Management practices for high yielding Spring Wheat

Project Duration
2018, 2020

Collaborators
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Objectives
To quantify the yield benefit of intensive management practices in spring wheat, and to determine if these management practices provide the same benefit to a variety of cultivars.

Results and Discussion
Plant Height
The four cultivars included in this study varied in plant height, with AAC Cameron VB being the tallest at all sites and AAC Viewfield being the shortest (data not shown).

There were no significant height differences between management practices at the Roblin site in both years of the study. At the locations where there were height differences between management practices, the PGR reduced height relative to the standard and additional N treatments (Figure 1 and 2). Compared to standard management, the addition of a PGR reduced plant height by 6, 5, and 2 cm at Arborg, Carberry, and Melita, respectively in 2018 (Figure 1). In 2020, the additional of a PGR reduced plant height by 7, 4, and 8 cm compared to the standard treatment at Arborg, Carberry, and Melita, respectively.

There was a significant interaction between management and cultivar at Arborg in 2018, but not in any other site years. This significant interaction indicates that not all cultivars had the same height response to management. Response to the PGR varied for the four cultivars, with no significant difference between standard management and the addition of the PGR for AAC Brandon. The height difference between the standard management treatment and the PGR treatment for AAC Cameron and AAC Viewfield were 4 and 6 cm, respectively. AAC Viewfield, the shortest variety, had a 13 cm height difference between the standard and PGR treatments (Figure 3).

Lodging
There was no lodging at any of the sites in 2018 and 2020.

Yield
There was no significant yield difference between cultivars at any of the sites in 2018 and 2020. Yield differences between management treatments were significant at Arborg and Melita in 2018 (Figure 4) and Arborg, Carberry and Melita in 2020 (Figure 5). Yield was not reported at Roblin in 2020. There was no significant interaction between cultivar and management in either year, indicating that the cultivars had similar yield responses to the management treatments (data not shown).

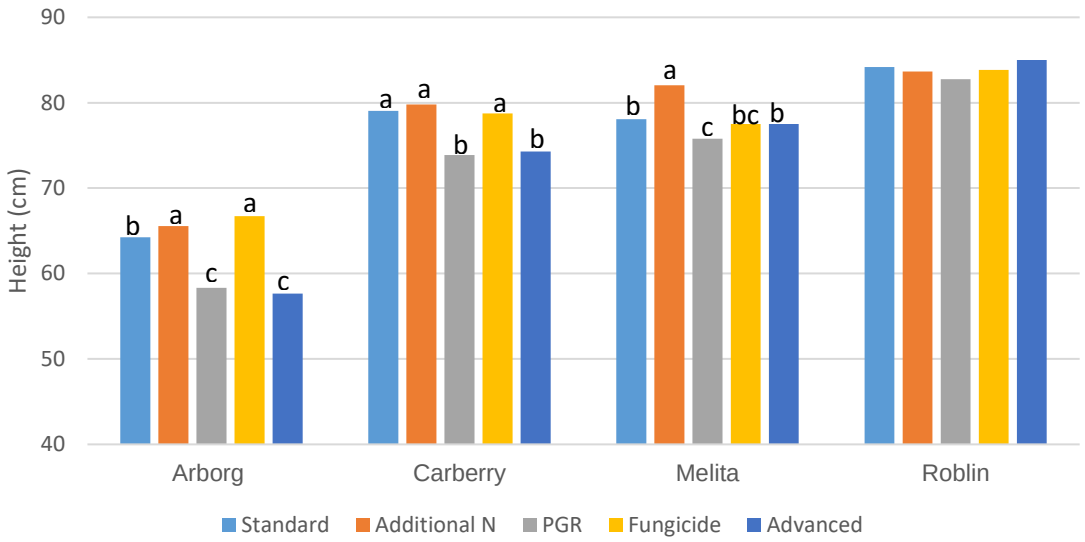

Figure 1. *Height (cm) of the five treatments averaged across cultivars at Arborg, Carberry, Melita, and Roblin in 2018. Letters above the bars show statistically significant differences. Treatments within the same site with the same letter are not significantly different (P<0.05).*

