Hyper Yielding Crops Project

Provisional 2020 Barley Results

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Interpretation Notes

Figures followed by the same letter are not considered to be statistically different (p=0.05).

Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement in this case). All provisional results have been analysed through ARM software with further spatial analysis from SAGI when the final results are released.

Overall objective

The barley hyper yielding crops program aimed to investigate the synergies utilizing a framework of genetics x environment x management (GxExM) to increase yield potential per se and convert more biomass into yield. This well help determine whether growers have the correct Genetic and Management tools to reliably achieve 10t/ha grain yield in all regions High Rainfall Zone and remain competitive with wheat.

2020 Research Questions and Approach:

The following report presents results from a series of experiments aimed to address two major physiological limitations to achieving greater productivity in the higher rainfall zones of Australia

1. **Increasing yield potential per se relies upon intercepting more radiation and transpiring more water.**

What germplasm and management practices such as sow date, nutrition, crop cycle length, row type, tillering capacity will raise the frontier on biomass (>22t/ha) and grain number capacity compared to current practice (RGT Planet)

2. **Converting more biomass into grain and protecting yield potential:**
What genetic resources and management practices such as disease and lodging control can raise harvest index of barley (>40%) at dry matter yields greater than 22t/ha compared to current practice (RGT Planet).

2020 Autumn sown barley Hyper Yielding sites

- VIC Crop Technology Centre - Gnarwarre, Victoria
- SA Crop Technology Centre - Millicent, South Australia
- WA Crop Technology Centre - Green Range, Western Australia

2020 Spring sown barley Hyper Yielding sites

- TAS Crop Technology Centre – Hagley, Tasmania

2020 Barley Multi site summary of G x E x M interactions

Identifying suitable germplasm for the HRZ

Across all environments a simple screen was conducted to examine the phenology, disease resistance and standing power of new barley germplasm established in the traditional late April/early May sowing window relative to current practice. In these experiments disease was not controlled and plant growth regulators were not applied

Key observations:

- Up to 25 new cultivars were evaluated and were under consistent pressure from disease, lodging and head loss for mid-April - May sowing dates at all the Crop Technology Centres (CTC), while there was extra pressure of stem brackling at the spring sown centre in Tasmania
- New spring introductions all have improved net form net blotch resistance compared to the current control RGT Planet but were weaker for Scald. Leaf rust was evident in high yielding European introductions Laureate and Sanette
- Winter barley had superior disease packages compared to spring barley, but head loss and lodging was a major constraint in 2020 and the winter barleys were inferior to spring barley for head retention.
- All cultivars had significant variation for all traits suitable for hyper yielding crops and offer opportunity to exploit with targeted management.

Implications and discussion:

There is considerable variation in new germplasm introduced for all the key traits of interest such as disease, phenology, lodging, brackling, and headloss. Unfortunately, there remains significant weaknesses for each cultivar type and they will require different management focus depending on environment to manage these constraints. Based on the trial data the following weakness and opportunities were identified in 2020 (table 1). These learnings were further evaluated in the HYC elite screen where disease and lodging were managed for hyper-yields. These data have informed management protocols for 2021 and highlights the importance of germplasm choice to achieve high yields.

Table 1. Table of weakness and opportunities for different barley types for the crop technology centre regions based on 2020 experiments, green shaded boxes indicate a cultivar is well suited with appropriate management intervention, amber shaded means a cultivar is likely to be suited with significant management intervention but will still have some potential downside risks. Red shaded indicates the cultivar type is not suited even with management and there are likely better germplasm options.

	SA/Vic Early Sowing	SA/VIC May sowing	WA late April – May sowing	Tasmania spring sown
RGT Planet (Current Benchmark)	Very Susceptible to NFNB. Crop development earlier than optimal but remains the most broadly adapted cultivar with the highest yield potential. Suited to early sowing with strong fungicide and PGR program for head loss	Very Susceptible to NFNB, headloss moderate risk. Crop development ideally suited with strong disease control and well adapted	Very Susceptible to NFNB, headloss moderate risk. Crop development ideally suited with strong disease control and well adapted	Very Susceptible to NFNB, headloss and brackling moderate risk. Crop development ideally suited with strong disease control and well adapted
Rosalind	Crop development speed considered too early and has a slightly reduced yield potential relative to Planet but has been broadly adapted across seasons, head loss and brackling moderate risk.	Crop development still earlier than optimal but has excellent canopy structure and can achieve high yields with little management intervention. Likely to benefit from a PGR application	Crop development earlier than optimal but well adapted and suited to drier seasons. Consistently high yielding cultivar in this environment	Crop development too fast, reduced yield potential. High brackling risk. Unsuited for spring planting
Australian faster spring lines	Crop development not suited, high lodging, brackling and head loss risk. Reduced yield potential compared to Planet. Disease responses variable depending on cultivar. Not suited	Crop development more aligned to environment but lack yield potential. Disease, Lodging, head loss and brackling responses variable depending on cultivar. Not suited	Crop development better adapted to environment. Better disease packages than Planet but head loss and lodging in higher yielding seasons will need to be managed.	Crop development suited in some cultivars and superior grain size, but they lack the standing power and yield potential under irrigated spring sown conditions. Not suited.
European derived higher yielding spring lines	Crop development earlier than optimal. Evidence of improved tolerance to NFNB in comparison to Planet but weaker against other diseases scald and leaf rust. Variation in head loss and standing power. Evidence of higher yield potential. Maybe suited with more evaluation	Crop development aligned to environment. Improved tolerance to NFNB in comparison to Planet but weaker against other diseases scald and leaf rust. Reduced lodging and headloss. Evidence of higher yield potential. Well suited with more evaluation	Crop development slightly too late for this environment (based on 2020 season). Improved tolerance to NFNB in comparison to Planet but weaker against other diseases scald and leaf rust. Unlikely to be suited	Crop development ideally suited . This environment is similar to European spring barley production, evidence of improved disease packages and yield potential in 2020. Grain size maybe an issue in hot summers. Well suited with more evaluation
2 and 6 Row Winter	Crop development well aligned to environment, higher yield potential and superior disease packages than other options. However, head loss and lodging are a major constraint and will need to be overcome before any adoption	Crop development well aligned to environment, limited evaluation from this sowing date.	Crop development too slow with the exception of Urambie which has reduced yield potential. Unsuited for this environment until faster developing winters are available	Will not adequately fulfil vernalisation and flower too late. Not suited

Evaluating development and yield potential of barley germplasm

Across all environments an elite screen was conducted with the objective to examine the yield potential of new winter and spring germplasm grown under HYC Management packages against spring and winter controls in the traditional late April/early May sowing window.

Key observations across HYC Elite screen experiments:

- Six row winter barley was introduced to Australia and evaluated in yield plots for the first-time and flowered during the optimum period in the SA and Vic crop technology centre but were too late in WA (figure 1).
- The yields achieved by the highest yielding 2 and 6 row winter barley were comparable with the spring barley control RGT Planet in Vic but not at any other sites due to head loss and lodging in SA, and flowering too late and thus heat and drought in WA (table 2).
- The 6-row winter Pixel was the most consistent performer and will progress to management trials in 2021.
- RGT Planet and Rosalind remain among the highest yielding cultivars across all centres and are broadly adapted despite flowering earlier than most other cultivars and remain the benchmarks in adaptation and yield performance.
- Yields greater than 10t/ha were achieved in spring sown barley in Tasmania and the cultivar Laureate was the highest yielding at 11.4 t/ha. This becomes the benchmark yield for the remainder of the project

Table 2. Grain yield (t/ha) of the relevant spring controls and best performing introduced or alternate spring, 2 row winter and 6 row winter at each crop technology centre. Shaded treatments within a site are statistically the highest yielding treatments for the site.

CTC	Rosalind (Fast Spring Control)	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.

Flowering time responses to yield depended on environment (figure 1).

- The second sowing date in SA allowed the spring cultivars to effectively flower within a more optimum period. The large decline in yield from later flowering was due to increased head loss in those cultivars and reduced light conditions.
- There was no response to flowering date in Victoria due to increased cloudy conditions in 2020 and a lack solar radiation to maximise yield potential from later flowering times.
- Early flowering was favoured in WA. Winter cultivars flowered later than the spring cultivars in WA relative to other environments.

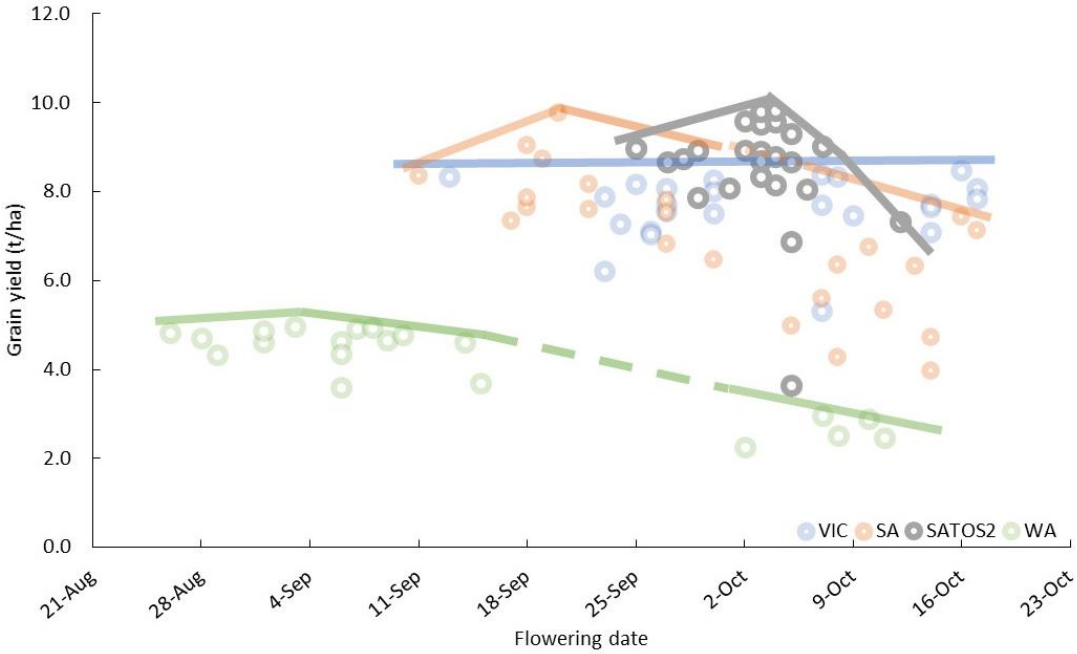

Figure 1 Grain yield response to flowering date across all crop technology centres (excluding TAS).

Exploiting management to better match genetics to environments

The objective of the Genotype x Environment x Management (GEM) trial series was to assess the performance of winter and spring barley germplasm managed under four different management intensities (mid-April to early May sown) at two levels of fungicides. Other management factors included canopy intervention techniques such as the addition a PGR, defoliation and additional Nitrogen.

Key observations across GEM experiments:

The data from the GEM series confirms many findings from the Elite experiment and highlights the effect of cultivar compared to management across environments. The spread between box plots in the visual demonstration below (figure 2) highlights the effect of cultivar, and the spread within the box plot represents the difference in management. Within each boxplot all levels of management are included. At SA, WA, and TAS the effect of cultivar was greater or equal to the variation possible with management, whereas at Victoria management was more important than cultivar.

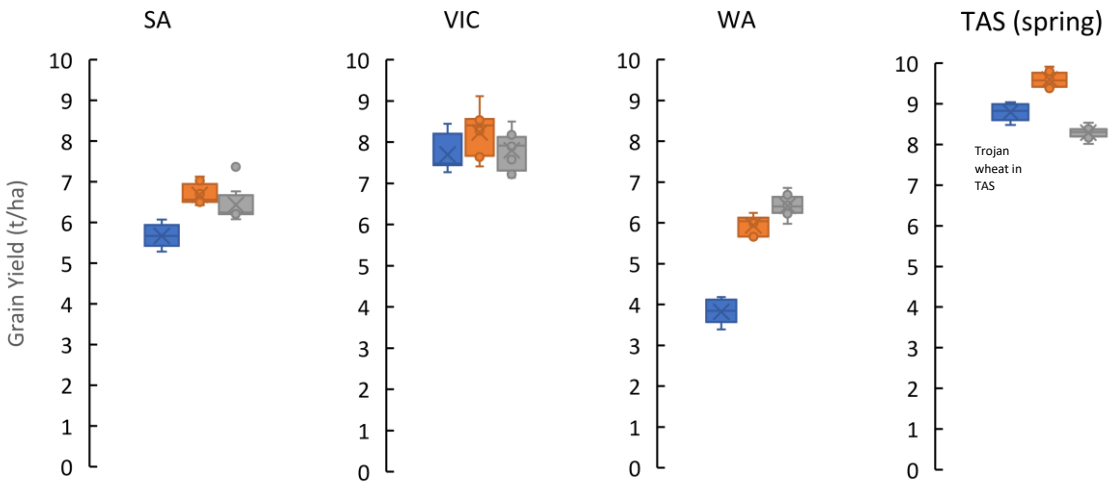

Figure 2. Boxplot representation blue (•Cassiopee winter barley (Trojan in Wheat in TAS), •RGT Planet, and •Rosalind) grain yields across all management combinations (n = 8 per box plot) and environments (blue = trojan wheat in TAS spring sown).

Implications and discussion:

This means that cultivars are likely to respond different to management across environments. For example (figure 3), in Victoria yield increases were derived from different management levers in each cultivar. Planet benefited most from a more intensive fungicide regime, whereas as Cassiopee responded well to PGR for canopy control, and Rosalind benefited from both forms of canopy control PGR and or Defoliation.

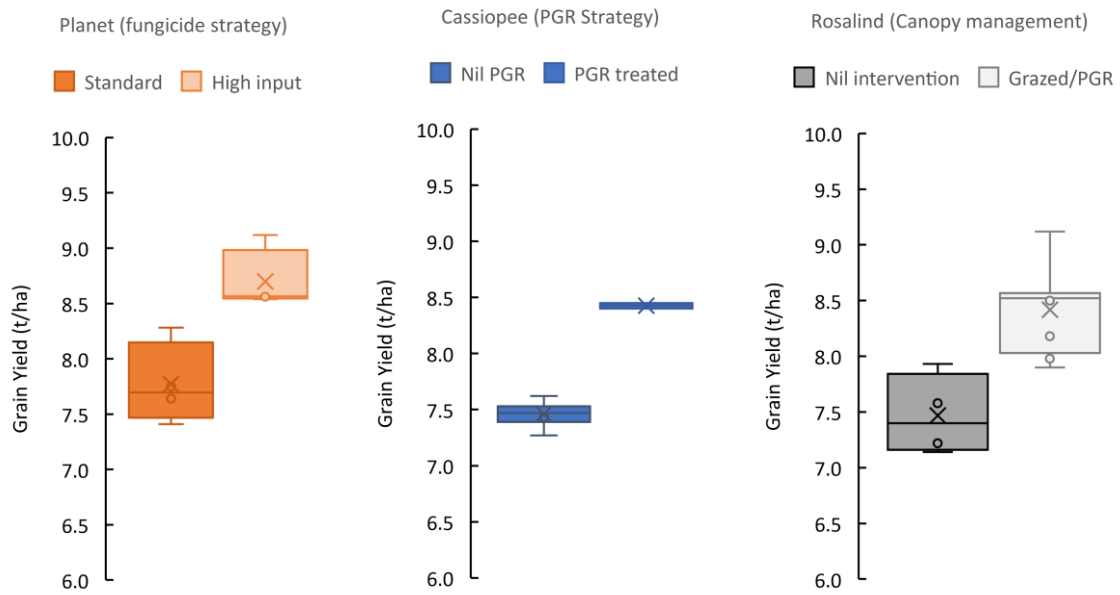

Figure 3. Response to management in each cultivar Planet, Cassiopee and Rosalind in Victoria 2020.

The major biological reason for crops not achieving 10t/ha in the GEM trials were due to both low dry matter and low conversion of dry matter to yield (Harvest Index). Our results (figure 4) show it is possible to manipulate this relationship with management but often comes with a trade off in low harvest index and increased biomass, or a high harvest index and low biomass (for example defoliation) effectively meaning yields remain the same across treatments. HYC experiments in 2020 need to further exploit this relationship.

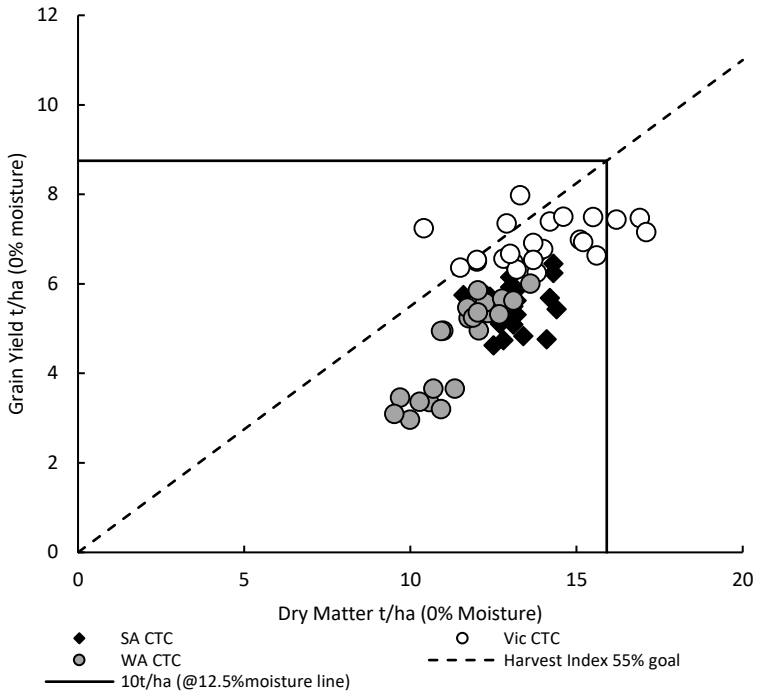

Figure 4. Relationship between dry matter and grain yield (t/ha) at 0% moisture across all GEM experiments, cultivars and management levels in 2020. The dotted line represents aspirational yields that are possible with a harvest index of 55%. The fixed line represents how much dry matter is required to achieve 10/ha grain yield at 12.5% moisture.

Other key findings:

- The fungicide experiments highlighted maintaining a green leaf during grain fill are important minimizing grain quality downgrading in malting barley consistently across the high rainfall zone and even in the absence of a yield response this should not be overlooked.
- The plant growth regulator (PGR) responses in 2021 have demonstrated there is little downside risk with the use of PGRs in the higher rainfall zone. The combined application of one spray at GS31 and a later application at GS37 – 49 were the most effective in reducing both lodging and head loss. These findings are significant as they assist growers with on farm logistics by allowing more flexibility with harvest date, and the PGR timings also align well with fungicide timings.
- Nutrition responses recorded in 2020 begin to build the story that in fertile conditions there are likely to be limited responses to applied N fertilization.

2020 SA Crop Technology Centre - Millicent, South Australia
Time of Sowing 1

Sown: 16-17 April 2020
Harvested: 12 December 2020
Rotation position: 1st cereal after canola, 2018 wheat.
Soil type & management: Neutral-slightly alkaline Organosol (Peat soil) – high organic matter (0-30cm).
Soil Mineral N (0-90cm): 201.86kg/ha on 29 June 2020

Trial 1. HYC 1st Stage Screen

Objective: To examine the phenology, disease resistance and standing power of new barley germplasm established in the traditional late April sowing window relative to current practice.

Key Points:

- For mid-April sowing dates at the SA Crop Technology Centre (CTC) barley has been under consistent pressure from disease and lodging.
- New spring introductions all have improved net form net blotch resistance compared to the current control RGT Planet but are weaker for Scald (referenced in table 2)
- Leaf rust was evident in high yielding European introductions Laureate and Sanette
- Winter barley reference in table 2 (shaded in light red) had superior disease packages compared to spring barley.
- Head loss, brackling and lodging was a major constraint in 2020 at this location and the winter barleys were inferior to spring barley for head retention.
- Some of these lines were also assessed for yield at the same sowing date in the HYC Elite Screen trial (Trial 2 – next write up).

Treatments: 25 lines sown in small plots (4-6m in length depending on site) with standard nitrogen management but no fungicide or no PGR input and not taken to yield

Table 1. Phenology evaluation, Zadoks growth stage recorded at key points in the season

Variety	Type	28-Jul	29-Sep
RGT Planet	2 row, spring	31	71
Rosalind	2 row, spring	33	69
Cassiopee	2 row, winter	29	55
Surge	2 row, winter	29	45
AGTB0213	2 row, spring	31	59
AGTB0245	2 row, spring	32	71
HV8 Nitro	2 row, spring	31	71
WI4592	2 row, spring	31	69
Laureate	2 row, spring	31	59
Sanette	2 row, spring	31	59
Traveler	2 row, spring	32	75
GSP-17-27-B	2 row, spring	32	65
GSP-18-44-B	2 row, spring	32	71
Operette	2 row, spring	32	65
SC27274PH(Madness)	2 row, winter	29	45
SC21529PH (Newton)	2 row, winter	29	39
Etencil	6 row, winter	29	45
Pixel	6 row, winter	27	45
Memento	2 row, winter	29	39
SC56325QH	2 row, winter	29	51
SC15643QH	2 row, winter	29	45
IDILIC	2 row, winter	29	45
943PH (Pulco)	6 row, winter	29	51
COCCINEL	6 row, winter	30	45
Visual	6 row, winter	30	39

Table 2. Disease Observations from 26 October 2020.

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

Table 3. Lodging (Index 0-500) and Brackling (% plot) assessed on 10 December 2020

Variety	Type	Lodging Index (0-500)	Brackling (%)
RGT Planet	2 row, spring	0.0	99.0
Rosalind	2 row, spring	25.0	87.5
Cassiopee	2 row, winter	32.5	30.0
Surge	2 row, winter	0.0	67.5
AGTB0213	2 row, spring	0.0	90.0
AGTB0245	2 row, spring	15.0	97.5
HV8 Nitro	2 row, spring	0.0	95.0
WI4592	2 row, spring	0.0	100.0
Laureate	2 row, spring	0.0	87.5
Sanette	2 row, spring	250.0	50.0
Traveler	2 row, spring	0.0	95.0
GSP-17-27-B	2 row, spring	40.0	95.0
GSP-18-44-B	2 row, spring	40.0	57.5
Operette	2 row, spring	180.0	55.0
SC27274PH(Madness)	2 row, winter	87.5	25.0

SC21529PH (Newton)	2 row, winter	47.5	15.0
Etencil	6 row, winter	247.5	12.5
Pixel	6 row, winter	80.0	57.5
Memento	2 row, winter	55.0	1.5
SC56325QH	2 row, winter	45.0	7.5
SC15643QH	2 row, winter	127.5	67.5
IDILIC	2 row, winter	60.0	35.0
943PH (Pulco)	6 row, winter	30.0	17.5
COCCINEL	6 row, winter	52.5	45.0
Visual	6 row, winter	35.0	17.5

Trial 2. HYC Elite Screen

Objective: To examine the yield potential of new winter and spring germplasm grown under HYC Management packages against spring and winter controls in the traditional late April/early May sowing window.

Key messages:

- The highest yielding spring cultivar at 9.76t/ha yielded similar to the control RGT Planet at 8.72t/ha while Rosalind was lower yield at 8.35t/ha
- The highest yielding 2 row and 6 row winter barley was Newton at 7.13t/ha and Pixel 7.43t/ha respectively (shaded green in table below).
- Proteins were in the range for malting however test weights were low suggesting some weather damage these ranged from 63.3 – 68.3 in spring cultivars, and 60.4 – 67.7 in winter cultivars.
- The phenology responses range from the earliest flowering in the spring cultivars Rosalind on the 11th September and Planet on the 19th September.
- Winter cultivars developed slower with the fastest winter being Urambie flowering on the 30 September through to the 17th October in Newton
- Despite flowering at a more optimum time for Millicent yields were lower from later flowering. This was due to a combination of reduced light limiting potential yield and head loss and lodging were the major causes of yield loss in the winter cultivars.

