SECTION 10

Plant growth regulators and canopy management

10.1 Canopy management

Canopy management is the manipulation of the green surface area of the crop canopy to optimise crop yield and inputs. It is based on the premise that the crop's canopy size and duration determine its photosynthetic capacity and therefore its overall grain productivity.

Adopting canopy-management principles and avoiding excessively vegetative crops may enable growers to achieve a better match of canopy size with yield potential, as defined by the available water. Other than sowing date, plant population is a starting point for the grower to influence the size and duration of the crop canopy. [1]

More information

BCG: Barley canopy management trial—Mallee

GRDC: Disease management and crop canopies

SFS: Crop agronomy trials—June sown Gairdner, Inverleigh, Vic.

The concept of canopy management has been primarily developed in Europe and New Zealand—both different production environments from those typically found in most grain-producing regions of Australia.

Canopy management includes a range of crop-management tools for crop growth and development, to maintain canopy size and duration, thereby optimising photosynthetic capacity and grain production. One of the main tools available to growers to manage the crop canopy is the rate and timing of applied fertiliser nitrogen (N). [2]

Results from the Southern Region have shown potential for the use of canopy management, especially in areas with high yield potential and therefore higher N inputs. At Inverleigh in Victoria, June-sown Gairdner⊕ showed a significant yield advantage when N application was timed at stem elongation (Zadoks growth stage, GS31–33) over N applied in the seedbed. [3]

10.1.1 Importance of canopy management

Nitrogen application at stem elongation is associated with higher protein levels. Therefore, growers of malting barley need to be aware that although delayed timing of N can be useful in barley, higher protein content may need to be countered with lower total N doses if a greater proportion of N application is moved from seedbed to stem elongation. [4]

If the canopy becomes too big, it competes with the growing heads for resources, especially during the critical 30-day period before flowering. This is when the main yield component (grain number per unit area) is set. Increased competition from the

[1] N Poole (2005) Cereal growth stages. GRDC, http://www.grdc.com.au/uploads/documents/GRDC%20Cereal%20Growth%20Stages%20Guide1.pdf

[2] G McMullen (2009) Canopy management in the northern grains region—the research view. Northern Grains Alliance, July 2009, http://www.nga.org.au/results-and-publications/download/31/australian-grain-articles/general-1/canopy-management-tactical-nitrogen-in-winter-cereals-july-2009-.pdf

[3] SFS (2007) Defining guidelines for canopy management in barley for the different climatic regions of Australia—June sown Gairdner—Inverleigh, Vic. Crop Agronomy Trials. Southern Farming Systems/Online Farm Trials GRDC, http://www.farmtrials.com.au/view_attachment.php?trial_attachment_id=5118

[4] N Poole (2005) Cereal growth stages. GRDC, http://www.grdc.com.au/uploads/documents/GRDC%20Cereal%20Growth%20Stages%20Guide1.pdf

canopy with the head may reduce yield by reducing the number of grains that survive for grainfill.

After flowering, temperature and evaporative demand increase rapidly. If there is not enough soil moisture, the canopy dies faster than the grain develops, leading to the production of small grain.

Excessive N application and high seeding rates are the main causes of excessive vegetative production. Unfortunately, optimum N and seeding rates are season-dependent. Under drought conditions, N application and seeding rates that would be regarded as inadequate under normal conditions may maximise yield, whereas higher input rates may result in progressively lower yields. Alternatively, in years of above-average rainfall, yield may be compromised with normal input rates.

The extreme of this scenario of excessive early growth is haying-off, where a large amount of biomass is produced, using a lot of water and resources. Then, later in the season, there is insufficient moisture to keep the canopy photosynthesising and not enough stored water-soluble carbohydrates to fill the grain. Therefore, grain size and yield decrease.

To attain maximum yield, it is important to achieve a balance between biomass and resources. The main factors that can be managed are:

- plant population
- row spacing
- inputs of N
- sowing date
- weed, pest and disease control

Of these, the most important to canopy management are N, row spacing and plant population. [5]

10.1.2 Grazing cereal crops as a management tool

Well-managed, dual-purpose cereals provide producers with an opportunity for increased profitability and flexibility in mixed farming systems by enabling increased winter stocking rates and generating income from forage and grain. Typically, these crops are earlier sown, longer season varieties that provide greater DM production for grazing. Research has shown that to avoid grain-yield penalties, stock must be removed from cereals before the end of tillering (GS30). However, the timing and intensity of grazing during the season can incur yield penalties, particularly when grazing pressure is high and late in the grazing period.

