

Trial 3. HYC Barley G.E.M Trial series (FAR WAA B22-03)

Aim: To increase yield of barley in the high rainfall zone with improvements in barley crop management that considers all aspects of canopy management (genotype, PGR, Fungicide, Nitrogen, and Defoliation).

Objective: To assess the performance of four spring barley germplasm managed under four different management intensities (sown 20 April) at two levels of fungicides.

Key Messages:

- In 2022, when barley was sown early (20 April) there was a significant interaction between canopy management and variety with yields ranging from 4.31- 5.86 t/ha.
- Averaged across all managements, Laureate yielded (5.35 t/ha) significantly higher than RGT Planet (5.02 t/ha) and Laperouse (4.53 t/ha), but not Rosalind (5.27 t/ha). Laureate grew best under the hyper yield management where it received higher fungicide input, PGRs and more nitrogen.
- There was no significant difference in yield from management on Laperouse.
- RGT Planet, Rosalind and Laureate all benefited from a better fungicide package as they produced higher yields when compared to the standard treatments, especially in a year with high disease pressure.
- Higher levels of nutrition in general did increase yield, although it was only significant in Laureate (5.19 t/ha to 5.86 t/ha).
- Defoliation did not reduce the yields in RGT Planet, *but* instead produced a significant increase, suggesting that delayed flowering and canopy management was potentially advantageous.
- PGRs did significantly reduce plant height but gave varied yield results, increasing the yield of Rosalind under high fungicide management, but reducing the yield of RGT Planet under standard fungicide input.
- The hyper yielding system, with higher inputs of nitrogen (around 150kg/ha N) *produced* a significantly higher protein content of 12.8% compared to the other treatments, but struggled to translate this into a significantly higher yield.
- Mid flowering (GS65) biomass highlighted a significant reduction in dry matter volume and tiller weight in the dual purpose system compared to all the other treatments. Biomass taken at maturity (GS89) from the hyper yielding system showed a significantly higher volume of dry matter from Rosalind and Laureate compared to the other varieties.
- Although all cultivars were spring varieties, there was a three week delay to reach the beginning of flowering (GS49) between the fastest maturing variety, Rosalind (28 July) and the slowest, Laureate (18 August) in the standard treatment.
- Mechanical defoliation delayed flowering across all cultivars by 10-24 days.

Trial details

The 4 varieties comprised of four two-row spring types (Rosalind, RGT Planet, Laperouse and Laureate), with six management treatments which consisted of combinations of nitrogen (N) rate, fungicides applied, plant growth regulators (PGR) and mechanical defoliation as per Table 1.

Table 1. Fungicide package, canopy intervention and nitrogen (N) rate applied to each of the six management treatments.

Trt	Management	Fungicide	Canopy Intervention	Total N applied
1	Standard fungicide & no intervention	Standard ¹	None	98 kg N/ha
2	Standard fungicide & PGR	Standard ^{1,3}	PGR	98 kg N/ha
3	Higher input fungicide & no intervention	Higher input ²	None	98 kg N/ha
4	Higher input fungicide & PGR	Higher input ^{2,3}	PGR	98 kg N/ha
5	Hyper-yield system	Higher input ^{2,3}	PGR	148 kg N/ha
6	Dual-purpose system	Higher input ^{2,4}	Defoliation	148 kg N/ha

¹Standard: GS31 – 500 mL/ha Tilt (500g/L propiconazole), GS39 – 500 mL/ha Opus (125 g/L Epoxiconazole).

²Higher input: Seed dressing – 150 mL/100kg Systiva (333g/L fluxapyroxad), GS31 – 300 mL/ha Prosaro (210g/L prothioconazole + 210g/L tebuconazole), GS39 – 500 mL/ha Aviator Xpro (Bixafen 75 g/L+Prothioconazole 150 g/L)

³Plant growth regulator (PGR): GS31 – 200 mL/ha Moddus Evo (250g/L trinexapac-ethyl).

⁴Defoliation: Prior to GS31 – defoliation with lawn mower to height of 6cm.

All plots recovered an initial 11N at seeding in the form of MAP with top-ups being applied as urea, with all treatments receiving 55N on 31 May and 32N applied on 30 June for a total of 98kg N/ha for the season. Management treatments 5 and 6 also received an additional 25N on 1 July and another 25N on 20 July, taking their total nitrogen applied to 148kg N/ha.

The spring barley varieties were defoliated at the start of stem elongation (GS30-31) on 1 July, ensuring that the growing points were not removed.

Table 2. Influence of cultivar on grain yield (t/ha) under different management regimes.