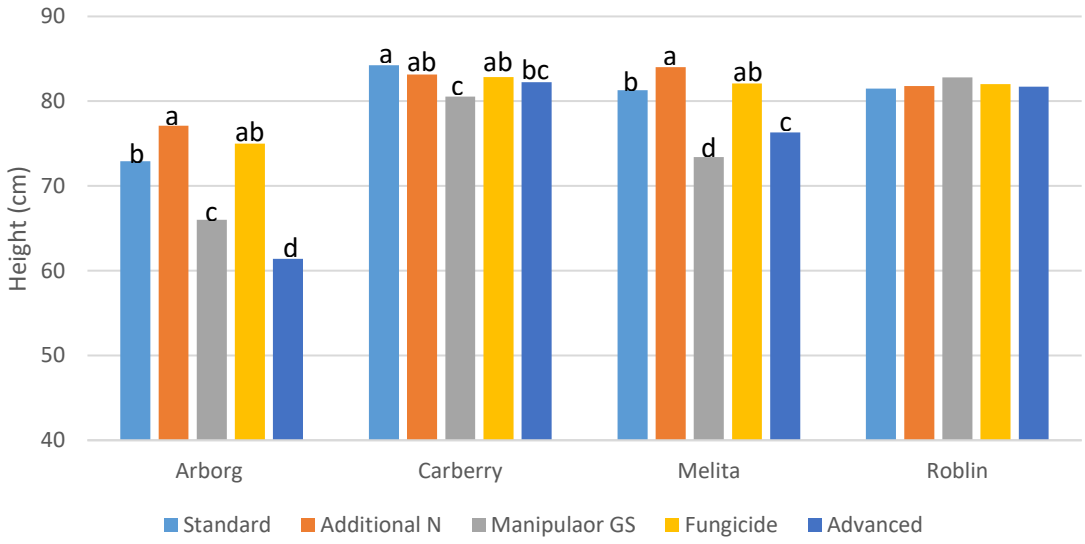

Figure 2. *Height (cm) of the five treatments averaged across cultivars at Arborg, Carberry, Melita, and Roblin in 2020. Letters above the bars show statistically significant differences. Treatments within the same site with the same letter are not significantly different (P<0.05).*

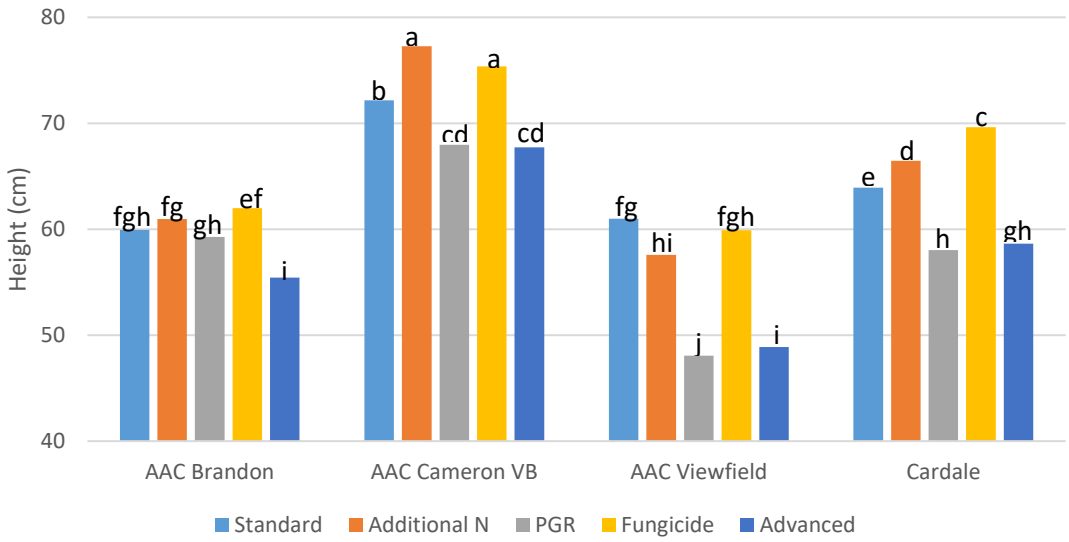

Figure 3. *Height (cm) of the five treatments for each cultivar at Arborg 2018. Letters above the bars show statistically significant differences. Bars with the same letter are not significantly different (P<0.05).*

