers in small, local groups
• Sharing ideas in the paddock
• Learning off each other
Focus Paddock Trials
• Seeing is believing
• Paddock scale strip trials
• Answering local questions
HYC Awards
• Agronomy benchmarking
• Actual : Potential yield comparisons

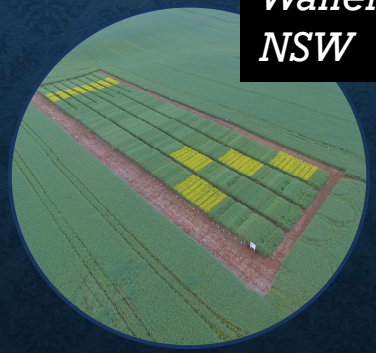
HYPER YIELDING CROPS

5 Research Centres

Hagley, Tasmania

Millicent, South Australia

Green Range, WA



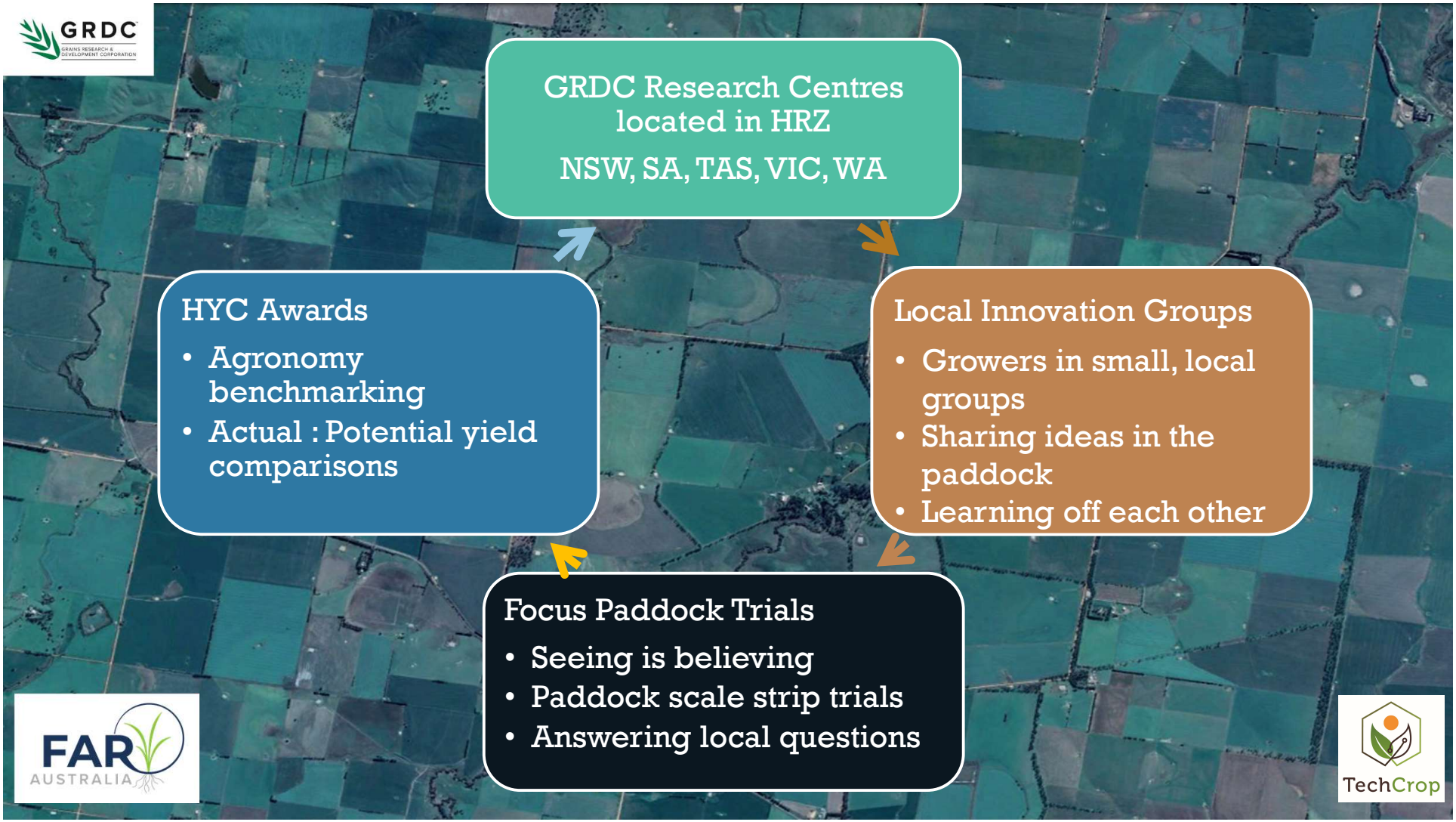
Wallendbeen, NSW

Gnarwarre, Victoria

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

FAR AUSTRALIA

TechCrop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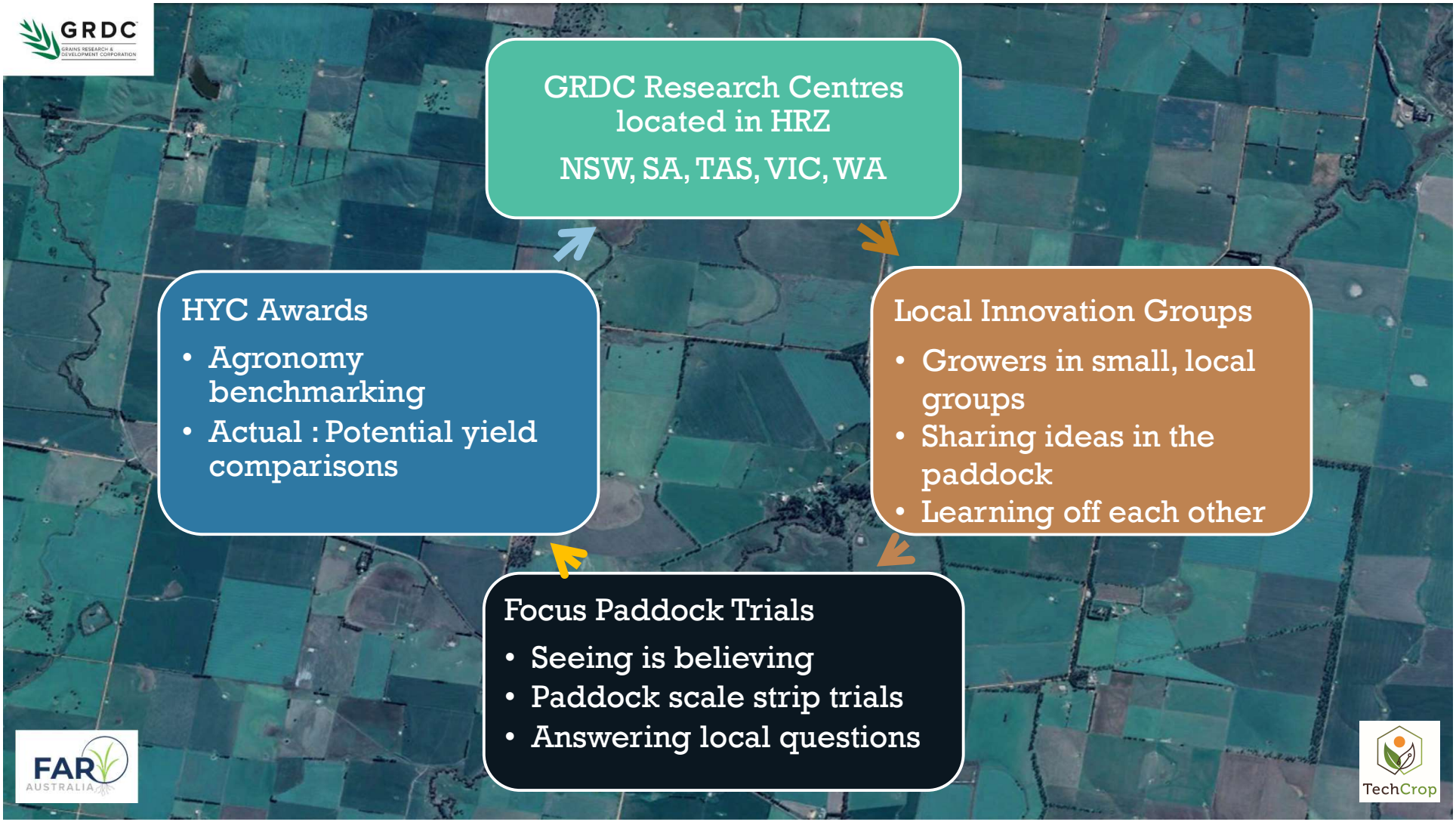
HYC Awards
• Agronomy benchmarking
• Actual : Potential yield comparisons
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
FAR AUSTRALIA
TechCrop

