The interaction between plant growth regulator (PGR) and nitrogen application in early-sown first wheat

Location: Dookie, Victoria

Sowing date: 19 May 2015
Rotation: First wheat after canola
Variety: Trojan
Stubble management: Canola unburnt
Rainfall:
GSR: 233mm (April–Oct)
Summer rainfall: 76mm

Key points

- With an average yield of almost 3t/ha, increasing the rate of nitrogen (N) applied (40 and 80 extra kilograms N/ha) did not affect dry matter (DM) accumulation, crop height or final yield of first wheat following canola.
- Applying a plant growth regulator (PGR) (chlormequat + Moddus) decreased crop height, but did not influence DM or grain yield.
- Although differences were small, the PGR application significantly decreased screenings and increased test weight.
- Applying the PGR also decreased crop reflectance, measured as normalised difference vegetation index (NDVI), during stem elongation (GS39); a result also observed during 2013 and 2014.
- The lower NDVI readings suggest PGR altered the greenness of the crop canopy or the orientation of the leaves, decreasing the crop reflectance.

Method

A commercial crop of wheat, cv Trojan, sown 19 May 2015, was fertilised with three different rates of nitrogen (142, 188 and 222kg N/ha) applied as granular urea fertiliser (46% N). The nitrogen was applied as detailed in Table 1. Nitrogen treatments then received a single application of PGR (chlormequat + Moddus) at the second-node stage (GS32) as outlined in Table 2.

Results

i) Dry matter accumulation

Increasing nitrogen application above the farm standard and applying a PGR had no significant effect on crop DM when assessed at booting (GS43), watery ripe grain fill (GS71) and harvest (GS99) (Table 3). However, there was a significant interaction of the two factors on DM at harvest (Figure 1). The interaction between PGR and nitrogen timing suggested that at the highest rate of nitrogen DM increased with PGR, which was not seen with no PGR applied.

ii) Crop reflectance using normalised difference vegetation index

The additional nitrogen applied above the farm standard did not increase the NDVI recorded with the Greenseeker® after the third node (GS33) assessment (Figure 2 and Table 4). As was seen during 2014, the PGR application resulted in a slight decrease in NDVI. This may be due to the PGR treatment making the leaves more erect in the crop canopy, resulting in less crop reflectance, however the differences were very small being significant on only one occasion post application in 2015.

iii) Crop height

The application of PGR significantly decreased crop height by 5cm (Table 5). However, as the additional nitrogen did not affect crop height, there was no interaction between factors.

TABLE 1 Nitrogen application rates and timings Dookie, Victoria

Nitrogen treatment	19 May 2015 (sowing) (kg N/ha)	3 July 2015 (kg N/ha)	24 July 2015 (GS23) (kg N/ha)	31 July 2015 (kg N/ha)	12 August 2015 (kg N/ha)	Total nitrogen applied (kg N/ha)
Standard nitrogen applied	4	46	Nil	46	46	**142**
Standard + 40kg N/ha	4	46	40	46	46	**182**
Standard + 80kg N/ha	4	46	80	46	46	**222**

TABLE 2 PGR application details

		Application equipment	GS32
		Nozzle brand	Agrotop
		Nozzle type	Air inducted flat fan
Crop height (cm)	40	Nozzle size	AirMix 11001
Equipment	CO_2 pressurised backpack sprayer with hand boom	Nozzle spacing (cm)	50
Soil moisture	Moist	Boom height above crop(cm)	50
Air temperature (°C)	13.8	Operating pressure (kPa)	260
Cloud cover (%)	98		
Relative humidity (%)	61.1	Spray volume (L/ha)	100
Droplet size	Medium		

TABLE 3 Dry matter 24 September 2015, flag leaf fully emerged (GS39), 15 October 2015, start of grain fill (GS71) and 20 November 2015, harvest (GS99)

	DM (t/ha)		
Nitrogen treatment	**GS39**	**GS71**	**GS99**
Standard (142kg N/ha)	8.11[a]	11.22[a]	10.74[a]
Standard + 40kg N/ha	8.76[a]	11.66[a]	11.10[a]
Standard + 80kg N/ha	8.71[a]	11.32[a]	10.55[a]
Mean	**8.53**	**11.40**	**10.80**
LSD	0.67	0.78	1.08
PGR treatment			
Untreated control	8.61[a]	11.44[a]	11.03[a]
Moddus + chlormequat	8.45[a]	11.36[a]	10.57[a]
LSD	0.55	0.64	0.88

Figures followed by different letters are regarded as statistically significant.