Treatments: (24 elite lines tested under HYC High input management (full foliar fungicide program (Systiva & 3 foliar fungicides – GS31, GS39 & GS61) and PGR management applied as Moddus 200ml @ GS30 - GS32

Table 1. Grain yield and quality (protein (%) and test weight (kg/hL) and screenings (%))

Variety		**Grain yield and quality**									
		Yield		Protein		Test weight		Screenings		Retention	
		t/ha		%		Kg/hL		% <2.2mm		%>2.2mm	
1.	RGT Planet	8.72	abc	11.0	efg	64.5	cde	2.3	bcd	89.1	c-g
2.	Rosalind	8.35	bcd	11.6	cde	66.0	b	2.4	bcd	87.8	fg
3.	Cassiopee	6.35	h-k	13.2	a	68.0	a	1.3	def	94.4	ab
4.	AGTB0213	6.81	e-i	11.6	c-f	67.6	a	1.0	def	94.0	ab
5.	AGTB0245	9.76	a	11.0	efg	63.5	efg	2.3	bcd	88.4	d-g
6.	HV8 Nitro	7.65	b-h	11.3	d-g	67.6	a	1.4	def	92.8	a-d

7.	WI4592	7.34	c-h	11.8	bcd	68.3	a	1.2	def	93.1	abc
8.	Laureate	7.82	b-g	10.9	fg	64.1	ef	1.1	def	92.8	a-e
9.	Sanette	7.52	c-h	11.6	c-f	63.3	fg	2.4	bcd	86.9	fg
10.	Traveler	7.87	b-f	11.6	cde	66.0	b	0.5	ef	96.4	a
11.	GSP-17-27-B	8.17	b-e	11.6	c-f	65.7	b	1.9	b-e	90.3	b-f
12.	GSP-18-44-B	9.04	ab	11.6	c-f	64.2	def	2.2	bcd	88.2	efg
13.	Operette	7.59	c-h	11.4	d-g	65.9	b	1.4	def	93.3	abc
14.	Madness	6.76	f-i	11.4	c-g	67.4	a	0.6	ef	93.8	ab
15.	Newton	7.13	d-h	12.4	b	66.0	b	0.6	ef	95.2	a
16.	Etencil	3.96	m	10.9	efg	65.2	bcd	1.5	c-f	90.3	b-f
17.	Pixel	7.43	c-h	10.8	g	63.4	fg	0.4	f	93.8	ab
18.	Memento	6.33	h-k	11.9	bcd	67.7	a	0.5	ef	95.5	a
19.	SC56325QH	4.99	klm	12.1	bc	67.5	a	0.7	ef	95.7	a
20.	SC15643QH	4.28	lm	11.8	bcd	62.6	g	5.1	a	76.7	i
21.	IDILIC	5.33	j-m	10.8	g	65.6	b	1.8	b-e	88.1	fg
22.	943PH (Pulco)	4.72	lm	10.9	fg	65.1	bcd	0.3	f	97.0	a
23.	COCCINEL	5.59	i-l	11.3	d-g	60.4	h	2.8	bc	85.6	gh
24.	Urambie	6.47	g-j	11.9	bcd	65.3	bc	2.8	b	81.9	h
	Mean	6.92		11.51		65.45		1.60		90.89	
	LSD	1.39		0.73		1.04		1.38		4.58	
	P Val	<0.001		<0.001		<0.001		<0.001		<0.001	

Table *. Trial input and management details (kg, g, ml/ha).

Plant pop'n:		160 seeds/m^2
Seed treatment:		Vibrance/Gaucho
Basal Fertiliser:	18 April	100kg MAP
Nitrogen:	29 July	87 kg Urea (40 N)
	11 August	87 kg Urea (40 N)
	2 September	87 kg Urea (40 N)
PGR:	28 July	Moddus Evo 200mL/ha
Fungicide:	28 July	Prosaro 300mL/ha
	26 August	Radial 840mL/ha
	28 September	Tilt 500mL/ha

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

Trial 3. HYC G.E.M Trial series

Objective: To assess the performance of winter and spring barley germplasm managed under four different management intensities (mid-April to early May sown) at two levels of fungicides.

Key Messages:

- Variety responses differed with canopy management consistent with other trials.
- Additional Nitrogen had a detrimental effect on yield in the winter cultivar Cassiopee when the canopy was not managed. While the application of a PGR increased yield in Rosalind and Planet was not responsive to canopy management
- Disease pressure was lower than in previous years and similar yields were achieved between the standard and higher input fungicide strategy in all cultivars.
- These results confirm the importance of variety choice and management, Planet was the highest yielding cultivar across all management regimes, however Rosalind was able to achieve similar yields when managed with a PGR. The data highlights the downside risk of winter cultivar Cassiopee and suggests it is not as well adapted to Millicent conditions were large canopies are unavoidable. An additional PGR application may be required for the winter cultivar.
- Defoliation did not result in a yield penalty in any cultivar highlight the application of barley for dual purpose use (grain and graze).

Treatments: Lever 1 – Level of fungicide inputs x Lever 2 – Canopy Control and additional N (to service 25% higher yield potential) x Lever 3 - Germplasm

Sown: 17 April 2020
Harvested: 10 December 2020

Table 1. Influence of fungicide management strategy, variety and canopy management regime on grain yield (t/ha).

	RGT Planet		***Cassiopee***		***Rosalind***		***Mean***	
Variety	6.68	a	5.67	c	6.44	b	***6.26***	
		LSD	0.17			***P Value***	***<0.001***	
Fungicide Management								
Standard Fungicide Management	6.52	-	5.63	-	6.39	-	**6.18**	-
High Input Fungicide management	6.84	-	5.71	-	6.48	-	**6.35**	-
Fungicide Management		***LSD***	***0.32***			***P Value***	***0.305***	
Fungicide Mgmt x Variety		***LSD***	***0.24***			***P Value***	***0.409***	
Canopy Management Regime								
No Intervention	6.62	bcd	5.83	g	6.15	efg	**6.2**	-
No Intervention + Nitrogen	6.85	ab	5.36	h	6.21	ef	**6.14**	-
Defoliation + Nitrogen	6.79	abc	6.02	fg	6.33	def	**6.38**	-
PGR + Nitrogen	6.46	cde	5.47	h	7.07	a	**6.33**	-
Canopy Management Regime		***LSD***	***0.31***			***P Value***	***0.516***	
Variety x Canopy Mgmt Regime		***LSD***	***0.34***			***P Value***	***<0.001***	
Fungicide Mgmt. x Canopy Mgmt. Regime								
Standard Fungicide Management								
No Intervention	6.53	-	5.82	-	6.21	-	**6.19**	-

No Intervention + Nitrogen	6.57	-	5.29	-	6.21	-	**6.02**	-
Defoliation + Nitrogen	6.56	-	5.98	-	6.38	-	**6.31**	-
PGR + Nitrogen	6.43	-	5.42	-	6.77	-	**6.21**	-
High Input Management								
No Intervention	6.71	-	5.83	-	6.08	-	**6.21**	-
No Intervention + Nitrogen	7.13	-	5.44	-	6.21	-	**6.26**	-
Defoliation + Nitrogen	7.03	-	6.07	-	6.28	-	**6.46**	-
PGR + Nitrogen	6.50	-	5.52	-	7.37	-	**6.46**	-
Fungicide Mgmt x Canopy Mgmt			***LSD 0.44***				***P Value 0.907***	
Fungicide Mgmt x Canopy Mgmt x Variety			***LSD 0.47***				***P Value 0.521***	

"Defoliation" – simulated grazing using mechanical defoliation.

Table 2. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		200 seeds/m^2			
		Standard (Nil)	**Standard + Nitrogen**	**Graze GS30 + Nitrogen**	**PGR GS30-32 + Nitrogen**
Grazed:		----	---	✓	---
Seed treatment:		Vibrance / Gaucho**			
Basal Fertiliser:	17 April	100Kg MAP	100Kg MAP	100Kg MAP	100Kg MAP
Nitrogen:	29 July	40 kg N	80 kg N	80 kg N	80 kg N
	11 August	40 kg N	40 kg N	40 kg N	40 kg N
	2 September	40 kg N	40 kg N	40 kg N	40 kg N
Total N (With 10N at sowing)		**130 Kg N**	**170 Kg N**	**170 Kg N**	**170 Kg N**
PGR:	GS31	----	----	Moddus Evo. 200ml	----
	GS37	----	----	Moddus Evo. 200ml	----
Fungicide:					
Standard Management		GS31 Tilt 500ml fb GS39 Folicur 290ml			
High Input Management		Systiva, GS31 Prosaro 300ml fb GS39 Radial 840ml fb Tilt 500ml			

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

**Timings of PGRs and fungicides were adjusted to take account of the differences in spring and winter barley phenology (development).*

***Base seed treatment standard across trial.*

Trial 4. HYC Disease Management germplasm interaction

Objective: To develop profitable and sustainable approaches to disease management in HRZ barley.

Key messages:

- The fungicide treatments were effective in reducing the incidence of foliar disease, however yield responses to fungicide were not significant at this site in 2020.
- Hv8 Nitro had greater infection of Spot Form Net Blotch (SFNB) than Planet, The addition of the seed treatment Systiva combined with a 2-spray foliar fungicide program reduced the infection levels of SFNB on Nitro. In the absence of a seed treatment the additional fungicide at GS39 had little effect on SNFB control suggest GS31 treatments are more effective.
- RGT Planet is more susceptible than HV8 Nitro to NFNB, greater control of infection was achieved in Planet with two foliar sprays compared to one application and untreated, while Nitro achieved similar control with one application at GS31. In this season the addition of Systiva as a seed treatment did not further improve control in Planet, or Nitro.
- Grain quality responses were significant and disease control enabled Planet to achieve malting specification. All fungicide treatments improved test weight by more than 1kg/hl and increased grain plumpness by between 4 – 6% larger.

Treatments: 4 fungicide management levels applied to 2 varieties

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

		Yield		
	Fungicide Management	RGT Planet	HV8 Nitro	Mean
1	Untreated	7.17 -	7.72 -	7.44 -
2	GS31 Radial 840mL/ha	7.42 -	7.17 -	7.30 -
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	7.67 -	7.49 -	7.58 -
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	7.68 -	7.56 -	7.62 -
	Mean	7.48 -	7.49 -	
Fungicide Management		LSD	0.71	P val 0.7288
Cultivar		LSD	0.26	P val 0.9836
Fungicide x Cultivar		LSD	0.52	P val 0.1143
CV		4.5		

Table 2. Influence of fungicide management and cultivar on grain yield and grain quality.

		Yield	**Protein**	**Test Weight**	**Screenings**	**Retention**
		t/ha	%	kg/hl	%	%
1	Untreated	7.44 -	11.3 -	65.1 c	4.5 a	81.5 b
2	GS31 Radial 840mL/ha	7.30 -	11.3 -	66.3 b	3.0 b	85.8 a
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	7.58 -	11.2 -	66.1 b	2.9 b	85.6 a

4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	7.62	-	11.4	-	66.7	a	2.6	b	87.6	a
	LSD P=.05	0.71		0.2		0.2		0.9		2.1	
	P Value	0.729		0.446		<0.001		0.007		<0.001	
1	RGT Planet	7.48	-	11.1	b	64.8	b	3.5	a	84.0	b
2	HV8 Nitro	7.49	-	11.5	a	67.3	a	3.0	b	86.4	a
	LSD P=.05	0.26		0.1		0.2		0.3		0.8	
	P Value	0.984		<0.001		<0.001		0.011		<0.001	
	Grand Mean	**7.49**		**11.3**		**66.1**		**3.3**		**85.2**	

Table 2. Influence of fungicide management of RGT Planet on grain yield and grain quality.

		Yield		**Protein**		**Test Weight**		**Screenings**		**Retention**	
		t/ha		%		kg/hl		%		%	
1	Untreated	7.17	-	11.0	c	64.0	-	4.4	-	81.6	d
2	GS31 Radial 840mL/ha	7.42	-	11.1	bc	64.9	-	3.2	-	84.1	c
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	7.67	-	11.1	c	64.8	-	3.4	-	83.7	c
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	7.68	-	11.3	b	65.4	-	2.8	-	86.4	b
	LSD P=.05	0.71		0.2		0.2		0.9		2.1	
	P Value	0.729		0.446		<0.001		0.007		<0.001	

Table 3. Influence of fungicide management and cultivar on net form net blotch infection (% plot) on 25/11/2020.

		Net Form Net Blotch					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	73.8	a	8.8	d	41.3	a
2	GS31 Radial 840mL/ha	48.8	b	3.8	d	26.3	b
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	27.5	c	7.5	d	17.5	b
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	31.3	c	10.0	d	20.6	b
Mean		45.3	a	7.5	b		
Fungicide Management			LSD	10.5		P val	0.003
Cultivar			LSD	5.7		P val	<0.001
Fungicide x Cultivar			LSD	11.4		P val	<0.001

Table 4. Influence of fungicide management and cultivar on spot form net blotch infection (% plot) on 25/11/2020.

		Spot Form Net Blotch					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	5.0	b	32.5	a	18.8	-
2	GS31 Radial 840mL/ha	3.8	b	22.5	a	13.1	-
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	6.3	b	25.0	a	15.6	-
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	3.8	b	6.3	b	5.0	-
Mean		4.7	b	21.6	a		
Fungicide Management			LSD	9.6		P val	0.051
Cultivar			LSD	5.1		P val	<0.001
Fungicide x Cultivar			LSD	10.1		P val	0.017

Table 5. Influence of fungicide management and cultivar on Scald infection (% plot) on 25/11/2020.

		Scald					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	2.5	-	52.5	-	27.5	-
2	GS31 Radial 840mL/ha	3.8	-	21.3	-	12.5	-
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	2.5	-	21.3	-	11.9	-
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	2.5	-	25.0	-	13.8	-
Mean		2.8	b	30.0	a		
Fungicide Management			LSD	13.1		P val	0.073
Cultivar			LSD	11.5		P val	<0.001
Fungicide x Cultivar			LSD	23.0		P val	0.153

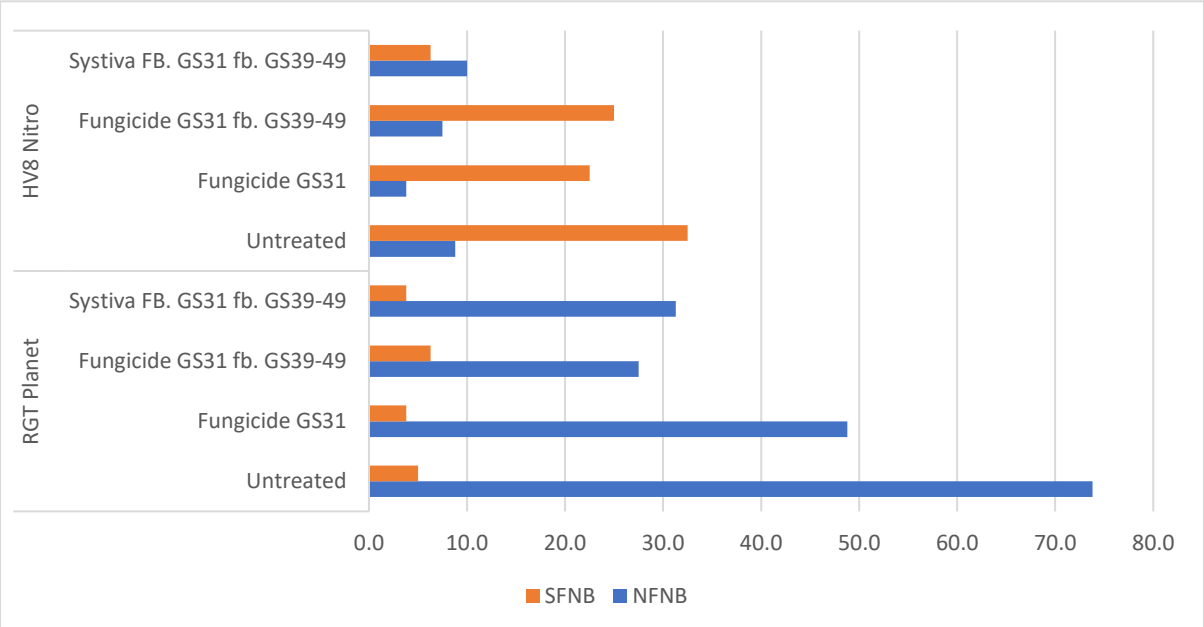

Figure 1. Influence of fungicide management and cultivar on net form net blotch (NFNB) and spot form net blotch (SFNB) infection (% plot) on 25/11/2020.

Trial 5. HYC PGR x harvest date interaction

Objective: To assess the value of PGRs with delayed harvest in HRZ regions

Key messages:

- When harvested on time RGT Planet achieved a grain yield of 8.8 t/ha significantly higher than the winter cultivar Cassiopee at 6.6 t/ha.
- Delaying harvest timing by 3 weeks resulted in a significant yield penalty of 2.2 t/ha and 1.7t/ha in RGT Planet and Cassiopee respectively. This highlights the importance of harvesting barley in a timely manner.
- Applications of PGRs did not increase yield when harvest was delayed at this site in 2020. A significant weather event occurred prior to the timing of harvest in the 'on time' treatments which may have masked some of the treatment effects.

Treatments: 4 PGR management approaches applied to two cultivars, to be harvested at two harvest dates.

Table 1. Influence of harvest date, variety and canopy management regime on grain yield (t/ha).

		RGT Planet		***Cassiopee***		***Mean***	
Variety		*7.68*	*a*	*5.73*	*b*	**6.70**	
	LSD		***0.43***	***P-Value***		***0.003***	
Harvest Date							
On time		8.80	-	6.60	-	***7.70***	***a***
Delayed 3 weeks		6.57	-	4.85	-	***5.71***	***b***
Harvest Date Management	***LSD***		***0.78***	***P-Value***		***0.002***	
Harvest Date x Variety	***LSD***		***1.11***	***P-Value***		***0.447***	
Canopy Management Regime							
Untreated		7.88	-	5.72	-	6.80	ab
GS31 PGR		7.28	-	5.64	-	6.46	b
GS31 + GS37 PGR		8.10	-	5.98	-	7.04	a
GS31 + GS49 PGR (Europe style)		7.46	-	5.57	-	6.51	b
Canopy Management Regime	***LSD***		***0.44***	***P-Value***		***0.041***	
Variety x Canopy Mgmt Regime	***LSD***		***0.62***	***P-Value***		***0.607***	
Harvest Date. x Canopy Mgmt. Regime							
On Time							
Untreated		9.05	-	6.58	-	7.81	-
GS31 PGR		8.41	-	6.32	-	7.37	-
GS31 + GS37 PGR		9.15	-	6.81	-	7.98	-
GS31 + GS49 PGR (Europe style)		8.57	-	6.71	-	7.64	-
Delayed 3 weeks							
Untreated		6.72	-	4.87	-	5.79	-
GS31 PGR		6.15	-	4.96	-	5.56	-
GS31 + GS37 PGR		7.05	-	5.14	-	6.09	-
GS31 + GS49 PGR (Europe style)		6.34	-	4.43	-	5.39	-
Harvest Date x Canopy Mgmt	***LSD***		***0.62***	***P-Value***		***0.743***	
Harvest Date x Canopy Mgmt x Variety	***LSD***		***0.88***	***P Value***		***0.727***	

Table 2. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		200 seeds/m^2
Seed treatment:		Vibrance / Gaucho
Basal Fertiliser:	17 April	100Kg MAP
Nitrogen:	29 July	40 kg N
	11 August	40 kg N
	2 September	80 kg N
Total N (With 10N at sowing)		**170 Kg N**
Fungicide:	6 August	Prosaro 300 ml/ha
		Aviator Xpro 500 ml/ha
		Radial 840 ml/ha

Trial 6: Nutrition for Hyper Yielding Barley

Objectives: To assess the value of higher nutrition input for barley

Individual objectives specific to the trial are:

- Assess whether growers are currently under fertilizing barley crops in the region and N requirements required to reach target yields of 10 – 12 within each region.

Key messages:

- A mean yield of 8.8t/ha was achieved across the experiment and proteins were greater than 10.5% and within malt barley specification.
- There wasn't any additional yield benefit from an extra 25% and 50% N combined when applied either with or without the additional P and S fertilizer compared to the farmer applied nutrition which totaled 130 Nkg.ha
- The aspirational N treatment of an additional 60 units of N increased grain protein by ~0.4% compared to the current practice.
- All other yield components and lodging were not influenced by N nutrition in this experiment

Treatments: Five nutrition treatments

Current Practice: 130 N kg/ha + 21 P kg/ha
Current Practice + 25% N: 160 N kg/ha + 21 P kg/ha
Current Practice + 25% NPK*: 160 N kg/ha + 21 P kg/ha + 8.1 S kg/ha
Aspirational N: 190 N kg/ha + 21 P kg/ha
Aspirational NPK*: 190 N kg/ha + 31 P kg/ha + 11.5 S kg/ha
*no additional K added due to soil test reports

Sown: 17 April 2020
Variety: RGT Planet
Harvested: 11 December 2020

Table 1. Grain yield and quality (protein (%) and test weight (kg/hL) and screenings (%))

Variety		Grain yield and quality									
		Yield		Protein		Test weight		Screenings		Retention	
		t/ha		%		%		%		%	
1.	Current Practice	9.06	-	11.1	c	67.7	-	1.1	-	92.9	-
2.	Current Practice + 25% N	8.79	-	11.2	bc	67.8	-	1.3	-	92.9	-
3.	Current Practice + 25% NPK	8.92	-	11.2	bc	68.0	-	1.1	-	93.1	-
4.	Aspirational N	8.66	-	11.5	a	67.9	-	0.9	-	93.3	-
5.	Aspirational NPK	8.93	-	11.4	ab	67.8	-	1.2	-	92.9	-
	Mean	8.871		11.26		67.8		1.1		93.0	
	LSD	0.604		0.22		0.4		0.4		0.9	
	P Val	0.661		0.014		0.691		0.427		0.810	
	CV	4.42		1.29		0.4		22.9		0.64	

Table 2. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		200 seeds/m^2
Seed treatment:		Vibrance / Gaucho
Basal Fertiliser:	17 April	100Kg MAP
Nitrogen:	29 July	40 kg N
	11 August	40 kg N
	2 September	40 kg N
Total N (With 10N at sowing)		**170 Kg N**
Fungicide:	6 August	Prosaro 300 ml/ha
		Aviator Xpro 500 ml/ha
		Radial 840 ml/ha

Trial 7: Novel management strategies to reset barley development

Objective: Are we better to increase seeding rate and reset phenology in faster spring Barley sown early to capitalize on root growth, greater carbohydrate reserve, and initiate more tillers rather than utilise current winter germplasm options sown early in the HRZ? Is spring barley more sensitive to changes in plant density than winter barley?

Treatments: 2 Plant densities x 3 cultivars x 2 reset manipulation treatments

Sown: 17 April 2020

Harvested: 11 December 2020

Key Messages:

- Similar yields were achieved at low and higher plant densities. While defoliation reduced yield on average by 0.6t/ha.
- Defoliation at GS32 in Rosalind corresponded to a defoliation date of GS31 in RGT Planet and mid tillering in the winter cultivar Cassiopee. This had profound influences on crop development and delayed flowering by 25 days in Rosalind, 13 days in RGT Planet, and 7 days in Cassiopee.