INNOVATION GROUPS

Planning, designing and discussion of Focus paddock trials

Visit to paddocks in-season to discuss Focus trial progress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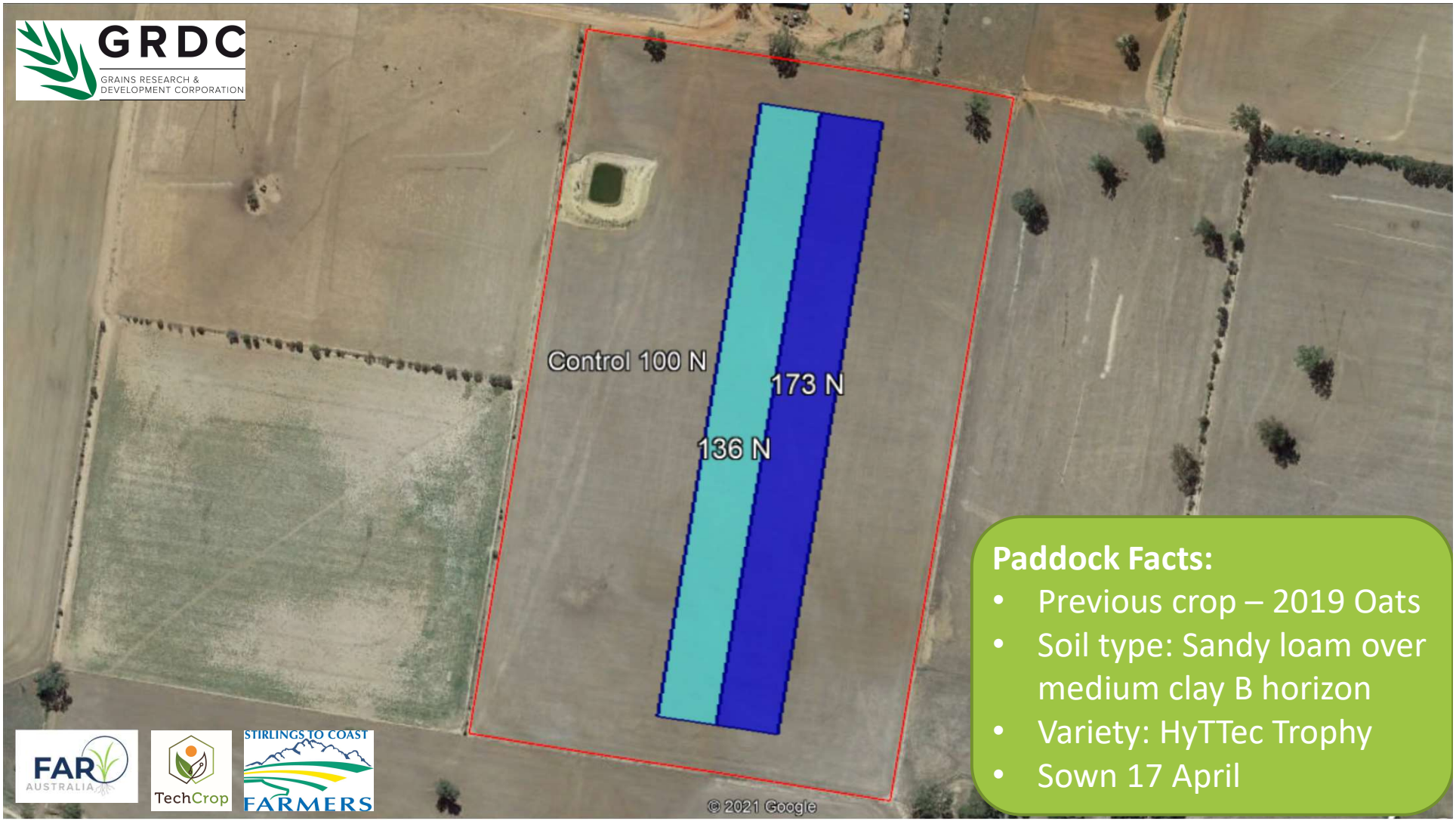
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
Control 100 N
173 N
136 N
FAR AUSTRALIA
TechCrop
STIRLINGS TO COAST FARMERS
© 2021 Google
Paddock Facts:
• Previous crop – 2019 Oats
• Soil type: Sandy loam over medium clay B horizon
• Variety: HyTTec Trophy
• Sown 17 April

HYC AWARD REPORT

20 page report with over 50 comparative metrics with wheat paddocks in your region