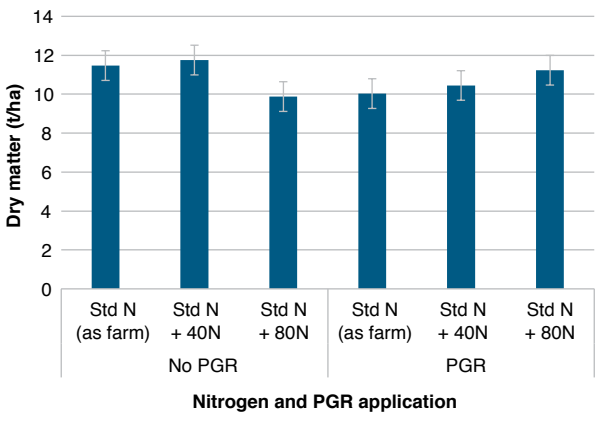

FIGURE 1 Interaction between nitrogen rate and PGR application on dry matter production 27 November, harvest (GS99)
The error bars are a measure of LSD.

iv) Yield and quality

Nitrogen effect

Additional nitrogen did not affect yield, although test weight increased and screenings were lower with the highest nitrogen application (Table 6). The low yields and high protein levels indicate the optimum nitrogen application for this site was lower than the farm standard of 142kg N/ha, which meant the extra nitrogen had no positive effect on yield in this trial.

PGR effect

PGR application resulted in significantly higher test weight and reduced screenings, but yield was not affected.

Nitrogen x PGR interaction

The interaction between additional nitrogen and PGR was not significant in terms of yield and grain quality (Figures 3 and 4).

TABLE 4 NDVI readings measured 25 August, second node (GS32), 11 September, third node (GS33), 24 September, flag leaf fully emerged (GS39) and 15 October, start of grain fill (GS71)

Treatment	NVDI reading (scale 0–1)			
Nitrogen treatment	**GS32**	**GS33**	**GS39**	**GS71**
Standard (142kg N/ha)	0.57[a]	0.68[b]	0.76[a]	0.45[a]
Standard + 40kg N/ha	0.59[a]	0.71[a]	0.78[a]	0.46[a]
Standard + 80kg N/ha	0.58[a]	0.70[ab]	0.78[a]	0.46[a]
Mean	**0.58**	**0.70**	**0.77**	**0.46**
LSD	0.02	0.05	0.04	0.03
PGR treatment				
Untreated control	0.58[a]	0.71[a]	0.78[a]	0.47[a]
Moddus + chlormequat	0.58[a]	0.69[a]	0.76[b]	0.45[a]
LSD	0.03	0.02	0.01	0.03

Figures followed by different letters are regarded as statistically significant.

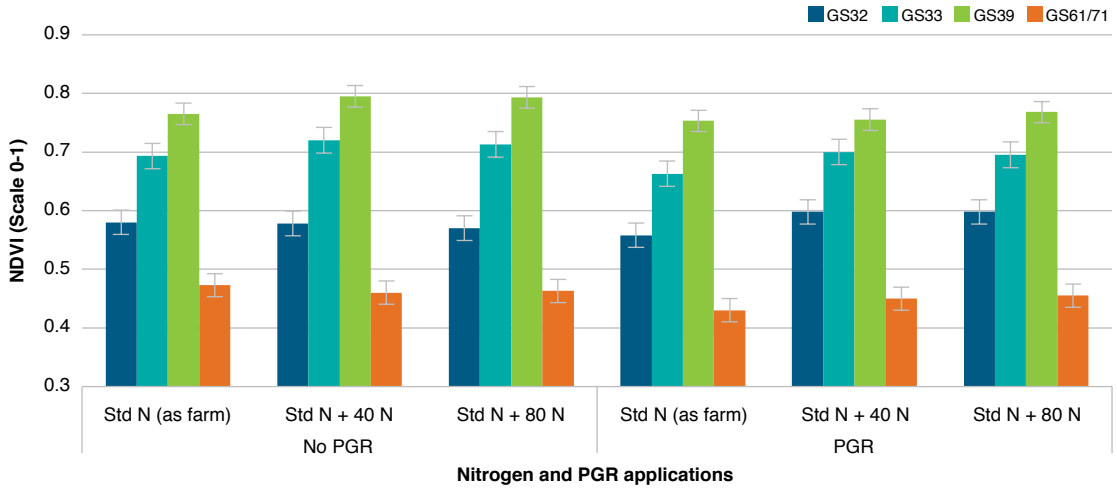

FIGURE 2 Interaction between nitrogen rate and PGR application on NDVI (0–1 scale) GS32–GS71
The error bars are a measure of LSD