- Despite a 48% difference in the dry matter removed on 8 July between the spring varieties Rosalind and RGT Planet in contrast to the winter variety Cassiopee there was no significant interaction between variety and defoliation for final yield.
- At harvest while there were significant differences in head numbers between varieties, with Rosalind and RGT Planet having 280 and 240 heads more than Cassiopee respectively, plant population and defoliation did not significantly impact head numbers.

Table 1. Influence of fungicide management strategy, variety and canopy management regime on grain yield (t/ha).

	RGT Planet		***Cassiopee***		***Rosalind***		***Mean***	
Variety	7.91	a	6.32	c	7.38	b		
		LSD	0.41			***P Value***	***<0.001***	
Plant Population								
130 plants/m²	8.07	-	6.60	-	7.58	-	**7.42**	**-**
250 plants/m²	7.75	-	6.04	-	7.17	-	**6.99**	**-**
Plant Population		***LSD***	***0.39***			***P Value***	***0.080***	
Plant Population x Variety		***LSD***	***0.58***			***P Value***	***0.878***	
Canopy Management Regime								
Untreated	8.25	-	6.53	-	7.72	-	7.50	a
GS32 Defoliation	7.57	-	6.11	-	7.03	-	6.90	b
Canopy Management Regime		***LSD***	***0.17***			***P Value***	***<0.001***	
Variety x Canopy Mgmt Regime		***LSD***	***0.31***			***P Value***	***0.482***	
Plant Pop. x Canopy Mgmt. Regime								
130 plants/m²								
Untreated	8.38	-	6.87	-	7.85	-	7.70	-
GS32 Defoliation	7.77	-	6.33	-	7.31	-	7.14	-
250 plants/m²								
Untreated	8.13	-	6.20	-	7.59	-	7.31	-
GS32 Defoliation	7.36	-	5.89	-	6.75	-	6.67	-
Plant Pop x Canopy Mgmt		***LSD***	***0.25***			***P Value***	***0.695***	
Plant Pop x Canopy Mgmt x Variety		***LSD***	***0.44***			***P Value***	***0.541***	

"Defoliation" – simulated grazing using mechanical defoliation.

Table 2. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		150 seeds/m² or 300 seeds/m²
Grazed:	8 July	Rosalind GS33
		RGT Planet GS32
		Cassiopee GS26
Seed treatment:		Vibrance / Gaucho
Basal Fertiliser:	17 April	100Kg MAP
Nitrogen:	29 July	40 kg N
	11 August	40 kg N
	2 September	80 kg N
Total N (With 10N at sowing)		**170 Kg N**
Fungicide:	6 August	Prosaro 300 ml/ha
		Aviator Xpro 500 ml/ha
		Radial 840 ml/ha

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

2020 SA Crop Technology Centre - Millicent, South Australia
Time of Sowing 2

Sown: 11-12 May 2020
Harvested: 11-12 December 2020
Rotation position: 1st cereal after canola, 2018 wheat.
Soil type & management: Neutral-slightly alkaline Organosol (Peat soil) – high organic matter (0-30cm).

Trial 1. HYC 1st Stage Screen

Objective: To examine the phenology, disease resistance and standing power of new barley germplasm established in the traditional late April/early May sowing window relative to current practice.

Key Points:

- For mid-May sowing dates at the SA Crop Technology Centre (CTC) barley has been under consistent pressure from disease and lodging.
- The levels of NFNB were less in the current control RGT Planet at the second sowing date suggesting delaying sowing date is a viable solution to reducing NFNB pressure.
- European introductions Laureate and Sanette were clean for disease at this sowing date compared to Australian cultivars.
- Crop development speed rankings changed at this sowing date compared to the earlier sowing date. There is a suite of new spring introductions more suited to the long season environment with improved disease resistance package compared to RGT Planet. This presents an exciting opportunity for subsequent HYC trials.
- Some of these lines were also assessed for yield at the same sowing date in the HYC Elite Screen trial (Trial 2 – next write up).

Treatments: Proposed 25 lines sown in small plots (4-6m in length depending on site) with standard nitrogen management but no fungicide or no PGR input not taken to yield

Table 1. Phenology evaluation, Zadoks growth stage recorded at key points in the season (Zadoks GS00-99)

Variety	Type	29-Sep
RGT Planet	2 row, spring	51
Rosalind	2 row, spring	61
Cassiopee	2 row, winter	43
AGTB0213	2 row, spring	45
AGTB0245	2 row, spring	43
HV8 Nitro	2 row, spring	51
WI4592	2 row, spring	61
Laureate	2 row, spring	41
Sanette	2 row, spring	45
Traveler	2 row, spring	45
GSP-17-27-B	2 row, spring	51
GSP-18-44-B	2 row, spring	51
Operette	2 row, spring	55

Urambie	2 row, winter	45
Westminster	2 row, spring	41
AGTB0244	2 row, spring	45
AGTB0247	2 row, spring	41
Alestar	2 row, spring	65
Compass	2 row, spring	62
Oxford	2 row, spring	41
Line 30 15/3	2 row, spring	55
Line 44 60/1	2 row, spring	59
Fathom	2 row, spring	55
IGB1844	2 row, spring	61
AGFBA5618	2 row, spring	41

Table 2. Disease Observations from 26 October 2020.

Variety	NFNB	SFNB	Scald	Ramularia	Leaf Rust
RGT Planet	45	0	0	2	0
Rosalind	2	2	0	2	3
Cassiopee	4	2	0	6	0
AGTB0213	10	3	50	0	2
AGTB0245	35	2	0	0	0
HV8 Nitro	45	2	15	3	0
WI4592	0	0	95	0	0
Laureate	2	4	3	1	0
Sanette	7	3	2	0	0
Traveler	35	2	0	0	0
GSP-17-27-B	35	2	0	3	0
GSP-18-44-B	65	2	0	2	0
Operette	20	2	35	0	0
Urambie	2	2	0	4	0
Westminster	6	3	0	5	0
AGTB0244	75	2	3	0	0
AGTB0247	12	2	0	2	0
Alestar	15	2	0	2	0
Compass	2	4	0	0	50
Oxford	25	3	10	10	4
Line 30 15/3	65	2	0	3	0
Line 44 60/1	60	2	0	0	8
Fathom	45	3	10	2	5
IGB1844	3	1	10	0	0
AGFBA5618	45	0	0	0	0

Table 3. Lodging (Index 0-500) and Brackling (% plot) assessed on 10 December 2020

Variety	Type	Lodging Index (0-500)	Brackling (%)
RGT Planet	2 row, spring	20.0	35.0
Rosalind	2 row, spring	0.0	87.5
Cassiopee	2 row, winter	7.5	2.5
AGTB0213	2 row, spring	15.0	62.5
AGTB0245	2 row, spring	17.5	47.5
HV8 Nitro	2 row, spring	40.0	45.0
WI4592	2 row, spring	15.0	77.5
Laureate	2 row, spring	15.0	57.5
Sanette	2 row, spring	30.0	72.5
Traveler	2 row, spring	45.0	45.0
GSP-17-27-B	2 row, spring	0.0	85.0
GSP-18-44-B	2 row, spring	0.0	77.5
Operette	2 row, spring	0.0	95.0
Urambie	2 row, winter	20.0	62.5
Westminster	2 row, spring	2.5	75.0
AGTB0244	2 row, spring	130.0	32.5
AGTB0247	2 row, spring	40.0	62.5
Alestar	2 row, spring	40.0	32.5
Compass	2 row, spring	0.0	92.5
Oxford	2 row, spring	0.0	95.0
Line 30 15/3	2 row, spring	0.0	30.0
Line 44 60/1	2 row, spring	82.5	40.0
Fathom	2 row, spring	170.0	55.0
IGB1844	2 row, spring	10.0	25.0
AGFBA5618	2 row, spring	0.0	0.0

Table 4. Trial input and management details (kg, g, ml/ha).

Plant pop'n:		200 seeds/m^2
Seed treatment:		Vibrance/Gaucho
Basal Fertiliser:	18 April	100kg MAP
Nitrogen:	29 July	87 kg Urea (40 N)
	11 August	87 kg Urea (40 N)
	2 September	87 kg Urea (40 N)

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

Trial 2. HYC Elite Screen

Objective: To examine the yield potential of new winter and spring germplasm grown under HYC Management packages against spring and winter controls in the traditional late April/early May sowing window.

Key Points:

- The highest yielding spring cultivar was Laureate at 9.83t/ha yielded similar to the control RGT Planet at 9.58t/ha while Rosalind yielded 8.98 respectively.
- Despite being sown later the winter cultivar Cassiopee achieved 7.33t/ha
- Proteins were in the range for malting.
- Importantly test weights were higher at the second sowing date suggesting barley is better adapted to this position in the rotation. Testweights ranged from 64.5 – 70.7 all in the range for malting.
- In general yields were higher from the second sowing date. The data demonstrates that there are now cultivars capable of achieving similar yields to Planet with improved disease resistance (when combined with the disease data from stage 1 screen)

Treatments: (24 elite lines tested under HYC High input management (full foliar fungicide program (Systiva & 3 foliar fungicides – GS31, GS39 & GS61) and PGR management

Table 1. Grain yield and quality (protein (%) and test weight (kg/hL) and screenings (%))

Variety		**Grain yield and quality**									
		Yield		Protein		Test weight		Screenings		Retention	
		t/ha		%		%		%		%	
1.	RGT Planet	9.59	abc	10.2	ijk	67.5	hi	2.9	b-f	89.5	c-g
2.	Rosalind	8.99	a-e	10.7	f-i	68.9	ef	3.7	bcd	84.6	ghi
3.	Cassiopee	7.33	fg	12.4	a	70.5	ab	1.2	fg	95.6	a
4.	AGTB0213	8.16	c-g	11.0	def	68.9	ef	2.8	b-f	90.2	a-f
5.	AGTB0245	9.03	a-e	10.2	ijk	65.6	kl	3.3	b-e	86.9	d-i
6.	HV8 Nitro	9.80	ab	10.4	g-k	70.3	abc	2.0	d-g	91.9	a-d
7.	WI4592	8.68	a-f	11.4	cde	70.7	a	0.7	g	95.4	a
8.	Laureate	9.83	a	10.4	h-k	66.5	jk	2.5	b-g	88.8	c-h
9.	Sanette	8.34	b-f	11.1	c-f	66.3	jk	3.5	b-e	86.4	e-i
10.	Traveler	8.94	a-e	11.3	cde	69.2	def	1.0	fg	95.3	ab
11.	GSP-17-27-B	8.80	a-e	11.0	def	69.5	c-f	2.8	b-f	92.4	a-d
12.	GSP-18-44-B	9.51	a-d	10.6	f-j	67.7	gh	2.4	b-g	89.2	c-h
13.	Operette	8.92	a-e	10.9	efg	69.9	a-d	1.6	efg	93.1	abc
14.	Urambie	6.87	g	12.0	ab	68.6	fg	4.1	b	82.8	i
15.	Westminster	8.06	d-g	11.5	bcd	69.4	c-f	2.0	d-g	91.5	a-e
16.	Sure	8.70	a-f	10.2	ijk	66.5	jk	2.1	c-g	89.5	c-g
17.	AGTB0244	9.31	a-e	10.0	k	65.2	lm	3.3	b-e	83.8	hi
18.	AGTB0247	8.68	a-f	10.1	jk	65.7	jkl	4.1	bc	85.4	f-i
19.	Alestar	8.90	a-e	10.6	f-j	68.7	f	2.2	b-g	89.9	b-g
20.	Line 30 15/3	8.75	a-f	10.9	e-h	66.4	jk	2.4	b-g	90.5	a-f
21.	Line 44 60/1	7.87	efg	10.9	e-h	69.7	b-e	0.8	g	95.5	a
22.	Fathom	8.08	d-g	11.6	bc	66.6	ij	3.3	b-e	87.8	c-i
23.	IGB1844	9.58	abc	12.0	ab	69.3	def	3.3	b-e	83.8	hi
24.	AGFBA5618	3.65	h	11.1	c-f	64.5	m	10.3	a	67.3	j

Mean	8.52	10.93	68.01	2.84	88.62
LSD	1.46	0.54	0.94	1.95	5.45
P Val	<0.001	<0.001	<0.001	<0.001	<0.001
CV					

Table *. Trial input and management details (kg, g, ml/ha).

Plant pop'n:		160 seeds/m^2
Seed treatment:		Vibrance/Gaucho
Basal Fertiliser:	18 April	100kg MAP
Nitrogen:	29 July	87 kg Urea (40 N)
	11 August	87 kg Urea (40 N)
	2 September	87 kg Urea (40 N)
PGR:	7 August	Moddus Evo 200mL/ha
Fungicide:	7 August	Prosaro 300mL/ha
	9 September	Radial 840mL/ha
	20 October	Tilt 500mL/ha

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

Trial 4. HYC Disease Management germplasm interaction

Objective: To develop profitable and sustainable approaches to disease management in HRZ barley.

Key Points:

- Compared to the untreated control a single application of fungicide did not improve yields despite reducing the incidence of NFNB in Planet, and Scald in HV8 Nitro.
- The movement to a two spray fungicide strategy with the first timing at GS31 followed by the second timing at GS39 – 49 increased yield by 0.9 and 1t/ha respectively compared to the untreated control or single unit application.
- The inclusion of an SDHI seed dressing Systiva did not improve yields relative to the two unit fungicide strategy.
- These findings suggest the second timing of GS39-49 is providing the majority of the yield improvement observed at this experiment in 2020, this finding is also true for the level of disease infection expressed
- The use of fungicides applied at GS39 – 49 are consistently improving grain quality and the frequency in which malting quality is achieved even in the absence of a yield response and should not be ignored
- The lack of yield response to seed dressings, and early applications of fungicide suggest that the disease is developing later in the canopy from this sowing date. Subsequent work will follow up this observation in 2021.

Treatments: 4 fungicide management levels applied to 2 varieties

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

		Yield		
	Fungicide Management	RGT Planet	HV8 Nitro	Mean
1	Untreated	8.01 -	7.55 -	7.78 b
2	GS31 Radial 840mL/ha	8.04 -	7.69 -	7.87 b
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	9.02 -	8.73 -	8.88 a
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	9.29 -	8.83 -	9.06 a
	Mean	8.59 a	8.20 b	
Fungicide Management		LSD	0.33 P val	<0.001
Cultivar		LSD	0.33 P val	0.026
Fungicide x Cultivar		LSD	0.67 P val	0.973
CV		5.15		

Table 2. Influence of fungicide management and cultivar on grain yield and grain quality.

		Yield	**Protein**	**Screenings**	**Retention**	**Test weight**
		t/ha	%	%	%	Kg/hL
1	Untreated	7.78 b	10.0 -	2.8 a	89.8 b	67.0 c
2	GS31 Radial 840mL/ha	7.87 b	10.2 -	2.7 a	89.7 b	67.0 c

3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	8.88	a	10.1	-	1.7	b	92.7	a	68.8	a
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	9.06	a	10.2	-	1.9	b	92.7	a	68.4	b
LSD P=.05		0.33		0.3		0.6		1.2		0.4	
P Value		<0.001		0.229		0.003		<0.001		<0.001	
1	RGT Planet	8.59	a	9.9	b	2.1	-	91.2	-	66.7	b
2	HV8 Nitro	8.20	b	10.3	a	2.4	-	91.2	-	68.9	a
LSD P=.05		0.33		0.1		0.4		0.7		0.3	
P Value		0.0259		<0.001		0.131		0.942		<0.001	
Grand Mean		**8.40**		**10.1**		**2.3**		**91.2**		**67.8**	

Table 3. Influence of fungicide management and cultivar on net form net blotch infection (% plot) on 26/11/2020.

		Net Form Net Blotch					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	90.0	a	15.0	de	52.5	a
2	GS31 Radial 840mL/ha	78.8	b	8.8	ef	43.8	b
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	26.3	c	5.0	f	15.6	c
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	18.8	cd	5.0	f	11.9	c
Mean		53.4	a	8.4	b		
Fungicide Management			LSD	4.7		P Val	<0.001
Cultivar			LSD	3.8		P Val	<0.001
Fungicide x Cultivar			LSD	7.6		P Val	<0.001

Table 4. Influence of fungicide management and cultivar on spot form net blotch infection (% plot) on 26/11/2020.

		Spot Form Net Blotch					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	2.5	b	32.5	a	17.5	a
2	GS31 Radial 840mL/ha	5.0	b	33.8	a	19.4	a
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	5.0	b	11.3	b	8.1	b
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	2.5	b	10.0	b	6.3	b
Mean		3.8	b	21.9	a		
Fungicide Management			LSD	6.1		P Val	0.002
Cultivar			LSD	4.8		P Val	<0.001
Fungicide x Cultivar			LSD	9.5		P Val	0.002

Table 5. Influence of fungicide management and cultivar on Scald infection (% plot) on 26/11/2020.

		Scald					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	0.0	c	36.3	a	18.1	a
2	GS31 Radial 840mL/ha	0.0	c	20.0	b	10.0	b
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	0.0	c	1.3	c	0.6	c
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	0.0	c	7.5	c	3.8	bc
Mean		0.0	b	16.3	a		
Fungicide Management			LSD	7.2		P Val	0.002
Cultivar			LSD	4.9		P Val	<0.001
Fungicide x Cultivar			LSD	9.8		P Val	0.001

Table 6. Influence of fungicide management and cultivar on Ramularia infection (% plot) on 26/11/2020.

		Ramularia					
		RGT Planet		HV8 Nitro		**Mean**	
1	Untreated	0.0	-	3.8	-	1.9	-
2	GS31 Radial 840mL/ha	0.0	-	3.8	-	1.9	-
3	GS31 Radial 840mL/ha fb. GS39-49 Aviator Xpro 417mL/ha	0.0	-	0.0	-	0.0	-
4	Systiva FB. GS31 Prosaro 300mL/ha fb. GS39-49 Radial 840mL/ha	0.0	-	0.0	-	0.0	-
Mean		0.0	-	1.9	-		
Fungicide Management			LSD	3.5		P Val	0.436
Cultivar			LSD	2.4		P Val	0.118
Fungicide x Cultivar			LSD	4.9		P Val	0.449

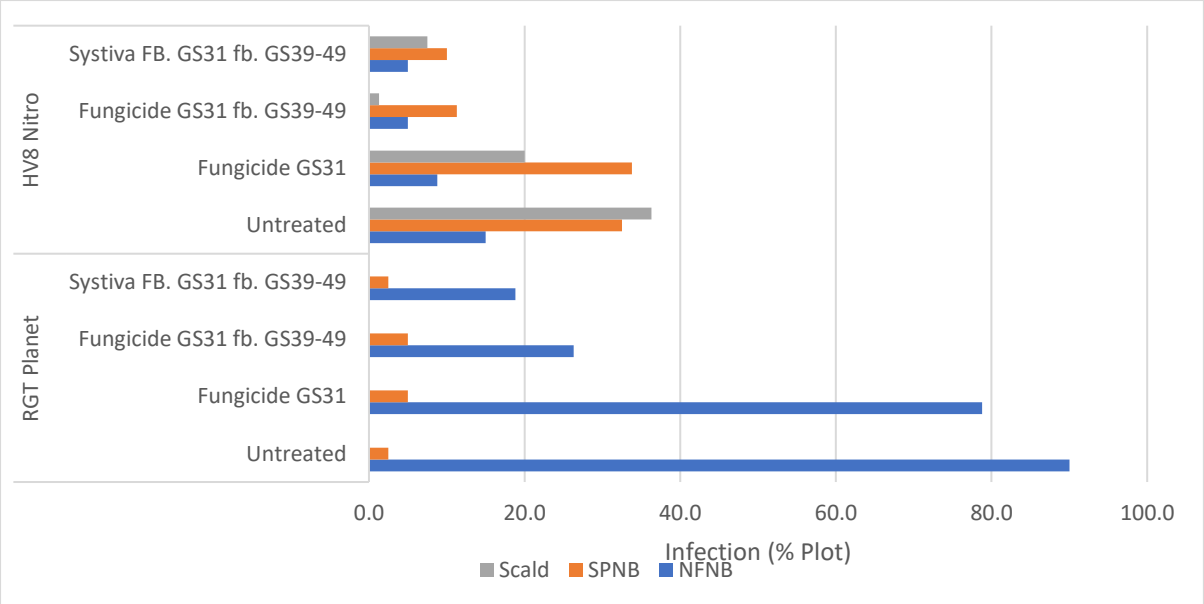

Figure 1. Influence of fungicide management and cultivar on net form net blotch (NFNB), spot form net blotch (SFNB) and Scald infection (% plot) on 26/11/2020.

Trial 6: Nutrition for Hyper Yielding Barley

Objective: To assess the value of higher nutrition input for barley

Individual objectives specific to the trial are:

- Assess whether growers are currently under fertilizing barley crops in the region and N requirements required to reach target yields of 10 – 12 within each region.

Key Points:

- Means yields of 8.99t/ha were achieved and despite grain protein levels below 10% there wasn't any additional yield benefit from and extra 25% and 50% N combined when applied either with or without the additional P and S fertilizer compared to the farmer applied nutrition which totaled 130 Nkg.ha
- The aspirational N treatment of an additional 60 units of N increased grain protein by ~0.3% compared to the current practice.
- Other components such as lodging were not influenced by N nutrition in this experiment
- These findings are consistent with the first sowing date and suggests more N from applied fertilizer is unlikely to significant increase grain yields.

Treatments: Five nutrition treatments

Current Practice: 130 N kg/ha + 21 P kg/ha
Current Practice + 25% N: 160 N kg/ha + 21 P kg/ha
Current Practice + 25% NPK*: 160 N kg/ha + 21 P kg/ha + 8.1 S kg/ha
Aspirational N: 190 N kg/ha + 21 P kg/ha
Aspirational NPK*: 190 N kg/ha + 31 P kg/ha + 11.5 S kg/ha
*no additional K added due to soil test reports

Sown: 11 May 2020
Variety: RGT Planet
Harvested: 12 December 2020

Table 1. Grain yield and quality (protein (%) and test weight (kg/hL) and screenings (%))

Variety		**Grain yield and quality**									
		Yield		Protein		Test weight		Screenings		Retention	
		t/ha		%		Kg/hl		%		%	
1.	Current Practice	8.87	-	9.9	b	67.9	-	1.9	-	92.5	-
2.	Current Practice + 25% N	8.95	-	10.0	b	68.4	-	1.6	-	94.0	-
3.	Current Practice + 25% NPK	9.14	-	9.9	b	67.8	-	1.5	-	93.6	-
4.	Aspirational N	8.89	-	10.2	a	68.2	-	1.5	-	93.7	-
5.	Aspirational NPK	9.10	-	10.2	a	67.6	-	1.8	-	93.0	-
	Mean	8.99		10.0		68.0		1.7		93.4	
	LSD	0.67		0.1		0.7		0.4		1.4	
	P Val	0.857		0.000		0.131		0.249		0.193	
	CV	4.81		0.77		0.62		17.24		0.97	

Table 2. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		200 seeds/m^2
Seed treatment:		Vibrance / Gaucho
Basal Fertiliser:	17 April	100Kg MAP
Nitrogen:	29 July	40 kg N
	11 August	40 kg N
	2 September	40 kg N
Total N (With 10N at sowing)		**130 Kg N**
Fungicide:	6 August	Prosaro 300 ml/ha
		Aviator Xpro 500 ml/ha
		Radial 840 ml/ha

2020 VIC Crop Technology Centre Results- Gnarwarre, Victoria

Sown: 25-26 April, 2020
Harvested: 14-15 December, 2020
Rotation position: 1st cereal following canola
Soil Type: Grey clay loam

Trial 1. HYC 1st Stage Screen

Objective: To examine the phenology, disease resistance and standing power of new barley germplasm established in the traditional late April/early May sowing window relative to current practice.