Canopy Management	Cultivar (Grain yield t/ha)									
	RGT Planet		Rosalind		Laureate		Laperouse		Mean	
Std fungicide	5.11	efg	5.02	efg	5.24	c-f	4.63	hij	5.00	-
Std fungicide, PGR	4.64	hij	5.03	efg	4.97	fgh	4.38	j	4.75	-
High Fungicide	5.36	b-e	5.14	ef	5.52	a-d	4.49	ij	5.13	-
High Fungicide, PGR	5.06	efg	5.58	abc	5.19	def	4.58	ij	5.10	-
Hyper Yielding, High N	4.79	ghi	5.69	ab	5.86	a	4.78	ghi	5.28	-
Dual-Purpose, High N	5.18	def	5.16	ef	5.30	c-f	4.31	j	4.99	-
Mean	5.02	b	5.27	a	5.35	a	4.53	c	5.04	
LSD (P=0.05) Variety	0.1				P-Value				<0.001	
LSD (P=0.05) Canopy Management	ns				P-Value				0.210	
LSD (P=0.05) Variety x Canopy Management	0.3				P-Value				<0.001	

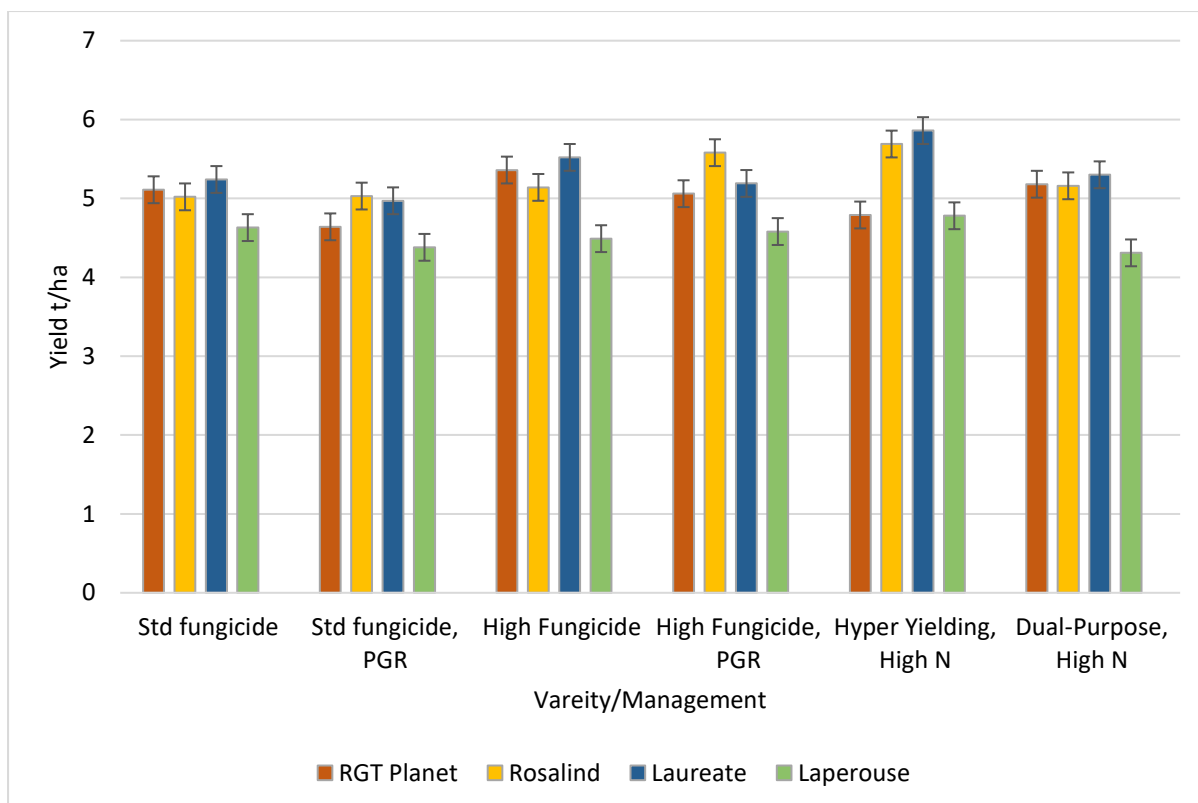


Figure 1. Influence of cultivar on grain yield (t/ha) under different canopy management regimes.

