

TAKE HOME MESSAGES

1
In 2014 – a dry season with limited growth and yield at the trial site – Plant Growth Regulators (PGRs) were not economically viable or worthwhile.

2
PGR use in a tough season may pose more risk than benefit to cereal crops; their use should be gauged on seasonal outlooks.

3
In 2014, reduction in plant height was greatest with a PGR applied either as a single late, or a split application, not an early application.

4
The combination of a fungicide such as Amistar Xtra with a PGR such as Moddus Evo, appears to increase the effect of the PGR on plant growth.

PLANT GROWTH REGULATORS IN SCOPE CL BARLEY

Kelly Angel (BCG) and Rob Launder (Agritech Rural)

BACKGROUND

Scope CL is a popular barley variety due to its tolerance to the Clearfield herbicide Intervix®. However some of its other traits are not so desirable.

Scope CL is a moderately tall variety, which is susceptible to lodging and head loss. In seasons with high yield potential the risk of barley yield loss increases with the development of heavy heads relative to plant height and stem strength. One mitigation practice adopted by growers over recent years has been the application of Plant Growth Regulators (PGRs).

Growers in the Wimmera have had limited experience in the use of PGRs. They have not yet developed management practices that optimise the agronomic and economic application of these products, particularly in terms of choice of product and timing of application.

Previous work carried out by BCG looked at the use of a single PGR (Moddus Evo) applied with or without fungicide. Research conducted in 2013 found a significant response to the use of PGRs in terms of both height reduction and increased grain yield. Proponents of PGRs claim that they work better when applied in a mixture with fungicides under conditions of rapid vegetative growth.

In 2014, BCG, in collaboration with Agritech Rural, investigated the use of Moddus Evo, applied with and without a fungicide at a wide range of application timings.

AIM

To determine whether Moddus Evo, applied with and without fungicide at different timings, influenced the level of lodging and head loss in Scope CL barley, and to compare its performance against other PGRs when applied at GS31.

TRIAL DETAILS

Location:	Horsham
Soil type:	Clay with sub-soil constraints
GSR (Apr-Oct):	172mm
Crop type/s:	Scope CL barley
Sowing date:	13 May
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Target plant density:	130 plants/m ²
Harvest date:	13 November

TRIAL INPUTS

Fertiliser:	MAP @ 55kg/ha at sowing followed by urea @ 90kg/ha top-dressed at GS13 and 100kg/ha top-dressed at GS30.
PGRs/fungicides:	See Table 1.

Pests and weeds were controlled to best management practice commercial standards.

METHOD

A replicated field trial was sown using a randomised block design. Treatments were sprayed at the appropriate time (Table 1.) using a hand boom. Assessments carried out in season included physical crop biomass at GS65 (flowering), crop height (maturity), internode length, stem width (early grain fill), grain yield and quality, NDVI measurements (using a handheld GreenSeeker®) at first node, full flag leaf emergence, awn peep and late grain fill. Fungicides were included as a treatment however no additional fungicides were applied for disease management. Disease levels remained low throughout the season.

Plots were harvested with a plot header, with yields recorded and grain samples analysed in the lab for all of the normal barley delivery requirements. Results for the various assessments were analysed using ANOVA. For ease of presenting results, the Amistar Xtra/Moddus Evo treatments and the GS31 treatments were evaluated separately.

Table 1. PGR and fungicide treatments.

Treatment	Product(s)	Timing	Rate (ml/ha)
1	Control	-	-
2	Amistar Xtra	GS31	400
3	Amistar Xtra	GS39	400
4	Amistar Xtra	GS45	400
5	Amistar Xtra	GS31 & GS39	400, 400
6	Moddus Evo	GS31	400
7	Moddus Evo	GS39	200
8	Moddus Evo	GS45	200
9	Moddus Evo	GS31 & GS39	400, 200
10	Amistar Xtra	GS31	400
	Moddus Evo		400
11	Amistar Xtra	GS39	400
	Moddus Evo		200