Crop and paddocks details

Detailed annual inputs record

Growing season weather – Rainfall, temperature and radiation

Actual v Potential yield

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STIRLINGS TO COAST FARMERS

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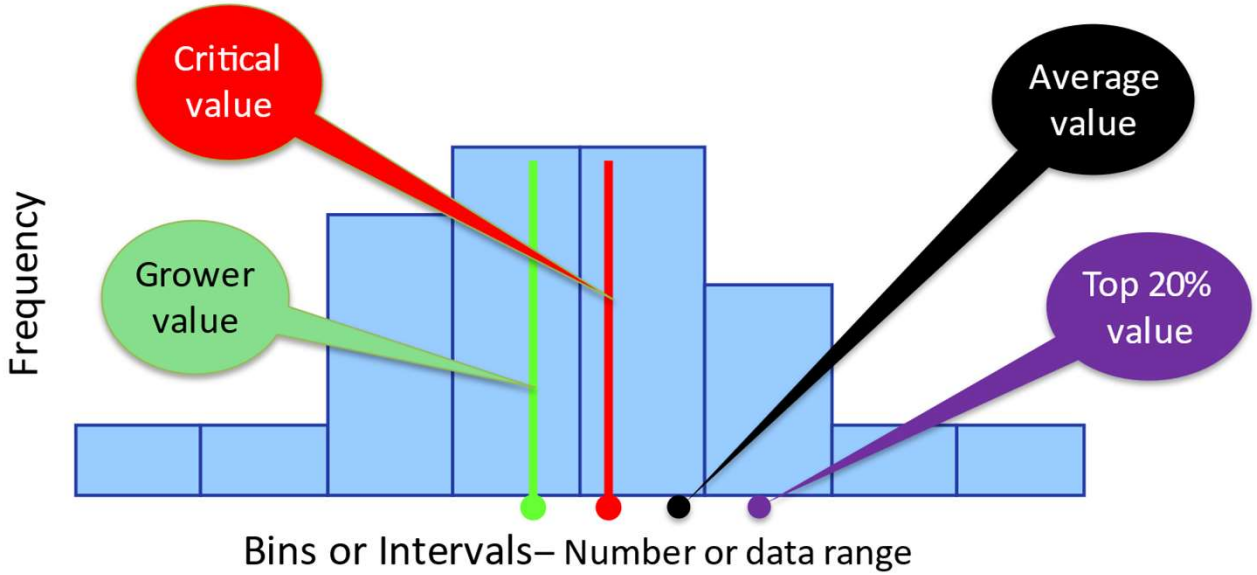
HYC AWARDS

Use of histograms for to display the range of comparative data



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Hyper Yielding Crops

HYC Award report - 2020

GRDC

WA

FAR2004-0025AX

The details shown below are a record of the inputs you applied to your crop of wheat during the growing season. Your agronomic decisions will have been made based on crop development, the seasonal variations in the weather and your judgement on the crops yield potential. This data plus additional information has been used in this report to compare your individual agronomy and management to the other Award growers in your region.

The data provided allows us to benchmark your key agronomy decisions with the other Award growers in your region and by comparing this data we're able to see the agronomic benchmarks of the top 20% in your region, the average and where you sit compared to the rest. Where appropriate we also add in critical levels, like soil test levels for example, for you to further benchmark your decisions.

This report will help you identify different agronomic decisions you made and the growing conditions that you had during the season that you could consider when looking at closing the yield gap on what you achieved compared to the potential for your paddock.

Crop details 2020

Crop	Cereal: Wheat
Variety	Devil
Area	22.00ha
Sow Rate	120.00 kg/ha
Sow Date	26-05-20
Harvest Date	20-12-20
Harvest Yield	5.36T/ha
Harvest Yield Method	Harvester (Direct)
Stubble Management 1	Retained Pasture
Fallow Management 1	Grazed (Sheep)
Seeder type	Tyne (Knife Point)
Seeder name	Bourgault Hoe Drill
Row spacing	250mm

Location

Key growth stages

Date	Band	Growth Stage
23-09-20	Anthesis	65: Mid flowering

Paddock history

Season	Crop	Variety
2020	Cereal: Wheat	Devil
2019	Other: Short term Pasture	
2018	Cereal: Barley	

Soil

Type and texture

Soil order	Tenosol
Soil texture	Sandy loam

National Soil Grid estimates 95% EV

Depth	BD	AWC	Clay	Silt	Sand
0-5cm	1.4g/cm3	13.7%	7.0%	1.3%	90.6%
5-15cm	1.4g/cm3	13.8%	7.7%	1.4%	87.8%
15-30cm	1.4g/cm3	14.1%	13.9%	2.3%	78.3%
30-60cm	1.4g/cm3	13.8%	24.4%	2.7%	69.0%
60-100cm	1.5g/cm3	13.4%	29.2%	3.2%	62.5%

Inputs

Seed

Date	Product	AI	Rate	Units
26-05-20	Devil		120	kg/ha

Seed treatment

Date	Product	AI	Rate	Units	Growth Stage
26-05-20	Gaucho	Imidacloprid (600 GAI)	200	mL/100kg	PP (Pre Plant Incorporation)

Fertiliser

Date	Product	AI	Rate	Units	N	P	K	S	Zn	Mn	Cu	Mo	B
26-05-20	AgFlow Mn		40.5	kg/ha	4	7	0	2	0.0	1.2	0.0	0.0	0.0
26-05-20	MAP		49.5	kg/ha	5	11	0	1	0.0	0.0	0.0	0.0	0.0
26-05-20	MOP		20	kg/ha	0	0	10	0	0.0	0.0	0.0	0.0	0.0
01-07-20	NS51		90	kg/ha	33	0	0	8	0.0	0.0	0.0	0.0	0.0
19-08-20	Flexi-N		80	L/ha	34	0	0	0	0.0	0.0	0.0	0.0	0.0
		Cumulative total			**76**	**18**	**10**	**11**	**0.0**	**1.2**	**0.0**	**0.0**	**0.0**

Herbicide

Date	Product	AI	Rate	Units	Growth Stage
19-05-20	Estercide Xtra 680	2,4-D Ester (680 GAI)	0.5	L/ha	KD (Knock Down)
19-05-20	Glyphosate 450	Glyphosate (450 GAI)	2.5	L/ha	KD (Knock Down)
26-05-20	Diuron 900 WDG	Diuron (900 GAI)	0.1	kg/ha	IBS (Incorporated by sowing)
26-05-20	TriflurX	Trifluralin (480 GAI)	2	L/ha	IBS (Incorporated by sowing)
26-05-20	Spike	Carfentrazone ethyl (240 GAI)	0.03	L/ha	IBS (Incorporated by sowing)
26-05-20	Luximax	Cinmethlyin (750 GAI)	0.5	L/ha	IBS (Incorporated by sowing)
26-05-20	Paraquat 250	Paraquat (250 GAI)	2.5	L/ha	IBS (Incorporated by sowing)
20-07-20	Bromoxynil 200	Bromoxynil (200 GAI)	0.8	L/ha	GS31 (1st node detectable)
20-07-20	Tigrex	MCPA Ester (250 GAI) Diflufenican (25 GAI)	1	L/ha	GS31 (1st node detectable)

Fungicide

Date	Product	AI	Rate	Units	Growth Stage
09-09-20	Veritas	Azoxystrobin (120 GAI) Tebuconazole (200 GAI)	0.4	L/ha	GS39 (Flag leaf fully emerged)

Insecticide

Date	Product	AI	Rate	Units	Growth Stage
09-09-20	Trojan	Gamma-cyhalothrin (150 GAI)	15	Ml/ha	GS39 (Flag leaf fully emerged)
09-09-20	Chlorpyrifos 500	Chlorpyrifos (500 GAI)	150	Ml/ha	GS39 (Flag leaf fully emerged)

