Plant Growth Regulators in Spring Wheat

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Background and Objectives

Lodging is a major crop production issue, especially in high yielding environments. Yield losses can range from 5 to 40%, with the greatest losses occurring when lodging occurs ten days to two weeks following head emergence. When the crop lodges early in the season, before full stem elongation, plants may recover by "elbowing" to an upright position. Once the crop has flowered, heads will not regain an upright position.

Lodging can be managed through variety selection and agronomics. Crop varieties vary in their resistance to lodging, with stem length, thickness of stem internodes, root structure, and head density and shape affecting resistance to lodging. Producers are encouraged to review lodging ratings in Seed Manitoba when selecting varieties. Seeding and nitrogen rates also play a role in lodging. Internode shading increases with increasing plant populations, which can increase internode elongation and create taller, weaker stems. High nitrogen rates can have a similar effect with excessive tillering leading to increased internode shading and elongation.

Plant growth regulators (PGRs) are another management tool used to reduce lodging. PGRs are synthetic compounds that alter hormonal activity to modify plant growth and development. PGRs are used to improve crop standability, as they are intended to produce shorter, thicker, and stronger stems. There are two main groups of PGRs, ethylene releasing compounds and gibberellin inhibitors. Gibberellin inhibitors such as Manipulator (active ingredient chlormequat chloride) are the more common type of PGR in Western Canada.

The effects of PGRs are not well known. There are reports of PGRs increasing yield, as well as reports of PGRs causing stem elongation and reducing yield. The objective of this project is to demonstrate the effects of PGR application on spring wheat height and yield.

Materials and Methods

Trials were conducted at the crop diversification centers in Portage, Melita, and Arborg in 2015, and in Melita and Arborg in 2016. Three spring wheat varieties were planted at each site, Waskada (CWRS, tall), AAC Brandon (CWRS, semi-dwarf), and AAC Penhold (CPSR). In 2016 a fourth variety, Prosper (CNHR), was also planted. Treatments included no PGR (check), manipulator at ideal timing (GS 31), split application of manipulator (GS 12-30 and GS31), and an unregistered PGR "PGR B" (GS 31). Plant height and yield data were collected in both years of the trial. Data were analysed using Analysis of Variance and means were separated at P =0.05.

Results

Plant Height

PGRs reduced plant height in all varieties in both years of the trial. On average, the single and split applications of Manipulator reduced plant height by 7 cm in 2015 and 8 cm in 2016. PGR B reduced plant height by an average of 5 cm in 2015 and 7 cm in 2016 (Figure 1 and 2). In 2015 there was no significant height interaction between variety and PGR treatment. In 2016 Waskada, the taller variety, had a greater height reduction with a single application of Manipulator than AAC Brandon, AAC Penhold, and Prosper.

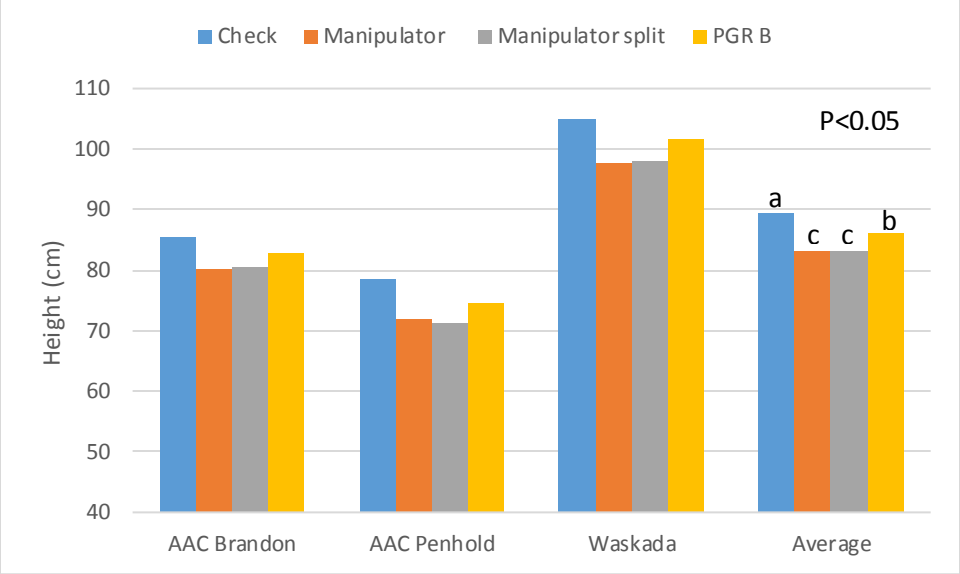

Figure 1. Impact of PGR application on height of three spring wheat varieties and average height in 2015. Treatments within the same year with the same letter are not significantly different (P<0.05).