Key Points:

- Disease pressure and lodging were high at the VIC Crop Technology Centre (CTC) in 2020
- New spring introductions all have improved net form net blotch resistance compared to the current control RGT Planet but are weaker for Scald
- Head loss and lodging was a major constraint in 2020 at this location and the winter barleys were inferior to spring barley for head retention.
- New spring introductions were slower to develop than current controls RGT Planet, and winter cultivars flowered during the optimum period for Gnarwarre.
- Some of these lines were also assessed for yield at the same sowing date in the HYC Elite Screen trial (Trial 2 – next write up).

Treatments: 20 lines sown in small plots (6m in length depending on site) with standard nitrogen management but no fungicide or no PGR input and not taken to yield

Table 1. Phenology evaluation, Zadoks growth stage recorded at key points in the season (Zadoks GS00-99)

Variety	Type	15-Jun	14-Jul	11-Aug	11-Sep	20-Oct
RGT Planet	2 row, spring	23	31	33	49	85
AGTB0213	2 row, spring	23	31	33	49	83
AGTB0245	2 row, spring	24	31	33	49	77
WI4592	2 row, spring	24	31	33	39	87
Laureate	2 row, spring	24	31	33	53	86
Sanette	2 row, spring	24	30	33	49	77
Traveler	2 row, spring	24	30	32	49	83
GSP-17-27-B	2 row, spring	23	30	32	49	85
GSP-18-44-B	2 row, spring	24	30	33	41	83
SC27274PH(Madness)	2 row, winter	24	29	31	39	73
SC21529PH (Newton)	2 row, winter	23	29	30	32	75
Etencil	6 row, winter	23	27	31	33	73
Pixel	6 row, winter	23	29	31	39	71
Memento	2 row, winter	23	29	30	33	65
SC56325QH	2 row, winter	25	29	31	49	83
SC15643QH	2 row, winter	25	29	29	32	65
IDILIC	2 row, winter	24	29	30	39	71
943PH (Pulco)	6 row, winter	24	29	31	32	71
COCCINEL	6 row, winter	23	29	30	39	71
Visuel	6 row, winter	23	29	31	33	65

Table 2. Disease severity (% Plot) on 30 July GS32.

	SFNB		NFNB		Scald	
Variety	% Plot		% Plot		% Plot	
RGT Planet	0.7	-	2.3	-	0.0	-
AGTB0213	0.2	-	0.4	-	0.0	-
AGTB0245	1.3	-	2.8	-	1.7	-
WI4592	0.3	-	0.8	-	0.0	-
Laureate	0.7	-	0.3	-	0.0	-
Sanette	0.5	-	1.5	-	0.0	-
Traveler	0.1	-	0.7	-	0.3	-
GSP-17-27-B	0.5	-	0.8	-	0.0	-
GSP-18-44-B	0.3	-	2.2	-	0.3	-
SC27274PH(Madness)	0.2	-	0.4	-	0.2	-
SC21529PH (Newton)	0.2	-	0.0	-	0.0	-
Etencil	0.0	-	0.7	-	0.2	-
Pixel	0.0	-	0.3	-	0.3	-
Memento	0.2	-	0.0	-	0.0	-
SC56325QH	0.2	-	0.3	-	0.0	-
SC15643QH	0.3	-	0.2	-	0.2	-
IDILIC	0.0	-	0.2	-	0.0	-
943PH (Pulco)	0.0	-	0.0	-	0.0	-

COCCINEL	0.0	-	0.0	-	0.0	-
Visuel	0.0	-	0.2	-	0.0	-
Mean	0.28		0.71		0.16	
LSD	1.13		2.26		1.15	
P Val	0.728		0.342		0.551	

Table 3. Details of the management levels (kg, g, ml/ha).

Sowing date:		**26-April**
Seed Rate:		200 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:		Nil
Nitrogen:	23 June	69 N kg/ha
	7 August	69 N kg/ha
PGR:		Nil
Fungicide:		Nil

Trial 2. HYC Elite Screen

Objective: To examine the yield potential of new winter and spring germplasm grown under HYC Management packages against spring and winter controls in the traditional late April/early May sowing window.

Key messages:

- Similar yields were achieved between the highest yielding spring and winter cultivars despite flowering a month apart and at a more optimum time for Gnarwarre. We postulate higher yields were not achieved from later flowering due to a combination of reduced light in October limiting potential yield (biomass) and increased incidence of lodging in the winter cultivars.
- The highest yielding spring cultivar was the quick spring cultivar control Rosalind at 8.33t/ha, while RGT Planet yielded 7.88t/ha.
- The highest yielding 2 row and 6 row winter barley was Newton at 8.37/ha and Pixel 8.48t/ha respectively (shaded green in table below).
- Proteins were in the range for malting however test weights were low particularly in the six row winter cultivars consistent with other sites. Test weights ranged from 63.6 – 68.0 in spring cultivars, and 55.8 – 67.4 in winter cultivars.

Treatments: (24 elite lines tested under HYC High input management (full foliar fungicide program (Systiva & 3 foliar fungicides – GS31, GS39 & GS61) and PGR management – split application Moddus 200ml @ GS30 - GS32.

Table 1. Grain yield of the variety evaluation trial (t/ha, % site mean), (shaded cultivars are winter).

	Grain Yield	
Variety	Yield	Site Mean

	(t/ha)		(%)	
RGT Planet	7.88	a-f	103.3	a-f
Rosalind	8.33	abc	109.3	abc
Cassiopee	8.33	abc	109.2	abc
Baudin	6.20	h	81.2	h
AGTB0213	7.55	d-g	99.0	d-g
AGTB0245	8.16	a-e	107.0	a-e
HV8 Nitro	7.28	fg	95.4	fg
WI4592	7.04	g	92.3	g
Laureate	7.72	b-g	101.3	b-g
Sanette	8.06	a-e	105.7	a-e
Traveler	7.51	efg	98.5	efg
GSP-17-27-B	8.25	a-d	108.1	a-d
GSP-18-44-B	7.99	a-f	104.7	a-f
Operette #	7.10	g	93.1	g
SC27274PH(Madness)	8.37	ab	109.8	ab
SC21529PH (Newton)	7.83	a-f	102.7	a-f
Etencil	7.72	b-g	101.2	b-g
Pixel	8.48	a	111.2	a
Memento	8.07	a-e	105.8	a-e
SC56325QH	7.45	efg	97.6	efg
IDILIC	7.65	c-g	100.2	c-g
943PH (Pulco)	7.09	g	92.9	g
COCCINEL	5.30	i	69.5	i
Urambie	7.70	b-g	100.9	b-g
Mean	7.63		100.0	
LSD 0.05	0.72		9.4	
P Val	<0.001		<0.001	

Table 2. Grain quality results of the variety evaluation trial (shaded cultivars are winter).

	Grain Quality							
Variety	Protein		Test wt		Retention		Screenings	
	%		kg/HL		%		%	
RGT Planet	11.1	c-h	65.7	c-f	93.1	abc	1.7	de
Rosalind	11.5	b-f	66.5	bcd	88.5	a-e	2.8	b-e
Cassiopee	12.2	a	67.4	ab	94.2	ab	1.4	de
Baudin	12.0	ab	65.0	e-h	84.7	def	4.2	bc
AGTB0213	10.9	e-h	68.2	a	92.4	abc	2.2	cde
AGTB0245	10.6	ghi	63.6	ijk	87.4	b-e	3.2	b-e
HV8 Nitro	11.7	abc	67.4	ab	90.5	a-d	2.5	cde
WI4592	11.8	abc	68.0	a	90.9	a-d	2.1	cde
Laureate	10.9	d-h	63.5	jk	88.0	a-e	3.3	b-e
Sanette	10.0	i	64.2	g-k	89.5	a-e	2.5	cde
Traveler	11.7	abc	65.5	d-g	94.7	a	1.3	e
GSP-17-27-B	11.4	b-f	65.0	e-i	90.5	a-d	2.7	b-e
GSP-18-44-B	10.8	fgh	66.2	b-e	89.4	a-e	2.5	cde
Operette #	11.4	b-f	66.6	bcd	88.2	a-e	3.3	b-e
SC27274PH(Madness)	11.3	b-g	66.9	abc	79.9	fg	2.6	cde
SC21529PH (Newton)	11.6	a-d	63.9	h-k	86.0	c-f	2.1	cde
Etencil	10.8	fgh	63.2	k	75.3	g	4.9	b
Pixel	10.5	hi	61.0	l	72.9	g	3.7	bcd

Memento	11.6	a-e	67.1	ab	84.0	def	2.3	cde
SC56325QH	12.0	ab	65.6	c-f	90.2	a-d	2.2	cde
IDILIC	11.6	a-e	65.0	e-h	85.0	def	3.0	b-e
943PH (Pulco)	10.8	fgh	63.7	h-k	89.9	a-d	2.0	cde
COCCINEL	11.1	c-h	55.8	m	55.8	h	11.2	a
Urambie	11.8	abc	64.8	f-j	82.7	ef	3.4	b-e
Mean	11.3		65.0		86.0		3.1	
LSD 0.05	0.8		1.4		7.1		2.3	
P Val	<0.001		<0.001		<0.001		<0.001	

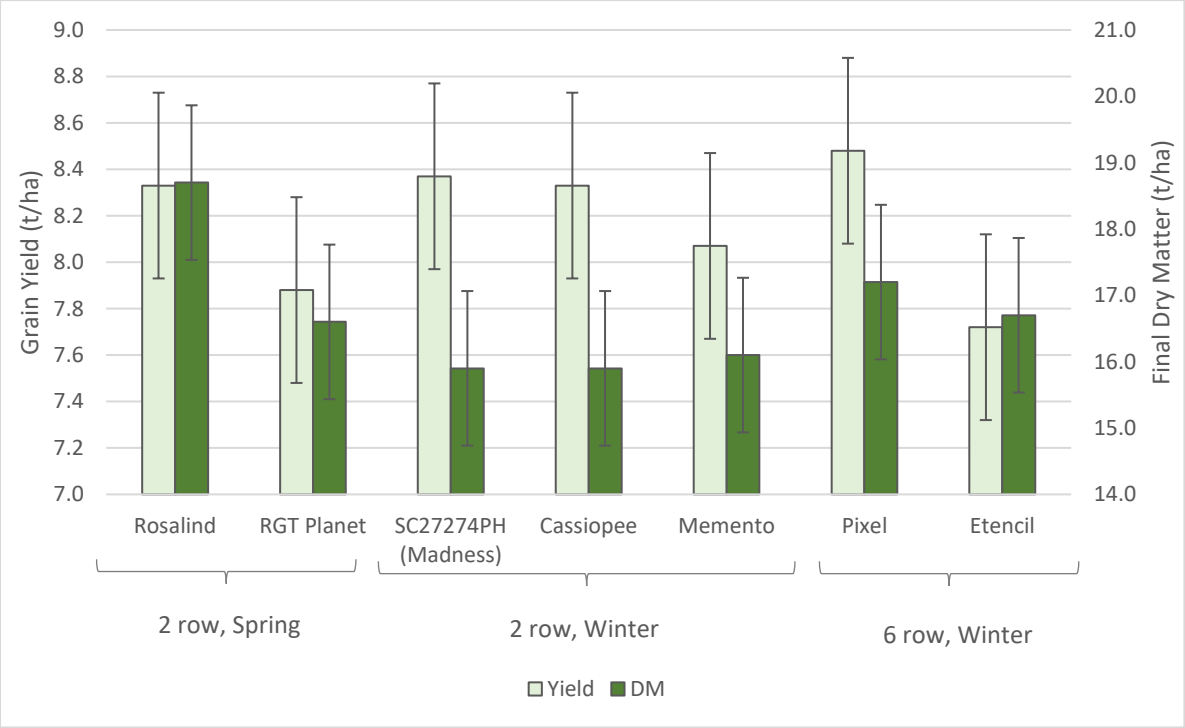

Figure 1. Final dry matter production (t/ha) and grain yield (t/ha) across two row spring barley, two row winter barley and six row winter barley examples.

Table 2. Details of the management levels (kg, g, ml/ha).

Sowing date:		**25-April**
Seed Rate:		200 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:		Nil
Nitrogen:	23 June	69 N kg/ha
	7 August	69 N kg/ha
PGR:	GS30	Moddus Evo 200ml/ha
	GS37	Moddus Evo 200ml/ha
Fungicide:	GS00	Systiva
	GS31	Prosaro 300ml/ha
	GS39	Radial 840ml/ha
	GS59-61	Prosaro 300ml/ha

PGR and fungicide inputs applied across various dates to target the correct phenology for individual varieties.

Trial 3. HYC G.E.M Trial series

Objective: To assess the performance of winter and spring barley germplasm managed under four different management intensities (mid-April to early May sown) at two levels of fungicides.

Key Points:

- In a season with a wetter than average growing season and timely rainfall, the fast-developing spring barley Rosalind significantly out yielded RGT Planet (7.80t/ha) and the slower-developing winter barley Cassiopee (7.70t/ha).
- There were significant visual differences in disease protection between the standard and high fungicide inputs which translated to yield increases of 0.93t/ha in the most susceptible cultivar RGT Planet and 0.49t/ha in Rosalind respectively. This means they require a more robust fungicide strategy whereas cultivars with improved resistance such as Cassiopee achieved similar yields with the standard management.
- Extra N increased yields but only when significant canopy management was adopted, however the management strategy depended on cultivar. When extra N was applied the plant growth regulator intervention increased yield by 0.9t/ha in the winter cultivar Cassiopee but not in other cultivars RGT Planet and Rosalind. RGT Planet and Rosalind benefited from defoliation and both yielded 0.7t/ha higher when defoliated an extra N was applied where as Cassiopee did not benefit from defoliation.
- Defoliation was more effective at reducing lodging than the PGR strategy in all cultivars.
- These results highlight the importance of canopy management to improve the crop structure in the higher rainfall zone to maximize the yield and benefit of inputs such as fungicide and nitrogen.

Treatments: Lever 1 – Level of fungicide inputs x Lever 2 – Canopy Control and additional N (to service 25% higher yield potential) x Lever 3 – Germplasm

Table 1. Influence of fungicide management strategy, variety and canopy management regime on grain yield (t/ha).

	RGT Planet		***Cassiopee***		***Rosalind***		***Mean***	
Variety	8.23	a	7.70	b	7.80	b	**7.91**	
		LSD	***0.25***			***P Value***	***<0.001***	
Fungicide Management								
Standard Fungicide Management	7.77	bc	7.66	c	7.56	c	**7.66**	**b**
High Input Fungicide management	8.70	a	7.74	bc	8.05	b	**8.16**	**a**
Fungicide Management		***LSD***	***0.26***			***P Value***	***0.009***	
Fungicide Mgmt x Variety		***LSD***	***0.35***			***P Value***	***0.005***	
Canopy Management Regime								
No Intervention	7.99	bcd	7.48	e	7.36	e	**7.61**	**b**
No Intervention + Nitrogen	8.10	b	7.52	de	7.58	cde	**7.73**	**b**
Defoliation + Nitrogen	8.70	a	7.37	e	8.24	ab	**8.10**	**a**
PGR + Nitrogen	8.15	b	8.42	ab	8.04	bc	**8.20**	**a**
Canopy Management Regime		***LSD***	***0.27***			***P Value***	***<0.001***	
Variety x Canopy Mgmt Regime		***LSD***	***0.50***			***P Value***	***0.002***	

Fungicide Mgmt. x Canopy Mgmt. Regime								
Standard Fungicide Management								
No Intervention	7.41	-	7.50	-	7.14	-	**7.35**	-
No Intervention + Nitrogen	7.64	-	7.43	-	7.22	-	**7.43**	-
Defoliation + Nitrogen	8.28	-	7.27	-	7.98	-	**7.84**	-
PGR + Nitrogen	7.75	-	8.45	-	7.90	-	**8.03**	-
High Input Management								
No Intervention	8.57	-	7.47	-	7.58	-	**7.87**	-
No Intervention + Nitrogen	8.56	-	7.62	-	7.93	-	**8.03**	-
Defoliation + Nitrogen	9.12	-	7.47	-	8.50	-	**8.36**	-
PGR + Nitrogen	8.54	-	8.40	-	8.18	-	**8.37**	-
Fungicide Mgmt x Canopy Mgmt			***LSD***	***ns***			***P Value***	***0.778***
Fungicide Mgmt x Canopy Mgmt x Variety			***LSD***	***ns***			***P Value***	***0.985***

"Defoliation" – simulated grazing using mechanical defoliation at GS30.

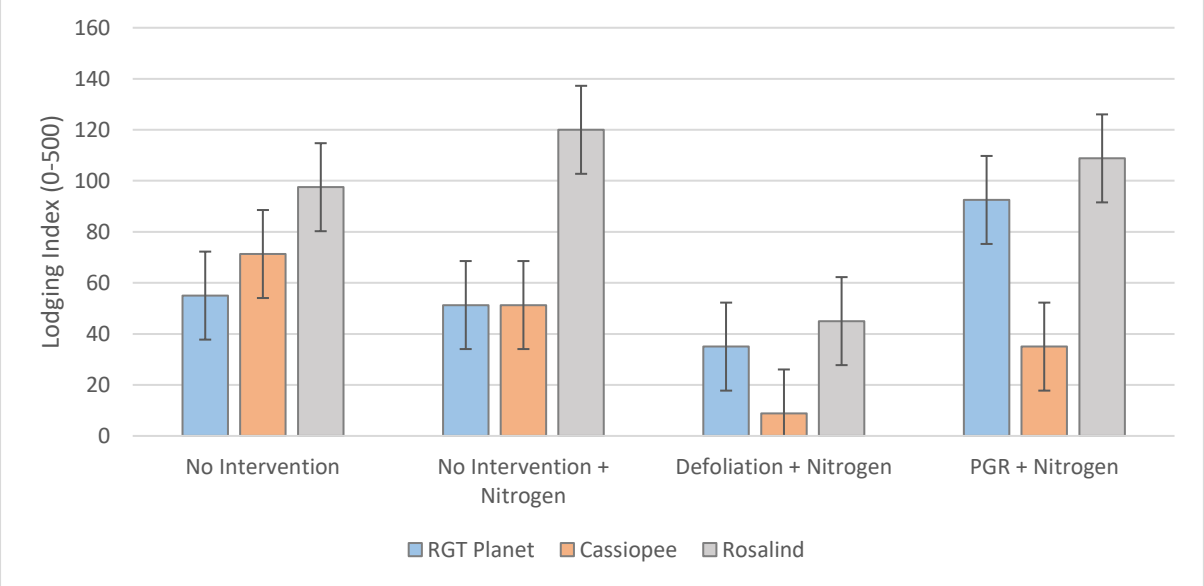

Figure 1. Lodging Index scores (0-500) derived from a severity score (0-5) multiplied by plot area affected (%), assessed at crop maturity (GS99) under the standard management level (the error bars represent the LSD).

Table 2. Details of the management levels (kg, g, ml/ha).

Sowing date:		**25-April**			
Seed Rate:		200 seeds/m^2			
Sowing Fertiliser:		100kg/ha MAP			
Seed Treatment		Vibrance & Gaucho ± per treatment list			
		Standard (Nil)	**Standard + Nitrogen**	**Graze GS30 + Nitrogen**	**PGR GS30-32 + Nitrogen**
Grazed:		----	---	✓	---
Seed treatment:		Rancona Dimension/ Gaucho			
Nitrogen:	23 June	69 kg N/ha	86 kg N/ha	86 kg N/ha	86 kg N/ha
	7 August	69 kg N/ha	86 kg N/ha	86 kg N/ha	86 kg N/ha
Total N (With 10N at sowing)		**148 Kg N/ha**	**183 Kg N/ha**	**183 Kg N/ha**	**183 Kg N/ha**

PGR:	GS30-32	----	----	----	Moddus Evo. 200ml
	GS37	----	----	----	Moddus Evo. 200ml
Fungicide:					
Standard Management		GS31 Tilt 500ml fb GS39 Prosaro 300ml			
High Input Management		Systiva, GS31 Radial 840ml fb GS39 Aviator Xpro 500ml			

Trial 4. HYC Disease Management germplasm interaction

Objective: To develop profitable and sustainable approaches to disease management in HRZ barley.

Key Points:

- The fungicide treatments were effective in reducing the incidence of foliar disease (namely Scald and Net From Net Blotch), prolonging green leaf area and significantly increasing yield at this site in 2020.
- In two susceptible cultivars a single spray application of Prosaro at GS31 increased grain yield on average by 0.62t/ha and shifting to a two-spray strategy with the addition of Radial at GS39-49 increased yield by 1.5t/ha. The addition of the seed treatment Systiva at sowing to this treatment did not further reduce disease infection levels or increase grain yield. These results highlight the later follow up application is likely to be more effective and important than fungicide usage prior to GS31.
- The yield responses observed from the two foliar spray strategies are correlated to both a reduction in Scald and Net Form Net Blotch but also an increase in green leaf area.
- Grain quality responses were significant, noticeably the later fungicide application increased test weight by 2kg/hL in RGT Planet.
- The benefits of maintaining a green leaf during grain fill are influencing grain quality in malting barley consistently across the high rainfall zone and even in the absence of a yield response should not be overlooked.

Treatments: 4 fungicide management levels applied to 2 varieties

Table 3. Influence of management strategy and variety of barley grain yield (t/ha).

Treatment			**RGT Planet**	**HV8 Nitro**	**Mean**
GS00	**GS31**	**GS39-49**	Yield (t/ha)	Yield (t/ha)	Yield (t/ha)
---	---	---	5.88 -	5.90 -	**5.89 c**
---	Prosaro 300ml/ha	---	6.78 -	6.23 -	**6.51 b**
---	Prosaro 300ml/ha	Radial 840ml/ha	7.71 -	7.08 -	**7.39 a**
Systiva	Prosaro 300ml/ha	Radial 840ml/ha	7.71 -	7.19 -	**7.45 a**
Mean			**7.02 a**	**6.60 b**	**6.81**
LSD Variety P=0.05			0.45	P val	<0.001
LSD Fungicide P=0.05			0.18	P val	<0.001
LSD Variety x Fungicide P=0.05			ns	P val	0.057
CV			3.46		

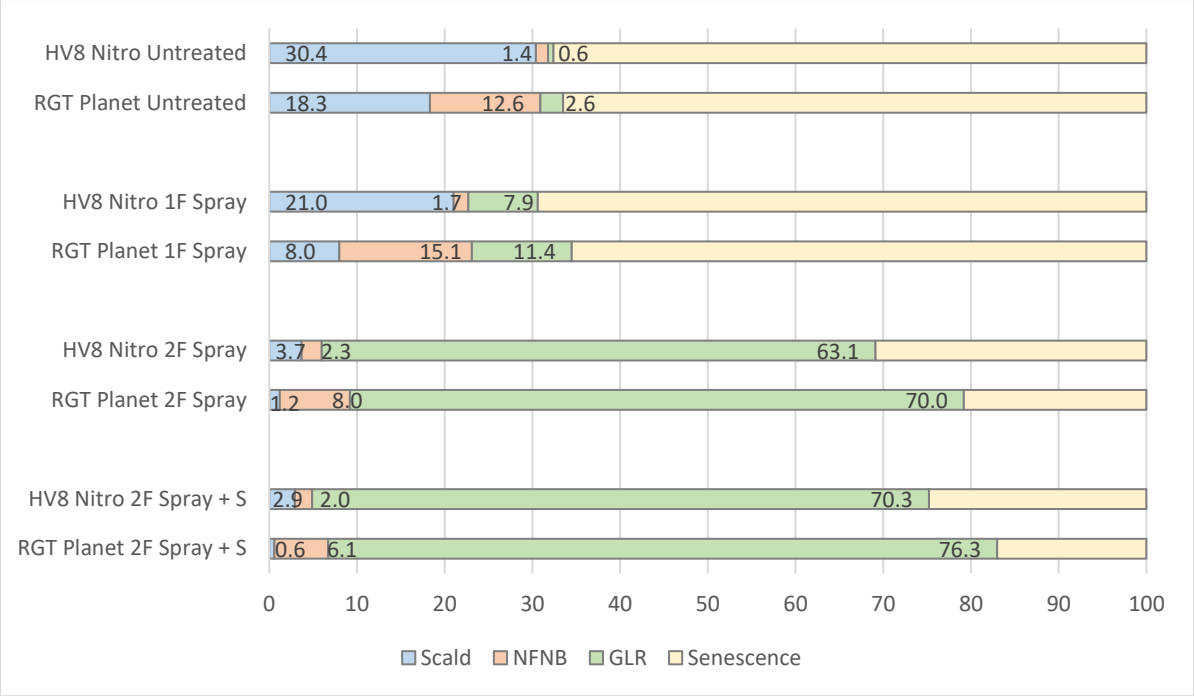

Figure 1. Disease severity, green leaf retention (GLR) and senescence of the flag-1 leaf, assessed 23 October, GS77.