More information

GRDC Update Papers: Grazing wheat and barley—impacts on crop management, lodging and grain yield

Grazing can sometimes be beneficial to grain production by reducing lodging; in seasons with dry springs, grazing can increase grain yields by reducing water use in the vegetative stages, leaving more soil water for grainfill. The challenge for growers is to find the balance of optimising DM removal without compromising grain production. [6]

10.1.3 Key stages for disease control and canopy management

The optimum timing for foliar-applied fungicides in cereals is from the start of stem elongation to ear emergence (GS30–59). In barley, the second-last leaf formed is the key leaf. This is the leaf below the flag and is termed flag minus 1 (flag –1). This leaf appears at approximately the third-node stage (GS33). This period coincides with the emergence of the four most important leaves in the crop and the ear.

5 N Fettell, P Bowden, T McNee, N Border (2010) Barley growth & development. PROCROP Series. Industry & Investment NSW/NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/516180/Procrop-barley-growth-and-development.pdf

6 GRDC (2102) grazing wheat and barley—impacts on crop canopy management. GRDC Update Papers, 23 March 2012), http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/03/Grazing-wheat-and-barley-impacts-on-crop-canopy-management-lodging-and-grain-yield

The optimum time for spraying a fungicide to protect a leaf is at full emergence. Leaves not emerged at the time of application will not be properly protected. Leaves will usually be free from foliar disease on emergence. The time between when the disease spores land on the leaf and when an infection point is visible is called the latent period or latent phase. This period is temperature-driven and differs between diseases. It can be as short as 7 days for diseases such as powdery mildew. [7]

It was common 5–10 years ago to make decisions on fungicide applications for foliar disease based on thresholds of infection. These thresholds varied from 1% to 5% of plants infected. However, growers and advisers found that, in the paddock, it was difficult to calculate when this disease threshold had been reached, not least because of the sporadic nature of the initial foci of the disease. In addition, by the time growers realised that the threshold had been reached and carried out the spray operation, the crops were badly infected. When crops that are badly infected with stripe rust are treated with fungicides, the control is poor because fungicides work better as protectants than as curatives.

Because the flag leaf is less important in barley than in wheat, it is far more difficult to pinpoint an optimal timing window for fungicide application in barley. In addition, most of the popular varieties such as Gairdner⊕ have some disease weaknesses. Therefore, growers are advised to monitor from late tillering (GS25) for the presence of disease on the older leaves. Consider application based on propiconazole (Tilt®, Bumper®) where net blotch and/or scald are evident on newer leaves at GS30, or triadimefon for mildew.

Barley requires careful monitoring, and its lower leaves, which emerge earlier than in wheat, are more important to the plant than are the lower leaves in wheat. Other points to consider when using fungicide in barley canopy management:

- The flag leaf is relatively small and unimportant in barley compared with wheat, and its appearance is therefore not a convenient midseason focal point for strategies.
- Earlier, more important, leaves that require fungicide application create a later season gap in protection; therefore, making two sprays more effective in this crop (Figure 1).
- Two-spray programs increase the likelihood of fungicide rate reduction with each spray. In wheat, fungicide activity against rusts is very effective at low rates; however, the existing fungicides do not control barley diseases as effectively at equally low rates.
- Barley often suffers from wet-weather diseases early in the season, but then is subject to drier/warmer weather diseases later in the season, again making it more difficult to target a single spray program under diverse disease pressure.

[7] N Poole (2005) Cereal growth stages. Grains Research and Development Corporation, http://www.grdc.com.au/uploads/documents/GRDC%20Cereal%20Growth%20Stages%20Guide1.pdf

