Trial 4. HYC Disease Management Germplasm Interaction

Objectives: To develop profitable and sustainable approaches to disease management in high yielding and HRZ regions.

Individual objectives specific to the trial were:

- To evaluate whether newer germplasm or new fungicide chemistry allows a reduction in the number of fungicide applications whilst increasing profitability (note: reducing the number of fungicides is seen as a key measure for slowing down resistance development in cropping systems).
- Examine whether there is germplasm (varieties tested) that has sufficient early season disease resistance to replace the need for the "at sowing fungicide" and Timing 1 (T1) spray applied at GS31-32.
- To determine the cost benefit ratio of fungicide application in HRZ regions of different season lengths.

Key Messages:

- The feed winter wheats RGT Accroc, Anapurna and RGT Cesario significantly out yielded all other cultivars at all three levels of fungicide input and achieved over 10t/ha with fungicide input.
- There was a significant interaction between cultivar and fungicide management with the stripe rust susceptible cultivars Trojan and Catapult giving yield responses of 1.09 and 3.58t/ha to a single flag leaf fungicide compared to less than a 1t/ha with the majority of cultivars.
- Septoria tritici blotch (STB) was the principal disease in untreated crops of Scepter and Beckom, whilst stripe rust (pathotype 239 dominant with 198 pathotype also present) was the main disease in Trojan, RGT Accroc and Catapult. Other cultivars were subject to low levels of both stripe rust and STB disease pressure.
- Only Trojan and Catapult gave significant yield increases to the application of more than one fungicide unit while only Trojan gave a significant yield increase to four units of fungicide (seed treatment and three foliar fungicides).
- The significant interaction observed in grain yields was also apparent in the grain quality (protein, test weights and screenings) and the resulting wheat grade.
- Highest return on investment with fungicide was seen in the spring wheat cultivars Trojan, Beckom and Catapult due to both higher grain yield and better grain quality.

Increasing fungicide input across seven cultivars of wheat produced significant interactions in both grain yield and quality (protein, test weight and screenings) (Tables 1 – 5). The influence of treatment on net margin, cost benefit ratios ($ earnt for $ spent) and gross margins are presented in Tables 6-8. The disease recorded in the trials was principally Septoria tritici blotch (STB), stripe rust and leaf rust, levels of which are presented.

Table 1. Influence of disease management strategy and variety on grain yield (t/ha).

	Management Level (Yield t/ha)								
Cultivar	**Untreated**		**1 Fungicide Unit**		**2 Fungicide Units**		**4 Fungicide Units**		**Mean**
Trojan (spring)	3.51	l	4.60	k	5.24	j	6.56	i	**4.98**
Scepter (Spring)	7.14	gh	7.67	efg	7.92	e	8.05	e	**7.70**
RGT Cesario (Winter)	10.50	bcd	11.14	a	10.89	abc	10.87	abc	**10.85**
Anapurna (Winter)	10.46	cd	10.84	abc	10.83	abc	10.79	abc	**10.73**
RGT Accroc (Winter)	9.99	d	11.05	a	11.01	ab	10.94	abc	**10.75**
Beckom (Spring)	6.94	hi	7.71	ef	7.84	e	8.10	e	**7.65**
Catapult (Spring)	3.18	l	6.76	hi	7.28	fgh	7.59	efg	**6.20**
Mean	**7.39**		**8.54**		**8.71**		**8.99**		
Cultivar	**LSD**	0.36t/ha		P val	<0.001				
Management	**LSD**	0.20t/ha		P val	<0.001				
Cultivar x Management	**LSD**	0.54t/ha		P val	<0.001				

Table 2. Influence of disease management strategy and variety on grain protein %.

	Management Level (Protein %)								
Cultivar	**Untreated**		**1 Fungicide Unit**		**2 Fungicide Units**		**4 Fungicide Units**		**Mean**
Trojan (spring)	14.9	ab	15.1	a	15.0	a	14.8	abc	14.9
Scepter (Spring)	15.1	a	14.9	ab	14.8	abc	14.4	bcd	14.8
RGT Cesario (Winter)	10.6	lm	10.5	m	11.0	kl	11.5	ijk	10.9
Anapurna (Winter)	12.2	g	12.1	gh	11.9	ghi	12.0	gh	12.0
RGT Accroc (Winter)	11.9	ghi	11.2	jk	11.6	hij	11.6	hij	11.6
Beckom (Spring)	14.0	def	13.6	f	13.6	f	13.8	ef	13.7
Catapult (Spring)	14.1	de	13.9	def	14.3	cd	14.0	def	14.1
Mean	**13.3**		**13.0**		**13.2**		**13.1**		
Cultivar	**LSD**	0.4		P val	<0.001				
Management	**LSD**	ns		P val	0.212				
Cultivar x Management	**LSD**	0.5		P val	0.036				

Table 3. Influence of disease management strategy and variety on grain test weight (kg/hl).