Averaged across all managements, Laureate yielded (5.35 t/ha) significantly higher than RGT Planet (5.02 t/ha) and Laperouse (4.53 t/ha), but not Rosalind (5.27 t/ha). It also had the largest range in yields (4.97-5.86 t/ha) suggesting it was the most responsive to treatment differences. RGT Planet, Rosalind and Laureate all benefited from a better fungicide package as they produced higher yields here when compared to the standard treatments especially in a year with high disease pressure. Due to its strong genetic resistance to disease, there was no yield difference caused by the higher fungicide package in Laperouse.

Higher levels of nutrition in general did increase yield, although it was only significant in Laureate (5.19 t/ha to 5.86 t/ha). In general, defoliation did reduce yield, except for RGT Planet which instead produced a significant increase, suggesting that delayed flowering and canopy management was potentially advantageous.

Plant growth regulators (PGR) had the desired effect, producing a significantly shorter crop (data not shown), however there is evidence of its potential in decreasing yield, especially in RGT Planet and Laureate, with losses of 0.4 t/ha and 0.3 t/ha respectively. Rosalind, the shortest variety, had a yield increase with the application of PGRs, indicating that there may be a relationship between plant height and the effects of PGRs on yield.

There were no significant differences between yield when comparing different management strategies (variety yields averaged).

Table 3. Grain quality (protein (%), test weight (kg/hL), screenings (%) and retention (%)) for variety and management.

Cultivar	Protein		Test Weight		Screenings		Retention	
	%		kg/hL		% <2.0mm		% > 2.5mm	
RGT Planet	11.5	c	67.3	c	0.8	c	95.4	a
Rosalind	12.1	b	67.7	b	1.8	b	88.7	c
Laureate	11.0	d	65.4	d	2.1	a	88.7	c
Laperouse	12.5	a	69.6	a	0.9	c	94.2	b
P-value	<0.001		<0.001		<0.001		<0.001	
LSD (P=0.05)	0.2		0.3		0.2		1.1	
Management								
Std. fungicide	11.7	b	67.7	-	1.4	b	91.9	b
Std. fungicide & PGR	11.6	b	67.1	-	1.9	a	89.6	c
Higher fungicide	11.7	b	67.9	-	1.0	c	93.8	a
Higher fung. & PGR	11.3	b	67.2	-	1.2	bc	92.7	ab
Dual-purpose	12.8	a	67.4	-	1.4	b	91.3	bc
Hyper-yield	11.6	b	67.6	-	1.5	b	91.2	bc
P-value	<0.001		0.070		<0.004		0.003	
LSD (P=0.05)	0.5		ns		0.4		1.8	

Grain protein varied across treatments from 10.3-13.4%, which was influenced by both variety and management. On average, Laperouse had the highest grain protein (12.5%) and RGT Planet the lowest (11.5%). Management had the largest effect on protein, with values ranging from 12.8% in the hyper yielding system to 11.3% in the high input fungicide with PGR.

There was a significant interaction between screenings, variety and management, with values ranging from 0.5-3%. Although there is a large variability in the screening results, CBH receival standards have no limit on this assessment meaning this wouldn't influence the grade of the grain for any management. Hectolitre rate varied (64.8-70.4kg/hL), being particularly high in Laperouse (69.6kg/hL) and low in Laureate (65.4kg/hL). However, all treatments cleared the CBH receival standards of 56kg/hL, with no impact from management.

Phenology

Table 4. Cultivar effect on the onset of flowering (GS49), influenced by two different managements, standard and dual purpose (defoliated on 1 July).

Variety x Management	Awn Emergence (GS49)*	DAS
Std RGT Planet	1-Aug	103
Std Rosalind	28-Jul	99
Std Laureate	18-Aug	120
Std Laperouse	5-Aug	107
Dual Purpose RGT Planet	25-Aug	127
Dual Purpose Rosalind	14-Aug	116
Dual Purpose Laureate	31-Aug	133
Dual Purpose Laperouse	15-Aug	117

*Barley is noted to flower before the head emerges, so GS49 is considered to be a good surrogate for the start of flowering

As the four varieties sown were all spring barleys, their development throughout the season didn't show high levels of variability. However, Rosalind was the fastest developing cultivar, reaching awn emergence (GS49) late July (28 July) and maturity (GS89) around by the end of October. In comparison, RGT Planet reached flowering on 1 August, Laperouse on 5 August, and the slowest of all the varieties, Laureate, on 18 August, three weeks later than Rosalind.

Mechanical defoliation of the dual-purpose system and a higher level of nutrition delayed the onset of flowering of every variety by 10-24 days.

Table 5. Net Form Net Blotch (NFNB) incidence (%) across the 6 different management treatments and 4 varieties, assessed on the 12 Sep (GS59-80).