Other

Date	Product	AI	Rate	Units	Growth Stage
19-05-20	SOA	Sulphate of Ammonia	1	%	KD (Knock Down)
19-05-20	Banjo	Methyl Ester Canola Oil (725 GAI)	1	%	KD (Knock Down)

HYC Awards - Actual Yield and Potential Yield

Management to achieve a high % of potential yield is an important aspiration and benchmarking exercise for grain growers

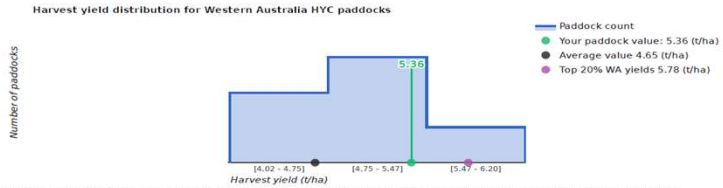
For the HYC Awards potential yields we have developed some models which take into account the three key climatic drivers of yield namely; water, temperature and radiation:

- The rainfall, plus irrigation where appropriate, at your paddock location during the year
- The available water capacity (AWC) from your paddock's soil down to 1 metre
- The temperature and radiation during the critical period of grain number determination between terminal spikelet and flowering.
- The radiation captured by the plant during the season and it's conversion into biomass.

To estimate potential yields, we calculate the theoretical possible yield using a combination of the seasons climatic variables and crop growth functions derived from previous best practice experimental research. This method assumes that management is optimised and the 'best' known variety is grown with no agronomic constraints such as disease, nutritional issues, lodging or other factors such as heat, frost or waterlogging that limit yield apart from radiation, water, and temperature on your soil for the 2020 season. The relationship with yield potential (grain number) also assumes no other significant stresses in the critical period such as extreme temperature, water or nitrogen stress. The conversion of biomass to yield is also assumed to be high and optimised during the grain fill period.

Actual yield	**5.36 t/ha**
Potential yield	**8.05 t/ha**
% of potential yield	**66.58%**

Recorded yields



There were 65 HYC Award paddocks in 2020. Headline results for your paddock are shown in benchmark figures below shown by:

- The yield from your region
- The highest % of the potential yield from your region
- The yield order nationally
- The order of the % of the potential yields nationally

Western Australia: Harvest yield (Wheat)

Position	Grain yield (t/ha)
#1	6.20
#2	5.36
#3	4.88
#4	4.79
#5	4.50

Western Australia: % of potential yield (Wheat)

Position	% of potential yield
#1	70.3
#2	66.6
#3	64.3
#4	57.4
#5	54.0

National: Harvest yield (Wheat)

Position	Grain yield (t/ha)	State
#1	11.00	TAS
#2	10.96	TAS
#53	5.36	WA

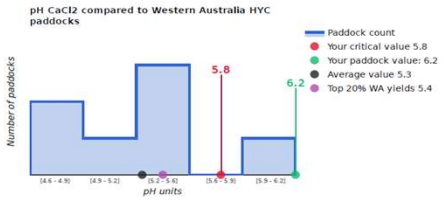
National: % of potential yield (Wheat)

Position	% of potential yield	State
#1	104.4	VIC (North)
#2	99.3	SA
#45	66.6	WA

Soil Analysis

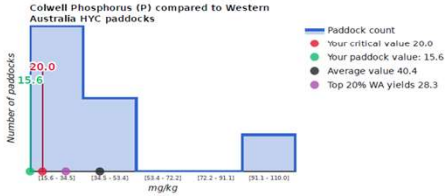
Paddock topsoil and subsoil, texture, bulk density and available water capacity (AWC) are vital in allowing estimation of soil water holding capacity and, along with seasonal rainfall, the water available to your crop.
Soil analyses provided through APAL tell us texture, organic matter, PBI and nutrient status. We use this soil texture and PBI information, where appropriate, to set critical soil values which are shown in the histograms specifically for your paddock soil type.

Data and critical soil nutrient levels provided by Australian precision ag laboraotory (APAL) who are undertaking the lab analysis for this GRDC project.



Topsoil pH

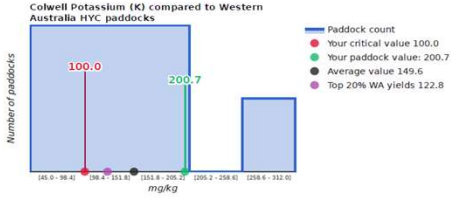
Soil pH(CaCl2) is the standard method of measuring soil pH in southern Australia. A soil pH (CaCl2) of 5.2–7.5 provides optimum conditions for most wheat varieties and at these levels the greatest amount of microbial activity occurs. Where extremes of acidity or alkalinity occur, various species of earthworms and nitrifying bacteria disappear. Soil pH also affects the availability of nutrients, and affects how the nutrients react with each other. At low pH, beneficial elements such as Mo, P, Mg, S, K, Ca and N become less available and others may become toxic.



Topsoil P - Colwell P

Adequate P is essential for the early growth of wheat. In most cropping systems, the Colwell-P soil test is the benchmark soil P test used in Australia.

A soil-test critical value is the soil-test value required to achieve 90% of crop yield potential. The critical value indicates whether nutrient supply is likely to result in a crop yield response. If the soil test value is less than the lower limit of the range, the site is highly likely to respond to an application of the nutrient.



Topsoil K - Colwell K

Potassium deficiency is more likely to occur on light soils and with high rainfall, especially where hay is cut and removed regularly. Factors such as soil acidity, soil compaction and waterlogging will modify root growth and the ability of crops to extract subsoil K.
Colwell K will measure extractable K in soil solution. The critical values for surface soils are generally around 80-250 mg/kg (ppm). The levels can be significantly lower on sandier soils.

HYC AWARD REPORT

- Detailed soil test analysis (0 – 10cm)
- Agronomy benchmarks
- Key cost comparisons
- Analysis of yield components
- Grain nutrient benchmarking

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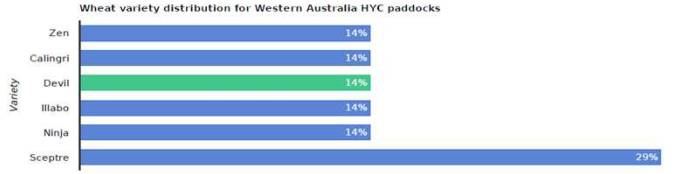
AGRONOMY

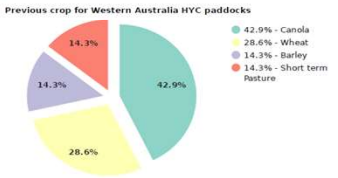
One of the advantages of the HYC Awards is that each participationg grower can learn from the top 20% highest yielding growers in your region by seeing how your specific agronomy benchmarks compare with what they are doing and there will be agronomic practices that can be taken back to your business that could well lead to improvements in yield and profitability. Based on these paddocks and 2020 experimental data from the GRDC HYC Crop Technology Centres some of the key indicators we have noted this season are:

1. High yields are not achievable by simply applying more nitrogen fertiliser above approx. 225 - 250kg N/ha. Effective rotations using break crops and legumes are the key.
2. Applying adequate nitrogen, including the use of multiple applications
3. Timeliness of operations is vital if you are to get the best out of your agronomic inputs. This starts with good planning at the start of the season, and continues with all inputs right through to harvesting.
4. Attention to detail