	Management Level (Test Weight kg/hL)								
Cultivar	**Untreated**		**1 Fungicide Unit**		**2 Fungicide Units**		**4 Fungicide Units**		**Mean**
Trojan (spring)	66.1	l	70.5	k	74.0	j	75.6	i	71.5
Scepter (Spring)	76.8	f-i	77.8	c-h	78.4	b-e	78.5	bcd	77.9
RGT Cesario (Winter)	77.9	c-g	78.0	c-g	78.4	b-f	78.8	bc	78.2
Anapurna (Winter)	79.9	ab	80.4	a	80.9	a	80.8	a	80.5
RGT Accroc (Winter)	75.5	ij	76.9	d-i	76.8	e-i	78.0	c-g	76.8
Beckom (Spring)	75.8	i	76.0	i	76.6	ghi	76.7	ghi	76.3
Catapult (Spring)	57.6	m	71.1	k	76.0	i	76.2	hi	70.2
Mean	**72.8**		**75.8**		**77.3**		**77.8**		
Cultivar	**LSD**		1.7		P val		<0.001		
Management	**LSD**		0.6		P val		<0.001		
Cultivar x Management	**LSD**		1.6		P val		<0.001		

Table 4. Influence of disease management strategy and variety on grain screenings (%).

	Management Level (Screenings %)								
Cultivar	**Untreated**		**1 Fungicide Unit**		**2 Fungicide Units**		**4 Fungicide Units**		**Mean**
Trojan (spring)	2.9	b	2.1	c	1.7	cd	1.2	d-h	2
Scepter (Spring)	1.0	fgh	0.8	h	0.9	gh	1.0	fgh	0.93
RGT Cesario (Winter)	1.4	d-g	1.1	e-h	1.1	e-h	1.2	d-h	1.21
Anapurna (Winter)	1.6	cde	1.5	d-g	1.4	d-h	1.4	d-h	1.45
RGT Accroc (Winter)	1.3	d-h	1.3	d-h	1.3	d-h	1.1	e-h	1.26
Beckom (Spring)	1.5	d-g	1.1	e-h	1.1	e-h	1.0	e-h	1.17
Catapult (Spring)	4.7	a	1.5	def	1.1	e-h	1.0	e-h	2.07
Mean	**2.0**		**1.4**		**1.2**		**1.1**		
Cultivar	**LSD**		0.4		P val		<0.001		
Management	**LSD**		0.2		P val		<0.001		
Cultivar x Management	**LSD**		0.6		P val		<0.001		

Table 5. Influence of disease management strategy and variety on receival wheat grade and price ($/t).

	Management Level (Wheat Grade and Price $/t)							
Cultivar	**Untreated**		**1 Fungicide**		**2 Fungicide**		**4 Fungicide**	
Trojan (spring)	FED1	$200*	AGP1	$241	AGP1	$241	AGP1	$241
Scepter (Spring)	H2	$356	H2	$356	H2	$356	H2	$356
RGT Cesario (Winter)	SFW1	$236	SFW1	$236	SFW1	$236	SFW1	$236
Anapurna (Winter)	SFW1	$236	SFW1	$236	SFW1	$236	SFW1	$236
RGT Accroc (Winter)	SFW1	$236	SFW1	$236	SFW1	$236	SFW1	$236
Beckom (Spring)	AUH2	$286	H2	$356	H2	$356	H2	$356
Catapult (Spring)	Undeliverable #	$150*	AUH2	$286	H2	$356	H2	$356

Prices as of 11/1/21 trading at Cootamundra GrainCorp.

**Price unavailable, nominal value used*

 # Low test weight did not meet grain specifications

Table 6. Influence of disease management strategy and variety on return on investment ($ earned for every $ spent) compared to unsprayed crop.