Table 2. Influence of management strategy and variety on grain quality, protein (%), test weight (kg/HL) and screenings (%).

Treatment				Protein		Test Weight		Retention		Screenings	
	GS00	GS31	GS39-49	%		kg/hl		%		%	
RGT Planet	---	---	---	11.4	cd	65.1	d	87.5	c	3.2	a
RGT Planet	---	Prosaro 300ml/ha	---	10.8	d	66.0	cd	91.2	b	2.1	b
RGT Planet	---	Prosaro 300ml/ha	Radial 840ml/ha	10.9	d	67.1	bc	94.6	a	1.4	b
RGT Planet	Systiva	Prosaro 300ml/ha	Radial 840ml/ha	11.3	cd	67.6	b	94.9	a	1.3	b
Mean				**11.1**	**b**	**66.4**	**b**	**92.1**	**a**	**2.0**	**b**
HV8 Nitro	---	---	---	12.2	ab	67.1	bc	85.6	c	4.0	a
HV8 Nitro	---	Prosaro 300ml/ha	---	12.4	a	67.7	b	87.8	c	3.4	a
HV8 Nitro	---	Prosaro 300ml/ha	Radial 840ml/ha	11.9	abc	69.9	a	93.2	ab	1.7	b
HV8 Nitro	Systiva	Prosaro 300ml/ha	Radial 840ml/ha	11.6	bc	69.9	a	94.5	a	1.4	b
Mean				**12.0**	**a**	**68.6**	**a**	**90.3**	**b**	**2.6**	**a**
			Grand Mean	11.6		67.5		91.2		2.3	
			LSD (p=0.05)	0.6		1.2		3.2		0.9	
			P Val	<0.001		<0.001		<0.001		<0.001	

Table 3. Details of the management levels (kg, g, ml/ha).

Varieties:		**HV8 Nitro & RGT Planet**
Sowing date:		**25-April**
Seed Rate:		200 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho ± per treatment list
Grazing:		Nil
Nitrogen:	23 June	69 N kg/ha
	7 August	69 N kg/ha
Fungicide:		As per treatment list

Trial 5. HYC PGR x harvest date interaction

Objective: To assess the value of PGRs with delayed harvest in HRZ regions

Key Points

- RGT Planet achieved a grain yield of 8.3 t/ha significantly higher than the winter cultivar Cassiopee at 8.0 t/ha when harvested on time.
- Untreated (without PGR) and harvested on time achieved an average yield of 7.89t/ha and delaying harvest by three weeks yielded 0.47t/ha less at 7.42t/ha due to headloss. PGR's increased yield on average irrespective of harvest date and enable growers more time to manage harvest logistics with limited downside risk. The two-spray strategy of a PGR at G31 followed by a second application at GS37 – 49 yielded significantly higher at 8.32t/ha when harvested on time, and did not suffer a yield penalty when harvest three weeks later.
- Irrespective of harvest date the PGR had the largest effect in Cassiopee and the use of a single PGR at GS31 increased yield by 0.5t/ha compared to untreated. This application benefit was primarily due to reducing lodging, the addition of a second application at GS37 did not further increase yield, however when the GS31 application was combined with a later application at GS49 yield increased 1.45t/ha due to the added head loss control.
- There wasn't any significant yield difference across all treatments in RGT Planet relative to the untreated control. While there was consistently 5 – 10 heads/m2 on the ground from delaying harvest in RGT Planet, these were not enough to influence yield.
- The pressure on head loss was less at this site in 2020 compared to other hyper yielding centers highlights under moderate head loss pressure RGT planet is unlikely to benefit from PGR applications while winter cultivars will require them.
- These results require further validation in 2021 but have demonstrated there is little downside risk with the use of PGRs in the higher rainfall zone. This works well for farm logistics and the timings of a PGR application at GS31 and later application could also be combined with the most effective fungicide timings.

Treatments: 4 PGR management approaches applied to two cultivars, to be harvested at two harvest dates.

Table 1. Influence of harvest date, variety and canopy management regime on grain yield (t/ha).

		RGT Planet		Cassiopee		Mean	
Variety		8.51	-	7.75	-	**8.13**	
	LSD		***ns***	***P-Value***		***0.076***	
Canopy Management Regime							
Untreated		8.36	a	6.95	c	**7.65**	**c**
GS31 PGR		8.55	a	7.73	b	**8.14**	**b**
GS31 + GS37 PGR		8.65	a	7.94	b	**8.29**	**ab**
GS31 + GS49 PGR (Europe style)		8.47	a	8.39	a	**8.43**	**a**
Canopy Management Regime	***LSD***		***0.24***	***P-Value***		***<0.001***	
Variety x Canopy Mgmt Regime	***LSD***		***0.33***	***P-Value***		***<0.001***	
Harvest Date. x Canopy Mgmt. Regime							
On Time							
Untreated		8.19	-	7.58	-	**7.89**	**c**
GS31 PGR		8.35	-	7.86	-	**8.10**	**bc**
GS31 + GS37 PGR		8.46	-	8.17	-	**8.31**	**ab**
GS31 + GS49 PGR (Europe style)		8.26	-	8.41	-	**8.33**	**ab**
Delayed 3 weeks							
Untreated		8.53	-	6.32	-	**7.42**	**d**
GS31 PGR		8.76	-	7.60	-	**8.18**	**bc**
GS31 + GS37 PGR		8.84	-	7.72	-	**8.28**	**ab**
GS31 + GS49 PGR (Europe style)		8.68	-	8.38	-	**8.53**	**a**
Harvest Date x Canopy Mgmt	***LSD***		***0.33***	***P-Value***		***0.040***	
Harvest Date x Canopy Mgmt x Variety	***LSD***		***ns***	***P Value***		***0.100***	

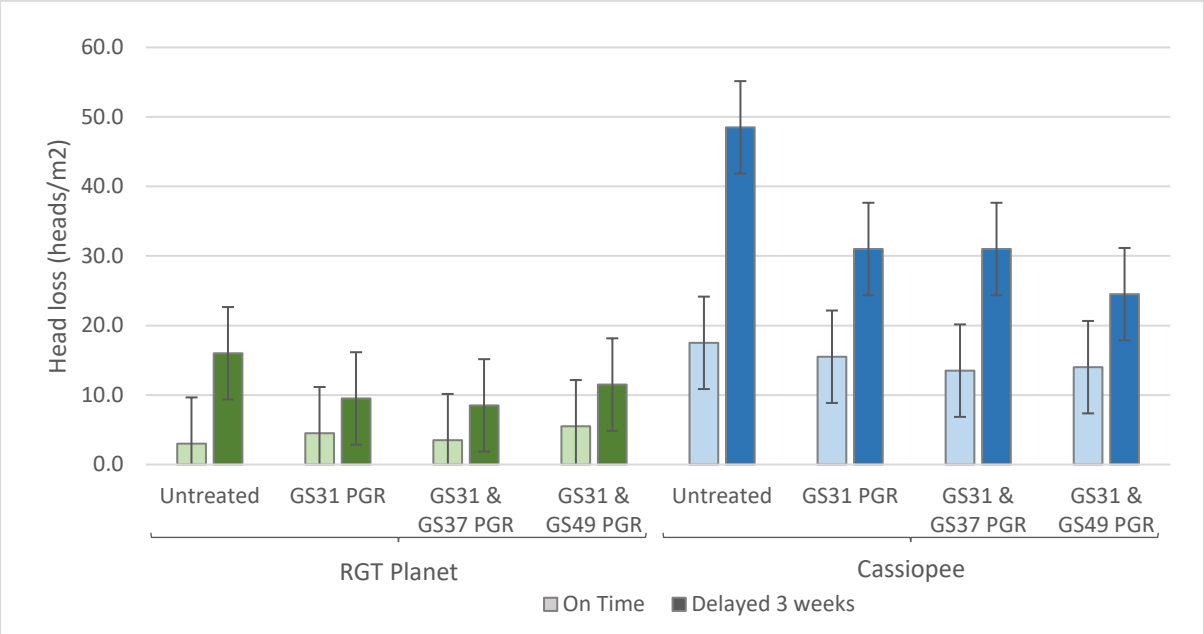

Figure 1. Variety, PGR management and harvest date influence on head loss (heads/m^2).

Table 2. Details of the management levels (kg, g, ml/ha).

Varieties:		**Cassiopee & RGT Planet**
Sowing date:		**25-April**
Seed Rate:		200 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:		Nil
PGR:		As per treatment list
Nitrogen:	23 June	69 N kg/ha
	7 August	69 N kg/ha
Fungicide:	17 August	Prosaro 300ml/ha
	29 September	Radial 840ml/ha
	28 October	Prosaro 300ml/ha

Trial 6: Nutrition for Hyper Yielding Barley

Objectives: To assess the value of higher nutrition input for barley

Individual objectives specific to the trial are:

- Assess whether growers are currently under fertilizing barley crops in the region and N requirements required to reach target yields of 10 – 12 within each region.

Key Points:

- A mean yield of 7.25 t/ha was achieved across the experiment and proteins were greater than 10.5% and within malt barley specification.
- There wasn't any additional yield benefit from and extra 25% and 50% N combined when applied either with or without the additional P and S fertilizer compared to the farmer applied nutrition which totaled 148kg N/ha
- The aspirational N treatment of an additional 35 units of N increased grain protein by ~1.7 % compared to the current practice.
- These results are consistent with other experiments across the high rainfall zones, were limited responses to applied N fertilization are measurable when application rates exceed 150 units of N.

Treatments: Five nutrition treatments

Table 1. Detailed treatment list, grain yield (t/ha) & % Site Mean.

Trt.		**Nitrogen rate**	**Phosphorus rate**	**Sulphur rate**	**Yield**	**Mean**
		kg N/ha	**kg P/ha**	**kg S/ha**	**(t/ha)**	**(%)**
1	Current Practice	148	22	---	7.06 -	97.3
2	Current Practice +25% N	183	22	---	7.27 -	100.2
3	Current Practice +25%NPKS	183	22	30	7.41 -	102.1
4	Aspirational N	217	22	---	7.08 -	97.7
5	Aspirational NPKS	217	22	45	7.45 -	102.7
				Mean	**7.25**	**100.0**
				LSD (p=0.05)	**ns**	**ns**
				P Val	**0.305**	**0.305**

NOTE: MAP was applied at a rate of 100kg/ha

Table 2. Influence of nitrogen rate on grain quality, protein (%), test weight (kg/HL) and screenings (%).

	Nitrogen rate	Phosphorus rate	Sulphur rate	Protein	Test weight	Retention	Screenings
Trt.	**kg N/ha**	**kg P/ha**	**kg S/ha**	**(%)**	**(kg/HL)**	**(%)**	**(%)**
1	148	22	---	10.1 b	66.9 -	96.0 a	1.2 c
2	183	22	---	11.8 a	66.2 -	92.6 bc	2.1 ab
3	183	22	30	12.0 a	66.7 -	93.1 b	2.0 ab
4	217	22	---	12.3 a	66.6 -	91.0 c	2.6 a
5	217	22	45	11.9 a	67.2 -	94.0 b	1.5 bc
			Mean	11.6	66.7	93.3	1.9
			LSD (p=0.05)	0.8	ns	1.8	0.7
			P Val	0.001	0.344	<0.001	0.010

Table 3. Details of the management levels (kg, g, ml/ha).

Variety:		**RGT Planet**
Sowing date:		**25-April**
Seed Rate:		200 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:		Nil
Nitrogen:	23 June	Farm standard 69 N kg/ha ± per treatment list
	7 August	Farm standard 69 N kg/ha ± per treatment list
Fungicide:	17 August	Prosaro 300ml/ha
	29 September	Radial 840ml/ha
	28 October	Prosaro 300ml/ha

Trial 7: Novel management strategies to reset barley development

Objective: Are we better to increase seeding rate and reset phenology in faster spring Barley sown early to capitalize on root growth, greater carbohydrate reserve, and initiate more tillers rather than utilise current winter germplasm options sown early in the HRZ? Is spring barley more sensitive to changes in plant density than winter barley?

Key Points:

- Similar yields were achieved at low and higher plant densities. While defoliation reduced yield on average by 0.3t/ha.
- Defoliation at GS32 in Rosalind corresponded to a defoliation date of GS31 in RGT Planet and mid tillering in the winter cultivar Cassiopee.
- RGT Planet suffered a 0.66t/ha yield penalty with defoliation, and Cassiopee yielded similar to the control.
- Despite the later than recommended defoliation date in Rosalind there was no significant reduction in yield and crop development was delayed. In other experiments Rosalind has responded well to this treatment and in frostier environments or in years where light conditions were more favorable in October it may be possible to increase yield with this strategy

Treatments: 2 Plant densities x 3 cultivars x 2 reset manipulation treatments

Table 1. Influence of plant population, variety and phenology resetting (defoliation) on grain yield (t/ha).

	RGT Planet		***Cassiopee***		***Rosalind***		***Mean***	
Variety	7.55	a	7.15	b	7.05	b	**7.25**	
		LSD	***0.39***			***P Value***	***0.038***	
Plant Population								
150 plants/m²	7.62	-	7.09	-	7.17	-	**7.29**	-
300 plants/m²	7.48	-	7.22	-	6.93	-	**7.21**	-
Plant Population		***LSD***	***ns***			***P Value***	***0.078***	
Plant Population x Variety		***LSD***	***ns***			***P Value***	***0.565***	
Defoliation								
Untreated	7.88	a	7.01	b	7.31	b	**7.40**	**a**
Defoliated when Rosalind reached GS32	7.22	b	7.09	b	7.00	b	**7.10**	**b**
Defoliation		***LSD***	***0.22***			***P Value***	***0.010***	
Variety x Defoliation		***LSD***	***0.38***			***P Value***	***0.033***	
Plant Population x Defoliation								
150 plants/m²								
Untreated	7.77	-	7.29	-	7.04	-	**7.37**	-
Defoliated when Rosalind reached GS32	7.46	-	6.88	-	7.30	-	**7.21**	-
300 plants/m²								
Untreated	7.98	-	7.32	-	6.99	-	**7.43**	-
Defoliated when Rosalind reached GS32	6.98	-	7.12	-	6.87	-	**6.99**	-
Plant Population x Defoliation		***LSD***	***ns***			***P Value***	***0.180***	
Plant Population x Defoliation x Variety		***LSD***	***ns***			***P Value***	***0.232***	

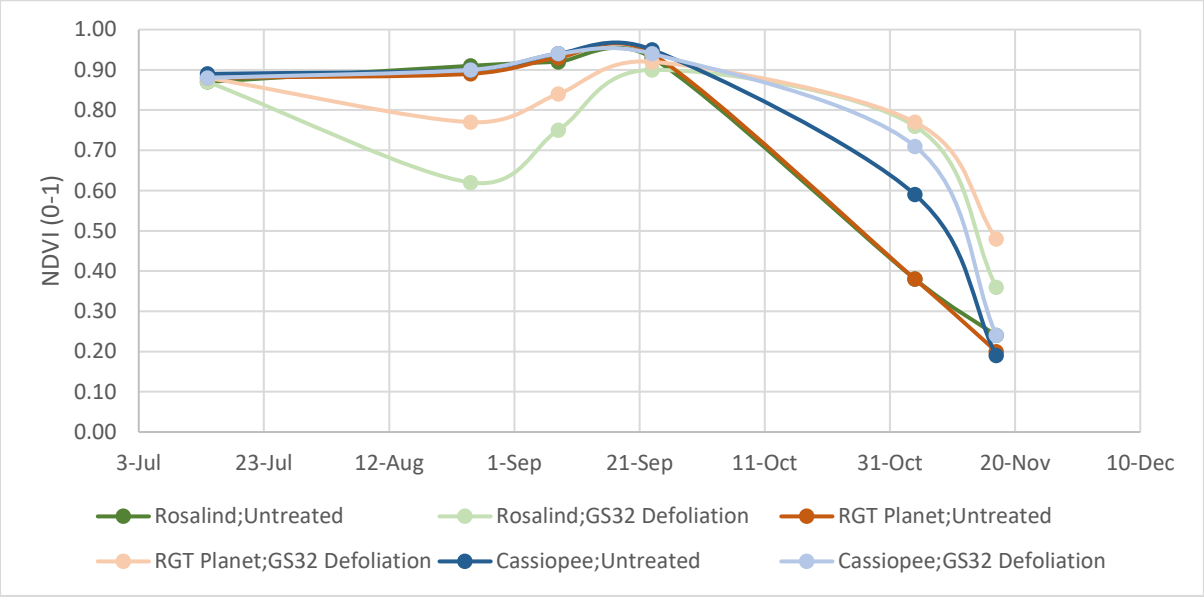

Figure 1. NDVI readings for Rosalind, RGT Planet and Cassiopee at both untreated and defoliated managements sown at 300 seeds/m^2.

Table 2. Details of the management levels (kg, g, ml/ha).

Varieties:		**Cassiopee, RGT Planet & Rosalind**
Sowing date:		**25-April**
Seed Rate:		As per treatment list
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:	28 July	Grazed when Rosalind reached GS32
Nitrogen:	23 June	69 N kg/ha
	7 August	69 N kg/ha
Fungicide:	17 August	Prosaro 300ml/ha
	29 September	Radial 840ml/ha
	28 October	Prosaro 300ml/ha

2020 WA Crop Technology Centre (Albany)
Green Range, Western Australia

Sown: 1-2 May 2020
Harvested: 26 November 2020 (Nutrition, Novel Management, Disease, G.E.M, PGR H.D-1)
17 December 2020 (Elite Screen, PGR H.D-12)

Rotation position: 1st cereal after canola, 2018 pasture, 2017 barley.
Soil type & management: Shallow duplex sand over gravel over clay. Clayed 2017, smudged 2019/20.

Trial 1. HYC 1st Stage Screen

Objective: To examine the phenology, disease resistance and standing power of new barley germplasm established in the traditional late April/early May sowing window relative to current practice.

Key Points:

- New spring introductions offered slower developing alternatives to RGT Planet, while Rosalind was the quickest cultivar
- There was a larger gap in the development speed of spring cultivars and winter cultivars in WA compared to the eastern states.
- The incidence of disease was very low in 2020 at this site and there were minimal differences between cultivars.
- These cultivars were evaluated for yield in stage 2 screen presented below

Treatments: 25 lines sown in small plots (5m in) with standard nitrogen management but no fungicide or no PGR input and not taken to yield

Table 1. Phenology evaluation, Zadoks growth stage recorded at key points in the season (Zadoks GS00-99)

Variety	Type	15 July	26 Aug	29 Sept	28 Oct	10 Nov
RGT Planet	2 row, Spring	31	41-43	75	81	89
Rosalind	2 row, Spring	32	57-65	83	85	89
Cassiopee	2 row, Winter	VE	31	49-55	71	85
Urambie	2 row, Winter	30	41-43	71	81	85
Westminster	2 row, Spring	31	55	77	85	85-87
AGTB0213	2 row, Spring	30	40	71	85	85-87
AGTB0245	2 row, Spring	31	47-49	71	85	85-87
Laperouse	2 row, Spring	31	53-55	73	85	85-87
Bottler	2 row, Spring	31	57	73	85	85-87
Compass	2 row, Spring	31	57	77	81	85-87
Traveler	2 row, Spring	31	49-55	75	79	85-87
GSP-17-27-B	2 row, Spring	VE	30	33	75	77
GSP-18-44-B	2 row, Spring	31	49	75	81	85-87

Operette #	2 row, Spring	30	49	75	81	85-87
SC27274PH (Madness	2 row, Winter	VE	VE	49	71	85
SC21529PH (Newton)	2 row, Winter	VE	VE	33	71	83
Etencil	6 row, Winter	VE	31	49-55	71	85-87
Pixel	6 row, Winter	VE	30-31	47-49	75	87
Operette #	2 row, Spring	VE	VE	33	69	77
Memento	2 row, Winter	VE	30-31	49	71	87-89
Spartacus CL	2 row, Spring	31-32	57-63	7	79	87-89
SC56325QH	2 row, Winter	VE	30	49-51	75	83
Visuel	6 row, Winter	30	41-43	71	75	87-89
HV8 Nitro	2 row, Spring	31-32	57-65	73	85	87-89
Maximus CL (IGB1705T)	2 row, Spring	31-32	55-57	75	81	87-89
IGB1844	2 row, Spring	31	41-43	75	81	89

*VE = Vegetative / Tillering

Table 2. Details of the management levels (kg, g, ml/ha).

Sowing date:		2 May
Seed Rate:		200 seeds/m^2
Sowing Fertiliser:		90kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:		Nil
Nitrogen:	19 May	33.3 kg N/ha
	2 Aug	27.6 kg N/ha
	11 Aug	16.6 kg N/ha
PGR:		Nil
Fungicide:		Nil

Trial 2. HYC Elite Screen

Objective: To examine the yield potential of new winter and spring germplasm grown under HYC Management packages against spring and winter controls in the traditional late April/early May sowing window.

Key Points:

- Spring cultivars were significantly higher yielding than winter cultivars at this site in 2020. This was due to a dry winter and increased heat during grain fill relative to other hyper yielding environments. Fast spring cultivars achieved higher yields by accumulating more biomass and a higher harvest index
- The highest yielding spring cultivar was Laperouse a new release at 4.96t/ha and similar to the quick spring cultivar control Rosalind at 4.83 t/ha, while the other quick – mid control RGT Planet yielded similar at 4.63t/ha.
- The highest yielding winter barley was Urambie at 3.69 t/ha compared to slower developing winters all yielding less than 3t/ha. This suggests faster winter types are required for WA and will require a targeted breeding effort.
- Proteins were in the range for malting however test weights were less than 60 in all winter cultivars particularly in the six row winter cultivars consistent with other sites.

