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Lodging management of barley in 2011 – Spring Ridge, Tamworth and Bellata

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Introduction

Lodging is a major limitation to the wider use of barley in northern farming systems. Lodged crops can severely limit grain yield and reduce grain quality, not to mention the difficulties associated with harvest. Research into lodging of barley has focussed on both genetic and management solutions. Management options available to growers include variety selection, plant population, defoliation and plant growth regulators (PGRs). Defoliation during tillering (GS25) and up to stem elongation (GS31) has been reported to be an effective means for reducing both the incidence and severity of lodging. Plant Growth Regulators are a widely used management tool for preventing lodging of cereal crops in Europe and New Zealand. The primary PGRs used for lodging management shorten the stem by inhibiting the synthesis of the plant hormone gibberellin. By preventing the synthesis of gibberellin at early stem elongation (GS30-32), PGRs have the capacity to shorten the lower internodes (space between nodes) of the stem, therefore, shortening the overall crop height. Crop height reductions can be in the order of 5–20 cm. There is also some evidence that PGRs can induce thickening of the stem wall which reduces lodging.

A trial investigating lodging management options including variety, plant population, defoliation and PGRs was conducted at 3 sites throughout the northern region in 2011. All sites experienced extremely dry conditions during June, July and August. In contrast, above average rainfall was received in September, October and November, which was also accompanied by very mild temperatures.

Site details

Location:	Tamworth	“Yarooga”, Spring Ridge	“Boggy Creek”, Bellata
Co-operator:	NSW DPI	Angus Murchison	Brian Lowe
Sowing Date:	10th June 2011	21st June 2011	6th June 2011

Treatments

Commander[Ⓛ] and Oxford[Ⓛ] were the two varieties used for the trial. Commander[Ⓛ] is extremely susceptible to lodging while Oxford[Ⓛ] has good straw strength. The two varieties were grown at plant populations of 60, 80 or 120 plants/m². There were four PGR treatments nil, Cycocel[®], Moddus[®] and a combination of Cycocel[®] and Moddus[®]. All treatments had either plus or minus defoliation at GS31.

Results

Yield

There was no significant interaction between treatments for grain yield at any of the 3 sites. Defoliation at stem elongation significantly reduced grain yield by 4.1 and 4.3% at Spring Ridge and Bellata, respectively. At Spring Ridge, Oxford[Ⓛ] significantly out yielded Commander[Ⓛ] by 0.31 t/ha. The PGR treatments had a significant affect on grain yield at Tamworth (Figure 1). Cycocel[®] (6.37 t/ha) had a greater grain yield than both Moddus[®] (6.05 t/ha) and the Nil treatment (5.94 t/ha) (Figure 1).

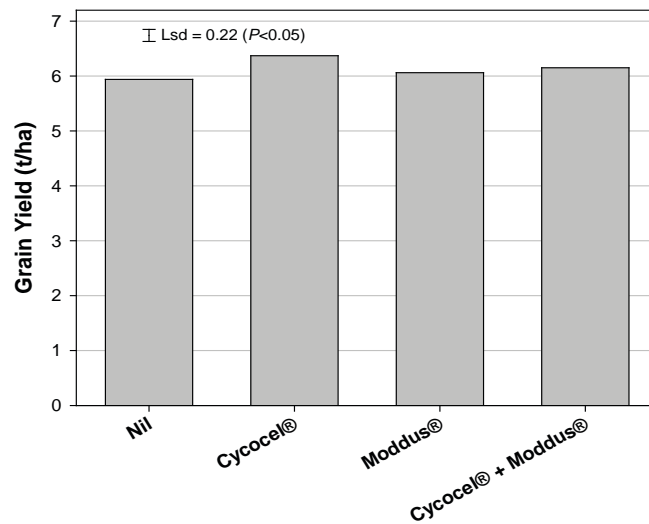


Figure 1. Grain yield at Tamworth for Nil, Cycocel®, Moddus® and Cycocel® + Moddus® PGR treatments.

Lodging

Bellata had minimal to no lodging pressure compared to Tamworth and Spring Ridge. Although the Tamworth site had lower lodging compared to Spring Ridge the trends were similar (Table 1). Commander[Ⓛ] is a more susceptible variety to lodging compared to Oxford[Ⓛ], which has strong straw strength (Table 1). At both the Tamworth and Spring Ridge sites lodging severity for Commander[Ⓛ] was approximately 3 times what was observed for Oxford[Ⓛ] (Table 1). Defoliation at stem elongation reduced lodging severity regardless of variety or PGR treatment (Table 1). The combination of Cycocel® and Moddus® was the most effective PGR treatment to reduce lodging severity compared to the control treatment (Nil PGR and – defoliation) (Table 1).

Table 1. Lodging scores (Scale 0-9, where 0 is standing and 9 is flat on the ground) at harvest for the Spring Ridge and Tamworth sites.