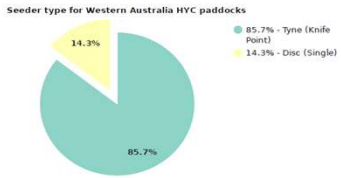
The following charts show how your agronomy compared to all other HYC Award growers in your region



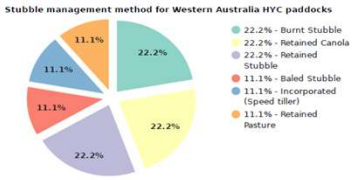
Previous crop



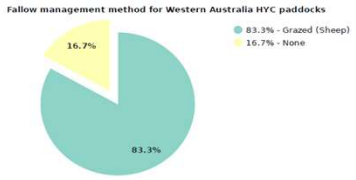
Seeder type



Stubble management method

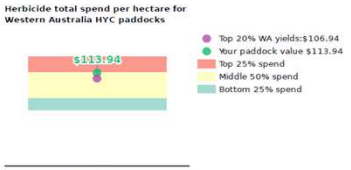


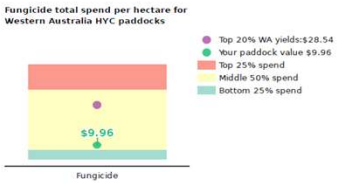
Fallow management method

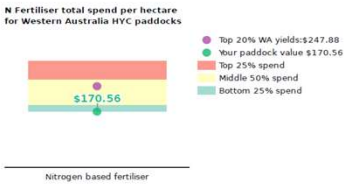


Key input costs per ha

Three key variable costs - herbicides, fungicides and nitrogen fertiliser have been put into individual charts. The total input cost per hectare, by State, has been divided into four: The minimum value, the 25th percentile value, the 75th percentile value and the maximum value. This determines the lowest 25%, middle 50% and top 25% spend.



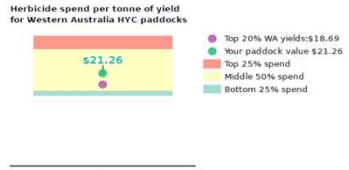


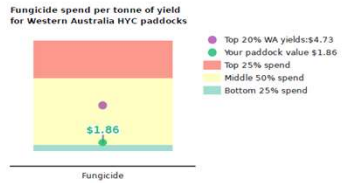


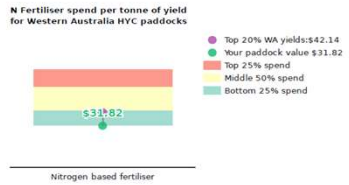
Input cost per tonne of production

The figures below have been derived from the use of standardized pricing across all HYC Award paddocks. The data came from the GRDC 2020 Farm Gross Margin and Enterprise Planning Guide.

These charts are probably of more importance than input cost per hectare as they give a better idea of your return as; cost per tonne produced.







Harvest Yield Components

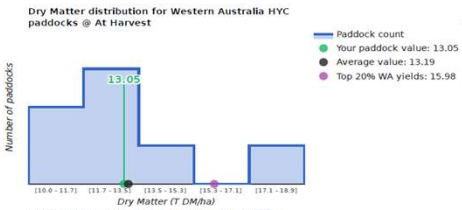
The key yield determining components at harvest in wheat are:

- Head number/m2
- Grains/head
- Grain weight

Their values are related to the success of different growth phases of the crop during the season:
Head number is a reflection of growth from the start of tillering to flag leaf appearance (GS39). Grain number/head is a reflection of the growth from GS39 to the start of flowering (GS61) and is deemed the critical period. Individual grain weight is the impact of the growth after flowering.

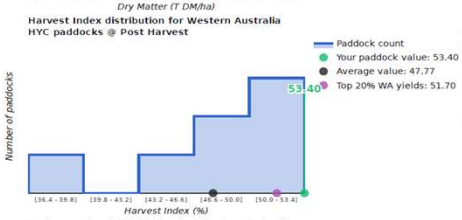
Each phase partially compensates for the outcome of earlier phases. A crop with a sparse shoot density tends to produce more grains/head and heavier grains than a thick crop. Conversely, poor performance in one phase increases reliance on good growing conditions in later phases.

Crop management and climate variables radiation and rainfall, soil type, soil depth will all affect grain yield. Grain yield is the principal product of crop growth, especially during the spring. Yields, therefore, depend on the condition the crop is in and how well it has been set up, leading into this period and then the growing conditions during this period.



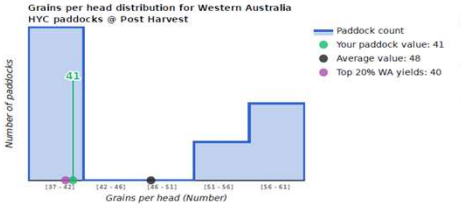
Harvest Dry Matter

Dry matter production at harvest is a reflection of your crops ability to convert the radiation, rainfall and soil water into biomass.



Harvest Index

The Harvest Index is the proportion of the total harvest dry matter that is harvested as grain. Therefore a harvest index of >50% has a greater % of grain compared to biomass present at harvest maturity.



Grains per head

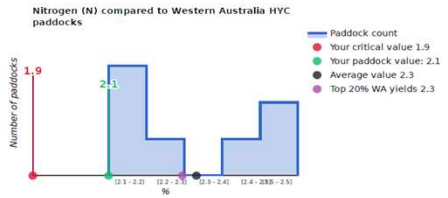
Grain number per head is largely controlled by survival of the florets while the last leaves and head are emerging, which is during the critical period just prior to flowering

Grain Nutrient Analysis

Making nutrient decisions based on analysis of harvested grain is an under utilised but extremely useful management tool.The HYC Award paddocks allows us to look at both soil and grain analysis and benchmark them, as a comparative analysis.

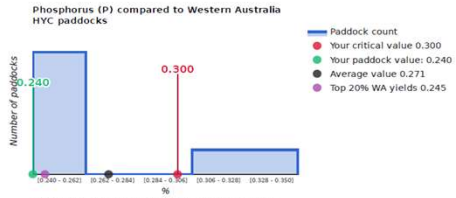
- Soil tests and their analysis tells us about the key nutrients and their potential availability. These are only taken once every 3-5 years normally!
- Grain analysis, does not replace soil tests but rather compliments them. The results will tell you about the crops uptake of those nutrients and acts as a respective check or post mortem.
- It tells you if the crop has utilised and benefited from applying trace elements
- Easy to collect a sample as long as it's done by paddock from the header
- Value of grain analysis
  - Allows you to measure P, K etc offtake
  - Allows you to cross check your soil analysis
  - Allows you to gauge possible nutrient deficiency
- Most research and confidence in N, P, S and Mn
- Less research work and so less information at present for K, Mg, Zn, Cu

Data and critical grain nutrient levels provided by Australian precision ag laboratory (APAL) who are undertaking the lab analysis for this GRDC project.