At Arborg and Melita 2018, the additional N and advanced management treatments yielded significantly more than the other three treatments, indicating that the additional 50 lb/acre of N resulted in a yield advantage (Figure 4). In 2020, the results were less clear. Compared to the standard treatment, additional N resulted in a significant yield increase at Arborg. Both additional N and fungicides resulted in a significant yield increase compared to standard at Melita, but the advanced treatment was highest yielding overall (Figure 5). Overall, additional N resulted in a yield increase in four of seven site years, and fungicides resulted in a yield increase in one of seven site years.

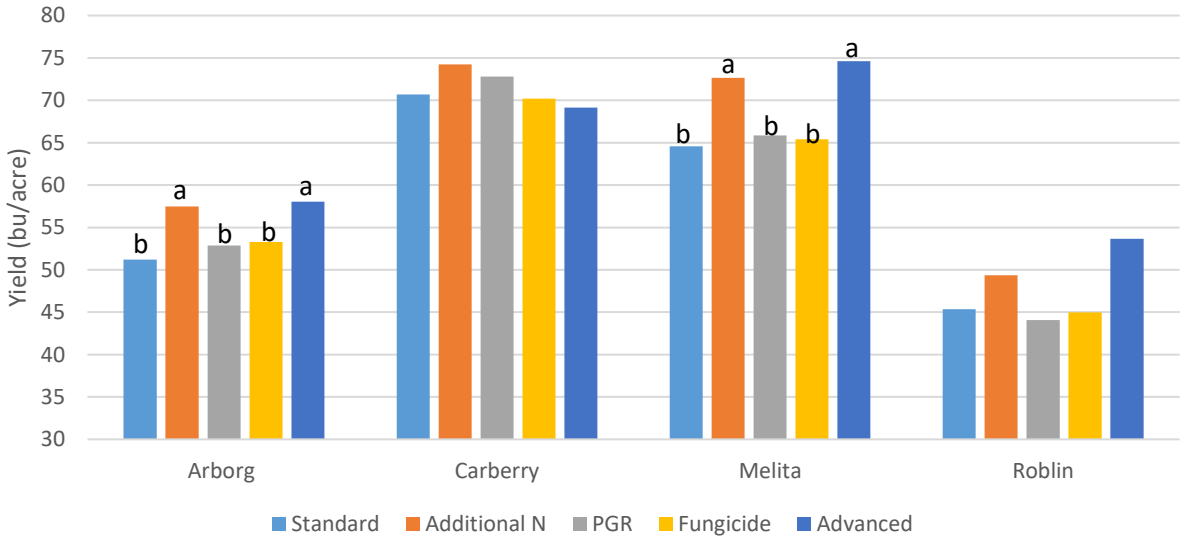

Figure 4. *Yield (bu/ac) of the five treatments averaged across varieties at Arborg, Carberry, Melita, and Roblin 2018. Letters above the bars show statistically significant differences. Treatments within the same site with the same letter are not significantly different (P<0.05).*

