PLANT GROWTH REGULATOR USE IN BARLEY: CHASING OPTIMAL TIMING

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TAKE HOME MESSAGES

- Know your growth stages. Application timing of plant growth regulators (PGRs) in barley could prove key at harvest.
- Understand the lodging risk of your varieties prior to PGR application, it may not be necessary.
- Nitrogen application rate had no effect on PGR application response in barley.

BACKGROUND

2016 was an exceptional season for the Wimmera and Mallee with Decile 9 and 10 rainfall during September supporting phenomenal crop growth. It was not uncommon to see severe lodging in many barley crops as a result of excessive plant height and additional biomass. Plant growth regulators (PGRs), if applied to these crops earlier in the season have been reported to have some influence on reducing the severity of lodging experienced by reducing plant height. PGRs have been used for a number of years by growers in the high rainfall zone. There is however, uncertainty about application timing on crops with high and low yield potentials and the economics and efficiency around their use in the Wimmera and Mallee.

Past research in the Wimmera has observed a reduction in plant height from PGR use and has suggested that in a dry year, where growth is limited, the use of PGRs in barley is not economically viable, even posing a greater risk than benefit (Angel and Launder 2014). While, in a year of above average rainfall, PGR use significantly increased barley yields. In both seasonal conditions however, the effect of PGRs on barley was greatest when combined with fungicide applications (Taylor 2016). Varying results to the application, and split application of PGRs in barley, suggest that seasonal conditions play a key role in determining the influence on barley yields and the economics of application that are out of our control. This trial work provides a clearer understanding on how to manage barley PGR applications in the medium and low rainfall zones i.e. the Wimmera and Mallee.

AIM

To determine the most effective application timing of PGRs to two barley varieties, and at what yield potential their application is economical.

PADDOCK DETAILS

Location:	Longerenong
Crop year rainfall (Nov-Oct):	424mm
GSR (Apr-Oct):	303mm
Soil type:	Clay
Paddock history:	Lentil, harrowed and burnt
Starting Soil N:	77kg/ha

TRIAL DETAILS

Crop type:	Compass barley and RGT Planet barley
Treatments:	Refer to Table 1
Target plant density:	140 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	15 May 2017
Replicates:	Four
Harvest date:	28 November 2017
Trial average yield:	6.7t/ha

TRIAL INPUTS

Fertiliser:	Granulock® Supreme Z + Impact® @ 60kg/ha at sowing and 80kg N/ha or 160kg N/ha applied as urea at GS22 according to Table 1
PGRs:	See Table 1
Seed treatment:	Systiva® @ 150ml/100kg and Gaucho® @ 240ml/100kg

Pests and diseases were managed by best practice management strategies

METHOD

A replicated field trial was sown using a randomised block design including two varieties, four PGR application timings (applied as Moddus Evo®) and a low and high nitrogen (N) rate application (Table 1). Assessments included emergence scores, plant height measured from the base of the plant to base of the head, internode length (between 1st and 2nd and 3rd and 4th nodes) and biomass measurements at maturity. Grain yield and quality parameters were also analysed.

Table 1. Treatment outline including barley varieties, PGR application timing and nitrogen topdressing amount applied as urea at GS22.

Variety	PGR treatment timing (Moddus Evo® @ 200ml/ha)	Nitrogen topdressing (4.5t/ha and 7t/ha yield potential)
Compass RGT Planet	1. No PGR applied 2. GS30 3. GS32 4. GS30 and GS37	80kg N/ha 160kg N/ha

RESULTS AND INTERPRETATION

What difference did treatments make to yield?

PGR treatments at four different timings had no effect on yield in either Compass or RGT Planet.

RGT Planet and Compass are two varieties known for their high yielding potential. On average in this trial, RGT Planet out yielded Compass by 0.5t/ha.

