Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Final Report

The final project report should be made available electronically (MS Word). Additional data tables and or graphs may be submitted in spreadsheet format. Due to formatting, printing and distribution requirements, final reports will not be accepted as PDF documents. Completed reports must be returned by email to Evaluation.Coordinator@gov.sk.ca.

Project Title:	Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties?
Project Number:	ADOPT20220425 (NARF), ADOPT 20220430 (CLC), ADOPT 20220428 (ECRF), ADOPT 20220429(ICDC), SWDC ref #278B-221123 (IHARF), SWDC ref#278A-221123 (WARC)
Producer Group Sponsoring the Project:	Northeast Agriculture Research Foundation
Project Location(s): *Provide the name or number of the rural municipality, nearest town or legal land location if possible. Provide the name of any cooperating landowner(s).*	Melfort, SK (NARF RM no.428), Scott, SK (WARC RM no. 380), Indian Head, SK (IHARF RM no. 156), Yorkton, SK (ECRF RM no. 244), Outlook, SK (ICDC RM no. 284), and Prince Albert, SK (CLC RM no. 461).
Project start date *(month & year):*	March 2023
Project end date *(month & year):*	February 10, 2024

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Abstract *(maximum 200 words)*

Detail key elements from the project objectives, methodology, results and conclusions to provide a short concise summary of the project. List extension activities such as field days or workshops and include the number of people who visited the project.

Sustainable Canadian Agricultural Partnership

Saskatchewan

Canada

Small plot demonstrations were conducted at six locations in 2023 to evaluate the response of four spring wheat varieties to the plant growth regulators (PGR) Manipulator and Moddus. The locations were Melfort, Scott, Yorkton, Prince Albert, Outlook, and Indian Head. The design was a split-plot with PGR as the main-plot and wheat variety as the sub-plot. Data collection included emergence, height, maturity, lodging, grain yield, and quality. The weather was hot and dry at all sites in 2023. Applying a PGR reduced crop height and lodging and prolonged maturity. When PGR product was significant, Moddus reduced yield and test weight, and Manipulator reduced test weight and protein. When variety was significant, varietal response was similar to characteristics in the SK seed guide. There were very few varietal interactions with PGR; however, AAC Redberry (tall, fair lodging) was the only variety to demonstrate reductions in lodging and height when a PGR was applied and AAC Brandon only had significant height reductions with Manipulator. Overall, there were very few differences in varietal response to PGRs, which suggests that these varieties responded to both PGRs in a similar manner in this one-year demonstration. The project was featured at several field days, and, to date, preliminary results have been shared at winter meetings.

Project Objectives

Provide a short statement outlining the project objectives. Identify the key concept this project was designed to demonstrate. For example, you might use a statement such as *"This project was intended to demonstrate and compare the benefits of……" or "The objective of this project was to demonstrate the impact of…."*

The main objective of this demonstration was to demonstrate the response of current and common Canadian Western Red Spring (CWRS) wheat varieties to the plant growth regulators registered for use in spring wheat

Project Rationale

Briefly describe why this project is of interest to local producers. Why is it important to have this project? What are the potential beneficial outcomes? What is the perceived need?

Spring wheat (*Triticum aestivum* L.) has been a staple of western Canadian agriculture since the time of major European colonization in the late 19th and early 20th centuries being cultivated on over 25 million acres across Canada in 2022 (McCallum and DePauw 2008; Statistics Canada 2022). Lodging is an abiotic stressor that can cause significant yield loss in wheat (Zuber et al. 1999), and also creates important harvest challenges when severe enough. Plant growth regulators (PGR) are one of the tools that farmers can use to manage lodging on their operations (Lovell 2012). The use of PGRs in cereals can shorten stems and increase both stem diameter and weight (Zuber et al. 1999). Chloromequat chloride (*Manipulator* Tamico Inc.) and trinexapac-ethyl (*Moddus* Syngenta) are two common PGRs registered for use on spring wheat. In a single year across multiple locations in Saskatchewan, chloromequat chloride reduced wheat plant height and lodging in conditions of adequate moisture and high nitrogen fertility (Brandt and Pratchler 2016; Holzapfel 2016). While improvements in wheat yield have been seen with the application of chloromequat chloride (Brandt and Pratchler 2016; Hall 2016; Holzapfel 2016), this yield increase is not always significant (Pratchler and Brandt 2016). Hall (2016) found that a wheat variety, Unity, with a lodging resistance rating of fair had greater decreases in plant height and greater increases in yield than var. Goodeve with a lodging resistance rating of very good. Since these demonstrations utilizing chloromequat chloride were conducted, the dominant wheat varieties grown in Saskatchewan have changed and the PGR trinexapac-ethyl has been registered for use. The studies on the effects of trinexapac-ethyl on spring wheat in Western Canada are limited. In barley (*Hordeum vulgare* L. var. CDC Copeland), an application of trinexapac-ethyl caused a greater reduction in plant height than chloromequat chloride and ethephon (Tiddeman et al. 2020). An investigation of the effects of chloromequat chloride and trinexapac-ethyl on the current dominant wheat cultivars in Western Canada would help farmers make better informed decisions on the use of these plant growth regulators for their wheat crops.