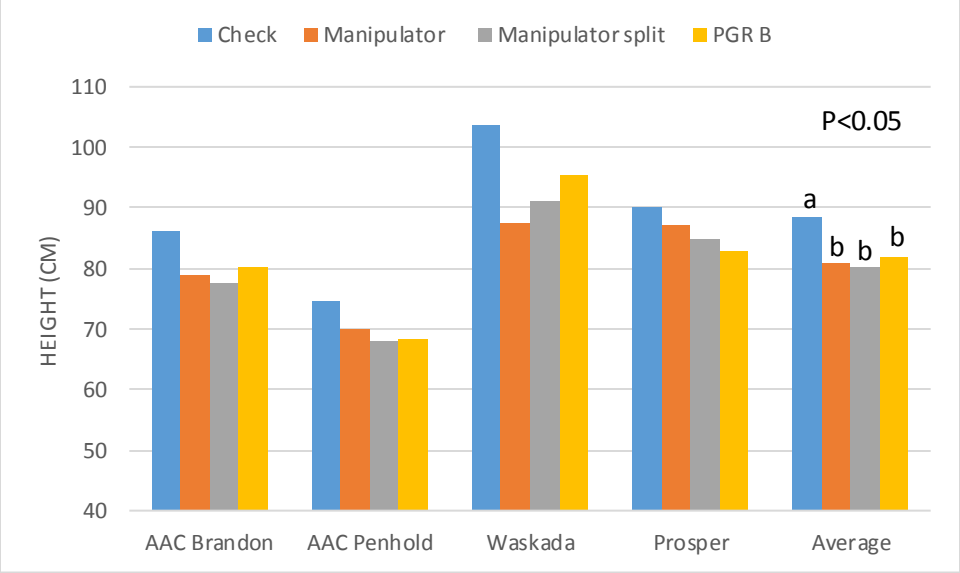

Figure 2. Impact of PGR application on height of four spring wheat varieties and average height in 2016. Treatments within the same year with the same letter are not significantly different (P<0.05).

Yield

Averaged across all varieties, PGR application did not increase yield in either year of the study. For the individual varieties, a single application of Manipulator resulted in a 4 bu/acre yield increase in Waskada in 2016 (Figure 4).

Yield decreases with PGR application were observed in both years of the study. Averaged across all varieties, in 2015 the split application of Manipulator resulted in a 3 bu/acre yield decrease from the check treatment (Figure 3). The split application of Manipulator resulted in a yield decrease compared to the check treatment in AAC Brandon and AAC Penhold in 2015, but there was no significant yield decrease with PGR application for Waskada. The single application of Manipulator and application of PGR B resulted in a significant yield decrease compared to the check in AAC Brandon in 2015, but not for AAC Penhold or Waskada (Figure 3).

Averaged across all varieties, in 2016 PGR B resulted in a 3 bu/acre yield decrease from the check treatment (Figure 4). Application of PGR B resulted in a yield decrease compared to the check in AAC Brandon and AAC Penhold in 2016, but not for Waskada and Prosper. Both the single and split applications of Manipulator resulted in a yield decrease in AAC Penhold in 2016, and the single application of Manipulator resulted in a yield decrease when applied to Prosper (Figure 4).