A yield penalty was incurred in treatments that received the high rate (160kg N/ha) of nitrogen in both varieties (Table 2). These application rates were calculated to chase yield potentials of 4.5t/ha and 7t/ha for the low and high rate, respectively. Yield results display that these targets were met and exceeded, suggesting a high level of in-season mineralisation of nitrogen. Nitrogen was top-dressed as urea on 28 June when conditions could support vigorous growth. There was loss in yield in high N rate treatments, suggesting excessive nitrogen caused moisture stress towards the end of the season limiting grain fill.

Table 2. Average yield (t/ha) for PGR treatments at the two N rates for Compass and RGT Planet barley.

PGR treatment	Compass 80N yield (t/ha)	Compass 160N yield (t/ha)	Planet 80N yield (t/ha)	Planet 160N yield (t/ha)
No PGR	6.30	6.09	7.24	6.74
Moddus Evo @ GS30	6.24	6.19	7.39	7.11
Moddus Evo @ GS32	6.43	6.24	7.24	7.14
Moddus Evo @ GS30 and GS37	6.50	6.51	7.20	7.10
Sig. diff.				
Variety		P<0.001		
N rate		P=0.028		
PGR timing		NS		
Variety x N rate		NS		
Variety x PGR timing		NS		
Variety x N rate x PGR timing		NS		
LSD (P=0.05)				
Variety		0.16		
N rate		0.16		
CV%		4.7		

How did PGRs effect plant growth?

PGRs are applied to growing cereals to stunt growth and produce plants of reduced height that are at a lower risk of lodging. Reduction in plant height was observed in both Compass and RGT Planet barley with the application of Moddus Evo (Figure 1).

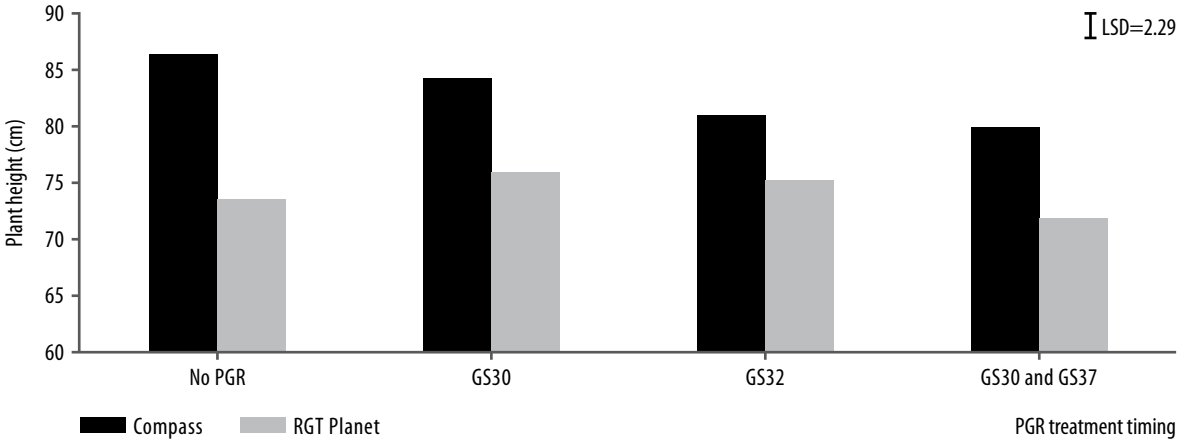

Figure 1. Plant height (cm) at maturity in Compass and RGT Planet barley with different PGR application timing treatments. Variety x PGR trt P=0.001, LSD=2.29, CV=2.9%.

Stem measurements showed a reduction in the internode length between the first and second node in Compass from the application of PGRs and showed a similar trend, (although not statistically significant at 95% confidence), in the length between the second and third node (Table 3). These results suggest reduction in internode length as a means by which PGRs reduce plant height.

Table 3. Average internode length measurements (cm) in Compass and RGT Planet at maturity under different PGR application timings. * not significant at 95% confidence, significant with 90% confidence.