	Management Level (Return on Investment)			
Cultivar	**1 Fungicide**	**2 Fungicide**	**4 Fungicide**	**Mean**
Trojan (spring)	$ 9.14	$ 7.35	$ 6.30	**$ 7.60**
Scepter (Spring)	$ 3.71	$ 3.14	$ 1.69	**$ 2.85**
RGT Cesario (Winter)	$ 2.77	$ 0.37	-$ 0.27	**$ 0.96**
Anapurna (Winter)	$ 1.24	$ 0.30	-$ 0.35	**$ 0.40**
RGT Accroc (Winter)	$ 5.25	$ 2.59	$ 0.86	**$ 2.90**
Beckom (Spring)	$ 22.68	$ 13.83	$ 8.04	**$ 14.85**
Catapult (Spring)	$ 30.80	$ 30.54	$ 17.50	**$ 26.28**
Mean	**$ 10.80**	**$ 8.30**	**$ 4.82**	

Table 7. Influence of disease management strategy and variety on net margin increase ($/ha) (extra income minus fungicide cost).

	Management Level (Increase in net margin $/ha)			
Cultivar	**1 Fungicide**	**2 Fungicide**	**4 Fungicide**	**Mean**
Trojan (spring)	365	493	757	**538**
Scepter (Spring)	149	210	204	**188**
RGT Cesario (Winter)	111	25	-33	**34**
Anapurna (Winter)	50	20	-42	**9**
RGT Accroc (Winter)	210	173	104	**162**
Beckom (Spring)	907	926	966	**933**
Catapult (Spring)	1232	2046	2103	**1794**
Mean	**432**	**556**	**580**	

Table 8. Influence of disease management strategy and variety on net margin ($/ha) (income minus Fungicide costs only).

	Management Level (Net Margin $/ha)				
Cultivar	**Untreated**	**1 Fungicide**	**2 Fungicide**	**4 Fungicide**	**Mean**
Trojan (spring)	702	1067	1195	**1459**	**1106**
Scepter (Spring)	2540	2689	**2751**	**2744**	**2681**
RGT Cesario (Winter)	2475	**2586**	2500	2442	**2501**
Anapurna (Winter)	2466	**2516**	2486	2424	**2473**
RGT Accroc (Winter)	2355	**2565**	2529	2459	**2477**
Beckom (Spring)	1796	2703	2722	**2761**	**2496**
Catapult (Spring)	477	1709	2523	**2580**	**1822**
Mean	**1830**	**2262**	**2386**	**2410**	

