

HYPER YIELDING CROPS (HYC)

ARE THERE LEARNINGS OUTSIDE OF THE HIGH RAINFALL ZONE?
NICK POOLE, FAR AUSTRALIA



GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

KEY POINTS



- The Hyper Yielding Crops (HYC) project is a GRDC national investment which aims to push the economically attainable yield boundaries of wheat, barley and canola across five states in the HRZ.
- Hyper yielding crops cannot be achieved with artificial fertiliser alone.
- The world record for wheat set in 2020 in New Zealand showed wetter soils (irrigated) improved nitrogen use efficiency (NUE) and illustrated the importance of good soil nitrogen (N) supply.
- Disease management is one of the most important management components of growing hyper yielding cereal crops in seasons that favour higher yield potential, such as 2020.
- Genetic resistance that allows a delay in making fungicide decisions gives; i). a better view of the season's yield potential ii). allows the "money leaves" to be sprayed at the same time and iii). reduces the number of fungicide applications (a key factor in reducing fungicide resistance risk).

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 across the country:



PROJECT OBJECTIVES

- To increase productivity of wheat, barley and canola across the high rainfall zone of Australia.
- To engage with, develop and support growers and advisers to set new economically attainable yield benchmarks.
- Establish Focus farms and a HYC awards programme to encourage growers to become involved and enable “*a seeing is believing participatory approach*”.



HYPER YIELDING CROPS

5 Research Centres of Excellence



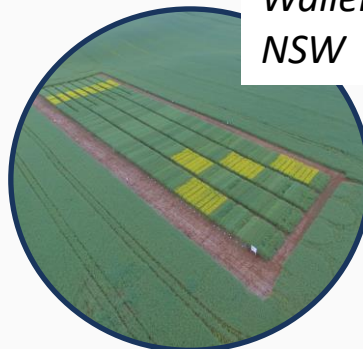
*Hagley,
Tasmania*



*Millicent,
South Australia*



*Green Range,
WA*



*Wallendbeen,
NSW*



*Gnarwarre,
Victoria*

HYC WHAT'S POSSIBLE? (PROVISIONAL ASSESSMENT)

Estimated long-term (since 1980) average yield potential at the HYC research sites based on the average photothermal quotient (PTQ) in the critical period (PY_{PTQ}), and on the seasonal water supply (PY_w) based on TE of 25 kg/ha/mm for cereals (Source: John Kirkegaard, CSIRO 2020)

What's limiting Yield Potential?

(1) radiation and temperature in the critical period (photothermal quotient, PTQ)

(2) water supply to the crop (soil and growing-season rainfall)

<i>Wheat and Barley</i>	<i>Flowering</i>	<i>Potential Yield</i> <i>t/ha</i> <i>(PY_{PTQ})</i>	<i>GSR + stored</i> <i>minus evap.</i> <i>(mm)</i>	<i>Potential Yield</i> <i>t/ha</i> <i>(PY_w)</i>
Hagley (TAS)	7 Nov	12.9	496	12.5
Wallendbeen (NSW)	10 Oct	13.4	432	10.8
Gnarwarre (VIC)	20 Oct	9.4	419	10.5
Millicent (SA)	15 Oct	9.1	559	14.0
Green Range (WA)	20 Sept	8.0	423	10.5

Just how much N
fertiliser do we need for
Hyper Yielding Crops?

Is NUE and soil N supply
more efficiently
delivered in good
seasons?



Hyper Yielding Crops Project wheat & barley research – VICTORIA Crop
Technology Centre, Gnarwarre, Victoria, October 2020

How much N do we need to grow a 10 t/ha wheat crop?

10 t/ha assuming we need 40kg N/ha supplied (fertiliser N and soil N)
= 400 kg N/ha supply

Hyper Yielding Crops, Southern Victoria 2020 cv RGT Accroc (Wheat after canola)

Trt.	Applied Nutrition (kg/ha)	Yield		Protein		Test Weight		Screenings		N offtake in grain (total incl. straw & chaff*)
		(t/ha)		%		Kg/hl		%		Kg N/ha
1	??? N kg/ha	10.14	ab	9.7	c	78.4	-	1.3	b	172 (229)
2	??? N kg/ha, 30 S kg/ha	10.29	a	10.2	b	78.4	-	1.4	b	184 (245)
3	??? N kg/ha	9.92	ab	10.4	b	78.0	-	1.4	b	181 (241)
4	??? N kg/ha, 45 S kg/ha	9.73	b	10.4	b	78.0	-	1.7	a	178 (237)
5	??? N kg/ha	9.91	ab	11.0	a	77.4	-	1.7	a	191 (254)
Mean		9.99		10.3		78.0		1.5		
LSD (p=0.05)		0.49		0.5		ns		0.2		
P Val		0.179		<0.001		0.829		0.005		

Soil Mineral N available in June (0-90cm) = 64kg N/ha

* Assumed that 25% N in the crop at harvest is present in the straw and chaff.