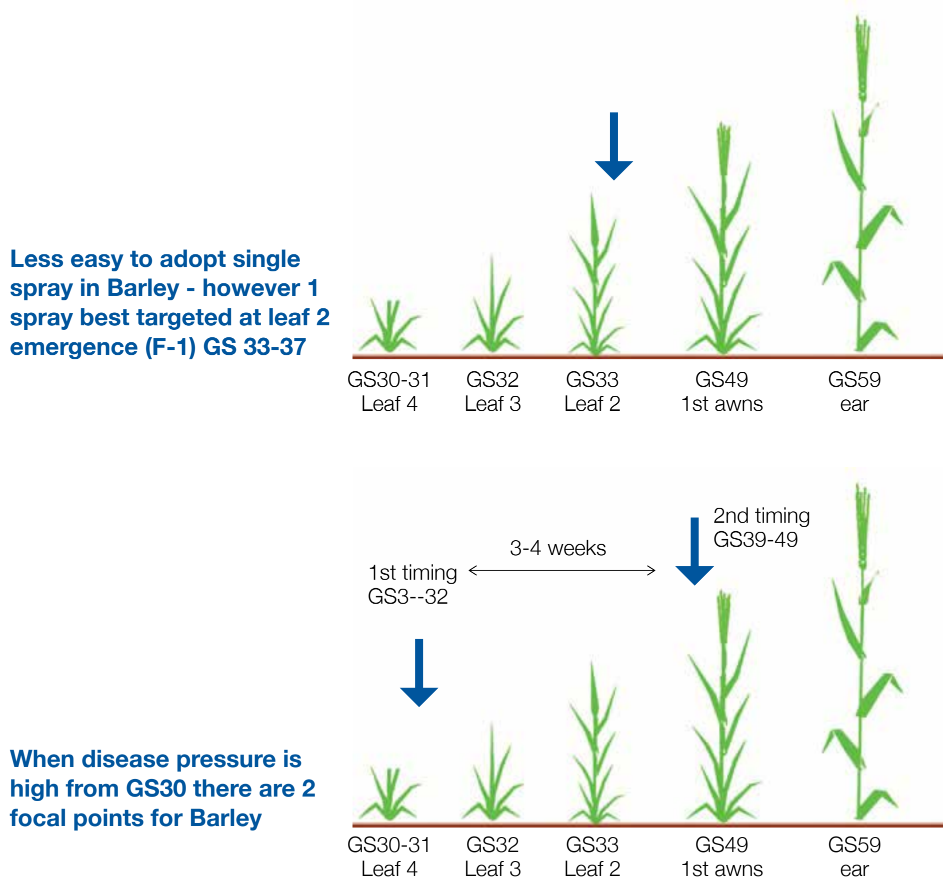

Figure 1: Key stages for disease control and canopy management.

Podcast

GRDC Driving Agronomy Podcasts: Disease management and crop canopies

10.2 Use of plant growth regulators

Plant growth regulators (PGRs) may be used to minimise crop lodging and maximise yield, particularly in high-N situations. PGRs have been used routinely in high-input, high-yielding cereal systems in Europe and New Zealand to shorten straw height and reduce the incidence of lodging. Lodging causes significant losses in crop production through reduced movement of water and nutrients and reduced translocation of plant-stored carbohydrates via the stem into the head. Lodging also reduces grain quality and increases harvest losses and the cost of the harvesting process.

Inhibitors of the plant hormone gibberellin and ethylene producers are the two main PGR groups. Research in Australia has focused on gibberellin-inhibitor products, which act by blocking gibberellin biosynthesis to reduce internode length in stems, thereby decreasing plant height. There are several phases in this pathway, and different PGRs act at different points. For example, chlormequat (Cycocel®) acts early in the pathway, whereas more recently developed products such as trinexapac-ethyl (Moddus®) act on later stages.

Plant growth regulators are reported to have a yield-enhancement effect by improving the proportion of crop DM that is partitioned into grain yield. This effect has been related to a reduction in the plant resources required for stem elongation, with these resources then available for grainfill. Some PGRs have also been associated with increased root growth, resulting in improved water extraction from soil. Yield responses to PGRs are

A 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

highly variable, with responses ranging from –40% to +2%, depending on product choice, application time, crop or variety, and growing-season conditions. [8]

In Australia, PGR availability for barley growers is limited to ethephon. Use of ethephon has generally been low because responses are viewed as variable, and growers have not regularly seen the benefit of incorporating it into their management programs. There is a lack of understanding of the conditions and situations under which to the use PGRs. Whereas a great deal of resource has been devoted to optimising crop-husbandry strategies to minimise lodging, relatively little has been devoted to identifying the situations in which to use PGRs for optimum results. If the field, variety or growing conditions are not conducive to lodging, then the use of a PGR will be of no benefit to the grower; many of the trials undertaken with PGRs have reached conclusions in circumstances where a PGR did not need to be applied in the first place. [9]

Moddus® (trinexapac-ethyl at 250 g/L) is used by cereal growers in several countries including New Zealand, the UK and Germany to reduce the incidence and severity of lodging and optimise the yield and quality of high-yielding wheat, barley and oat crops. Moddus® Evo is an enhanced dispersion-concentrate formulation developed to provide greater formulation stability and more effective uptake in the plant. With improved mixing characteristics and the potential to provide better consistency of performance, Moddus® Evo is registered with APVMA for Australian cereals.