Treatment	Product(s)	Timing	Rate (ml/ha)
12	Amistar Xtra	GS45	400
	Moddus Evo		200
13	Amistar Xtra	GS31 & GS39	400, 400
	Moddus Evo		400, 200
14	Amistar Xtra	GS31 & GS39 & GS45	400, 400, 400
	Moddus Evo		400, 200, 200
15	Ethrel	GS31	1000
16	Cycocel	GS31	1250
17	Amistar Xtra	GS31	400
	Moddus Evo		200
	Cycocel		1250

At the beginning of the season, the intention was to apply Moddus Evo at 400ml/ha for each of the treatment applications. However, given the seasonal conditions, it was necessary to reduce the Moddus Evo rate after the GS31 treatment, as it has been proven to have severe yield penalties when applied to stressed crops (*Staines et. al., 2013*).

RESULTS AND INTERPRETATION

The seasonal conditions experienced at the Horsham site in 2014 were very different from those of 2013. After a reasonable start, with good crop emergence and early growth, rainfall was limited and patchy and did not create the high growth situations within which the performance of PGRs and fungicides can be rigorously tested. The NDVI assessment conducted at GS31, prior to the first treatment application, showed no difference between treatments, indicating even emergence and good early growth in all plots.

Was there any advantage in the different Amistar Xtra and Moddus Evo application timings?

Despite the different rates and timings of Amistar Xtra and Moddus Evo, there was no significant difference in yield between any of the treatments in 2014, a result different from the 2013 findings. The key driver of this was probably the seasonal conditions. PGRs deliver maximum benefit in seasons conducive to good crop growth and high yield potential, therefore it is not surprising that in a poorer season these benefits were not observed. These results correlate with other trials at the site, such as the barley delayed harvest trial (*‘Impact of delaying harvest in barley’ pp 78*), where there was no yield penalty from delaying harvest. This is believed to be a result of crop stalks being strong enough to support the smaller heads produced in 2014, and resisting losses that might otherwise occur in a higher yielding year in which heavier heads relative to stem strength are common.

The application of a fungicide such as Amistar Xtra, which contains a mix of a triazole (cyproconazole) and a strobilurin (azoxystrobin), is reported to delay the maturity of the crop and extend the green leaf duration. The extension of green leaf should enable the plant to capture more ‘light’ to convert to energy via photosynthesis, potentially increasing yield in seasons with moist cool conditions during grain fill. This green leaf extension effect was measurable in 2013, according to NDVI readings, but was not visually observable in the trial and did not result in an increase in yield (*BCG 2013 Season Research Results, pp 86*).

The warm dry conditions during flowering and grain fill in 2014 reduced the occurrence of green leaf retention, as indicated by no significant difference in NDVI readings taken at GS87.



Possibly, in the 2014 season, this late assessment may have revealed different results if had been conducted earlier, as crops turned very quickly with the dry spring conditions experienced. However, it may also be possible that trying to achieve green leaf retention is not beneficial in barley and does not warrant the use of a product like Amistar Xtra for this purpose. Two years work has not shown green leaf retention to be a way to gain extra yield, with the key benefit still coming from disease management.

In 2014, there were some significant influences on plant height (Figure 1), with later (GS45) or split (GS31 and 39) applications of Moddus Evo causing the biggest reduction in plant height. It should be noted that this occurred only in treatments in combination with Amistar Xtra, supporting the claims that PGR used in combination with a fungicide creates an amplified effect. Earlier applications did not have a sustained effect through to maturity. This could be a result of a ‘kick’ or ‘bounce back’ effect (crop recovery) post application, whereby the plant compensates for the PGR application through increased growth. This is the reason many PGR labels suggest multiple applications for maximum benefit in reducing plant height. As expected, Amistar Xtra on its own had no impact on plant height, compared with the control, as it is not a PGR.