Canopy Management	NFNB Incidence (%)									
	RGT Planet		Rosalind		Laureate		Laperouse		Mean	
Std fungicide	4.1	a	1.0	bc	0.6	b-e	0.4	cde	1.5	a
Std fungicide, PGR	3.9	a	1.3	b	0.8	bcd	0.4	cde	1.6	a
High Fungicide	1.1	b	0.0	e	0.2	de	0.1	e	0.4	b
High Fungicide, PGR	0.3	de	0.0	e	0.0	e	0.0	e	0.1	b
Hyper Yielding, High N	1.1	bc	0.0	e	0.3	de	0.1	e	0.3	b
Dual-Purpose, High N	1.3	b	0.1	e	0.1	de	0.1	de	0.4	b
Mean	1.9	a	0.4	b	0.3	b	0.2	b	0.7	
LSD (P=0.05) Variety					0.3	P-Value			<0.001	
LSD (P=0.05) Canopy Management					0.5	P-Value			<0.001	
LSD (P=0.05) Variety x Canopy Management					0.7	P-Value			<0.001	

Disease was assessed throughout the season, and it was observed that both forms of net blotch were posing high levels of disease pressure, especially on RGT Planet (Table 3). Net Form Net Blotch (NFNB) was significantly higher in RGT Planet (1.9%) across all treatments when compared to the other varieties. Treatments with a higher fungicide package did significantly reduce disease infection. This is highlighted once again in RGT Planet with the two standard fungicide treatments having an incidence of 4.1% and 3.9%, compared to the high fungicide treatments with disease being significantly reduced to 1.1% and 0.3%. Spot Form Net Blotch was also present, with higher levels in the two standard fungicide (2.2% and 4.3%) with lower levels in the high fungicide (0.1% and 0.1%) but with no significant difference between variety and management (data not shown).

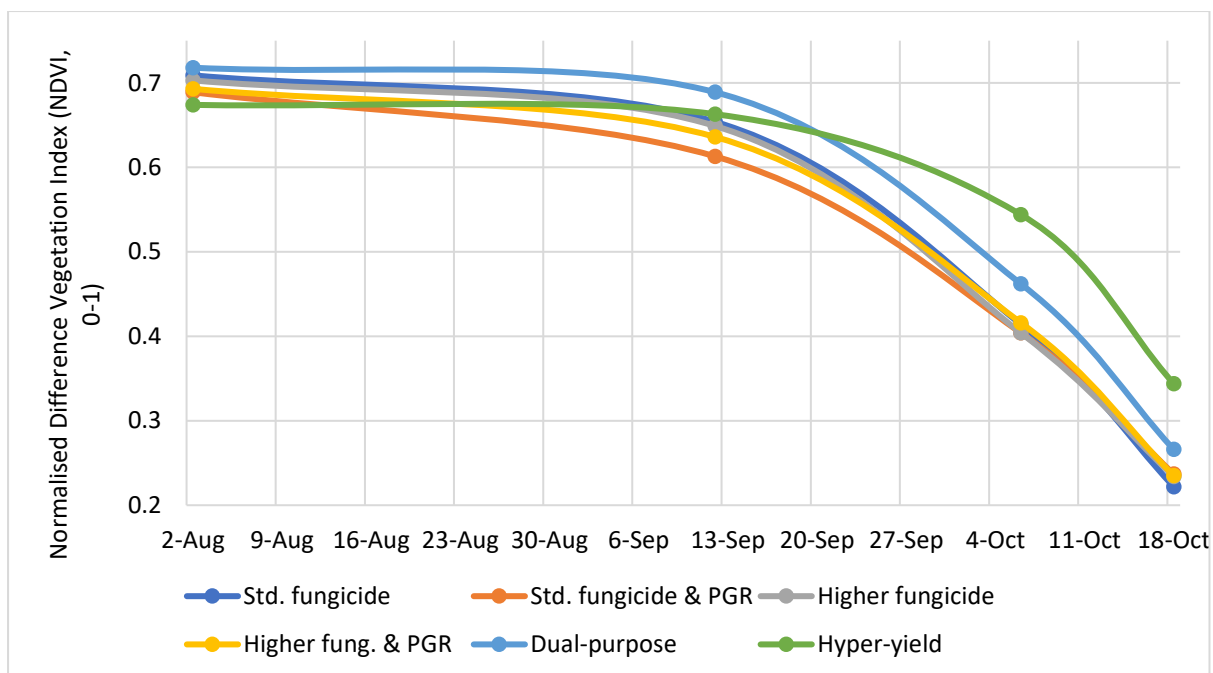


Figure 2. Measurement of Normalised Difference Vegetation Index (NDVI, 0-1) across the six different management treatments over several different dates and growth stages.