In 2011 and 2012, NSW DPI conducted trails on Moddus® to investigate the capacity of PGRs to reduce lodging in Commander⦶ barley, a high-yielding variety with poor straw strength. In both seasons, Commander⦶ and Oxford⦶, a high-yielding variety with good straw strength, were grown at a target plant population of 120 plants/m² with four treatments of: nil PGR, Cycocel® (0.2 L/ha), Moddus® (1.0 L/ha) and a combination of Cycocel® + Moddus® (0.2 + 1.0 L/ha). PGRs were applied in each season during stem elongation (GS31) at a water rate of 100 L/ha. In 2011, sites were established at Tamworth and Spring Ridge, and in 2012, sites were at Moree and Breeza. [10]

Results from 2011 showed that although the Tamworth site had lower lodging than Spring Ridge, the trends were similar (Table 1). The lodging severity for Commander⦶ was approximately 3 times that observed for Oxford⦶, again highlighting the importance of variety selection in lodging management. The combination of Cycocel® and Moddus® was the most effective PGR treatment for reducing the severity of lodging compared with the control treatment (nil PGR).

Table 1: Lodging scores (scale 0–9, where 0 is standing and 9 is flat on the ground) at harvest for Spring Ridge and Tamworth sites in 2011

PGR treatment	Spring Ridge		Tamworth	
	Commander⦶	Oxford⦶	Commander⦶	Oxford⦶
Nil PGR	7.2	3.0	3.0	1.0
Cycocel®	6.2	1.8	2.0	0.2
Moddus®	5.3	1.8	2.0	0.0
Cycocel® + Moddus®	4.6	1.9	1.8	0.0

8 M Gardner, R Brill, G McMullen (2013) A snapshot of wheat and barley agronomic trials in the northern grains region of NSW. GRDC Update Papers, 5 March 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/A-snapshot-of-wheat-and-barley-agronomic-trials-in-the-northern-grains-region-of-NSW

9 B. Staines, LM Forsyth, K McKee (2013) Moddus Evo: controlling plant growth for reduced lodging and improved cereal yields. GRDC Update Papers, 27 March 2013, https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/Moddus-Evo-Controlling-plant-growth-for-reduced-lodging-and-improved-yields

10 *M Gardner, R Brill, G McMullen (2013)* A snapshot of wheat and barley agronomic trials in the northern grains region of NSW. GRDC Update Papers, 5 March 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/A-snapshot-of-wheat-and-barley-agronomic-trials-in-the-northern-grains-region-of-NSW

The ability of PGRs to reduce the severity of lodging appears related to their capacity to restrict plant height (Figures 2a and 3a). At Spring Ridge (2011) and Moree (2012), the Cycocel® + Moddus® treatment was the most effective at reducing plant height. As a single product, Moddus® restricted plant height more than Cycocel® at both sites. There was a large difference in height reduction at the two sites, with maximum height reduction being 7 cm at Spring Ridge in 2011 and 34 cm at Moree in 2012. At Spring Ridge, the treatments containing Moddus® had no impact on yield compared with the nil treatment, whereas the Cycocel® treatment significantly increased the yield of Commander(PBR) by 8% compared with the nil treatment. The large reduction in plant height at Moree for the Moddus® and Cycocel® + Moddus® treatments resulted in a significant reduction in yield of 8% and 13%, respectively.