Treatments: (20 elite lines tested under HYC High input management (full foliar fungicide program (Systiva & 2 foliar fungicides – GS31, GS39)

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**	

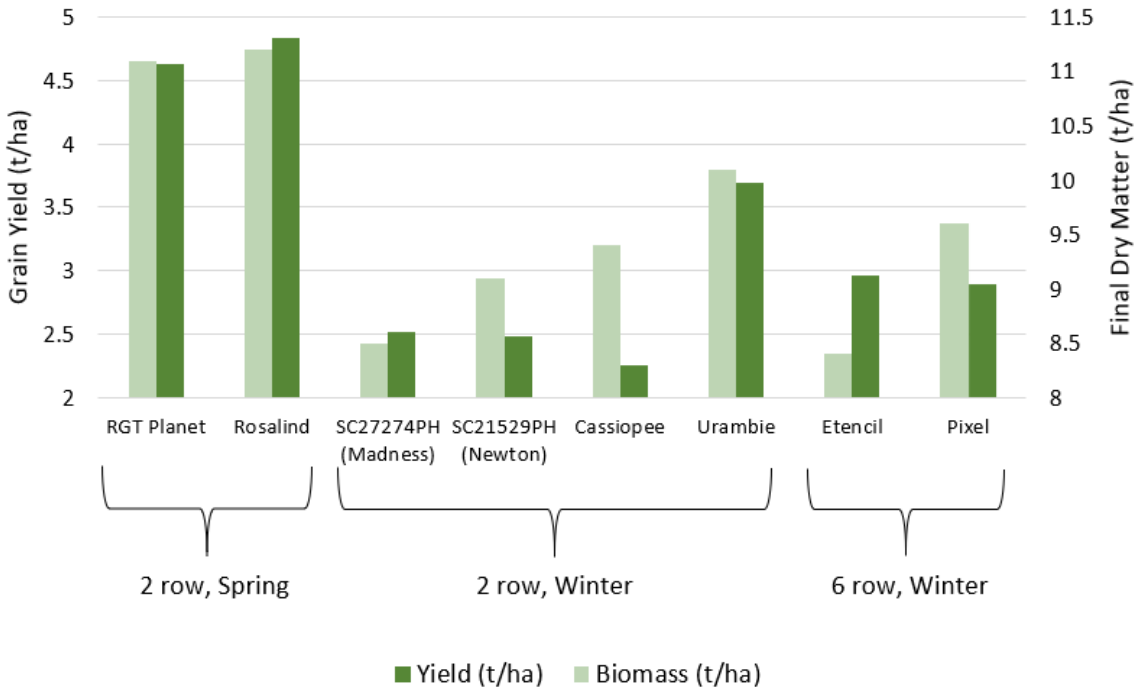

Figure 1. Grain Yield (t/ha) and Biomass (GS89) (t/ha) on selected 2, 6 row Winter, 2 row Spring cultivars.

Trial 3. HYC G.E.M Trial series

Objective: To assess the performance of winter and spring barley germplasm managed under four different management intensities (mid-April to early May sown) at two levels of fungicides.

Treatments: Lever 1 – Level of fungicide inputs x Lever 2 – Canopy Control and additional N (to service 25% higher yield potential) x Lever 3 - Germplasm

Key Results:

- With a decile 1 start (sowing – early August), barley following canola exceeded 6 t/ha with the fast-developing spring cultivar Rosalind significantly higher yielding than RGT Planet (6.5 v 6.0 t/ha) and the slower developing winter cultivar Cassiopee (3.77 t/ha).
- The highest yields at the site were observed with Rosalind grown under a full fungicide package based on Systiva and two foliar sprays (6.7 t/ha), despite low disease levels at early stem elongation.
- This higher fungicide input increased harvest dry matter and grain yield relative to a cheaper triazole based two spray programme (standard input) when averaged across all cultivars.
- There was no yield benefit of plant growth regulation in the trial.
- Mechanical defoliation at GS30 "simulating grazing" reduced grain yields on average by 0.29 t/ha relative to the ungrazed crop. The yield penalty was greater in the winter cultivar Cassiopee which reached GS30 later in the spring.
- An additional 50kg N/ha had no significant effect on yield irrespective of fungicide, variety, or defoliation.

Key Messages:

- Overall, matching crop development to environment (faster developing spring cultivars were favoured) and fungicide management had the greatest effect on yield at this site in 2020. This was due to greater harvest dry matter and head numbers.
- Canopy management tools including defoliation, additional nitrogen and plant growth regulators did not increase yield, suggesting the effect of environment (dry stem elongation period) had the larger influence on canopy yield development.

Table 1. Influence of fungicide management strategy, variety and canopy management regime on grain yield (t/ha).

	RGT Planet		***Cassiopee***		***Rosalind***		***Mean***	
Variety	5.94	b	3.82	c	6.42	a	**5.39**	
		LSD	**0.15**			**P Value**	**<0.001**	
Fungicide Management								
Standard Fungicide Management	5.77	-	3.68	-	6.22	-	**5.22**	**b**
High Input Fungicide management	6.11	-	3.97	-	6.62	-	**5.56**	**a**
Fungicide Management		**LSD**	**0.28**			**P Value**	**0.031**	
Fungicide Mgmt x Variety		**LSD**	**ns**			**P Value**	**0.758**	
Canopy Management Regime								
No Intervention	5.96	-	4.07	-	6.36	-	**5.46**	**a**
No Intervention + Nitrogen	6.09	-	4.01	-	6.58	-	**5.56**	**a**
Defoliation + Nitrogen	5.83	-	3.52	-	6.33	-	**5.23**	**b**
PGR + Nitrogen	5.89	-	3.7	-	6.4	-	**5.33**	**b**
Canopy Management Regime		**LSD**	**0.11**			**P Value**	**<0.001**	
Variety x Canopy Mgmt Regime		**LSD**	**ns**			**P Value**	**0.237**	

Fungicide Mgmt. x Canopy Mgmt. Regime								
Standard Fungicide Management								
No Intervention	5.66	-	3.95	-	6.23	-	**5.28**	-
No Intervention + Nitrogen	6.11	-	3.84	-	6.30	-	**5.41**	-
Defoliation + Nitrogen	5.67	-	3.39	-	5.98	-	**5.01**	-
PGR + Nitrogen	5.65	-	3.54	-	6.38	-	**5.19**	-
High Input Management								
No Intervention	6.25	-	4.18	-	6.48	-	**5.64**	-
No Intervention + Nitrogen	6.08	-	4.18	-	6.86	-	**5.70**	-
Defoliation + Nitrogen	6.00	-	3.66	-	6.69	-	**5.45**	-
PGR + Nitrogen	6.13	-	3.85	-	6.43	-	**5.47**	-
Fungicide Mgmt x Canopy Mgmt			**LSD 0.16**				**P Value 0.459**	
Fungicide Mgmt x Canopy Mgmt x Variety			**LSD 0.41**				**P Value 0.121**	

"Defoliation" – simulated grazing using mechanical defoliation at GS30.

Table 2. Details of the management levels (kg, g, ml/ha).

Plant pop'n:		200 seeds/m^2			
		Standard (Nil)	**Standard + Nitrogen**	**Graze GS30 + Nitrogen**	**PGR GS30-32 + Nitrogen**
Grazed:		----	---	✓	---
Seed treatment:		Rancona Dimension/ Gaucho			
Basal Fertiliser:	1 May	90Kg MAP	90Kg MAP	90Kg MAP	90Kg MAP
Nitrogen:	19 May	33.3 kg N	33.3 kg N	33.3 kg N	33.3 kg N
	2 August	27.6 kg N	27.6 kg N	27.6 kg N	27.6 kg N
	11 August	16.6 kg N	16.6 kg N	16.6 kg N	16.6 kg N
As per variety reaching GS31			50.0 kg N	50.0 kg N	50.0 kg N
Total N (With 9N at sowing)		**77 Kg N**	**137 Kg N**	**137 Kg N**	**137 Kg N**
PGR:	GS31	----	----	---	Moddus Evo. 200ml
Fungicide:					
Standard Management		GS31 Opus 500ml fb GS39 Prosaro 300ml			
High Input Management		Systiva, GS31 Radial 840ml fb GS39 Aviator Xpro 420ml			

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

**Timings of PGRs and fungicides were adjusted to take account of the differences in spring and winter barley phenology (development).*

Trial 4. HYC Disease Management germplasm interaction

Objective: To develop profitable and sustainable approaches to disease management in HRZ barley.

Key Points:

- There was limited visual disease symptoms at this site in 2020, however a significant yield response to fungicide was measured. Untreated achieved an average yield of 5.51t/ha.
- A single application of Folicur at GS31 increased yield by 0.35t/ha, and an additional application of Opus at GS39 – 49 did not offer any additional yield benefit.
- The treatment combining Systiva seed dressing, Folicur at GS31 and Radial at GS39-49 yielding 0.58t/ha higher than the untreated control but not significantly greater than the single application.
- The benefits of maintaining a green leaf during grain fill even in the absence of significant disease required further investigation.
- Later fungicide timings are consistently influencing grain quality in malting barley across the high rainfall zone and even in the absence of a yield response should not be overlooked.

Treatments: 4 fungicide management levels applied to 2 varieties

Table 4. Influence of management strategy and variety of wheat grain yield (t/ha).

Treatment			**RGT Planet**		**HV8 Nitro**		**Mean**	
GS00	**GS31**	**GS39-49**	Yield (t/ha)		Yield (t/ha)		Yield (t/ha)	
---	---	---	5.54	-	5.48	-	**5.51**	**c**
---	Folicur 290ml/ha	---	5.97	-	5.76	-	**5.86**	**ab**
---	Folicur 290ml/ha	Opus 500ml/ha	5.75	-	5.40	-	**5.57**	**bc**
Systiva	Folicur 290ml/ha	Radial 840ml/ha	6.02	-	6.17	-	**6.09**	**a**
Mean			**5.82**	**-**	**5.70**	**-**	**5.76**	
LSD Variety P=0.05			0.14		***P Value***		0.090	
LSD Fungicide P=0.05			0.32		***P Value***		0.008	
LSD Variety x Fungicide P=0.05			0.28		***P Value***		0.088	
CV			3.18					

Trial 5. HYC PGR x harvest date interaction

Objective: To assess the value of PGRs with delayed harvest in HRZ regions

Key points

- Buff achieved a grain yield of 6.29 t/ha significantly higher than RGT Planet at 5.85 t/ha when harvested on time.
- Harvest logistics and cultivar choice was the major factors influencing yield losses due to a delay in harvest. Buff suffered a 1.83t/ha yield penalty from delaying harvest by 3 weeks, and RGT Planet 1.07t/ha.
- Despite large yield losses to delaying harvest, plant growth regulators (PGRs) applied at all three timings did not offer any yield advantage in both cultivars whether harvested on time or when harvest was delayed. This is important because growers can have confidence in higher head loss risk areas that yield potential is unlikely to be compromised by PGR applications.
- Current recommendations to growers are to ensure timely harvest and to choose cultivars with improved head retention. Yields were lower than expected in 2020 and the additional benefits of PGR application for lodging and brackling control were not observed in this experiment.
- The use of PGRs for head loss control requires further development in 2021 but these and other center results have demonstrated there is little downside risk with the use of PGRs in the higher rainfall zone and a GS31 and later application could be combined with the most effective fungicide timings.

Treatments: 4 PGR management approaches applied to two cultivars and harvested at two harvest dates.

Table 1. Influence of fungicide management strategy, variety and canopy management regime on grain yield (t/ha).

		RGT Planet		***Buff***		***Mean***	
Variety		5.31	-	5.38	-	**5.35**	
	LSD	0.31		***P-Value***		0.475	
Harvest Date							
On time		5.85	b	6.29	a	6.07	a
Delayed 3 weeks		4.78	c	4.46	d	4.62	b
Harvest Date Management	***LSD***	0.18		***P-Value***		<0.001	
Harvest Date x Variety	***LSD***	0.26		***P-Value***		0.004	
Canopy Management Regime							
Untreated		5.08	-	5.37	-	5.23	-
GS31 PGR		5.29	-	5.29	-	5.29	-
GS31 + GS37 PGR		5.49	-	5.47	-	5.48	-
GS31 + GS49 PGR (Europe style)		5.39	-	5.37	-	5.38	-
Canopy Management Regime	***LSD***	0.34		***P-Value***		0.441	
Variety x Canopy Mgmt Regime	***LSD***	0.48		***P-Value***		0.730	
Harvest Date. x Canopy Mgmt. Regime							
On Time							

Untreated		5.46	-	5.95	-	5.70	-
GS31 PGR		5.93	-	6.35	-	6.14	-
GS31 + GS37 PGR		5.99	-	6.68	-	6.34	-
GS31 + GS49 PGR (Europe style)		6.01	-	6.20	-	6.11	-
Delayed 3 weeks							
Untreated		4.70	-	4.79	-	4.75	-
GS31 PGR		4.66	-	4.23	-	4.44	-
GS31 + GS37 PGR		5.00	-	4.27	-	4.63	-
GS31 + GS49 PGR (Europe style)		4.76	-	4.55	-	4.66	-
Harvest Date x Canopy Mgmt	***LSD***	0.48		***P-Value***		0.106	
Harvest Date x Canopy Mgmt x Variety	***LSD***	0.68		***P Value***		0.379	

Trial 6: Nutrition for Hyper Yielding Barley

Objectives: To assess the value of higher nutrition input for barley

Individual objectives specific to the trial are:

- Assess whether growers are currently under fertilizing barley crops in the region and N requirements required to reach target yields of 10 – 12 within each region.

Key Points:

- A mean yield of 4.24t/ha was achieved across the experiment and proteins were greater than 11.4% and outside of malt specifications suggesting N was not limiting in this experiment.
- There wasn't any additional yield benefit from an extra 25% and 50% N combined when applied either with or without the additional P and S fertilizer compared to the farmer applied nutrition which totaled 86kg N/ha
- The aspirational 25% and 50% more N treatments both increased grain protein by 1.1% and 1.9% which indicates the N was taken up but not contributing to yield
- These results are consistent with other experiments across the high rainfall zones, were limited responses to applied N fertilization are measurable when application rates exceed 150 units of N.

Table 1. Detailed treatment list, grain yield (t/ha) & % Site Mean.

Trt.		Nitrogen rate	Yield	Mean
		kg N/ha	(t/ha)	(%)
1	Current Practice	86	4.15 -	97.9
2	Current Practice +25% N	150	4.31 -	101.7
3	Current Practice +25%NPKS	150	4.27 -	100.7
4	Aspirational N	200	4.24 -	100.0
5	Aspirational NPKS	200	4.23 -	99.8
Mean			**4.24**	**100**
LSD (p=0.05)			**0.42**	
P Val			**0.951**	

NOTE: MAP was applied at a rate of 90kg/ha

Table 2. Influence of nitrogen rate on grain quality, protein (%), test weight (kg/HL), screenings (%) and retention (%).

	Nitrogen Rate	Protein	Test weight	Screenings	Retention
Trt.	**Kg N/ha**	**(%)**	**(kg/HL)**	**%**	**(%)**
1	86	11.4 d	69.6 -	2.3 c	86.5 a
2	150	12.5 c	69.1 -	3.6 abc	81.2 abc

3	150	12.7	bc	69.1 -	5.1	ab	75.9 bc
4	200	13.3	a	69.6 -	3.5	bc	82.8 ab
5	200	13.0	ab	68.9 -	6.0	a	73.7 c
Mean		**12.6**		**69.3**	**4.1**		**80.0**
LSD (p=0.05)		**0.4**		**0.8**	**2.4**		**8.1**
P Val		**<0.001**		**0.333**	**0.045**		**0.028**

Trial 7: Novel management strategies to reset barley development

Objective: Are we better to increase seeding rate and reset phenology in faster spring Barley sown early to capitalize on root growth, greater carbohydrate reserve, and initiate more tillers rather than utilise current winter germplasm options sown early in the HRZ? Is spring barley more sensitive to changes in plant density than winter barley?

Key Points:

- Cultivar choice had the biggest influence on head densities. Rosalind reached 965 heads/m^2, Planet 746 heads/m^2, and Urambie 820 heads/m^2. This reflects the genetic ability of these cultivars to tiller and the proportion of tillers that survive.
- Similar yields were achieved at low and higher plant densities, consistent with findings from other experiments that demonstrate limited yield responses at target densities above 150 seeds/m^2
- Defoliation reduced yield on average by 0.5t/ha.
- Defoliation at GS32 in Rosalind corresponded to a defoliation date of GS31 in RGT Planet and later tillering in the winter cultivar Urambie
- Despite the later than recommended defoliation date in Rosalind there was a significant delay in crop development. In other experiments Rosalind has responded well to this treatment and in frostier environments or in higher production environments years it may be possible to increase yield with this strategy from earlier planting dates.

Treatments: 2 Plant densities x 3 cultivars x 2 reset manipulation treatments

Table 1. Details of the management levels (kg, g, ml/ha).

Varieties:		**Urambie, RGT Planet & Rosalind**
Sowing date:		1 May
Seed Rate:		As per treatment list
Sowing Fertiliser:		90kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Grazing:		30 July (all varieties)
Nitrogen:	19 May	33.3 kg N/ha
	2 August	27.6 kg N/ha
	11 August	16.6 kg N/ha
Fungicide:	24 July	Prosaro 300ml/ha
	20 August	Radial 840ml/ha

Table 2. Tillers/m^2 recorded at GS32 in Untreated Plots for each cultivar.

Trt.	**Cultivar**	**150 Plants /m2**	**300 Plants /m2**
		Untreated	**Untreated**
1	Rosalind	395 c	411 c
2	RGT Planet	405 c	449 c

3	Urambie	581	b			819	a	
Mean		**460**						

*Analysed as an RCB due to selected plots assessed.

Table 3. Influence of plant population, variety and phenology resetting (defoliation) on head numbers (m2) recorded GS89.

	RGT Planet		**Urambie**		**Rosalind**		**Mean**	
Heads/m²	746	b	820	b	965	a	**844**	
		LSD	**133**			**P Value**	**0.001**	
Plant Population								
150 plants/m²	659	-	740	-	942	-	**780**	**b**
300 plants/m²	834	-	900	-	988	-	**907**	**a**
Plant Population		**LSD**	**155**			**P Value**	**0.009**	
Plant Population x Variety		**LSD**	**188**			**P Value**	**0.453**	
Defoliation								
Untreated	663	-	822	-	960	-	**815**	**-**
Defoliated when Rosalind reached GS32	829	-	818	-	970	-	**872**	**-**
Defoliation		**LSD**	**87**			**P Value**	**0.215**	
Variety x Defoliation		**LSD**	**151**			**P Value**	**0.250**	
Plant Population x Defoliation								
150 plants/m²								
Untreated	587	-	767	-	958	-	770	-
Defoliated when Rosalind reached GS32	732	-	877	-	927	-	790	-
300 plants/m²								
Untreated	740	-	713	-	962	-	860	-
Defoliated when Rosalind reached GS32	927	-	923	-	1013	-	954	-
Plant Population x Defoliation		**LSD**	**124**			**P Value**	**0.416**	
Plant Population x Defoliation x Variety		**LSD**	**214**			**P Value**	**0.966**	

Table 4. Yield (t/ha), Biomass at GS89 (t/ha), Harvest Index (%)

Trt.	**Cultivar**	**Yield**		**Biomass**		**Harvest Index**	
		t/ha		**t/ha**		**(%)**	
1	Rosalind	4.70	-	9.0	b	46.6	a
2	RGT Planet	4.61	-	10.0	a	40.9	b
3	Urambie	4.76	-	9.4	ab	44.6	ab
Mean		**4.69**		**9.4**		**44.0**	
LSD (p=0.05)		**0.53**		**0.7**		**4.1**	
P Val		**0.623**		**0.031**		**0.024**	

Table 5. Influence of plant population, variety and phenology resetting (defoliation) on grain yield (t/ha).

	RGT Planet		Urambie		Rosalind		Mean	
	t/ha		t/ha		t/ha			
Variety	4.61	-	4.76	-	4.70	-	**4.69**	
		LSD	**0.33**			**P Value**	**0.623**	
Plant Population								
150 plants/m^2	4.55	-	4.60	-	4.55	-	**4.57**	-
300 plants/m^2	4.68	-	4.92	-	4.85	-	**4.82**	-
Plant Population		**LSD**	**0.53**			**P Value**	**0.223**	
Plant Population x Variety		**LSD**	**0.47**			**P Value**	**0.799**	
Defoliation								
Untreated	4.86	b	4.95	b	5.17	a	**4.99**	**a**
Defoliated when Rosalind reached GS32	4.36	d	4.58	c	4.23	d	**4.39**	**b**
Defoliation		**LSD**	**0.11**			**P Value**	**<0.001**	
Variety x Defoliation		**LSD**	**0.19**			**P Value**	**0.001**	
Plant Population x Defoliation								
150 plants/m^2								
Untreated	4.79	-	4.73	-	4.99	-	**4.84**	-
Defoliated when Rosalind reached GS32	4.31	-	5.17	-	4.10	-	**4.30**	-
300 plants/m^2								
Untreated	4.94	-	4.48	-	5.34	-	**5.15**	-
Defoliated when Rosalind reached GS32	4.42	-	4.68	-	4.36	-	**4.49**	-
Plant Population x Defoliation		**LSD**	**0.16**			**P Value**	**0.246**	
Plant Population x Defoliation x Variety		**LSD**	**0.27**			**P Value**	**0.716**	

2020 TAS Crop Technology Centre - Hagley, Victoria

The hyper yielding barley experiments hosted at the Tasmanian crop technology centre focused on irrigated spring barley emerging in spring. The most common yield constraints to spring sown barley are consistent with the Autumn sown hyper yielding barley experiments on the mainland however the management levers differ in timing and intensity.

Climatic constraints and opportunities for spring sown barley

The climatic conditions for spring sown barley are more favourable in Tasmania compared to other regions of Australia. However, there are some major constraints that will influence management and germplasm decisions.

1. Crop development is typically a lot faster and the growing season is considerably reduced relative to autumn and winter sown crops, this has implications for yield development, seeding rates and timings of fungicide.
2. Flowering and thus grain filling is likely to occur later than optimal in warmer and drier conditions than Autumn sown barley, this will require cultivars that can maintain grain weight under these conditions.

A key focus of the Tasmania Spring barley experiments is to identify germplasm adapted to this system and develop management practices that optimise the system. The obvious climatic differences between autumn/winter sown and spring sown barley are temperature, daylength and rainfall patterns (figure 1)

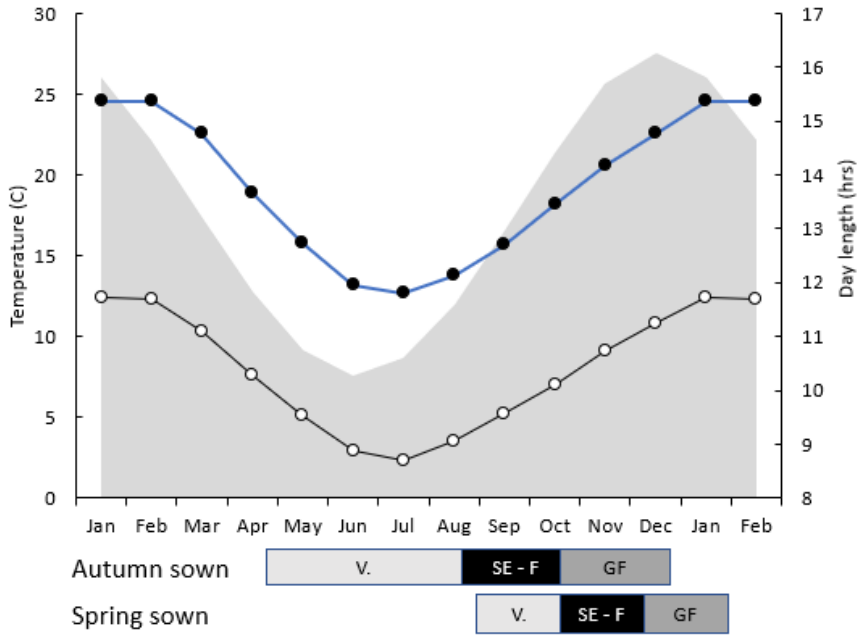

Figure 1. Schematic comparison of crop life cycle, vegetative (V), Stem elongation to flowering (SE-F), and grain filling in spring barley sown in Autumn and Spring. The mean max temperatures (●) and mean minimum temperatures (○) and shaded area represents the daylength (hrs) at Hagley Tasmania.