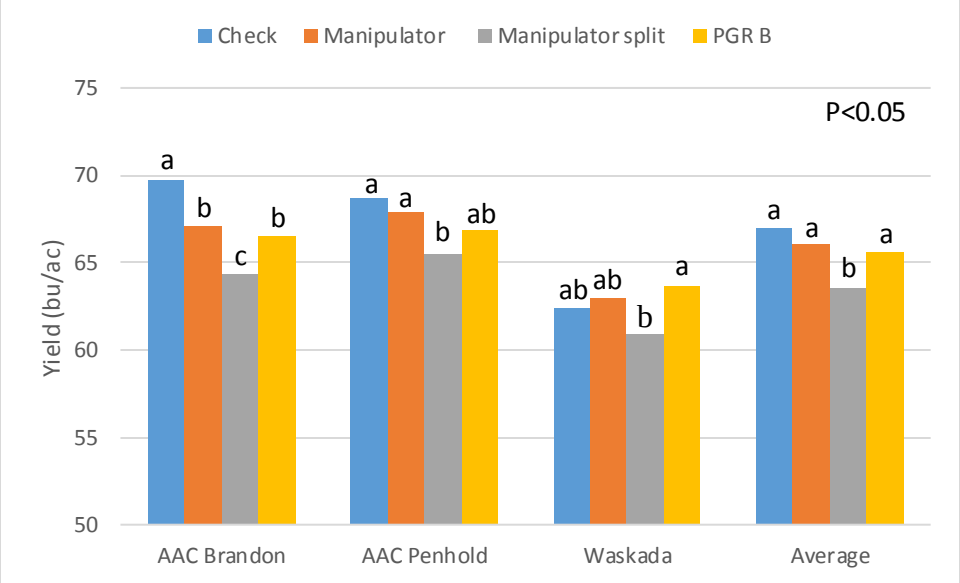

Figure 3. Impact of PGR application on yield of three spring wheat varieties and average yield in 2015. Treatments within the same year with the same letter are not significantly different (P<0.05).

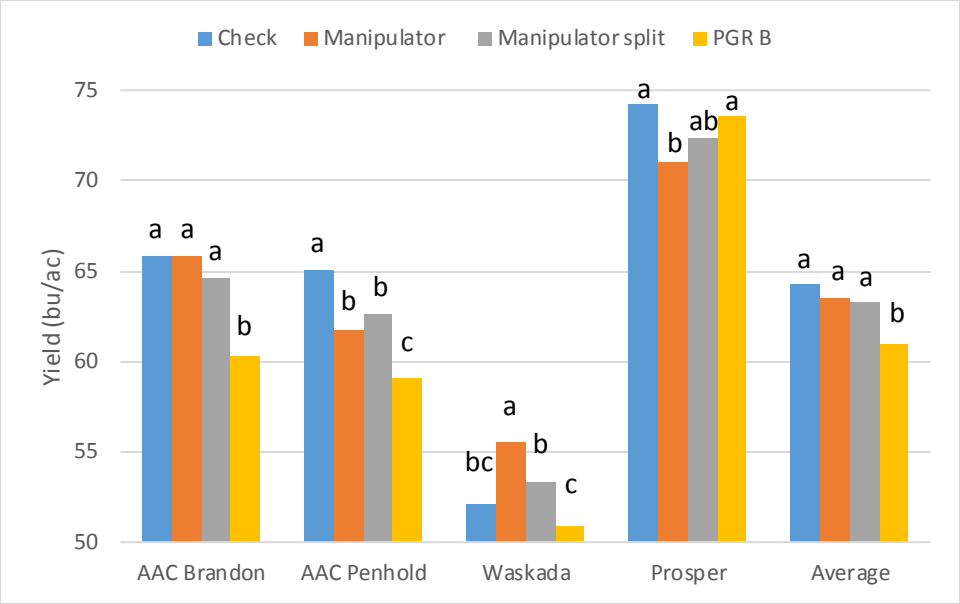

Figure 4. Impact of PGR application on yield of four spring wheat varieties and average yield in 2016. Treatments within the same year with the same letter are not significantly different (P<0.05).

Project Findings

In both years of the study minimal lodging occurred at the trial locations and in most instances there was no yield benefit to applying PGRs. In 2016, a single application of Manipulator resulted in a significant yield increase in Waskada compared to the check. Waskada is the tallest variety included in this study, and in 2016 more lodging was observed in Waskada than the shorter varieties. PGR application reduced height of Waskada by 8 to 16 cm on average in 2016, which may have resulted in less lodging and could account for higher yields.

PGR application reduced plant height of all varieties, which in the event of lodging, would be expected to reduce lodging and increase yield potential. The results of this study are consistent with other research that have showed inconsistent yield benefits with PGR application. PGRs can be used as a risk management tool to reduce lodging in high input systems, but cannot be expected to show a consistent positive yield response.

Manipulator is registered for use in Canada, but is not registered for use in the USA. The USA has not established a maximum residue limit (MRL) for chlormequat chloride, therefore wheat treated with Manipulator cannot be exported to the USA. Producers are advised to check with their grain buyer before applying PGRs to their crop.