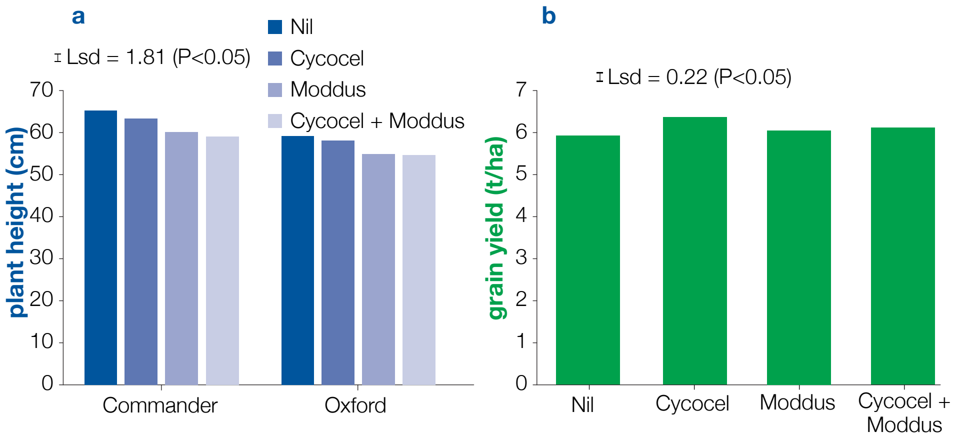

Figure 2: Effect of three PGR treatments on plant height and grain yield of Commander(PBR) compared with a nil-PGR control at Spring Ridge in 2011.

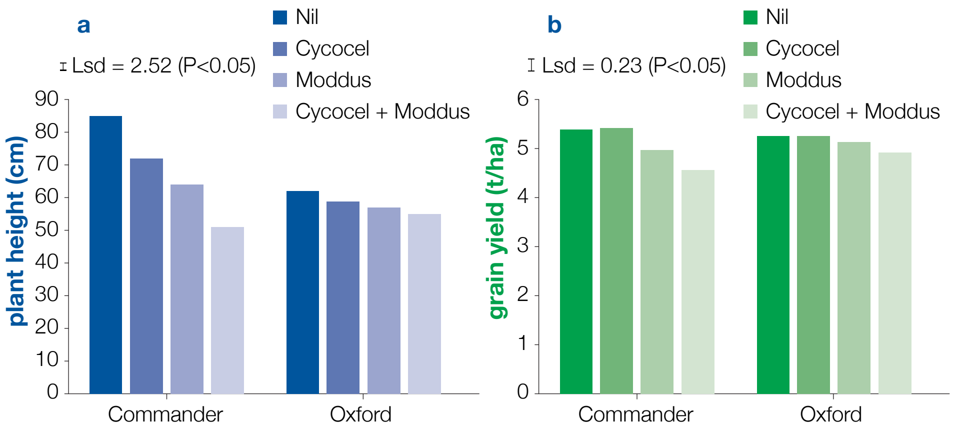

Figure 3: Effect of three PGR treatments on grain yield and plant height of Commander(PBR) and Oxford(PBR) compared with a nil-PGR control at Moree in 2012.

In 2008, a trial at the Tamworth Agricultural Institute found a significant yield increase with early (GS25) applications of a PGR combination of Moddus® and Cycocel® in the absence of lodging for wheat (EGA Gregory(PBR) and durum EGA Bellaroi(PBR)), whereas no effect was found in Gairdner(PBR) or Fleet(PBR) barley. Later application resulted in no significant differences compared with the control.

Between 2004 and 2011, field trials with Moddus® were run across Australia by Syngenta, the manufacturer of Moddus®, to investigate the value of applications to Australian cereals in terms of reducing lodging and improving yields. The trials encompassed a range of varieties, climatic conditions and geographical locations, and varied application rates were applied at different growth stages.

Measurements were taken of the effect of Moddus® application on plant growth, stem strength, stem-wall thickness, lodging, lodging score and yield, as well as grain-quality measurements (Figure 6). Several rates of Moddus® Evo were assessed for reduction of lodging and enhancement of yield in barley. Moddus® Evo applied at rates of 300 or 400 mL/ha was consistently found to improve yields and reduce barley lodging (Figure 4a, b). The optimal growth stage for Moddus® application to have the most consistent and greatest impact on yield was GS30–32.