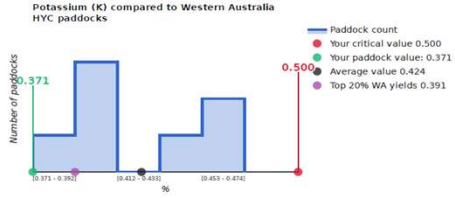
Grain N

Grain Nitrogen content relates directly to the grain protein, with a ratio of 1 to 5.7. So a grain N content of 1.75% equates to 10% protein. High concentrations of grain protein can arise either from large N uptake or poor starch formation during grain filling. Protein contents of wheat crops grown after a break crop are usually diluted by their greater yields. Conversely, factors that reduce yield without affecting N transport to grain, such as drought, early lodging or some diseases, may raise protein.



Grain P

Grain P levels of less than 0.3% indicate that the crop would have produced a worthwhile yield response if extra P uptake could have been achieved. Grain P levels of more than 0.3% indicate that responses to extra P uptake would be small and probably uneconomic.



Grain K

Values less than 0.5% indicate a need for
further checks on your K nutrition, especially by looking at your most recent soil analysis.

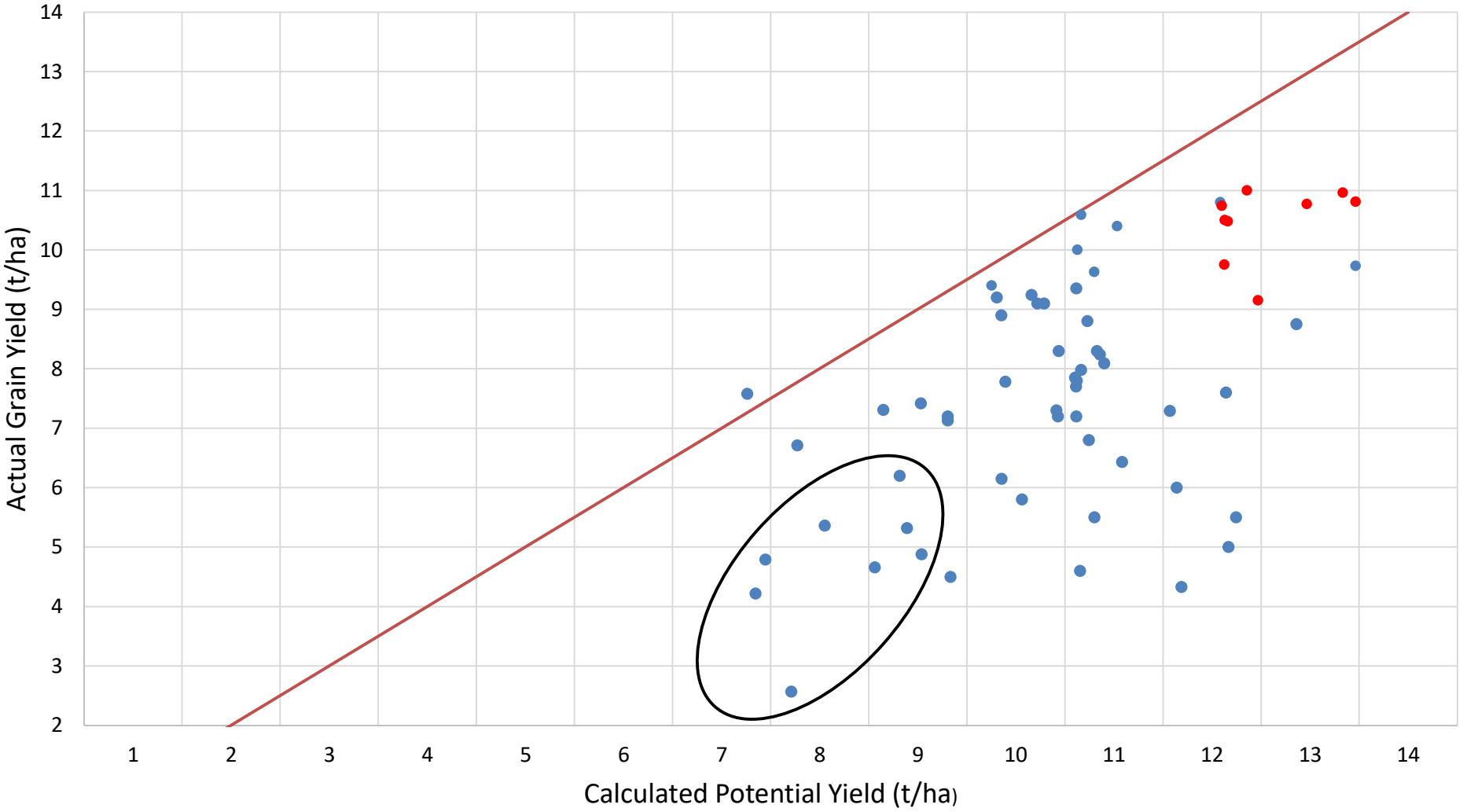
WHERE WE ARE TODAY AND WHAT WE SHOULD BE THINKING TOMORROW?

Focus is currently on dealing with specific problems

- Weed control – Ryegrass and Wild radish
- Fungicides for control for disease
- Nitrogen rates and timings
- Not much focus on soil structure and rooting depth
- Yield expectations are conservative based on historic results

What we should be thinking

- Optimise capture of water, light & nutrients
- Crop canopy size, structure and longevity
- Resilience of our cropping systems
- It's not all about the weather! Consider management, timing and attention to detail
- Raise the expectations of yield potential both water and light limited.