* This 25% maybe returned to the soil if the crop residues are not baled or burnt.

When soils are moist 10 t/ha wheat can be grown with less than 400kg N/ha supply

Hyper Yielding Crops, Southern Victoria 2020 cv RGT Accroc (Wheat after canola)

Trt.	Applied Nutrition (kg/ha)	Yield		Protein		Test Weight		Screenings		N offtake in grain (total incl. straw & chaff*)
		(t/ha)		%		Kg/hl		%		Kg N/ha
1	148 N kg/ha	10.14	ab	9.7	c	78.4	-	1.3	b	172 (229)
2	183 N kg/ha, 30 S kg/ha	10.29	a	10.2	b	78.4	-	1.4	b	184 (245)
3	183 N kg/ha	9.92	ab	10.4	b	78.0	-	1.4	b	181 (241)
4	217 N kg/ha, 45 S kg/ha	9.73	b	10.4	b	78.0	-	1.7	a	178 (237)
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When soils are moist 10 t/ha wheat can be grown with less than 400kg N/ha supply

Treatment	Yield (t/ha)	
Standard nutrition (Farm Standard – 152kg N/ha)	9.98	-
214.5 kg N/ha	10.30	-
257 kg N/ha	9.99	-
214.5 kg N/ha + 22P & 22K	10.11	-
257 kg N/ha + 22P & 22K	9.92	-
Grand Mean	10.06	
LSD P=.05	0.29	
Treatment Prob(F)	0.087	
CV	1.86	

**Hyper Yielding Crops, Wallendbeen 2020
cv RGT Accroc (Wheat after canola)**

Importance of genetic
resistance for Hyper
Yielding Crops?

And if you don't have it
good disease
management strategies!



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

Hyper Yielding Crops (HYC)

Wheat Disease Management studies (Protocol 4) – Germplasm x fungicide strategy interaction 2020 - Wallendbeen, NSW (featured), VIC & SA)

Plant pop'n:		180 seeds/m ² (150 plants/m ² target) - all three managements		
	Timing	Untreated	1 fungicide unit	4 fungicide units
Seed treatment:		Vibrance [®] /Gaucho [®]	Vibrance/Gaucho	As per 1 F unit + Systiva[®]
Basal Fertiliser:	21 April	120kg MAP (12 Kg N)	120kg MAP (12 Kg N/ha)	120kg MAP (12 Kg N/ha)
Nitrogen:	18 June	40kg N/ha	40kg N/ha	40kg N/ha
	29 July	70kg N/ha	70kg N/ha	70kg N/ha
Total N Applied:		122kg N/ha*	122kg N/ha*	122kg N/ha*
Fungicide:	GS31	---	---	Prosaro[®] 300 mL/ha
	GS39	---	Amistar Xtra[®] 800 mL/ha	Amistar Xtra 800 mL/ha
	GS59-61	---	---	Opus[®] 125 500 mL/ha

* N application varied between HYC sites Hyper Yield Crops research sites

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

	Untreated	1 Fungicide Unit (GS39)	4 Fungicide Units S.trt, GS31,39, 61	Mean
Cultivar	Yield t/ha	Yield t/ha	Yield t/ha	Yield t/ha
Trojan (spring)	2.28 n	7.55 hij	8.13 efg	5.98
Scepter (spring)*				
Nighthawk (facultative)				
Anapurna (winter)				
RGT Accroc (winter)				
Beckom (spring)				
Catapult (spring)				
Gregory (spring)				
Coolah (Spring)				
DS Bennett (Winter)				
LSD Cultivar p=0.05		0.26 t/ha	P val	<0.001
LSD Management p=0.05		0.28 t/ha	P val	<0.001
LSD Cultivar x Man. p=0.05		0.45 t/ha	P val	<0.001

We need good genetic resistance to allow us to get to flag leaf without the need for a fungicide.

3 reasons:

1. Clear view of seasonal prospects by that growth stage (both yield and disease pressure)
2. All of the important leaves in the canopy can be sprayed at the same time.
3. Prevent fungicide resistance by using less applications!