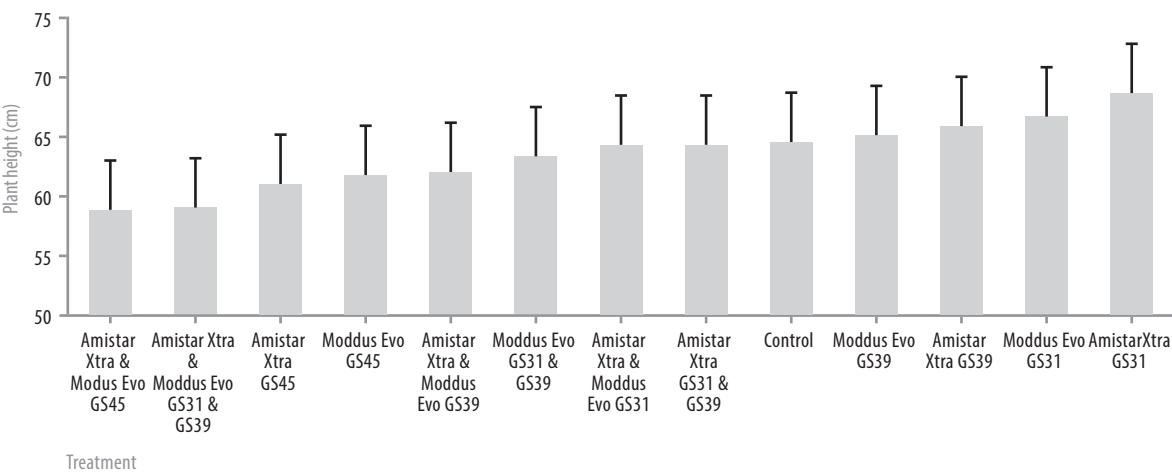


Figure 1. Plant height as influenced by Amistar and Moddus Evo combinations and timings.
(Stats: $P < 0.001$, $LSD = 4.2\text{cm}$, $CV\ 1.1\%$).

Can other PGRs influence yield and plant height when applied at early stem elongation?

When comparing a range of other PGRs and Amistar Xtra (applied at GS31), it was found that Ethrel and the Control yielded significantly less than Amistar Xtra (Figure 2.). Other treatments were not statistically different from each other or the control. This result, in some way, suggests two things: firstly, in a season like 2014, Ethrel appears to be quite harsh on the crop, significantly more so than other PGRs; and secondly, there may have been some disease suppression/control by having a GS31 Amistar Xtra application, which resulted in higher yields in this treatment. It is interesting to note this effect did not remain as strong when in combination with a PGR, raising the question of whether the Moddus Evo negated any Amistar Xtra response in 2014 at this early application timing.

From a commercial perspective, the early fungicide response seen in the trial was anecdotally supported by Agritech Rural staff who reported low levels of spot form net blotch and scald in early sown commercial crops.

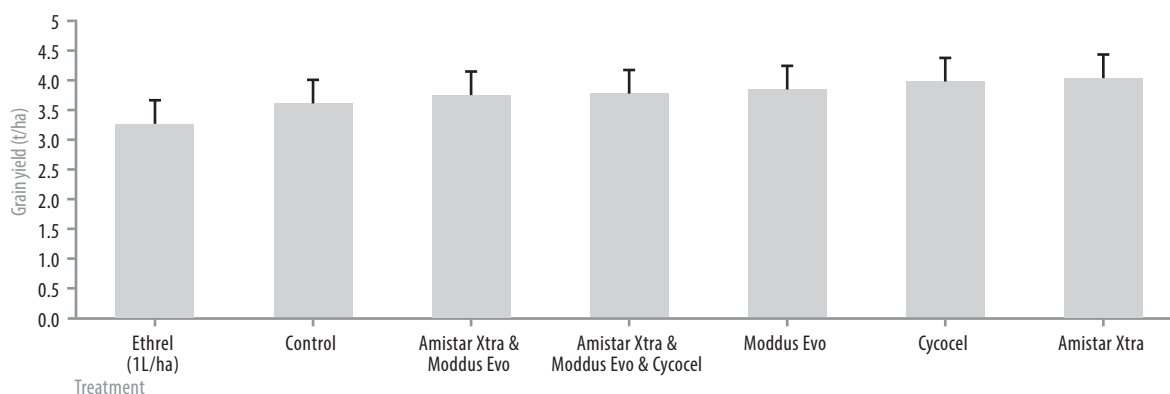


Figure 2. Scope CL barley yield as influenced by a fungicide and different PGR treatments applied at GS31. (Stats: P=0.014, LSD= 0.4t/ha, CV 3.6%).