PGR treatment timing	1st and 2nd internode length (cm)		2nd and 3rd internode length (cm)	
	Compass	RGT Planet	Compass	RGT Planet
No PGR	16.3	14.1	17.5	16.1
Moddus Evo @ GS30	15.2	13.8	16.4	14.4
Moddus Evo @ GS32	14.1	13.9	15.3	14.4
Moddus Evo @ GS30 and GS37	15.6	14.3	16.5	14.4
Sig. diff.				
Variety	P<0.001		P=0.02	
PGR timing	P=0.002		NS* (P=0.055)	
Variety x PGR timing	P=0.02		NS* (P=0.055)	
LSD (P=0.05)				
Variety	0.4		1.0	
PGR timing	0.6		1.4	
Variety x PGR timing	0.9		2.0	
CV%	5		10.9	

Application of PGRs had a reduction in lodging in Compass barley (Table 4). RGT Planet remained upright without the need for PGRs. Lodging assessments carried out at multiple times towards the latter part of the season suggest that the application and timing of Moddus Evo make a difference to overall lodging. A GS32 application or combination of GS30 and GS37 is more effective at reducing late season lodging than no application, or a single GS30 application (Table 4). The product label recommends application between GS31 and GS37. These trial results suggest that applying earlier than these timings as a single application would have no effect. Waiting to apply until after GS30 means that stem elongation has initiated and therefore upward stem growth would be affected. Applying too early or too late reduces the effect of the PGR as there is no stem growth to reduce.

There was extensive lodging seen in all Compass plots at harvest following a late season heavy storm that really tested stem strength. If early lodging occurs, as it did in many Compass crops in 2016, re-tillering is common causing harvest delays or the need to desiccate. In this trial, although there was no significant yield difference, a PGR application at GS32 or GS30 and GS37 on Compass could improve the efficacy of harvestability, being of great value in a tight harvesting program.

Table 4. Lodging scores (% of whole plot lodged flat on ground) taken early (18 Oct), late (21 Nov) and at harvest (27 Nov) in Compass and RGT Planet with different timings of PGR application. Late and harvest assessments were taken following 39mm rain event on 16 Nov. *not significant at 95% confidence, significant with 90% confidence. Note high CV% for scoring suggests plots were variable for each treatment. Results should be interpreted with caution.

PGR treatment timing	Early lodging (% of plot)		Late lodging (% of plot)		Lodging at harvest (% of plot)	
	Compass	RGT Planet	Compass	RGT Planet	Compass	RGT Planet
No PGR	71.9	0.0	85.0	0.0	87.5	0.0
GS30	51.2	0.0	76.9	0.0	78.1	0.0
GS32	38.1	0.0	63.1	0.0	65.0	0.0
GS30 and GS37	56.2	0.0	69.4	0.0	73.8	0.0
Sig. diff.						
Variety	P<0.001		P<0.001		P<0.001	
PGR timing	NS* (P=0.077)		P=0.043		P=0.03	
Variety x PGR timing	NS* (P=0.077)		P=0.043		P=0.03	
LSD (P=0.05)						
Variety	9.0		5.6		5.2	
PGR timing	12.7		7.9		7.4	
Variety x PGR timing	18.0		11.1		10.5	
CV%	65.7		30		27.3	

What was the effect on grain quality?

Compass was selected because of its increased susceptibility to head loss and lodging in high yielding environments. RGT Planet, a new variety in the region, was selected to better understand its performance and contribute towards an agronomic package. Compass produced grain with a higher retention and protein percentage than RGT Planet on average. Both varieties produced good protein. however as they are lacking malt accreditation at this stage this benefit was lost to feed grade (Table 5).

Table 5. Varietal differences in grain quality specifications (%) between Compass and RGT Planet barley. Note high CV% for screenings suggests plots were variable for each treatment. Results should be interpreted with caution.

Variety	Mean protein (%)	Mean retention (%)	Mean screenings (%)	Mean test weight (kg/hL)
Compass	13.25	83.65	3.99	65.02
RGT Planet	11.80	79.26	3.16	65.42
Sig. diff.	P<0.001	P=0.001	P=0.005	NS
LSD (P=0.05)	0.39	2.55	0.56	-
CV%	6.2	6.2	31.1	1.5

The high nitrogen rate (160kg N/ha) had negative impacts on grain quality. There was loss in yield in RGT Planet, increased screenings in Compass and reduced retention in both varieties as a result of excessive nitrogen causing moisture stress towards the end of the season (Table 6). Nitrogen rates applied in this trial had no interaction with PGR effects.