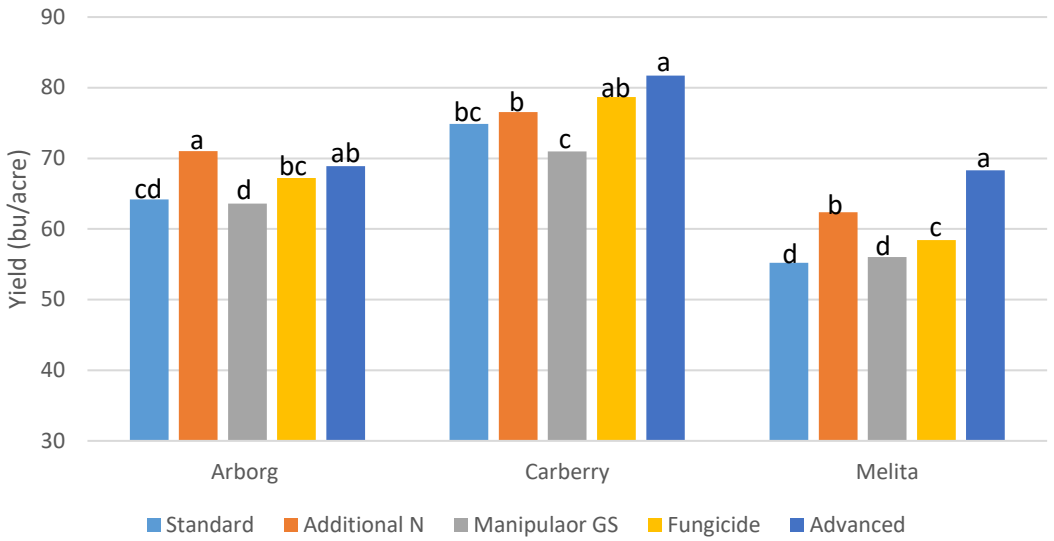

Figure 5. *Yield (bu/ac) of the five treatments averaged across varieties at Arborg, Carberry, and Melita 2020. Letters above the bars show statistically significant differences. Treatments within the same site with the same letter are not significantly different (P<0.05).*

Protein

Protein was measured on composite samples; therefore, results were not statistically analyzed. Of the management practices studied, treatments with higher N rates had the highest protein concentrations at most locations. Protein concentrations were similar between management treatments at Melita 2020 and Roblin 2018 (Table 4).

Table 4. *Protein concentration (%) comparisons among different wheat varieties & treatments.*

	Arborg		Carberry		Melita		Roblin
	2018	2020	2018	2020	2018	2020	2018
	---------- Protein (%) ----------						
Variety							
AAC Brandon	14.3	12.2	15.9	15.1	12.0	12.3	11.6
AAC Cameron VB	13.9	12.0	16.2	14.6	12.1	11.3	11.0
AAC Viewfield	13.5	11.4	15.0	15.7	11.8	11.8	10.4
Cardale	14.1	12.4	17.1	16.1	12.3	12.7	11.5
Management							
Standard	13.2	11.5	15.7	15.3	11.7	11.9	11.3
Manipuator	13.2	11.3	15.7	15.2	11.4	11.7	11.0
Fungicide	13.0	12.0	15.9	15.4	11.5	11.7	11.0
Additional N	15.3	12.4	16.4	15.4	12.9	12.7	11.3
Advanced	15.1	12.8	16.6	15.6	12.9	12.3	11.1

Background / Additional resources / References

Canadian Western Red Spring (CWRS) wheat cultivars are increasingly high yielding, and may require specific management practices to achieve their yield potential. A study looking at rates of yield gain in CWRS cultivars found that yields rose 0.67% per year between the early 1990's and 2013 (Thomas and Graf 2014). Higher yielding CWRS cultivars may require specific management practices in order to achieve their yield potential. While there are a variety of management practices promoted as increasing yields, this project will focus on nitrogen (N) rates, plant growth regulators (PGR's), and fungicides.

Targeting higher yields often means increasing N rates, which brings with it the increased risk of lodging. PGR's may be a good fit for management systems with higher N rates as they have been shown to reduce plant height in spring wheat (Clark and Fedak 1977), and can be used as a risk management tool to reduce lodging and maintain yield (Strydhorst et al., 2017). The PGR Manipulator (chlormequat chloride) is registered for use in Canada but more information about this PGR is needed as response depends on crop type and cultivar, application timing, and weather conditions.