When growth conditions were favourable, a bounce-back effect, where compensation growth occurred, was often observed. To reduce the impact of the bounce-back, a follow-up application of Moddus® Evo was evaluated. With a second application of Moddus® at GS37–39, growth compensation was reduced (Figure 4c). When conditions were favourable for bounce-back, the second application resulted in significant yield improvements. The results in Figure 6*d* are the average across a number of trials where a second application of Moddus® Evo was applied; not all of the trials favoured bounce-back growth, which has reduced the overall impact. [11]

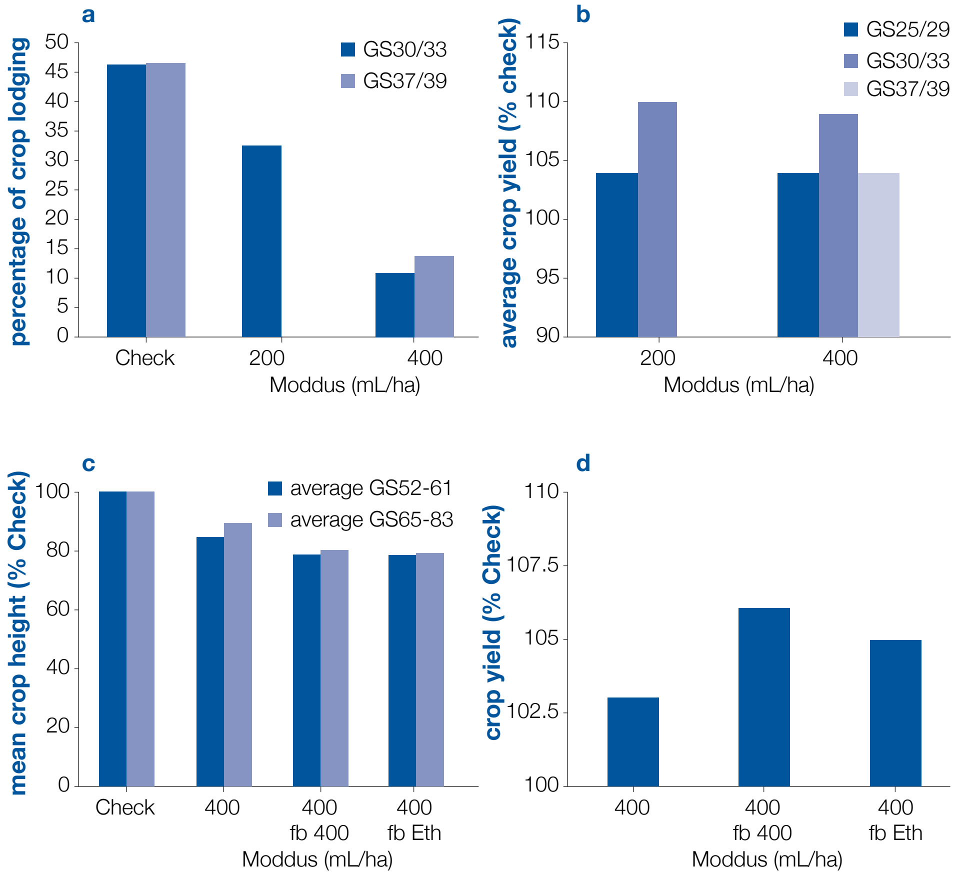

Figure 4: (a) Effect of Moddus® concentration on lodging when applied at early and late stem elongation in barley crops; data are a summary of multiple trials. (b) Effect of concentration and timing of Moddus® applications on barley yields, data are percentage improvement from untreated. Applications occurred on healthy growing plants, and conditions were not favourable for bounce-back growth. Average data are from five trials run in 2007; 80% of the trials did not have lodging. Effect of second application of Moddus® on (c) barley stem heights and (d) barley yields when conditions favour compensatory growth following initial application.

Overall improvements in yield were often correlated with a reduction in stem height whether or not lodging occurred. Yield improvements through the reduction of lodging are well documented. What is less understood is the impact, often positive, on yields with the use of Moddus® Evo in the absence of lodging.

11 B. Staines, LM Forsyth, K McKee (2013) Moddus Evo: controlling plant growth for reduced lodging and improved cereal yields. GRDC Update Papers, 27 March 2013, https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/Moddus-Evo-Controlling-plant-growth-for-reduced-lodging-and-improved-yields

Conversely, during the evaluation of effects of Moddus® Evo on yield enhancement and reduction in lodging, a few trials had anomalous results, where Moddus® Evo application did not improve yield. Environmental conditions at these trials during the lead-up to Moddus® Evo application were poor, with extensive frosting, drought, poor subsoil moisture profile or nutrient deficiencies within the crop. Therefore, it is recommended that Moddus® Evo be applied only to healthy growing crops with optimum yield potential.