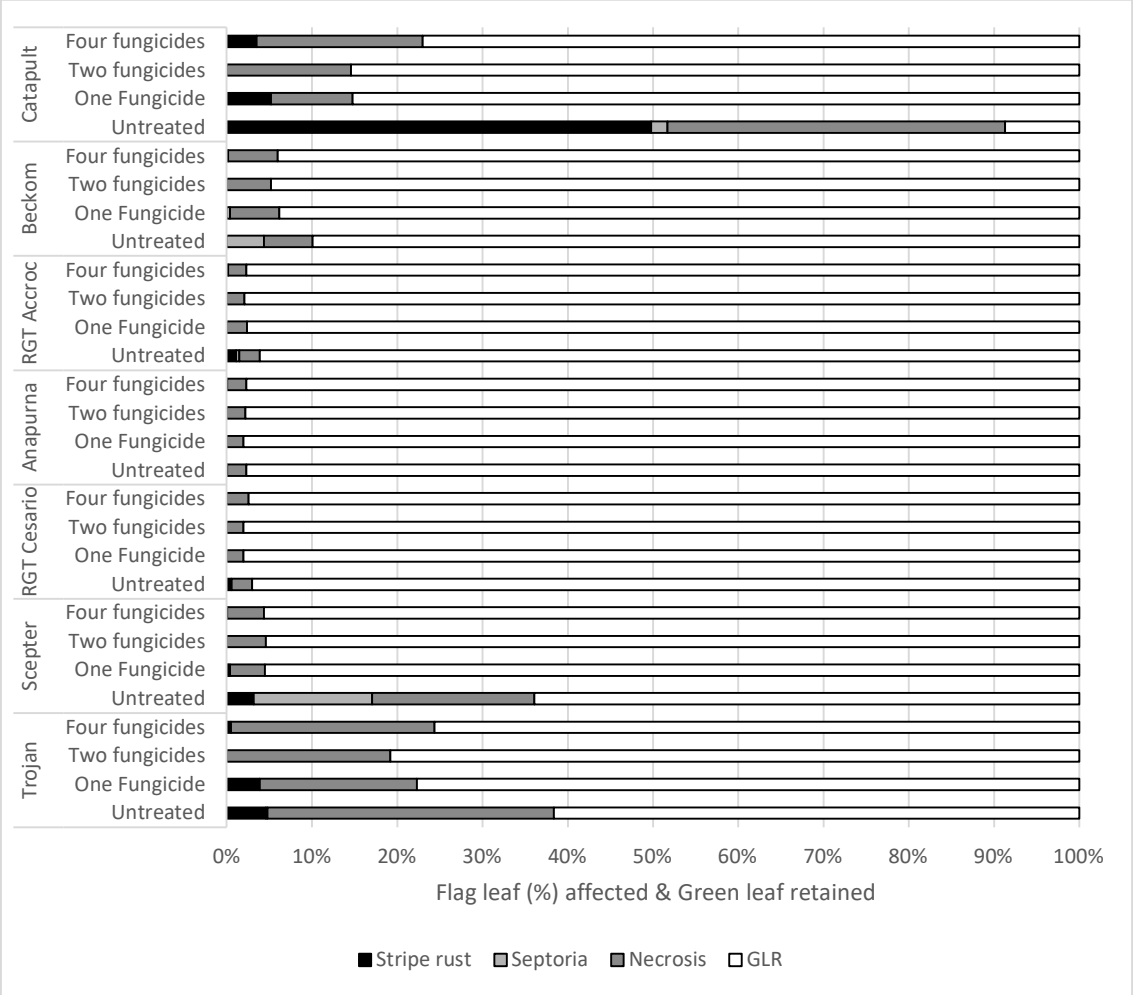

Figure 1. Influence of variety and fungicide programme on % disease leaf area infection of the **flag leaf**, % necrosis of the leaf and % green leaf retention.