Hyper Yielding Crops Project
wheat – Wallendbeen, NSW
2020 (sown 22nd April)

Disease Management Protocol 4
for Wheat

Good disease management is essential to hyper yielding crops

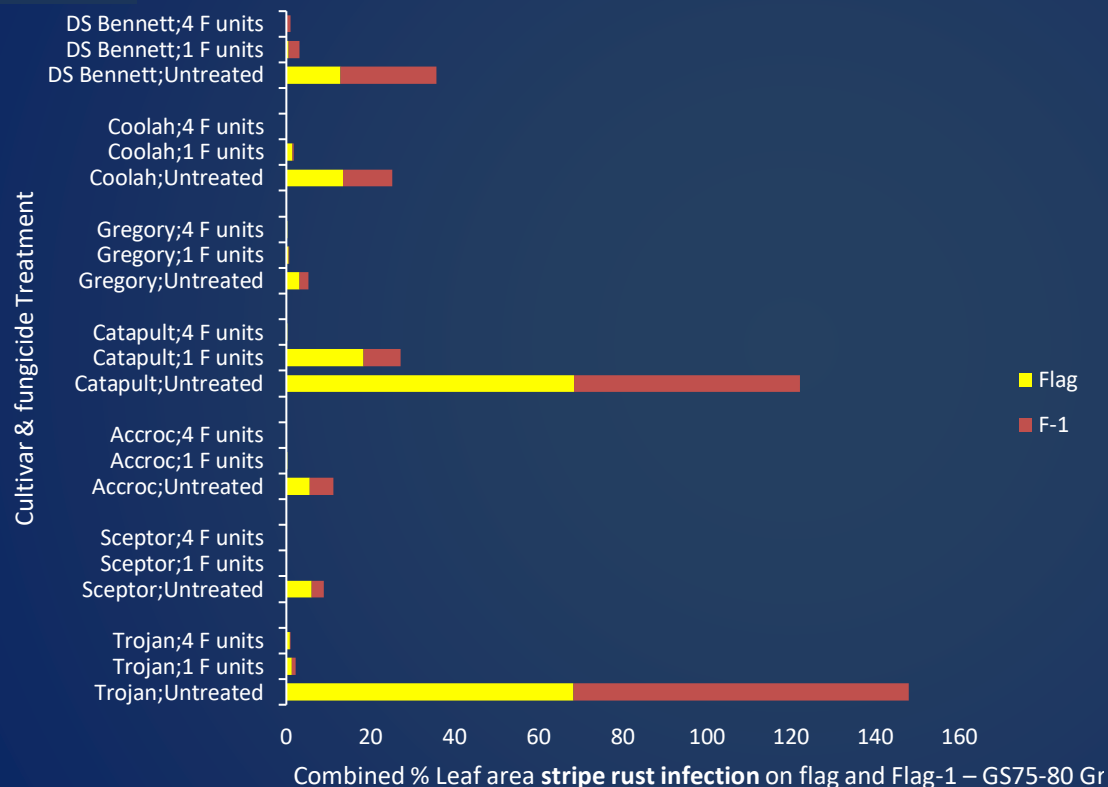
	Untreated	1 Fungicide Unit (GS39)	4 Fungicide Units S.trt, GS31,39, 61	Mean
Cultivar	Yield t/ha	Yield t/ha	Yield t/ha	Yield t/ha
Trojan (spring)	2.28 n	7.55 hij	8.13 efg	5.98
Scepter (spring)*	7.07 kl	8.60 d	8.55 de	8.07
Nighthawk (facultative)	7.98 gh	8.47 def	8.54 de	8.33
Anapurna (winter)	9.69 c	10.22 b	10.46 ab	10.12
RGT Accroc (winter)	9.72 c	10.86 a	10.83 a	10.47
Beckom (spring)	7.75 ghi	8.46 def	8.66 d	8.29
Catapult (spring)	6.06 m	7.84 ghi	8.46 def	7.45
Gregory (spring)	6.75 l	7.15 jkl	7.40 ijk	7.10
Coolah (Spring)	7.26 jk	8.07 fg	8.75 d	8.03
DS Bennett (Winter)	5.68 m	8.75 d	9.48 c	7.97
LSD Cultivar p=0.05		0.26 t/ha	P val	<0.001
LSD Management p=0.05		0.28 t/ha	P val	<0.001
LSD Cultivar x Man. p=0.05		0.45 t/ha	P val	<0.001

*Hyper Yielding Crops Project
wheat & canola research –
Wallendbeen, NSW 2020 (sown
22nd April)*