According to Syngenta, continuing research is aimed at developing a greater understanding of the factors that allow Moddus® Evo to improve cereal yields in the absence of lodging. Areas under investigation include:

- Survival and development of secondary tillers in high-biomass crops. Can the use of Moddus® Evo open the canopy, allowing the full development of secondary tillers in high-biomass crops with good soil moisture reserves?
- Enhanced root development. Research suggests that plants treated with Moddus® develop larger root systems. Larger root systems may allow plants to access greater soil moisture and nutritional reserves through the later stages of crop development.
- Redistribution of carbohydrates. Structural carbohydrates are converted to water-soluble forms to enhance crop yields under dry spring conditions. Preliminary results indicate that Moddus® has a significant effect on the concentration of WSC in wheat and barley.
- Frost damage reduction. The use of Moddus® Evo has been shown to delay midseason crop development by ~7–10 days. Although treated crops 'catch up' and do not incur a harvest-time penalty, on average, this initial delay results in later flowering and grain-filling in less frost-prone conditions.
- Barley head loss. Dramatic yield improvements were observed with certain barley varieties treated with Moddus® Evo due to head retention in conditions favourable to head loss. Further evaluation into the benefits of Moddus® Evo in reducing head loss in susceptible barley varieties is under way.

Syngenta concluded from its trials that Moddus® Evo offers growers in environments conducive to lodging an in-season option to reduce the impact of lodging while allowing them to manage crops for maximal yields. The timing and concentration of Moddus® Evo applications is critical to optimal yield improvements and it should only be applied to healthy growing crops. [12]

10.2.1 Variety-specific research from the northern region

Commander is grown on heavier soils in the south and lodges, but not to the degree in the north. Growth regulators and defoliants aren't used in the south.

Agronomist's view

https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/07/Plant-growth-regulators

[12] B. Staines, LM Forsyth, K McKee (2013) Moddus Evo: controlling plant growth for reduced lodging and improved cereal yields. GRDC Update Papers, 27 March 2013, https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/03/Moddus-Evo-Controlling-plant-growth-for-reduced-lodging-and-improved-yields

infocus

Commander⦶ is a malting barley variety that is gaining popularity with growers throughout the northern grains region. One of the major limitations to the further adoption of Commander⦶ is its susceptibility to lodging. Apart from being difficult to harvest, lodged crops can have limited grain yield by up to 40% and reduce grain quality.

NSW DPI trials investigating lodging management options for Commander⦶ were conducted at Spring Ridge and Tamworth between 2008 and 2011. These options included:

- Varying plant population. This was found to be an effective and easy way to reduce lodging severity. Reducing plant populations from 120 to 80 plants/m^2 reduced lodging severity by up to 32% in some trials, but further reduction in populations can also significantly reduce yield potential.
- Defoliation. When implemented just prior to stem elongation, defoliation has been shown to reduce lodging severity (by 8–35%) and the area affected by lodging (by 15–45%). However, it must occur prior to stem elongation to avoid yield penalties. Therefore, other methods are preferred.
- Potassium application.
- PGR application. In general, PGRs have resulted in reductions in lodging severity, primarily by reducing plant height by 5–12 cm. In some cases, unexpected yield benefits have occurred, with yield increases of 0.4–0.9 t/ha observed with PGR application relative to no PGR in the absence of lodging.

Owing to the strong susceptibility of Commander⦶ to lodging, the combination of appropriate plant populations, defoliation and PGR has been shown to give the greatest reductions in lodging severity.

Trials have shown that some effective management options are available to growers to minimise lodging in Commander⦶. The best lodging management practices are:

- Establish plant populations of ~80–100 plants/m^2. Higher plant population may be targeted in high-yielding situations, but other lodging-management practices will also need to be implemented.
- Defoliation through grazing can be used to minimise lodging. The closer to stem elongation that defoliation occurs, the more effectively the lodging risk is reduced.
- Avoid paddocks with excessively high soil N at sowing and, if possible, delay the application of N until stem elongation, when yield can still be increased without driving excessive grain protein concentration.
- PGRs do have the potential to reduce lodging through reduced plant height. A combination of PGR products offers the greatest reduction in lodging severity.
- In situations of high lodging risk, a combination of management practices may be required.

Similar management options for Commander⦶ and Oxford⦶ barley were investigated in NSW DPI trials at Bellata, Spring Ridge and Tamworth in 2011 (Figure 5). Oxford⦶ is a lodging-resistant variety.