PGR	Spring Ridge				Tamworth			
	Commander [Ⓛ]		Oxford [Ⓛ]		Commander [Ⓛ]		Oxford [Ⓛ]	
	– defoliation	+ defoliation	– defoliation	+ defoliation	– defoliation	+ defoliation	– defoliation	+ defoliation
Nil	7.2	5.2	3.0	1.9	3.0	2.3	1.0	1.0
Cycocel®	6.2	5.3	1.8	1.6	2.0	1.7	0.2	0.7
Moddus®	5.3	4.9	1.8	1.6	2.0	1.3	0.0	0.0
Cycocel® + Moddus®	4.6	4.3	1.9	0.9	1.8	1.4	0.0	0.0

Plant Height

The ability of PGRs to reduce the severity of lodging appears to be related to the capacity to restrict plant height (Figure 2). The nil PGR treatments had the greatest plant heights while Cycocel® + Moddus® was the most effective treatment at restricting plant height (approximately 4–5 cm) (Figure 2). Moddus® restricted plant height to a greater extent than Cycocel® (Figure 2). Again similar trends were observed at Tamworth, where Moddus® + Cycocel® significantly restricted plant height by 3 – 4 cm compared to the nil treatment (Figure 2).

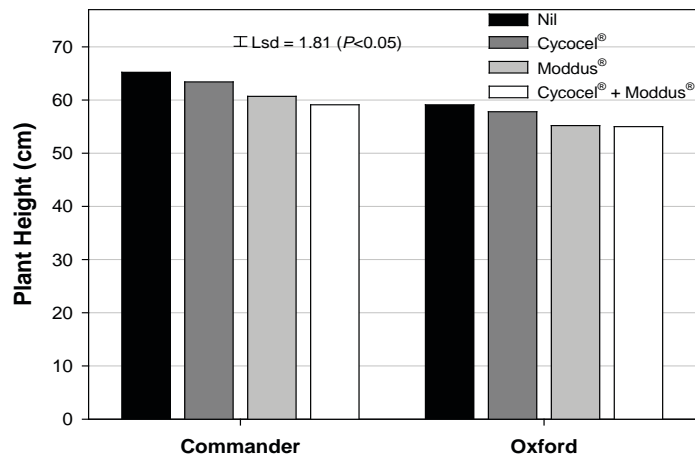


Figure 2. The effect of four PGR treatments on plant height of Commander and Oxford¹ at Spring Ridge 2011.

Dry Matter (DM) Yield

Restricting the size of the crop canopy or DM production, like restricting plant height, is another effective means of reducing the severity of lodging. Defoliation and plant population were the most effective management strategies for restricting the DM production at Anthesis (GS61) and maturity (GS99). On average across sites defoliation reduced DM yield at anthesis by 5 – 9%, however, these reductions in DM yield by maturity were negligible. In contrast, the 60 and 80 plants/m² populations maintained a significantly lower DM yields than 120 plants/m² population at both anthesis and maturity (Figure 3).

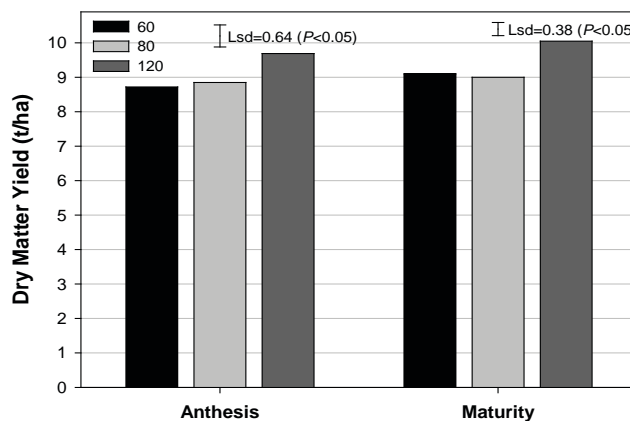


Figure 3. Dry Matter yield for the 60, 80 and 120 plants/m² populations at anthesis and maturity.

Summary

Choosing a variety that is less susceptible to lodging is the most effective management option for reducing the losses from and severity of lodging. Where a susceptible variety to lodging such as Commander¹ is grown defoliation prior to stem elongation can reduce the severity to lodging and limit the canopy size at anthesis. It is essential that defoliation **does not** occur beyond stem elongation (GS31) as significant yield penalties could be expected. Maintaining plant populations at approximately 80 plants/m² enabled DM yield to be restricted throughout the growing season, without significantly limiting yield. Of the PGR treatments the combination of Cycocel® and Moddus® reduced the severity of lodging to the greatest degree. It is important to note that Moddus® is not currently registered for use on cereals in Australia although it is widely used throughout New Zealand and Europe. Applying both Cycocel® and Moddus® blocks the synthesis of Giberellin in 2 places as opposed to 1 if a single product is applied, this may explain why this treatment was most effective at reducing. Responses to the application of PGR products have been highly variable between trial sites and between seasons. The mechanism that influences the efficacy of PGR products is not well understood under Australian conditions and requires further investigation.

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