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

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Key points

- For a wheat crop with an average yield of 4.5–5t/ha, increasing the rate of nitrogen (N) applied (40 and 80 extra kilograms of nitrogen per hectare above the farm standard) significantly increased dry matter (DM) accumulation, crop height and final yield of first wheat following canola.
- Applying a plant growth regulator (PGR) (Moddus + chlormequat) reduced crop height by 3cm and significantly decreased DM production.
- A small, non-significant yield reduction was measured with PGR application, which was similar to that observed during 2014, when yields were in the 5–6t/ha range. Conversely, during 2015, there was a positive yield effect of 0.1t/ha, when average crop yield was approximately 3t/ha.
- Although differences were small, the PGR application significantly increased screenings and decreased test weight, results that are not in line with the effects observed during 2015.
- After three years of trials there is no evidence to suggest PGR application has delivered any positive yield effects or consistent quality effects.
- In all three years of trials, PGR application showed a trend to reduce DM, which was significant in 2016.

Location: Yarrawonga, Victoria
Sowing date: 17 May 2016
Rotation: First wheat after canola
Variety: Beckom
Stubble management: Canola unburnt
Rainfall:
GSR: 604mm (April–October)
Summer rainfall: 125mm
Soil mineral nitrogen: 50kg N/ha (0–60cm)

Method

A commercial crop of wheat, cv Beckom, sown 17 May 2016, was fertilised with three different rates of nitrogen (104, 144 and 184kg 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 (Moddus + chlormequat) at the third-node stage (GS33) as outlined in Table 2.

Results

i) Dry matter accumulation

Increasing nitrogen application from 104kg N/ha to 184kg N/ha significantly increased DM production when assessed at flowering (GS61) and harvest (GS99). Applying the PGR significantly reduced DM when all levels of nitrogen were averaged at harvest (Table 3). There was no significant interaction of the two factors (nitrogen and PGR) on DM at harvest, indicating that PGR application did not influence DM based on nitrogen rate. There was a significant reduction in DM with PGR application when 104kg N/ha was applied, compared with 184kg N/ha, however the reduction without PGR was not significant (Figure 1).

ii) Crop reflectance using normalised difference vegetation index (NDVI)

The additional nitrogen applied above the farm standard significantly increased the NDVI recorded with the Greenseeker® after the third node (GS33) assessment (Table 4). The PGR application resulted in a slight decrease in NDVI as was seen during 2014 and 2015, but in 2016 this decrease was not significant when all nitrogen levels were averaged (Figure 2).

iii) Crop height

Under a standard nitrogen application, the addition of PGR reduced crop height by 3cm at harvest. However when a PGR was applied with an extra 80kg/ha of nitrogen, there was no reduction in crop height compared with the control (Figure 2). Additional nitrogen significantly increased crop height (by more than 4cm at the highest nitrogen level).

iv) Yield and quality

Nitrogen effect

Despite the 2016 trial being sown later than previous seasons (a factor that would traditionally decrease yield potential and with it the need for nitrogen), additional nitrogen significantly increased yield and resulted in a response of more than 1t/ha to an additional 80kg N/ha and a 0.5t/ha response from an extra 40kg N/ha when plus and minus PGR results were averaged (Table 5).

TABLE 1 Nitrogen application rates and timings Yarrawonga, Victoria

Nitrogen treatment	17 May 2016 (sowing) (kg N/ha)	25 July 2016 (kg N/ha)	28 July 2016 (GS30) (kg N/ha)	15 August 2016 (kg N/ha)	Total nitrogen applied (kg N/ha)
Standard nitrogen applied	7	58	Nil	39	**104**
Standard + 40kg N/ha	7	58	40	39	**144**
Standard + 80kg N/ha	7	58	80	39	**184**

TABLE 2 PGR application details

Application description		Application equipment	
Date	29 August 2016	**Nozzle brand**	Agrotop
Crop growth stage	GS33	**Nozzle type**	Air inducted flat fan
Crop height (cm)	50	**Nozzle size**	AirMix 11001
Equipment	Petrol driven backpack sprayer with hand boom	**Nozzle spacing (cm)**	50
Soil moisture	Moist	**Boom height above crop (cm)**	50
Air temperature (°C)	16.8	**Operating pressure (kPa)**	300
Cloud cover (%)	50	**Ground speed (km/h)**	4.82
Relative humidity (%)	70.8	**Spray volume (L/ha)**	100
Droplet size	Medium		
Wind velocity (km/h)	5.5		
Wind direction	NEE		