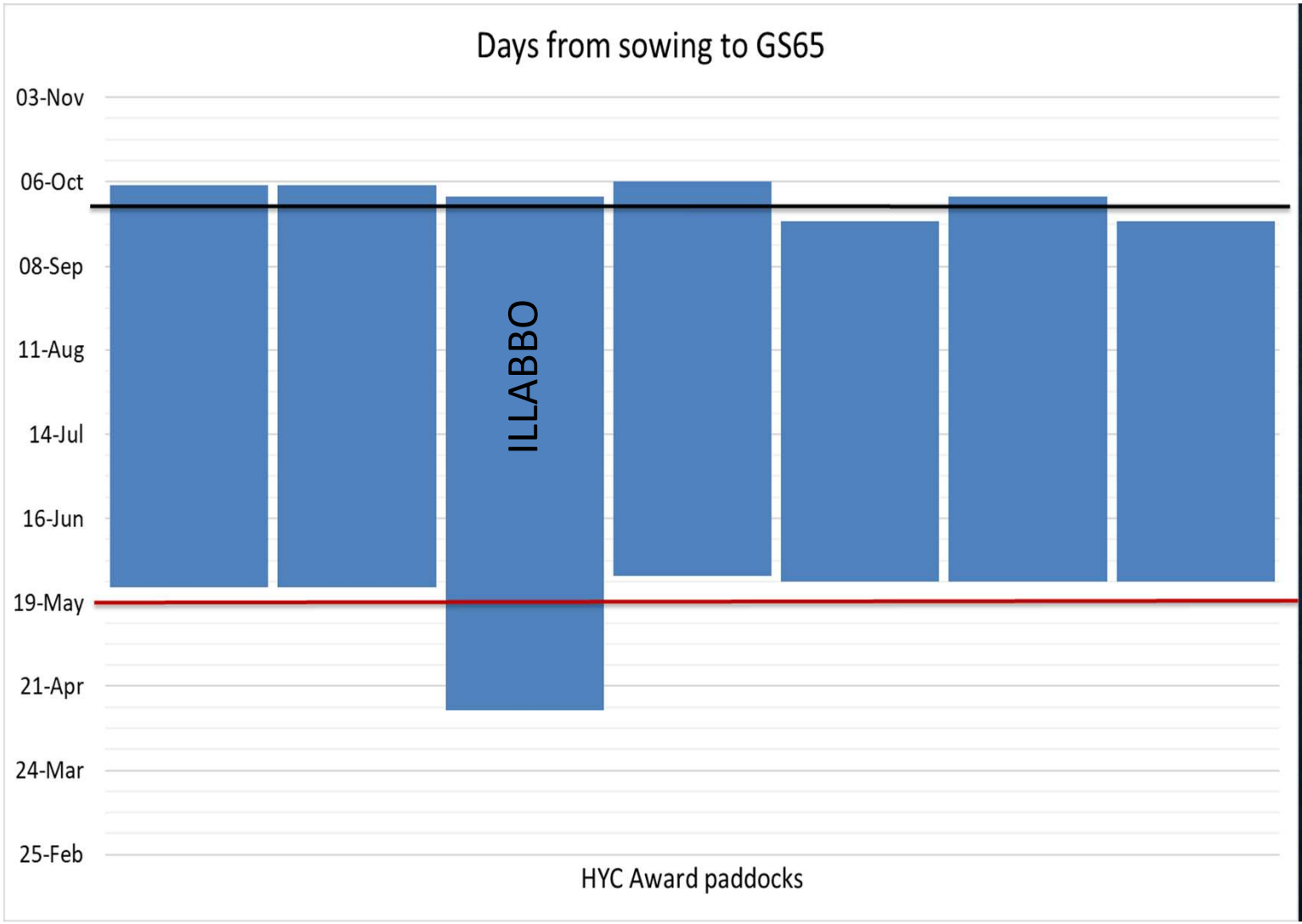

Actual Grain Yield (t/ha)
Calculated Potential Yield (t/ha)
14
13
12
11
10
9
8
7
6
5
4
3
2
1
2
3
4
5
6
7
8
9
10
11
12
13
14

CROP DEVELOPMENT AND RELATIONSHIP WITH YIELD

	Top 25%	Remaining 75%
So		
Mid		

The following data comparisons are just relationships between factors and yield!

We can't say they are definitely the cause of higher or lower yields.



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Average sowing date: 19 May

Average GS65: 30 Sept

Optimum start flowering : 20 Sept

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FALLOW AND SOWING MANAGEMENT AND RELATIONSHIP WITH YIELD

Metric	Top 25% Yield: 5.8 t/ha	Remaining 75% Yield: 4.2 t/ha
Row Width	250mm	280mm
Tine seeders (%)	100%	80%
Fallow M'ment	100% Grazed	60% Grazed 20% Baled 20% Speed tiller

CROP MANAGEMENT AND RELATIONSHIP WITH YIELD

Metric	Top 25% Yield: 5.8 t/ha	Remaining 75% Yield: 4.2 t/ha
N applied (kg N/ha)	129	107
Number of applic’	3	4
Cost of N / tonne yield	$46/t	$57/t
P applied (kg P/ha)	24	18
K applied (kg K/ha)	25	32


“Anyone who has never made a mistake has never tried anything new”
- Albert Einstein

CROP AGRONOMY AND RELATIONSHIP WITH YIELD

Metric	Top 25% Yield: 5.8 t/ha	Remaining 75% Yield: 4.2 t/ha
Fungicides ($/ha)	$29	$18
Fungicides ($/t)	$4.8	$4.0
Number of applic’	2	1
PGR applications	0	0

SOIL FACTORS AND RELATIONSHIP WITH YIELD

Metric	Top 25% Yield: 5.8 t/ha	Remaining 75% Yield: 4.2 t/ha
pH (CaCl)	5.4	5.2
Soil Org carbon (%)	2.6	3.1
Colwell P (mg/kg)	29	45#
Colwell K (mg/kg)	123	160*

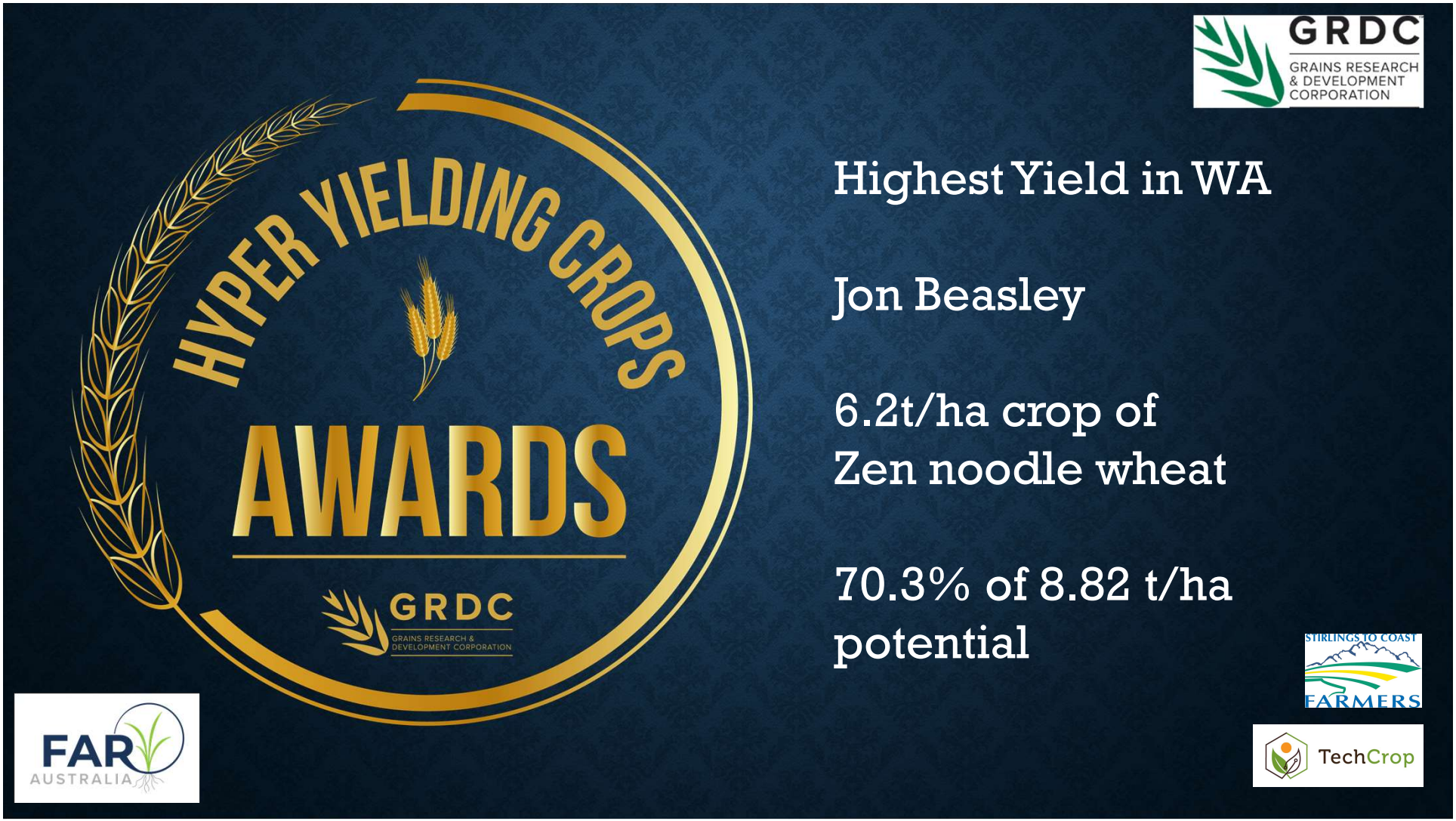
2 different paddocks – one 110 P #, other 312 K*