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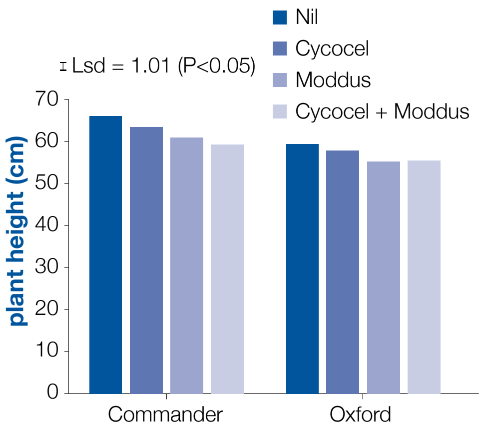

Figure 5: Effect of four PGR treatments on plant height of Commander(h and Oxford(h at Spring Ridge 2011.

Restricting the size of the crop canopy or DM production, like restricting plant height, was effective in 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. By contrast, populations of 60 and 80 plants/m^2 maintained significantly lower DM yields than a population of 120 plants/m^2 at both anthesis and maturity (Figure 6).

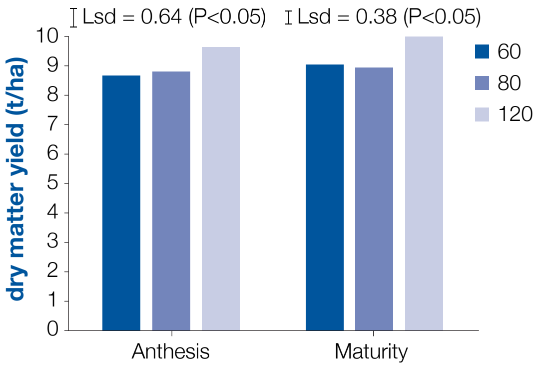

Figure 6: Dry matter yield for populations of 60, 80 and 120 plants/m^2 at anthesis and maturity.

In summary, this trial found that choosing a variety that is less susceptible to lodging is the most effective management option for reducing losses from, and severity of, lodging. Where a variety susceptible to lodging (such as Commander(h) is grown, defoliation prior to stem elongation can reduce the severity of lodging and limit canopy size at anthesis. It is essential that defoliation does not occur beyond stem elongation (GS31) because significant yield penalties could be expected. Maintaining plant populations at ~80 plants/m^2 enabled DM yield to be restricted throughout the growing season, without significantly limiting yield. Of the PGR treatments, the combination Cycocel® + Moddus® reduced the severity of lodging to the greatest degree.

To read more about the results, go to: NSW DPI: Northern grains region trial results—autumn 2012.

A further trial on lodging management of Commander(h was conducted in 2012 by NSW DPI at sites in Breeza, Gurley and Moree (Table 2). In all trials, PGR treatments were shown to reduce lodging to some degree, most likely a function of the reduced plant height obtained from PGR applications. Yield responses to PGR application ranged from –13% to +16% for Commander(h and Oxford(h compared with the untreated control. Commander(h was usually more responsive to application of PGRs than Oxford (h. Of the PGR treatments, the combined Cycocel® + Moddus® treatment resulted in the most consistent reduction in plant height and greatest responses in grain yield, whether negative or positive.

These results highlight the variability in responses to PGR application, which makes it difficult to predict the economic benefit of using PGRs within cropping systems.

Table 2: Lodging scores (scale 0–9, where 0 is standing and 9 is flat on the ground) at harvest for the Moree and Breeza sites

Minus and plus relate to defoliation treatments

PGR Treatment	Moree				Breeza			
	Commander(b)		Oxford(b)		Commander(b)		Oxford(b)	
	Minus	Plus	Minus	Plus	Minus	Plus	Minus	Plus
Nil	3.4	1.9	0.0	0.0	8.5	6.5	3.5	3.3
Cycocel®	2.2	1.5	0.0	0.0	7.5	5.3	3.0	3.0
Moddus®	0.0	1.0	0.0	0.0	–	–	–	–
Cycocel® + Moddus®	0.0	0.0	0.0	0.0	4.8	4.3	2.0	1.5

The much greater severity of lodging at Breeza than Moree was ostensibly due to irrigated conditions at Breeza. A dry finish to the season ensured that lodging of Commander(b) remained minimal at Moree. To read more about this trial, go to: NSW DPI: Northern grains region trial results—autumn 2012.