*Disease Management Protocol4
for Wheat*

*No significant difference in yield
between 1 & 4 units of fungicide*

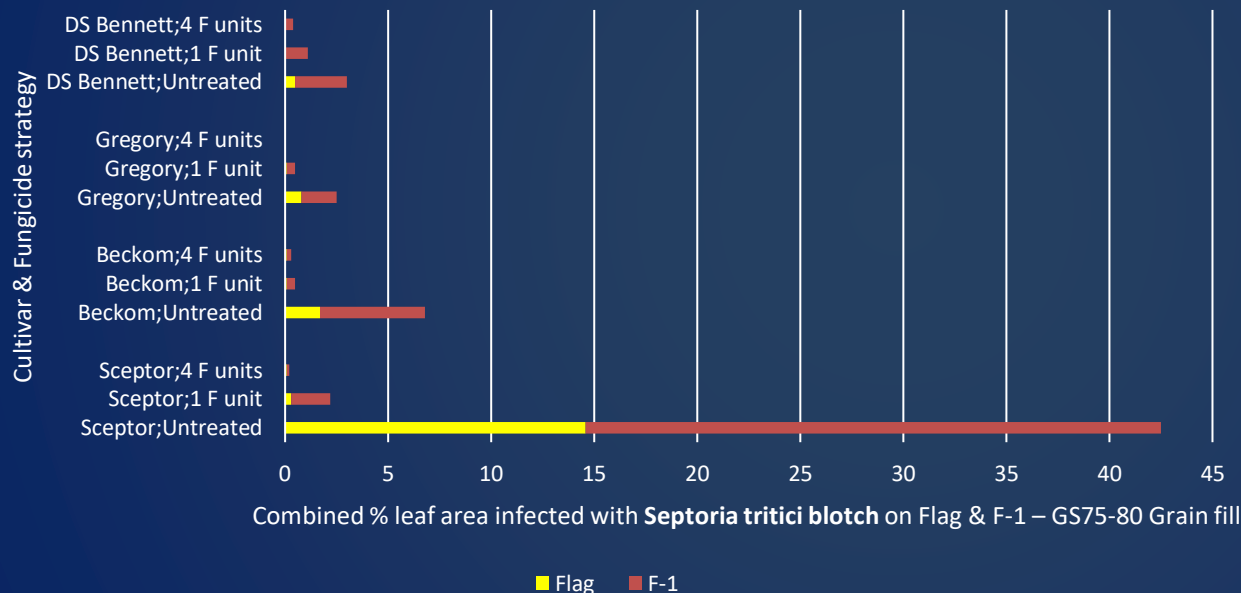
So what levels of disease lay behind these results?



*Hyper Yielding Crops Project
wheat research – Wallendbeen,
NSW 2020*

*Disease Management Protocol 4
for Wheat*

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*Hyper Yielding Crops Project
wheat research – Wallendbeen,
NSW 2020*

*Disease Management Protocol 4
for Wheat*

Good disease management is essential to hyper yielding crops

	Varietal yield under different levels of disease management					
	Untreated		1 Fungicide unit (GS39)		4 Fungicide units (S.trt, GS31,39, 61)	
Cultivar	Yield t/ha		Yield t/ha		Yield t/ha	
Trojan (spring)	2.14	p	2.90	o	8.97	d-g
Scepter (spring)	5.82	n	7.87	jkl	8.78	efg
Nighthawk (facultative)	7.21	m	7.60	lm	8.11	jk
Annapurna (winter)	8.30	hij	8.97	d-g	9.23	b-e
RGT Accroc (winter)	7.85	jkl	9.13	c-f	9.58	abc
RGT Calabro (winter)	7.67	klm	8.63	gh	8.95	efg
SFR 86-090 (winter)	5.94	n	9.15	c-f	9.82	a
Tabasco (winter)	7.67	klm	7.81	kl	8.11	ijk
SF Adagio (winter)	8.71	fgh	9.67	ab	9.44	a-d
SQP Revenue (winter)	5.71	n	7.92	jkl	8.58	ghi
LSD Cultivar x Man. p=0.05	0.47 t/ha		P val		>0.001	

*Hyper Yielding Crops Project
wheat & canola research –
Gnarwarre, Southern Victoria
(HRZ) 2020*

*Disease Management Protocol 4
for Wheat*

 *No significant difference in
yield between 1 & 4 units of
fungicide*

- Good disease management is essential in all regions when yield potential is higher due to spring rainfall!
- Only one wheat variety tested over three HRZ sites in 2020 offered sufficient genetic resistance to be left fully untreated with fungicide.
- Key foliar fungicide timings for wheat to protect the top four leaves and head are GS31 (1st node), GS39 (flag leaf) and GS59 (full head emergence).
- Where germplasm is susceptible to stripe rust e.g Trojan, DS Bennett, Catapult is to be planted this autumn ensure that flutriafol is applied to the basal fertiliser since stripe rust infection pre GS31 can be significant.

KEY POINTS



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Thank you to GRDC and collaborating colleagues

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¹Field Applied Research (FAR) Australia, ²South Australian Research and Development Institute (SARDI), ³Southern Farming Systems (SFS), ⁴Brill Ag and ⁵CSIRO

If you would like to get involved in South East SA then please get in touch with Jen Lillecrapp, your regional HYC Project Officer (Jen Lillecrapp <jen@brackenlea.com>).

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