* Two Award paddocks that were sown on 300mm row spacing produced 60 grains/head compared to an average of 47.6. This led to the higher result of 19,200!

Metric	Top 25% Yield: 5.8 t/ha	Remaining 75% Yield: 4.2 t/ha
Dry Matter (t/ha)	16	12.1
Harvest index	51.7%	46.5%
Head count (m^2)	445	384
Grains per head	40	50
Grains per m^2	17,735	19,200*
1000 grain weight	45.3	42.3

GRAIN NUTRIENTS AND RELATIONSHIP WITH YIELD

Metric	Top 25% Yield: 5.8 t/ha	Critical Values	maining 75% ield: 4.2 t/ha
Grain N	2.30	1.9	2.32
Grain P	0.25	0.3	0.28
Grain K	0.39	0.5	0.44
Grain S	0.14	0.17	0.14
Grain Cu	4.0	2.5	3.0
Grain Zn	19.5	21	22.2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HYPER YIELDING CROPS
AWARDS
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Highest Yield in WA
Jon Beasley
6.2t/ha crop of
Zen noodle wheat
70.3% of 8.82 t/ha
potential
FAR
AUSTRALIA
STIRLINGS TO COAST
FARMERS
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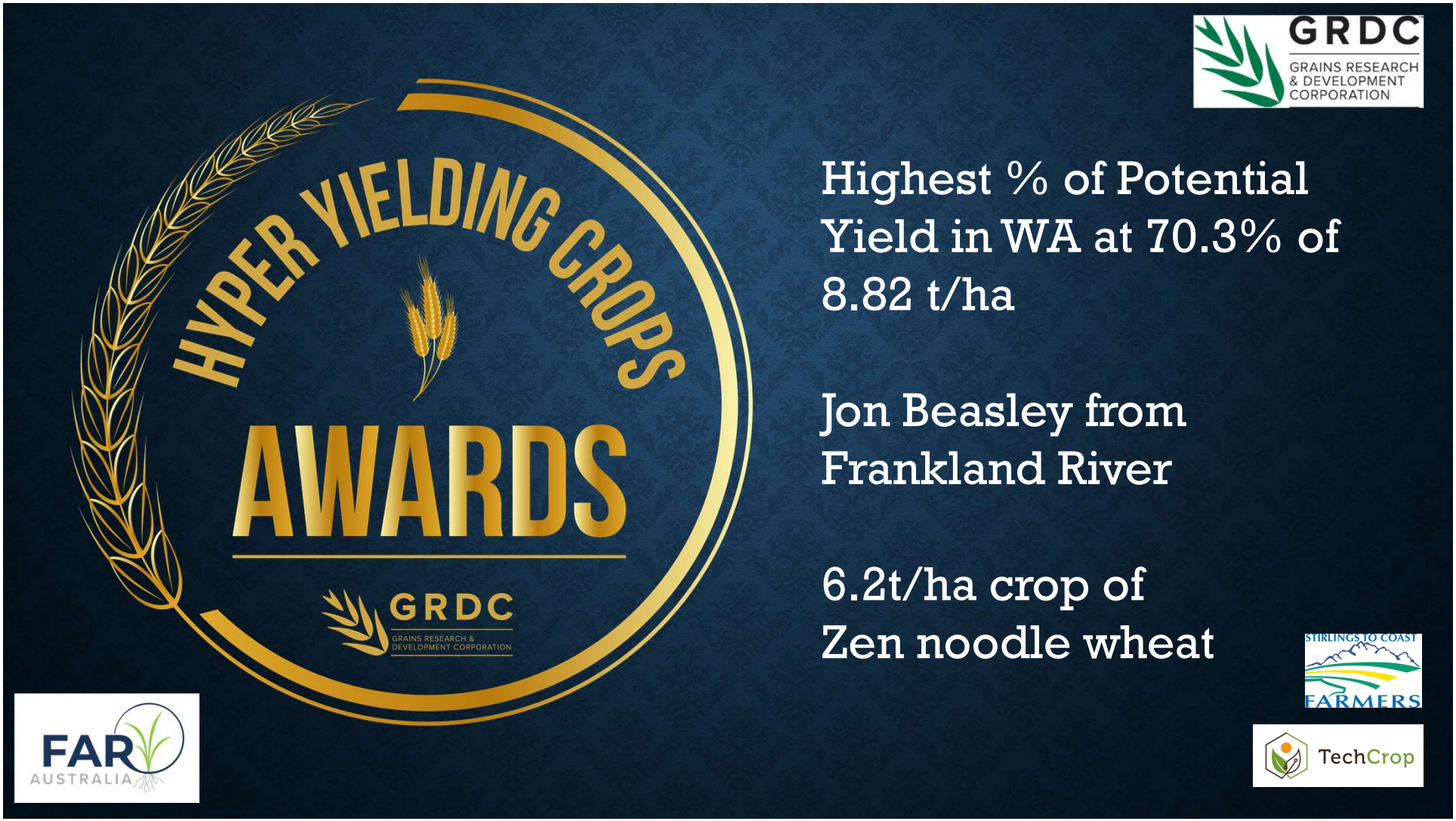
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HYPER YIELDING CROPS
AWARDS
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
Highest % of Potential Yield in WA at 70.3% of 8.82 t/ha
Jon Beasley from Frankland River
6.2t/ha crop of Zen noodle wheat
FAR AUSTRALIA
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WHERE TO FROM HERE?

JOIN ONE OF THE INNOVATION GROUPS IN WA AND GET INVOLVED IN CROP WALKS, IN PADDOCK DISCUSSION AND FOCUS TRIALS
PLUS
HYC WHEAT AWARDS FOR 2021

Growers, advisers and others wishing to become involved in the HYC project can contact their respective state project officer:

WA – Dan Fay from Stirlings to Coast Farmers dan.fay@scfarmers.org.au

or Jon Midwood of TechCrop, jon@techcrop.com.au