TABLE 3 Dry matter 9 September 2016, flag leaf fully emerged (GS39); 5 October 2016, start of flowering (GS61) and 7 December 2016, harvest (GS99)

Nitrogen treatment	DM (t/ha)		
	GS39	GS61	GS99
Standard (104kg N/ha)	3.97[a]	6.29[b]	10.37[b]
Standard + 40kg N/ha	4.10[a]	6.02[b]	11.14[b]
Standard + 80kg N/ha	4.15[a]	7.03[a]	12.23[a]
Mean	**4.07**	**6.45**	**11.25**
LSD	0.29	0.68	1.05
PGR treatment			
Untreated control	4.13[a]	6.46[a]	11.83[a]
Moddus + chlormequat	4.02[a]	6.44[a]	10.67[b]
LSD	**0.30**	**0.31**	**0.98**

Figures followed by different letters are regarded as statistically significant.

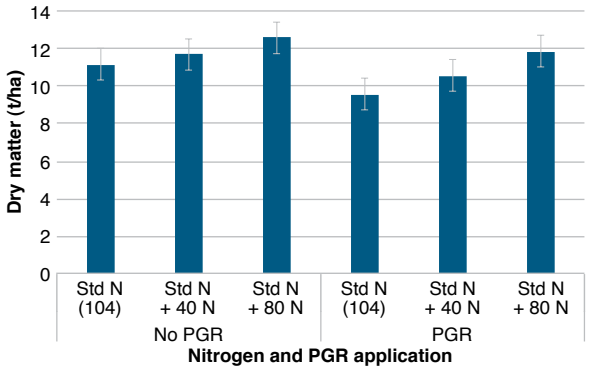

FIGURE 1 Interaction between nitrogen rate and PGR application on dry matter production 7 December, harvest (GS99)

The error bars are a measure of LSD 1.69 t/ha — *interaction not significant*

Despite a significant reduction in harvest DM with PGR application there was no significant difference in yield when all nitrogen levels were averaged. Additional nitrogen significantly increased grain protein, indicating applied nitrogen rates may have been sub-optimal as grain protein levels did not exceed 9%.

PGR effect

Although differences were small, PGR application resulted in significantly lower test weight and higher screenings (less than 1.0% difference), but yield was not affected.

Nitrogen x PGR interaction

There were no significant interactions between additional nitrogen and PGR application in terms of yield or grain quality (Figures 3 and 4). Differences in harvest DM with PGR addition did not correspond to any differences in the harvest index (% DM harvested as grain) as shown in Table 5.

Although there is no significant difference in yield plus and minus PGR at the lowest nitrogen level, it is noticeable that PGR looks to have been more detrimental at the lowest nitrogen level tested.

TABLE 4 NDVI readings measured 24 August, second node (GS32); 29 August, third node (GS33); 16 September, flag leaf fully emerged (GS39) and 6 October, start of flowering (GS61)

Nitrogen treatment	NVDI reading (scale 0–1)			
	GS32	GS33	GS39	GS61
Standard (104kg N/ha)	0.640[a]	0.694[a]	0.774[c]	0.694[c]
Standard + 40kg N/ha	0.620[a]	0.708[a]	0.815[b]	0.747[b]
Standard + 80kg N/ha	0.632[a]	0.748[a]	0.836[a]	0.777[a]
Mean	**0.631**	**0.717**	**0.808**	**0.739**
LSD	0.034	0.056	0.011	0.021
PGR treatment				
Untreated control	0.628[a]	0.704[a]	0.813[a]	0.750[a]
Moddus + chlormequat	0.633[a]	0.730[a]	0.804[a]	0.728[a]
LSD	0.027	0.030	0.019	0.022

Figures followed by different letters are regarded as statistically significant.