NDVI values were influenced by variety and management (Table 4), with higher values suggesting a greener, healthier plant. Higher rates of nitrogen in the hyper yielding system increased the NDVI value, especially when moving into maturity. The dual-purpose treatments had the significantly highest NDVI value at GS83 and GS85 which could be due to a delay in maturity as a result of the defoliation at GS30. There were no significant differences in green leaf retention (GLR) between the standard and high input fungicide treatments.

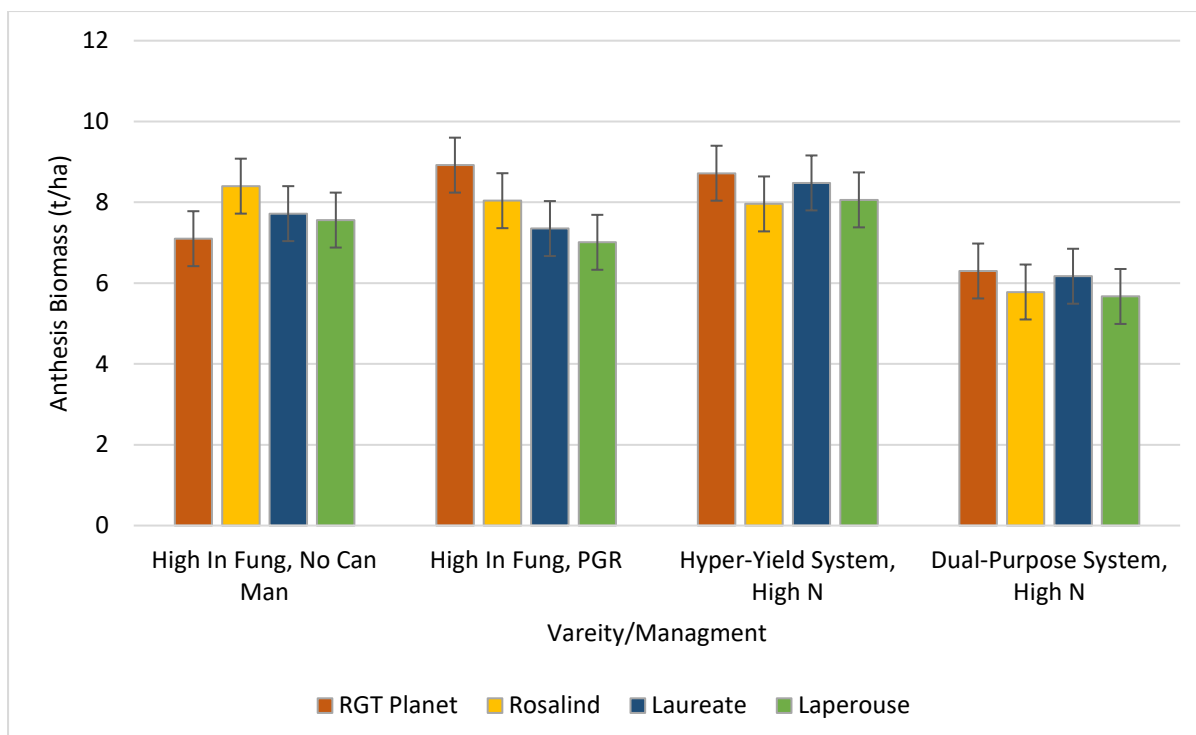


Figure 3. Variety and management effect on mid flowering (GS65) biomass (t/ha). Only measured in high fungicide input treatments (3,4,5 and 6). LSD P =0.05, 1.4.

Mid flowering (GS65) biomass was measured in all the treatments with high input fungicides applied (3, 4, 5 and 6). The only significant difference was a reduction in volume in the dual-purpose system (5.98 t/ha), which is to be expected with the defoliation earlier in the season (Figure 1). In addition, this treatment had smaller tillers (data not shown).

Table 6. Details of the management levels.

Sowing date:		20 April
Seed Rate:		200 Seeds/m ²
Sowing Fertiliser:		139 kg MAP/MOP
Seed Treatment:		Vibrance / Cruiser
Grazing:		Dual purpose system only
Nitrogen:	31 May	55 kg N/ha (20K)
	30 June	32 kg N/ha
	2 July	25 kg N/ha (high N treatments only)
	20 July	25 kg N/ha (high N treatments only)
PGR:	1 July	200 mL/ha Moddus Evo (PGR treatments only)
	31 July	200 mL/ha Moddus Evo (PGR treatments only)
Fungicide:	30 June (GS31)	As per treatment list
	31 July (GS37-45)	As per treatment list