Table 6. Average grain quality results of Compass and RGT Planet barley under high and low N rate treatments. Note high CV% for screenings suggests plots were variable for each treatment. Results should be interpreted with caution.

N rate	Mean protein (%)		Mean retention (%)		Mean screenings (%)		Mean test weight (kg/hL)	
	Compass	RGT Planet	Compass	RGT Planet	Compass	RGT Planet	Compass	RGT Planet
80N	12.8	11.3	86.6	80.8	3.4	3.0	65.3	65.1
160N	13.7	12.3	80.7	77.7	4.6	3.3	64.8	65.7
Sig. diff.								
Variety	P<0.001		P=0.001		P=0.005		NS	
N rate	P<0.001		P<0.001		P=0.011		NS	
Var x N rate	NS		NS		NS		NS	
LSD (P=0.05)								
Variety	0.4		2.6		0.6		0.5	
N rate	0.4		2.6		0.6		0.7	
Var x N rate	-		-		-		-	
CV%	6.2		6.2		31.1		1.5	

There was no effect on grain quality from any PGR treatments in either variety.

COMMERCIAL PRACTICE

Moddus Evo applied to Compass or RGT Planet barley in 2017 had no impact on final yields however, harvestability could have been improved through the reduction of lodging in Compass. When applied at GS32 and GS30 and GS37, lodging at harvest was reduced in comparison to Moddus Evo applied at GS30 or not at all. To have more standing crop would allow for faster harvest speeds and help with grain capture on uneven ground where lower harvest heights are not possible.

When it comes to application timing, earlier is not necessarily the answer, rather knowing your growth stages and getting the correct timing. Waiting to apply PGR with another spray may be missing the chance to make a difference at the end of the season. Application of Moddus Evo following GS30 (GS31 and GS37) will target stem elongation, potentially impacting on plant height growth. This trial

has shown that application early in stem elongation (GS32) has the greatest effect on plant height in Compass. A double application at early stem elongation and GS37 (the end of stem elongation) will help to reduce stem height growth and prevent 'bounce- back' when primary application effects begin wearing off.

Variety choice is an obvious message in this trial. RGT Planet is much less susceptible to lodging than Compass barley. Choosing a variety that suits the environment and understanding the economics around the local and seasonal risks is a key step. Looking at the whole package and understanding variety response to PGRs will help to make the decision of whether to apply a PGR like Moddus Evo to barley.

Choosing whether to apply a PGR to barley is a difficult decision as it needs to be made in July based on a prediction of what will happen in September. Given the uncertainty around seasonal rainfall in the dryland system of the Wimmera and Mallee, the investment in early PGR applications comes at a higher risk than in the high rainfall zone. PGR application however may provide an option to improve yield when a decision made earlier in the season is not beneficial to production later in the season e.g. variety choice, incorrect sowing date/window or mismatched nitrogen management.

ON-FARM PROFITABILITY

PGR application in 2017 had no economic benefit in Compass or RGT Planet barley at any of the timings. The cost of product and application would have set you back $19.65/ha for a single application and $39.30/ha for a double application.

Topdressing with a high rate of nitrogen had no impact on PGR effectiveness and caused moisture stress that was detrimental to final yield in RGT Planet, and grain quality in both varieties. The loss from lower grain quality was not enough to downgrade the barley as both varieties are currently feed varieties. The loss from reduced yield under the high nitrogen application rate in RGT Planet would equate to $51.83/ha.

Cost of urea applications at the low rate (80N or 174kg/ha) was $80/ha and high rate (160N or 348kg/ha) was $160/ha. So, considering the loss from yield at the high N application rate in RGT Planet and the increased cost of applying more urea, the total loss from high N rate application was $131.83/ha. As Compass did not present significant yield difference from the high N rate application, the only loss was in the additional cost of urea at $80/ha more than that of low N rate treatments.

REFERENCES

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