PGR effect on plant height was not significant. This again could be due to a ‘bounce back’ effect, given the early application, which may suggest the benefit of height reduction from PGR use did not carry through to crop maturity. A better use of PGRs for crop height management may involve multiple applications, or later applications, rather than a single early application.

What do other studies tell us?

AgriTech Rural carried out an unreplicated demonstration in 2012 focused on the impact of Moddus Evo, Amistar Xtra and combinations on barley varieties. In this demonstration, it was found that the dry finish, combined with high rates of Moddus Evo used at two application timings (GS32 and GS37), had a severe detrimental effect on yield. This is in line with label recommendations and other work which suggests that Moddus Evo, and other PGRs, need to be carefully considered and tailored to seasonal conditions (*Staines et. al., 2013*). If growing conditions are less than ideal and the crop is suffering environmental stresses (frost or moisture) the crop damage may outweigh the benefits. This emphasises the fact that PGR use may have seasonal benefits, but is not simply a one size fits all fix to manage losses from lodging and head loss.

COMMERCIAL PRACTICE

PGRs still have an unknown place in Wimmera farming systems, a view anecdotally reflected by grower perceptions about their use. These perceptions could possibly be derived from not fully understanding the seasons and conditions that have a best fit for PGR use. Over the years there is evidence to suggest that there are seasons where PGRs may deliver good results, as well as seasons where they may prove to be both uneconomical and risky to crop production. Growers can use seasonal outlooks and models such as Yield Prophet® to determine if the season is conducive to high biomass production and yield potential. It will be important to understand that if the paddock, crop, variety or growing conditions are not conducive to lodging, then the use of a PGR will have little or no benefit.

Application timing is also an area that still needs consideration. A single early application may not have benefits that carry through to maturity, as good growing conditions following application may result in a ‘bounce back’, or compensatory response in the plant. Under these circumstances, a second application may be required to realise the benefits of PGRs.

The combination of a fungicide such as Amistar Xtra with Moddus Evo, does appear to increase the response of the plant to the PGR, albeit marginally, and if it fits with seasonal outlooks and other factors that determine a PGR is warranted, it may offer savings in time as products can be applied as a tank mix.

An area worthy of further investigation is the use of PGRs to reduce head loss by strengthening the peduncle (the stem between the flag leaf and the head). By shortening this closer to the flag-leaf auricle (where the leaf peels away from the peduncle), it may provide greater strength and, potentially, head retention. This is an area thought to be of greater concern, in a medium rainfall environment, than crop lodging.

ON-FARM PROFITABILITY

Adoption of PGRs into the cropping program and their effectiveness depends heavily on whether there is a real need for managing crop height and harvest losses from lodging and direct head loss. Paddock, variety and seasonal outlook all play a part in the decision-making process, and growers need to keep in mind that high biomass production and high yield potential are the conditions that will offer maximum benefit from PGR use at the appropriate timing, both in terms of minimising losses and increasing returns.

With the cost of PGRs considered in this trial being in the range of \$10-\$27/ha (per application at upper end label rates), the benefits need to be seriously considered, and weighed up against other management practices that can reduce the risk of decreased returns from lodging and head loss.

In more susceptible varieties, avoid putting too much nitrogen (N) out early. Applying N in-crop can help reduce the amount of biomass produced, partially acting as a PGR. This also is about getting the management right, ensuring that yield is not N limited, but that protein is not pushed too high for malt varieties like Scope CL. This can reduce the amount of bulk and potentially act as an early PGR, allowing room for a later PGR application to be used more effectively and tailored more suitably to the season.

REFERENCES

Staines, B., Forsyth, L. M., McKee, K. Moddus Evo: Controlling plant growth for reduced lodging and improved yields. 2013 WA Crop Updates.

ACKNOWLEDGEMENTS

This trial was jointly funded by Agritech Rural and the GRDC through the 'Southern region barley agronomy' project (DAN00173).

KEY WORDS

barley, Scope CL, PGRs, Amistar Xtra, Moddus Evo, plant height, plant growth regulators, Cycocel, Ethrel, fungicide