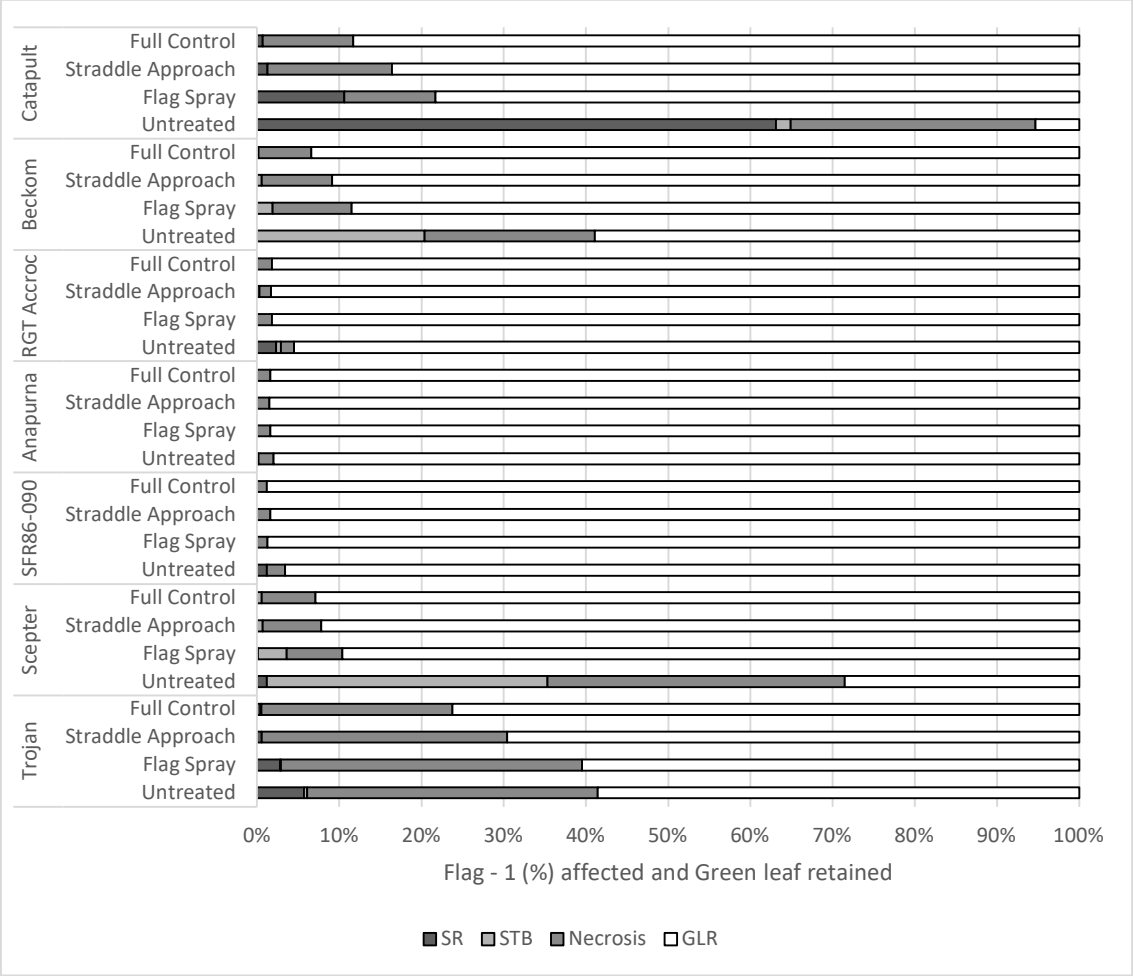

Figure 2. Influence of variety and fungicide programme on % disease leaf area infection of the **flag-1,** % necrosis of the leaf and % green leaf retention. *Note: 4 units of fungicide is referred to as full control, 2 units of fungicide is referred to as the "straddle approach" as fungicides are timed either side of the flag leaf and the flaf spray is one unit of fungicide applied at flag leaf emergence*

Table 9. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		180 seeds/m^2 (150 plants/m^2 target)			
	Timing	**Untreated**	**Flag Spray**	**2 Fungicides**	**Full Control**
Seed treatment:		Vibrance + Goucho	Vibrance + Goucho	Vibrance + Goucho	Vibrance + Goucho
Fert Treatment:		---	---	---	Flutriafol
Basal Fertiliser:	20 April	120kg MAP (12 Kg N)	120kg MAP (12 Kg N)	120kg MAP (12 Kg N)	120kg MAP (12 Kg N)
Nitrogen:	17 June	18.5kg N/ha	18.5kg N/ha	18.5kg N/ha	18.5kg N/ha
	11 Sep	138kg N/ha	138kg N/ha	138kg N/ha	138kg N/ha
Total N Applied:		**168kg N/ha**	**168kg N/ha**	**168kg N/ha**	**168kg N/ha**
PGR:		---	---	---	---
Fungicide:	GS31	---	---	FAR F1-19 750ml (GS33)	Prosaro 300ml

	GS39	---	FAR F1-19 750ml	---	FAR F1-19 750ml
	GS59-61	---	---	Opus 500ml	Radial 600ml

All other inputs of insecticides and herbicides were standard across the trial.

Trial 5. Nutrition for Hyper Yielding Wheat

Objectives: To assess the value of higher nutrition input (N, P, K & S) for wheat in the growing season.

Individual objectives specific to the trials were:

- To assess the value of additional nutrients in the growing crop (set up as small plots at the HYC Research sites).
- To assess the value of adding increased P and K when targeting higher yield potential rather than N alone.

Key Messages:

- There was no yield response in winter feed wheat cv RGT Accroc to additional nutrient input above the standard N input of 168kg N/ha, which included a standard of 120kg/ha MAP at sowing (12N, 24P) despite yields of 9.5-10t/ha.
- The average yield of the trial in RGT Accroc was 9.47t/ha compared to 7.83t/ha in the milling wheat Rockstar trial (in surrounding commercial crop).
- Protein levels in the zero N plots (control) were significantly increased from 9.5% to 11.7 – 12.0% with the additional nutrients, but the increases were not associated with higher grain yields above standard nutrition (168N, 24P) in the feed wheat RGT Accroc.
- With the farm crop milling wheat trial in Rockstar additional nutrition increased both yield and protein, even though protein was over %12.6.
- On average, protein levels were higher in the milling wheat Rockstar (13.6%) compared to the feed wheat RGT Accroc (11.3%).
- At harvest there were increased head numbers and dry matter production associated with greater nutrition input (cv RGT Accroc – feed wheat) but this did not lead to increased grain yield.
- There was no effect of additional nutrition on harvest index (data not presented), however the milling wheat Rockstar had higher harvest index (40.5%) compared to the feed wheat RGT Accroc (34.2%).
- The unfertilised crop of RGT Accroc had a N offtake in the grain of 129kg N/ha based on 7.74t/ha and 1.66% N in the grain (9.5% protein). If it is assumed that 25% of the N at harvest is in the straw and chaff then the unfertilised crop would have removed approximately 172kg N//ha of which 59.3 kg N/ha was recorded in the soil core on 29th July (0-60cm) with 12kg N/ha provided by the MAP.
- This residual fertility in the farming system would explain why the standard nutrition control removed 242kg N/ha in the canopy (based on the same calculations) when only 168kg N/ha was applied as fertiliser.

Treatments: Seven different nutrition strategies (Tables 5 & 6) were put in place in RGT Accroc that differed in the level of nutrition (N, P & K). The same trial was set up in the surrounding farm crop. The starting nitrogen (N) in the soil was 59.3kg N/ha (0-60cm) and a soil carbon of 1.9 % (0-10cm). Taken on 29 July 2021.