TABLE 5 Crop height at harvest (GS99), 27 November 2015

Treatment	Height (cm)
Nitrogen treatment	
Standard (142kg N/ha)	67.3[a]
Standard + 40kg N/ha	67.2[a]
Standard + 80kg N/ha	67.2[a]
Mean	**67.2**
LSD	1.8
PGR treatment	
Untreated control	69.7[a]
Moddus + Chlormequat	64.7[b]
LSD	1.5

Figures followed by different letters are regarded as statistically significant.

Conclusions

For the second year in succession there have been no yield benefits to the application of PGR (chlormequat + Moddus), although there was evidence in 2015 that PGR application reduced screenings and increased test weight. Although there has been a trend for PGR application to reduce final harvest dry matter in both 2014 and 2015 the reduction has not been significant.

Acknowledgements

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TABLE 6 Yield, protein, screenings and test weight at harvest (GS99), 27 November 2015

Treatment	Yield and quality			
Nitrogen treatment	**Yield (t/ha)**	**Protein (%)**	**Test weight (kg/hL)**	**Screenings (%)**
Standard (142kg N/ha)	3.05[a]	17.0[a]	79.7[b]	12.5[b]
Standard + 40kg N/ha	2.96[a]	17.2[a]	79.1[b]	15.7[a]
Standard + 80kg N/ha	2.86[a]	17.2[a]	80.6[a]	8.4[c]
Mean	**2.96**	**17.1**	**79.8**	**12.2**
LSD	0.21	0.8	0.9	3.0
PGR treatment				
Untreated control	2.91[a]	17.2[a]	78.9[b]	14.8[a]
Moddus + chlormequat	3.00[a]	17.1[a]	80.7[a]	9.6[b]
LSD	0.17	0.7	0.7	2.5

Figures followed by different letters are regarded as statistically significant.

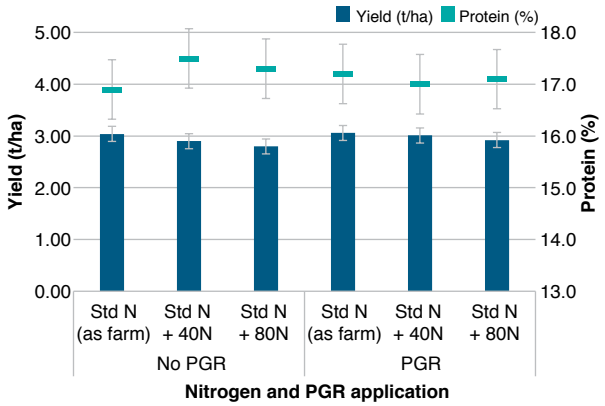

FIGURE 3 Influence of nitrogen application and PGR application on yield and protein
The error bars are a measure of LSD

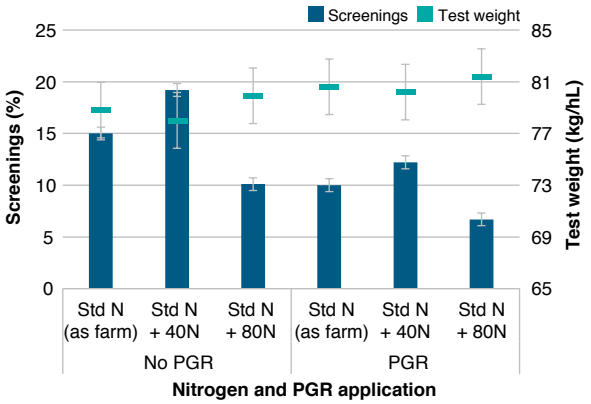

FIGURE 4 Influence of nitrogen application and PGR application on screenings and test weight
The error bars are a measure of LSD

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