Experimental Details

Sown: 1 September, 2020
Harvested: 18-19 February, 2021
Rotation position: 1st cereal after Potatoes
Soil Type: Chromosol

Trial 1. HYC 1st Stage Screen

Objective: To examine the phenology, disease resistance and standing power of new barley germplasm established at the start of spring.

Key Points:

- The variation in crop development highlighted the difference between the European and Australian spring germplasm suitability to spring sown conditions.
- Photoperiod (daylength) responsive cultivars progressed to heading too quickly for spring sown conditions, these examples include Rosalind, Fathom, IGB1844, and Laperouse.
- Photoperiod sensitive cultivars in the range from RGT Planet, Laureate, and Westminster developed slower and are likely to be more suited to spring planting
- Lodging and brackling responses varied across cultivars, however all introduced cultivars had lower levels of lodging than the lodging control Compass under irrigated conditions
- These lines progressed to yield evaluation in the next experiment

Treatments: 24 lines sown in small plots (5m in length depending on site) with standard nitrogen management but no fungicide or no PGR input not taken to yield

Table 1. Phenology evaluation, Zadoks growth stage recorded at key points in the season (Zadoks GS00-99)

Variety	10-Nov	8-Dec
Westminster	35.0	71.5
Sanette	35.0	72.5
Operette #	37.0	71.0
AGTB0247	37.0	71.5
Alestar	37.0	72.0
Traveler	37.0	72.0
HV8 Nitro	37.0	72.5
GSP-18-44-B	37.0	72.5
AGFBA5618	37.0	72.5
GSP-17-27-B	37.0	73.5
RGT Planet	38.0	71.0
Laureate	38.0	71.0
Sure	38.0	71.0
AGTB0245	38.0	72.5
AGTB0244	38.0	73.0
Compass	45.0	75.5
Rosalind	47.0	74.5

AGTB0213	49.0	73.0
Line 30 15/3	49.0	73.0
Line 51 94/5	49.0	74.5
WI4592 (Laperouse)	57.5	76.5
Fathom	58.5	76.5
Line 44 60/1	64.0	76.0
IGB1844	65.0	77.0

Table 1. Crop height and lodging of the variety evaluation trial.

	Crop Height		Lodging			
Variety	Height		Severity	Area		Index	
	cm		0-5	%		0-500	
RGT Planet	68.0	bcd	0.0 -	0.0	-	0.0	d
HV8 Nitro	67.0	bcd	0.0 -	0.0	-	0.0	d
GSP-17-27-B	64.0	bcd	1.0 -	7.5	-	15.0	cd
GSP-18-44-B	68.5	a-d	0.0 -	0.0	-	0.0	d
Rosalind	60.0	cd	0.0 -	0.0	-	0.0	d
Westminster	78.0	a	0.0 -	0.0	-	0.0	d
AGTB0213	48.0	e	0.0 -	0.0	-	0.0	d
AGTB0244	70.0	ab	1.0 -	7.5	-	15.0	cd
Alestar	68.5	a-d	0.0 -	0.0	-	0.0	d
Fathom	66.5	bcd	0.5 -	10.0	-	10.0	cd
IGB1844	59.0	d	0.0 -	0.0	-	0.0	d
AGTB0245	67.5	bcd	0.0 -	0.0	-	0.0	d
AGFBA5618	65.5	bcd	2.0 -	47.5	-	137.5	b
WI4592 (Laperouse)	64.0	bcd	0.0 -	0.0	-	0.0	d
Laureate	69.0	abc	0.5 -	5.0	-	5.0	d
Traveler	59.0	d	0.0 -	0.0	-	0.0	d
Line 51 94/5	69.0	abc	0.0 -	0.0	-	0.0	d
AGTB0247	64.0	bcd	1.0 -	7.5	-	15.0	cd
Compass	63.0	bcd	49.0 -	47.0	-	325.0	a
Operette #	69.5	abc	0.0 -	0.0	-	0.0	d
Sure	64.5	bcd	0.0 -	0.0	-	0.0	d
Line 30 15/3	70.5	ab	0.0 -	0.0	-	0.0	d
Line 44 60/1	60.0	cd	0.0 -	0.0	-	0.0	d
Sanette	66.5	bcd	1.5 -	40.0	-	120.0	bc
Mean	65.4		2.4	7.2		26.8	
LSD 0.05	9.9		27.7	41.3		111.2	
P Val	0.008		0.403	0.393		0.001	

Table 2. Details of the management levels (kg, g, ml/ha).

Sowing date:		**1-September**
Seed Rate:		300 plants/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Nitrogen:	2 Oct	115kg N/ha

Fungicide:		nil
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm

Trial 2. HYC Elite Screen

Objective: To examine the yield potential of new spring germplasm grown under HYC Management packages against spring controls in an early spring sowing window.

Key Points:

- The highest yielding spring cultivar in this experiment was Laureate at 11.42t/ha compared to the quick spring cultivar control Rosalind at 9.27 t/ha and RGT Planet yielded 10.43 t/ha.
- Yields achieved at this site were the highest across the hyper yielding program and shows the adaptation of barley to spring sown conditions in Tasmania. The long sunny days and cool grain fill conditions allowed for greater biomass accumulation and maintenance of grain weight.
- Alestar, Fathom, IGB1844, Laperouse, Rosalind and other photoperiod responsive cultivars yielded significantly lower (less than 9.5 t/ha) than the cultivars without a strong photoperiod requirement such as RGT Planet, Laureate, Hv8 Nitro, and the AGTB0244 line
- Grain proteins were greater than 12% and outside of malt specification, while testweight varied and in general the faster developing cultivars trended lower.
- At the time of this report final dry matters have yet to be calculated.

Treatments: (24 elite lines tested under HYC High input management (full foliar fungicide program (Systiva & 2 foliar fungicides – GS30 & GS49)

Table 1. Grain yield of the variety evaluation trial (t/ha, % site mean) and grain quality results.

	Grain Yield				Grain Quality							
Variety	Yield		Site Mean		Protein		Test wt		Retention		Screenings	
	(t/ha)		(%)		%		kg/HL		%		%	
RGT Planet	10.43	b-e	106.7	b-e	13.4	ef	67.6	bc	99.2	a	0.2	e
HV8 Nitro	10.29	cde	105.2	cde	14.3	bcd	68.8	a	98.9	a	0.2	e
GSP-17-27-B	9.87	def	100.9	def	13.6	de	67.4	bcd	98.5	ab	0.4	de
GSP-18-44-B	10.59	a-d	108.3	a-d	12.7	fg	67.4	bcd	99.3	a	0.2	e
Rosalind	9.27	fgh	94.8	fgh	14.4	bc	64.0	gh	95.9	de	0.7	bcd
Westminster	9.52	efg	97.3	efg	13.6	cde	68.2	ab	99.0	a	0.2	e
AGTB0213	8.88	ghi	90.9	ghi	14.8	b	63.6	h	96.9	cd	0.8	bc
AGTB0244	11.24	ab	115.0	ab	12.5	g	66.6	cde	99.0	a	0.2	e
Alestar	8.84	ghi	90.4	ghi	13.9	cde	67.0	cde	98.9	a	0.3	e
Fathom	8.03	i	82.2	i	16.2	a	63.4	h	97.4	bc	0.8	bc
IGB1844	8.82	ghi	90.3	ghi	14.7	b	64.2	gh	94.9	e	1.6	a
AGTB0245	11.18	abc	114.3	abc	12.7	fg	66.5	cde	99.1	a	0.2	e
AGFBA5618	10.54	a-d	107.8	a-d	12.4	g	66.0	ef	98.8	a	0.5	cde
Laperouse	8.41	hi	86.0	hi	16.0	a	65.1	fg	95.7	e	0.9	b
Laureate	11.42	a	116.8	a	13.3	ef	65.9	ef	98.5	ab	0.4	de
Traveler	8.88	ghi	90.8	ghi	13.7	cde	64.0	h	98.9	a	0.3	e
Line 51 94/5	8.01	i	81.9	i	14.3	bcd	61.9	i	97.4	c	0.7	bcd

AGTB0247	10.69	a-d	109.4	a-d	13.3	ef	66.4	de	98.8	a	0.3	e
Compass	10.00	def	102.3	def	14.7	b	63.4	h	95.7	e	1.4	a
Mean	9.73		99.6		13.9		65.7		97.9		0.6	
LSD 0.05	0.92		9.4		0.8		1.1		1.1		0.4	
P Val	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	

Table 2. Details of the management levels (kg, g, ml/ha).

Sowing date:		1-September
Seed Rate:		300 plants/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance, Gaucho & Systiva
Nitrogen:	2 Oct	115kg N/ha
Fungicide:	GS32	Radial 840ml/ha
	GS49	Prosaro 300ml/ha
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm

Trial 3. HYC G.E.M Trial series

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

Key Points:

- The influence of germplasm choice was greater than the influence of crop management. RGT Planet yielded 9.59t/ha, and Rosalind 8.29t/ha. The spring wheat Trojan yielded 8.79t/ha.
- Spring barley is well suited to this position in the crop rotation and is yielding higher than spring wheat at this sowing date, this is in contrast to autumn planted crops where wheat is superior to barley.
- Fungicide strategy was the only management strategy to significantly influence yield but this depended on cultivar. Moving from a standard management increased yield from 8.79t/ha to 9.67t/ha in RGT Planet, while there was no additional benefit in Rosalind and Trojan highlighting the importance of genetic resistance if lower input fungicide strategies are going to be used.
- Increasing N inputs upfront and moving a proportion of the N inputs towards tillering did not increase yield. Increasing seed density to 450 seeds/m2 also did not offer any additional benefit
- Dry matters and Harvest Index results are still being processed

Treatments: Lever 1 – Level of fungicide inputs x Lever 2 – Canopy Control and additional N (to service 25% higher yield potential) x Lever 3 – Germplasm

Table 1. Influence of fungicide management strategy, variety and canopy management regime on grain yield (t/ha).

	RGT Planet		Rosalind		Trojan		Mean	
Variety	9.59	a	8.29	c	8.79	b	**8.89**	
		LSD	***0.37***			***P Value***	***<0.001***	
Fungicide Management								
Standard Fungicide Management	8.79	-	8.34	-	8.63	-	8.83	-
High Input Fungicide management	9.67	-	8.24	-	8.96	-	8.96	-
Fungicide Management		***LSD***	***ns***			***P Value***	***0.371***	
Fungicide Mgmt x Variety		***LSD***	***ns***			***P Value***	***0.486***	
Canopy Management Regime								
80kg/N Upfront	9.72	-	8.26	-	8.80	-	8.93	-
140kg/N Upfront	9.45	-	8.19	-	8.68	-	8.77	-
80kg/N Upfront fb 60kg/N @ mid tiller	9.48	-	8.41	-	8.79	-	8.89	-
450seeds/m2 80kg/N Upfront fb 60kg/N @ mid tiller	9.73	-	8.30	-	8.90	-	8.98	-
Canopy Management Regime		***LSD***	***ns***			***P Value***	***0.417***	
Variety x Canopy Mgmt Regime		***LSD***	***ns***			***P Value***	***0.904***	
Fungicide Mgmt. x Canopy Mgmt. Regime								
Standard Fungicide Management								
80kg/N Upfront	9.64	-	8.17	-	8.72	-	8.84	-
140kg/N Upfront	9.52	-	8.38	-	8.48	-	8.79	-
80kg/N Upfront fb 60kg/N @ mid tiller	9.37	-	8.53	-	8.55	-	8.82	-
450seeds/m2 80kg/N Upfront fb 60kg/N @ mid tiller	9.55	-	8.28	-	8.77	-	8.86	-
High Input Management				-		-		
80kg/N Upfront	9.80	-	8.36	-	8.88	-	9.02	-
140kg/N Upfront	9.38	-	8.01	-	8.88	-	8.76	-
80kg/N Upfront fb 60kg/N @ mid tiller	9.60	-	8.29	-	9.03	-	8.97	-
450seeds/m2 80kg/N Upfront fb 60kg/N @ mid tiller	9.91	-	8.32	-	9.04	-	9.09	-
Fungicide Mgmt x Canopy Mgmt		***LSD***	***ns***			***P Value***	***0.752***	
Fungicide Mgmt x Canopy Mgmt x Variety		***LSD***	***ns***			***P Value***	***0.817***	

Table 2. Details of the management levels (kg, g, ml/ha).

Varieties:		**RGT Planet, Rosalind & Trojan**	
Sowing date:		**1-September**	
Seed Rate:		300 seeds/m^2 ± treatment list	
Sowing Fertiliser:		100kg/ha MAP	
Seed Treatment:		Vibrance & Gaucho ± treatment list	
Nitrogen:		As per treatment list	
Fungicide:		***Standard Fungicide Management***	***High Fungicide Management***
	GS00	---	Systiva
	GS30	Tilt 500ml/ha	Radial 840ml/ha
	GS49	Prosaro 150ml/ha	Aviator Xpro 500ml/ha
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm	

Trial 4. HYC Disease Management germplasm interaction

Objective: To develop profitable and sustainable approaches to disease management in HRZ barley.

Key Points:

- Disease pressure in spring sown barley is less than previous experience with autumn planted barley, this has implications for the fungicide management strategy. In this experiment scald was the main disease being controlled, and while all diseases were present including NFNB they did not cause significant defoliation in the untreated control
- The expensive and high input fungicide strategy which combined systiva seed dressing, and two fungicide applications yielded similar to all other cheaper and reduced input strategies.
- Lower application label rates achieved similar yield responses as rates on the higher end of the rate range
- Fungicide applications had little influence on grain quality at this site

Treatments: 6 fungicide management levels applied to 2 varieties

Table 5. Influence of management strategy and variety of wheat grain yield (t/ha).

Treatment			RGT Planet	HV8 Nitro	Mean
GS00	**GS30**	**GS39-49**	Yield (t/ha)	Yield (t/ha)	Yield (t/ha)
---	---	---	9.41 -	8.87 -	**9.14 c**
---	Prosaro 300ml/ha	---	9.10 -	9.20 -	**9.15 bc**
---	Prosaro 300ml/ha	Radial 840ml/ha	9.39 -	9.34 -	**9.37 abc**
Systiva	Prosaro 300ml/ha	Radial 840ml/ha	9.72 -	9.15 -	**9.43 a**
---	Radial 840ml/ha	Aviator Xpro 417ml/ha	9.65 -	9.20 -	**9.42 ab**
---	Prosaro 150ml/ha	Radial 420ml/ha	9.80 -	9.25 -	**9.52 a**
Mean			**9.51 -**	**9.17 -**	**9.34**
LSD Variety P=0.05			ns	**P val**	0.200
LSD Fungicide P=0.05			0.28	**P val**	0.041
LSD Variety x Fungicide P=0.05			ns	**P val**	0.076
CV					2.96

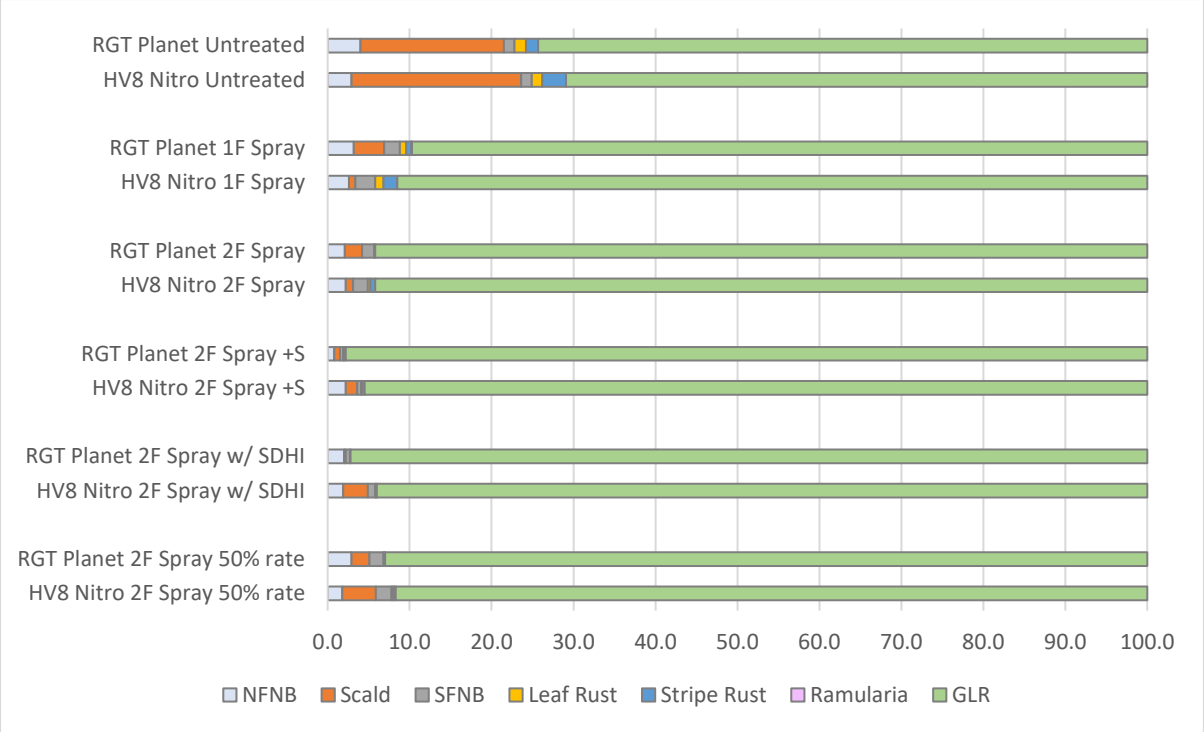

Figure 1. Disease severity and green leaf retention of the flag-1 leaf, assessed 7 January, GS80.

Table 3. Details of the management levels (kg, g, ml/ha).

Varieties:		**RGT Planet & HV8 Nitro**
Sowing date:		**1-September**
Seed Rate:		300 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho ± treatment list
Nitrogen:	2 Oct	115kg N/ha
Fungicide:		As per treatment list
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm

Trial 5. HYC Spring Barley PGR Evaluation

Objective: To assess the value of PGRs with spring sown barley in HRZ regions

Key Points:

- RGT Planet achieved a grain yield of 9.57 t/ha significantly higher than Rosalind at 8.37t/ha
- Delaying harvest had little impact on grain yield and were similar to crops harvested on time
- Despite a lack of response to a harvest delay, plant growth regulators still had a positive influence on yield but only when they were applied in a split treatment at GS31 and either GS37 or GS49. PGR applied at GS31 achieved a yield of 8.8t/ha and when applied in a split treatment achieved yields of 9.2t/ha

- These results require further validation in 2021 but have demonstrated there is little downside trade off with the use of PGRs in the higher rainfall zone and a GS31 and later application could be combined with the most effective fungicide timings.

Treatments: 4 PGR management approaches applied to two cultivars, to be harvested at two harvest dates.

Table 1. Influence of harvest date, variety and canopy management regime on grain yield (t/ha).

		RGT Planet	***Rosalind***	***Mean***
Variety		9.57 a	8.37 b	**8.97**
Canopy Management Regime				
Untreated		9.32 -	8.15 -	8.73 b
GS31 PGR		9.32 -	8.27 -	8.80 b
GS31 + GS37 PGR		9.77 -	8.63 -	9.20 a
GS31 + GS49 PGR (Europe style)		9.88 -	8.44 -	9.16 a
Variety	***LSD***	***0.10***	***P-Value***	***<0.001***
Canopy Management Regime	***LSD***	***0.23***	***P-Value***	***<0.001***
Variety x Canopy Mgmt Regime	***LSD***	*ns*	***P-Value***	***0.337***

Table 2. Details of the management levels (kg, g, ml/ha).

Varieties:		**RGT Planet & Rosalind**
Sowing date:		**1-September**
Seed Rate:		300 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Nitrogen:	2 Oct	115kg N/ha
Fungicide:	5 Nov	Radial 840ml/ha
	26 Nov	Prosaro 300ml/ha
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm

Trial 6: Nutrition for Hyper Yielding Barley

Objectives: To assess the value of higher nutrition input for barley

Individual objectives specific to the trial are:

- Assess whether growers are currently under fertilizing barley crops in the region and N requirements required to reach target yields of 10 – 12 within each region.

Key Points:

- A mean yield of 10.21 t/ha was achieved across the experiment and proteins were greater than 10.5% and within malt barley specification.
- There wasn't any additional yield benefit from 60 kg N/ha (extra 25%) and 120 kg N/ha (50% extra N) combined when applied either with or without the additional P and S fertilizer compared to untreated control
- The aspirational N treatment of an additional 60 units of N increased grain protein by ~1 % compared to the untreated but did not increase yield.

- These results are consistent with other experiments across the high rainfall zones, were limited responses to applied N fertilization are measurable on fertile soils.

Treatments: Five nutrition treatments

Table 1. Detailed treatment list, grain yield (t/ha) & % Site Mean.

Trt.		Nitrogen rate	Potassium rate	Sulphur rate	Yield	Mean
		kg N/ha	kg K/ha	kg S/ha	(t/ha)	(%)
1	**Untreated**	---	---	---	10.21 -	100.0
2	Current Practice +25% N	60kg N/ha	---	---	10.27 -	100.7
3	Current Practice +25%NPKS	60kg N/ha	41kg K/ha	17kg S/ha	10.32 -	101.1
4	Aspirational N	120kg N/ha	---	---	10.12 -	99.2
5	Aspirational NPKS	120kg N/ha	41kg K/ha	17kg S/ha	10.11 -	99.0
				Mean	10.21	100.0
				LSD (p=0.05)	ns	ns
				P Val	0.376	0.377

NOTE: MAP was applied at a rate of 100kg/ha

Table 2. Influence of nitrogen rate on grain quality, protein (%), test weight (kg/HL) and screenings (%).

	Nitrogen rate	Phosphorus rate	Sulphur rate	Protein	Test weight	Retention	Screenings
Trt.	**kg N/ha**	**kg P/ha**	**kg S/ha**	**(%)**	**(kg/HL)**	**(%)**	**(%)**
1	---	---	---	11.7 b	66.9 b	99.1 ab	0.2 ab
2	60kg N/ha	---	---	12.7 a	67.2 ab	99.1 a	0.1 ab
3	60kg N/ha	41kg K/ha	17kg S/ha	12.8 a	67.3 ab	99.1 a	0.1 b
4	120kg N/ha	---	---	12.7 a	67.5 a	99.0 ab	0.1 ab
5	120kg N/ha	41kg K/ha	17kg S/ha	12.9 a	66.9 b	98.9 b	0.2 a
			Mean	12.5	67.2	99.0	0.2
			LSD (p=0.05)	0.8	0.5	0.1	0.1
			P Val	0.054	0.083	0.213	0.100

Table 2. Details of the management levels (kg, g, ml/ha).

Varieties:		**RGT Planet**
Sowing date:		**1-September**
Seed Rate:		300 seeds/m^2
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Nitrogen:		As per treatment list
Fungicide:	5 Nov	Radial 840ml/ha
	26 Nov	Prosaro 300ml/ha
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm

Trial 7: Spring Sown Barley seed rate trial

Objective: Evaluate whether higher seeding rates are required for spring sown barley to increase head number and yield

Key Points:

- A low seed density of 100 seeds/m^2 yielded 0.5 t/ha less than the current recommended rate for spring sown barley (300 seeds/m^2)
- Seeding rates greater than 200 seeds/m2 up until 500 seeds/m2 did not result in additional yield or quality responses.
- Lodging was not exacerbated by higher seeding densities
- These results confirm growers can continue to target current recommended seed densities of 300 seeds/m^2 for spring sown barley

Treatments: Five seed rate treatments

Table 1. Influence of plant population) on grain yield (t/ha) and grain quality.