Fungicides to control FHB and leaf diseases are commonly used on spring wheat in Manitoba. Ransom and McMullen (2008) reported yield increases of 6-44% with foliar fungicide use, with the greatest increases occurring when susceptible cultivars were grown under high disease pressure.

References

Clark, R.V. and Fedak, G. 1977. Effects of chlormequat on plant height, disease development and chemical constituents of cultivars of barley, oats, and wheat. Can. J. Plant Sci. 57: 31-36.

Ransom, J.K. and McMullen, M.V. 2008. Yield and disease control on hard winter wheat cultivars with foliar fungicides. Agron. J. 100: 1130-1137.

Strydhorst, S., Hall., L., and Perrott, L. 2017. Plant growth regulators: what agronomists need to know. Alberta Agriculture and Forestry Agri-Facts. Agdex 100/548-1.

Thomas, J.B. and Graf, R.J. 2014. Rates of yield gain of hard red spring wheat in western Canada. Can. J. Plant Sci. 94: 1-13.

Materials and Methods

Field trials were established at Arborg, Carberry, Melita and Roblin in the 2018 and 2020 growing seasons. Treatments were laid out in a randomized complete block design with three replicate blocks in a two-factor split plot. There were four cultivars and five management practices, for 20 treatments in total (Table 1).

Table 1. *Treatments used in the trial.*

Cultivar (Main plot)	Management (Sub Plot)
AAC Brandon	Standard (100 lb N/ac, no PGR, no fungicide)
AAC Cameron VB	Additional N (150 lb N/ac, no PGR, no fungicide)
AAC Viewfield	PGR (100 lb N/ac, PGR Manipulator applied at BBCH 31-32, no fungicide)
Cardale	Fungicides (100 lb N/ac, no PGR, fungicides at flag leaf and anthesis)
	Advanced (150 lb N/ac, PGR, fungicides at flag leaf and anthesis)

Herbicides were applied pre-seed and during the growing season as necessary. Plots were seeded at a rate of 280 plants/m^2. Fungicides were applied at flag leaf and anthesis in treatments requiring fungicides, with products differing between locations. Fungicides applied at

flag leaf included Acapella, Headline, Prosaro, and Twinline. Prosaro was applied at anthesis for fusarium head blight (FHB) management. The plant growth regulator Maniplator 620 (chlormequat chloride) was applied at 1.8 L/ha as a single dose between Zadoka GS31 to 32. Data collection included plant height, lodging, grain yield and protein concentration in the grains.

***Table 2**. Agronomic information from different MB sites.*

	Arborg		**Carberry**		**Melita**		**Roblin**	
	2018	2020	2018	2020	2018	2020	2018	2020
Soil Series	Peguis Clay		Wellwood Loam		Waskada Loam	Newstead Loam	Erickson Loamy Clay	
Previous Crop	Canola	Canola	Canola	Canola	Soybean	Spring wheat	Oat	Barley
Seed Date	11-May	19-May	15-May	04-May	07-May	07-May	15-May	11-May
Plot Size	8.2 m^2	8.2 m^2	7.5 m^2	8.4 m^2	13 m^2	13 m^2	8.4 m^2	12 m^2
Harvest Date	20-Aug	20-Aug	30-Aug	24-Aug	13-Aug	18-Aug	23-Aug	01-Sep

Fig 1. Plant height differences among different treatments at Arborg site in 2020.

***Table 3.** Growing season summary (May 1 - September 30). Data from Manitoba Agriculture Growing Season Report: web43.gov.mb.ca/climate/SeasonalReport.aspx*

	Arborg		**Carberry**		**Melita**		**Roblin**	
	2018	2020	2018	2020	2018	2020	2018	2020
Precipitation (mm)	249	212	300	249	242	187	418	235
Normal precipitation[1]	320	320	307	307	338	338	300	300
Growing degree days	1668	1604	1747	1634	1780	1712	1461	1424
Normal GDD[1]	1554	1554	1524	1524	1637	1637	1396	1396

[1]Based on 30-year averages