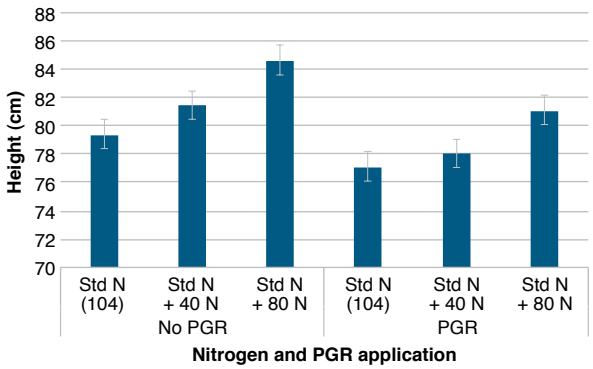

FIGURE 2 Interaction between nitrogen rate and PGR application on crop height at harvest, 7 December 2016

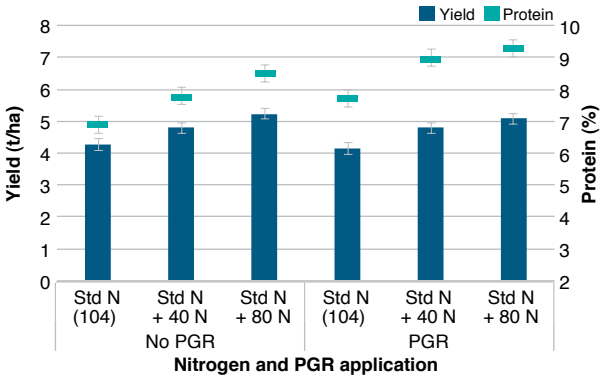

FIGURE 3 Influence of nitrogen application and PGR application on yield and protein

The error bars are a measure of LSD Yield (0.35 t/ha), Protein (0.54%) — interactions are not significant.

TABLE 5 Yield, protein, test weight, screenings, and harvest index (HI) at harvest (GS99), 11 December 2016

Nitrogen treatment	Yield and quality				
	Yield (t/ha)	Protein (%)	Test weight (kg/hL)	Screenings (%)	HI (%)
Standard (104kg N/ha)	4.21[b]	7.3[b]	79.4[a]	2.0[a]	40.3[a]
Standard + 40kg N/ha	4.79[a]	8.4[a]	80.3[a]	1.6[a]	42.5[a]
Standard + 80kg N/ha	5.15[a]	8.9[a]	79.6[a]	2.1[a]	41.5[a]
Mean	**4.72**	**8.2**	**79.8**	**1.9**	**41.4**
LSD	0.37	1.0	1.9	0.7	6.0
PGR treatment					
Untreated control	4.77[a]	7.7[b]	80.7[a]	1.5[b]	39.8[a]
Moddus + chlormequat	4.67[a]	8.6[a]	78.8[b]	2.3[a]	43.1[a]
LSD	0.20	0.3	1.3	0.5	4.1

Figures followed by different letters are regarded as statistically significant.

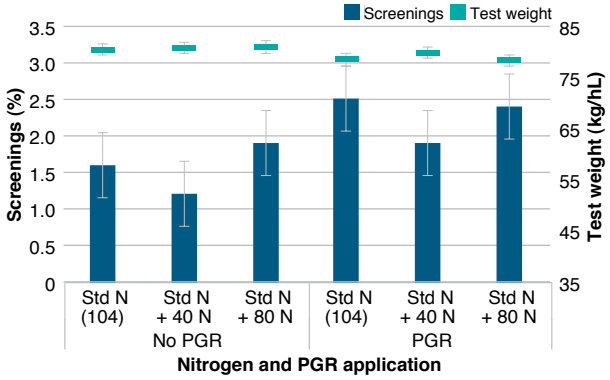

FIGURE 4 Influence of nitrogen and PGR application on screenings and test weight

The error bars are a measure of LSD Screenings (0.9%), Test weight (2.3kg/hl) – no interactions are significant.

Conclusions

For the third year in succession there have been no significant yield benefits to the application of PGR (Moddus + chlormequat) irrespective of the different nitrogen levels applied. There has been a trend in all three years (which was significant in 2016) to show that PGR application reduces final harvest DM. The influence of PGR application on grain quality has been minimal, with some small positive trends in 2015 and small negative effects recorded in 2016. With a range of soft finish (2014, 2016) and hard finish seasons (2015), the work has given variable results to increasing nitrogen rate (above 80–100kg N/ha) in first wheat after canola. In 2014 (5t/ha yields) and 2015 (3t/ha yields) there was no yield response to extra nitrogen due to high background nitrogen levels, while in 2016 there was up to a 1t/ha yield response to an extra 80kg N/ha when the trial was moved to a site with lower starting nitrogen levels.

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