	Seed rate	Yield	% of Mean	Protein	Test weight	Retention	Screenings
Trt.	**Seeds/m^2**	**t/ha**	**%**	**(%)**	**(kg/HL)**	**(%)**	**(%)**
1	100	9.42 b	95.8	12.9 -	67.0 b	98.9 b	0.2 -
2	200	9.82 ab	99.8	13.2 -	67.4 ab	99.2 a	0.1 -
3	300	9.99 a	101.6	12.6 -	67.5 ab	99.2 a	0.1 -
4	400	9.85 ab	100.2	13.0 -	67.5 ab	99.1 a	0.1 -
5	500	10.10 a	102.7	12.9 -	67.6 a	99.2 a	0.2 -
Mean		9.83	100.0	12.9	67.4	99.1	0.2
LSD (p=0.05)		0.50	5.1	0.7	0.5	0.2	0.1
P Val		0.093	0.093	0.549	0.208	0.095	0.448

Yield figures followed by the same letter are not considered to be statistically different (p=0.05).
Plot yields: To compensate for edge effect a full row width (22.5cm) has been added to either side of the plot area (equal to plot centre to plot centre measurement in this case).

Table 2. Details of the management levels (kg, g, ml/ha).

Varieties:		**RGT Planet**
Sowing date:		**1-September**
Seed Rate:		As per treatment list
Sowing Fertiliser:		100kg/ha MAP
Seed Treatment:		Vibrance & Gaucho
Nitrogen:	2 Oct	115kg N/ha
Fungicide:	5 Nov	Radial 840ml/ha
	26 Nov	Prosaro 300ml/ha
Irrigation:		17 Sep 12.5mm, 14 Nov 20.0mm, 20 Nov 18.0mm, 27 Nov 20mm, 17 Dec 10.0mm = Total 80.5mm

APPENDIX

METEOROLOGICAL DATA

Meteorological Data – South Australia Crop Technology Centre

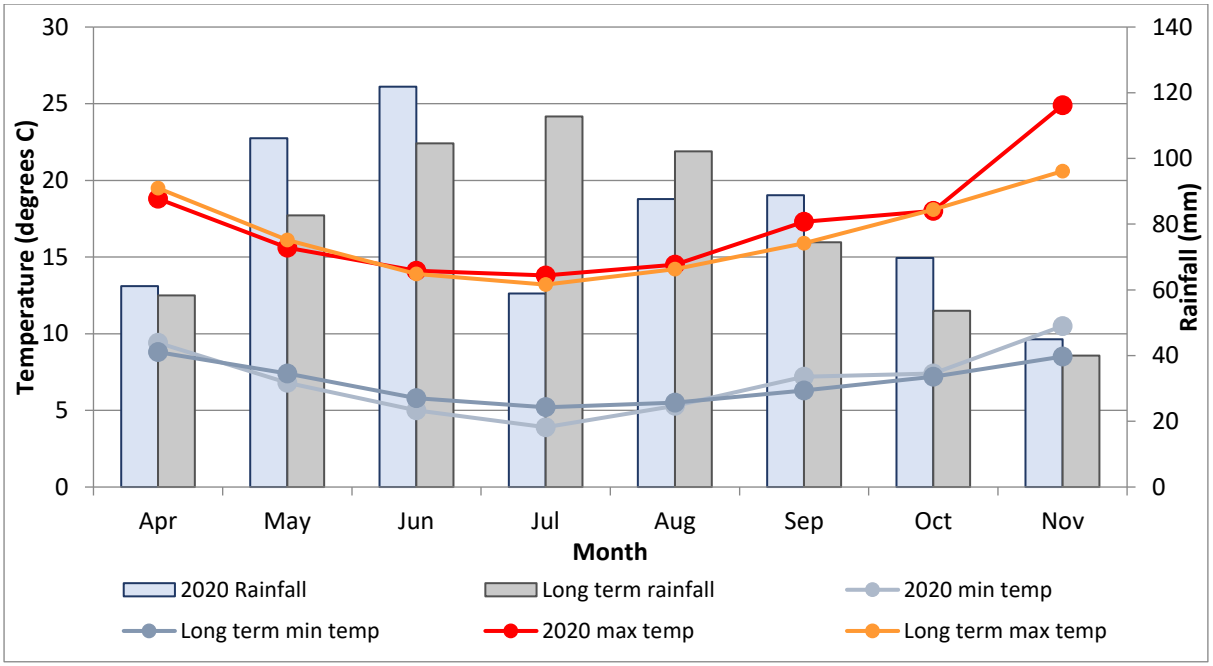

Figure 1. 2020 growing season rainfall and long-term rainfall, 2020 min and max temperatures recorded at Millicent (1877-2020) and long-term min and max temperatures recorded at Mount Gambier Aero (1941 to 2020) for the growing season (April to October). *Rainfall April to November= 639.1mm.*

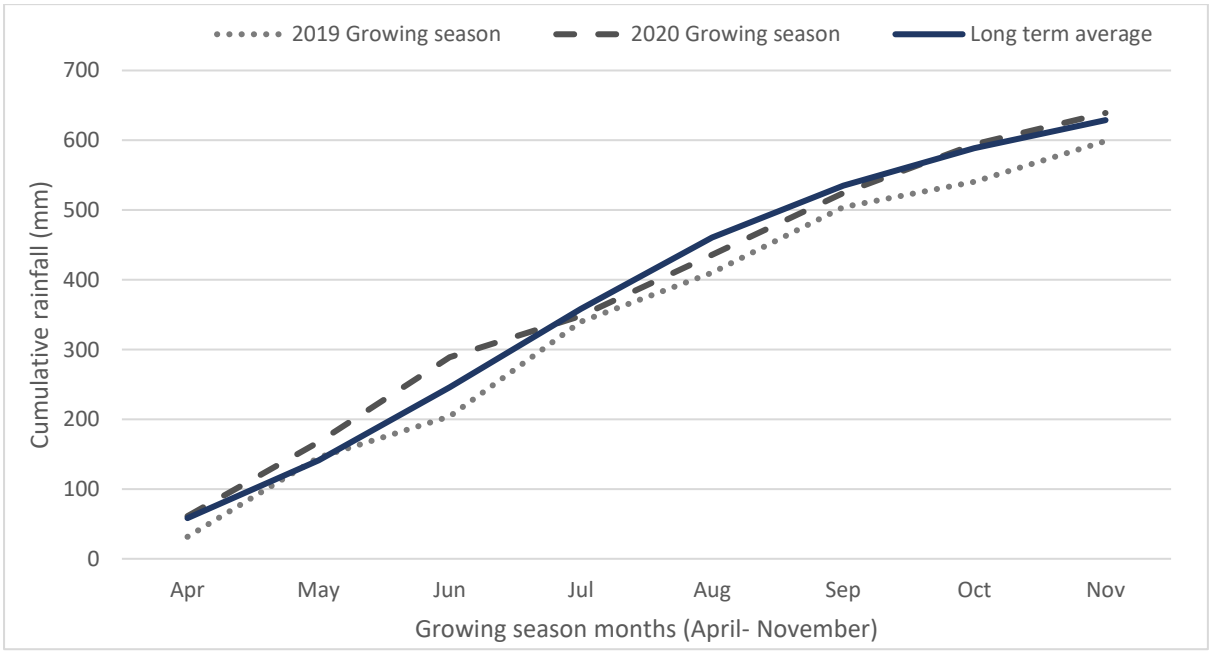

Figure 2. Cumulative growing season rainfall for 2019, 2020 and the long-term average for the growing season (April-November).

Meteorological Data – Victoria Crop Technology Centre

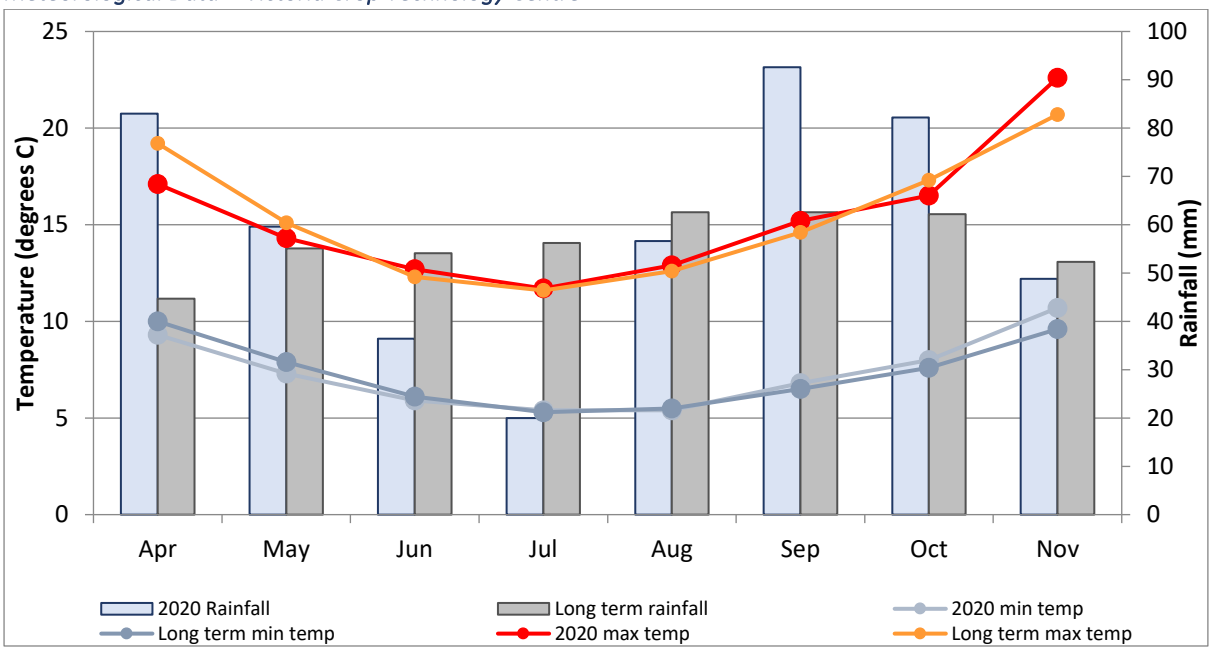

Figure 1. 2020 growing season rainfall and long-term rainfall (1968-2020) (recorded at Buckley (Balliwindi)), 2020 min and max temperatures and long-term min and max temperatures (2000-2020) (recorded at Colac (Mount Gellibrand)) for the growing season. *Rainfall April to November= 479.2mm.*

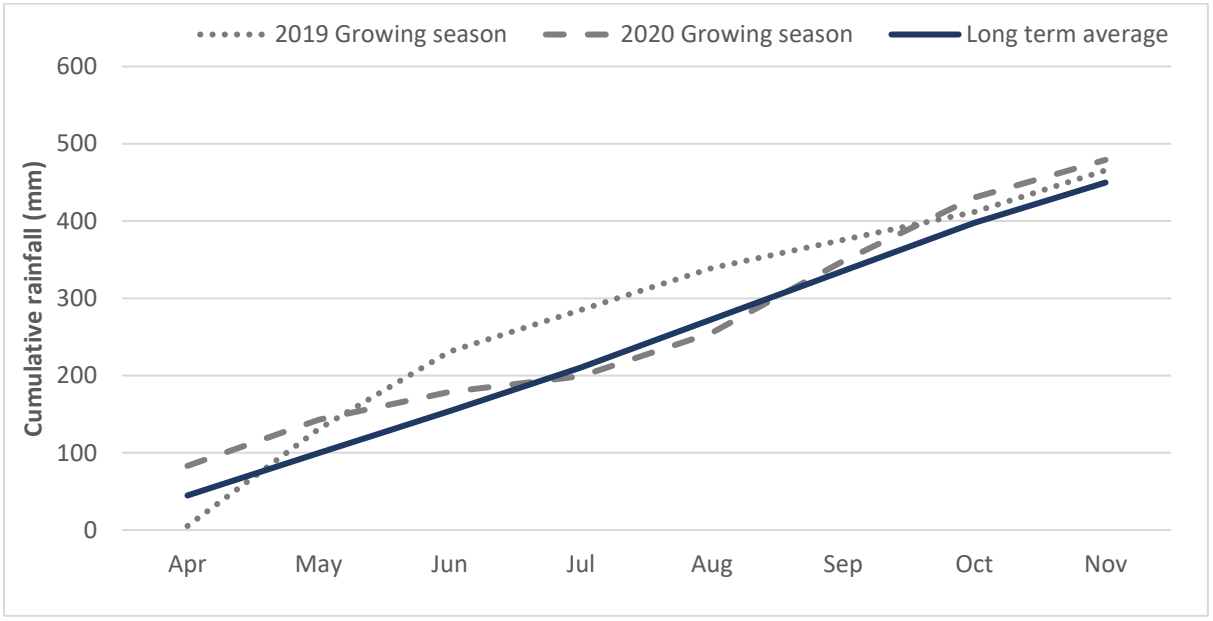

Figure 2. Cumulative growing season rainfall for 2019, 2020 and the long-term average for the growing season.

WA Crop Technology Centre (Albany)

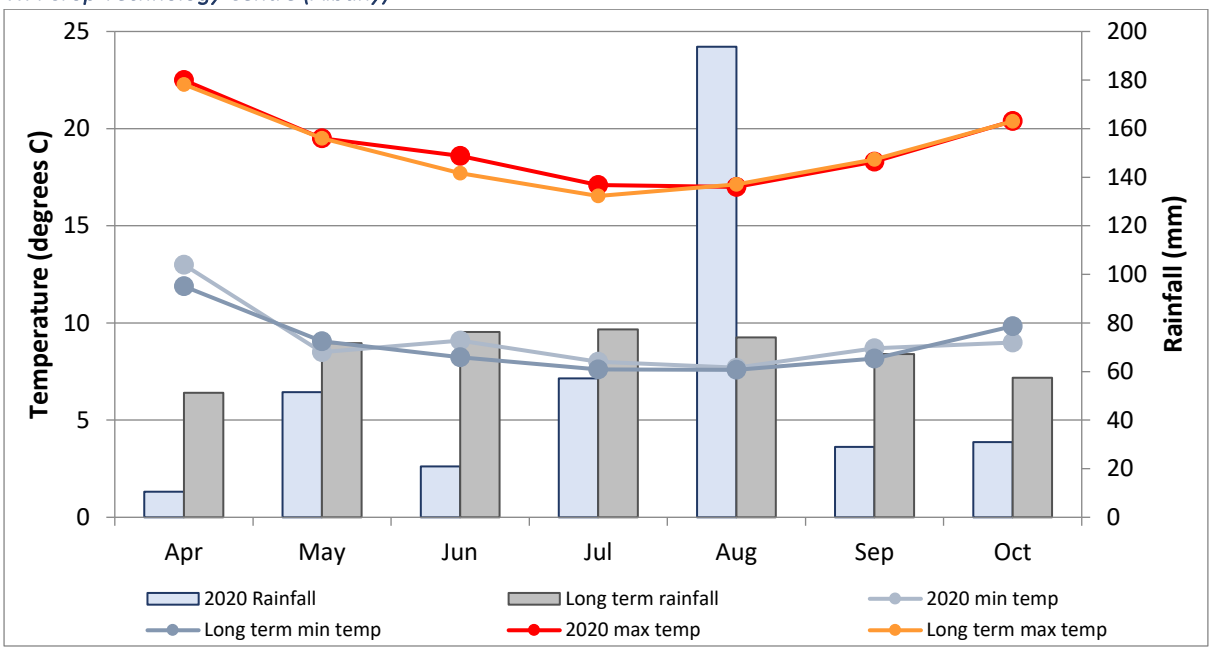

Figure 1. 2020 growing season rainfall and long-term rainfall, 2020 min and max temperatures and long-term min and max temperatures recorded at Warriup (1919 to 2020) for the growing season (April to October).

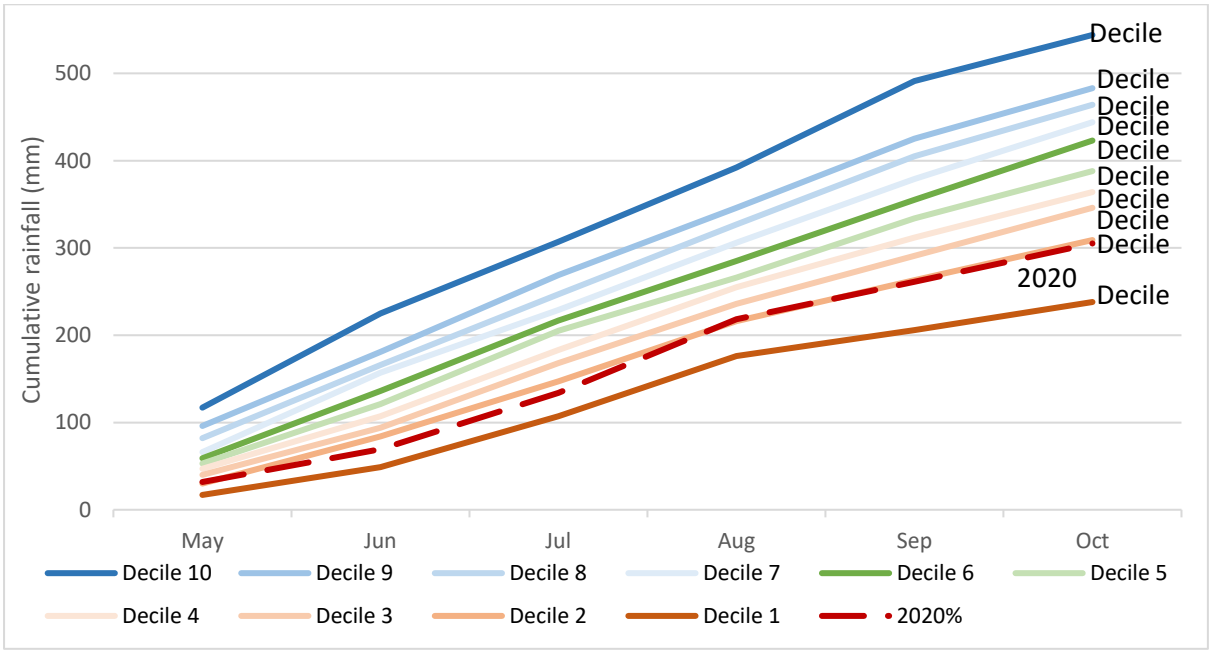

Figure 2. 2020 growing season (May to October) rainfall deciles recorded at Warriup (1919 to 2020).

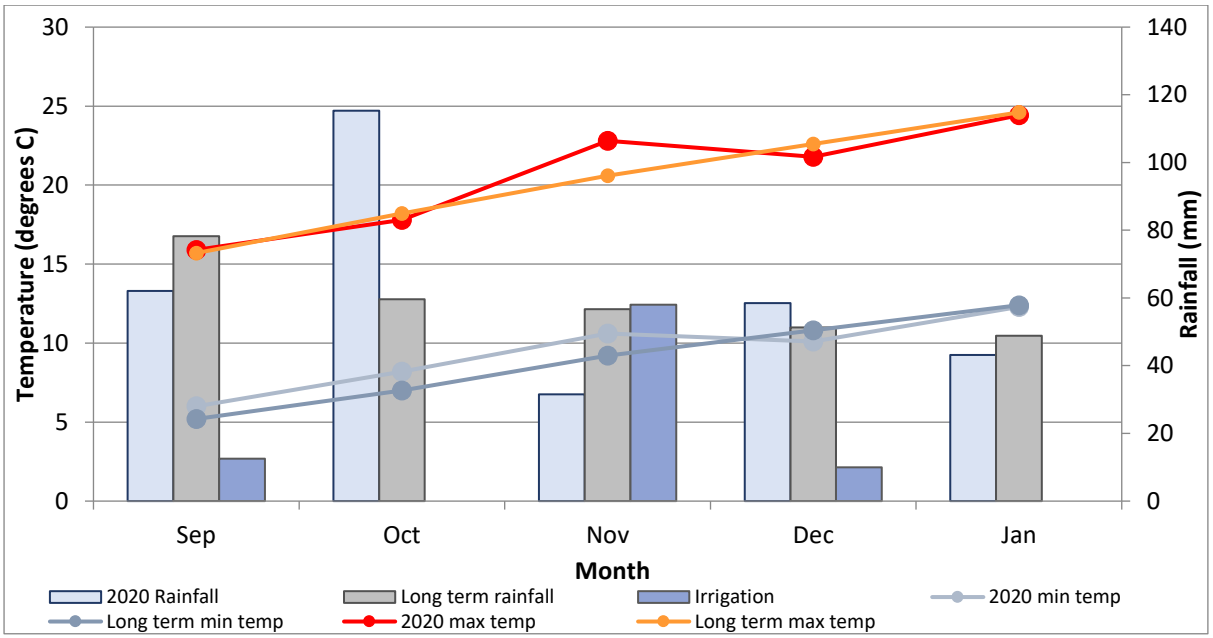

Figure 1. 2020/21 spring growing season rainfall and long-term rainfall (1978-2020) (recorded at Westbury (Birralee Road)), 2020/21 min and max temperatures and long-term min and max temperatures (1980-2020) (recorded at Launceston (Ti Tree Bend)) for the growing season. *Rainfall September to January (inc. irrigatin)= 391.1mm.*

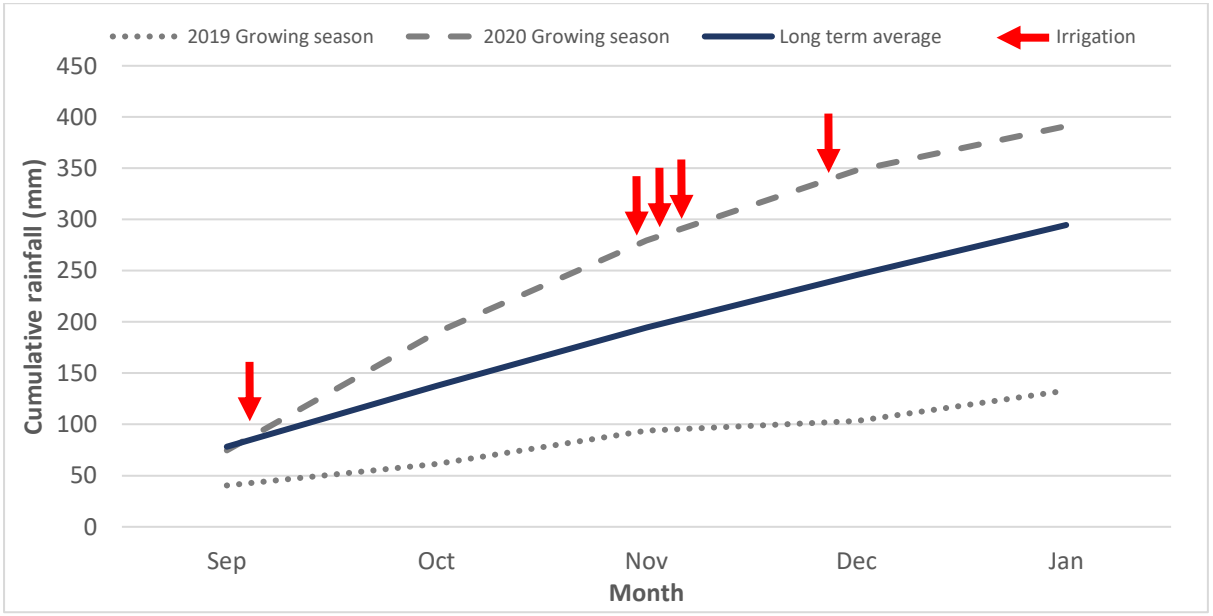

Figure 2. Cumulative growing season rainfall for 2019/20, 2020/21 and the long-term average for the spring growing season