Spring wheat was the most widely grown annual crop in Canada in 2022, being planted on over 25 million acres across the country (Statistics Canada 2022). However, the profitability of wheat is currently less than canola, even during the

period of high commodity prices seen in 2022 (Manitoba Ministry of Agriculture 2022; Saskatchewan Ministry of Agriculture 2022). Therefore, it is important that farmers have the necessary information to select inputs that improve the profitability of the wheat they grow. Lodging can cause significant yield and quality losses in wheat, depending on the crop stage when it occurs and the severity (Zuber et al. 1999). Wheat breeding efforts have consistently improved varietal resistance to lodging since its introduction in Western Canada (McCallum and DePauw 2008). Steps can be taken on the farm level as well to manage lodging that include precision fertility, pest management, varietal selection, and PGRs (Lovell 2012). As mentioned previously, a past demonstration on spring wheat found that the response to PGRs varied with variety (Hall 2016) and, with a single barley variety, the effectiveness was product dependent (Tideman et al. 2020). This demonstration aims to provide farmers with insight regarding the response of current wheat varieties of varying lodging resistance to two PGR products. With an economic comparison at the plot scale across varieties and products, farmers would be able to extend this comparison to their operations while considering additional factors such as fuel consumption, labour, and equipment hours.

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Methodology

Fully describe how the project was set up and run. You should provide enough information so that any reader can understand what you did, and where and when you did it. From that they can determine if your report has any relevance to their own operation. For example, your description should include all relevant items such as 1) the number and size of any field plots, 2) what was seeded, 3) what treatments were applied to the plots, 4) the schedule or timing of any relevant activities such as seeding, treatment application or harvest, and 5) what was measured to evaluate the success of any treatment. If your project dealt with animals, you should be sure to include 1) the number of animals in each trial group, 2) the treatment or procedure applied to each group, and 3) what was measured to evaluate the success of each treatment.

The demonstration was conducted at six different locations in the province of Saskatchewan. The locations were Melfort (NARF), Prince Albert (CLC), Outlook (ICDC), Indian Head (IHARF), Yorkton (ECRF), and Scott (WARC). The locations encompass a range of soil and climatic zones within the province, increasing the robustness of our results. The demonstration was arranged as a split-plot with four replications at all sites. The main plot was plant growth regulator (PGR), and the sub-plot was hard red spring (HRS) variety. The PGR treatments were an untreated control, Manipulator or Moddus. Manipulator and Moddus are the two PGR's currently registered for use in cereal crops in Western Canada. Both work by similar mechanisms, whereby they reduce stem internode length. Both products were applied at the recommended growth stage of BBCH 30-32 and at the recommended rate of 700mL/ac (Manipulator) and 340mL/ac (Moddus). Four CWRS wheat varieties were selected based on their popularity amongst producers for % of seeded acres in the province, in addition to differences in crop height and lodging resistance. The varieties chosen were AAC Redberry (Tall, Fair lodging), AAC Brandon (Short, Good lodging), AAC Alida (Tall, Very good lodging), and AAC Starbuck (Short, Fair lodging). The treatment factors of PGR and CWRS variety were combined to result in 12 treatments (Table 1).

Table 1. Treatments used in Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? at all sites in 2023.

Treatment #	PGR Product	Variety	Lodging Resistance*
1	No PGR	AAC Brandon	G
2		AAC Alida	VG
3		AAC Redberry	F
4		AAC Starbuck	F
5	Manipulator	AAC Brandon	G
6		AAC Alida	VG
7		AAC Redberry	F
8		AAC Starbuck	F
9	Moddus	AAC Brandon	G
10		AAC Alida	VG
11		AAC Redberry	F
12		AAC Starbuck	F

*Lodging resistance scale: VG-very good, G- good, F-fair

The trial was managed at all sites for best management practices. Weeds, disease, and insects were controlled using registered pesticides when needed at the discretion of each site manager. All dates of operations and agronomic information is provided in Table 14 of the appendices. Soil samples were collected in the trial area at all sites and results are reported in Table 15 of the appendices. Macronutrients (N,P,K,S) were applied at seeding based on soil sample results to achieve a high yielding wheat crop in each respective location. Nitrogen was to be applied at 1.5 times the recommended rate to increase the risk of lodging in wheat. However, this target was not possible at some sites due to very low residual N and seeder constraints. In most cases, N was applied beyond the 1X rate, but not as high as the 1.5X rate.

Data collection consisted of plant density, crop height, days to maturity, crop lodging, grain yield, test weight, thousand kernel weight, and grain protein. Plant density was measured by counting seedlings along two 1-meter sections of crop row per plot and converting the averaged values to plants/m^2 (PPMS). Crop height was determined by measuring the average height of the plants to the nearest cm for 6-8 plants per plot. Lodging was determined by rating every plot for severity of lodging prior to harvest. A scale of 0 to 9 was used where 0 equated to no lodging, and 9 equated to the whole plot lying flat. Days to maturity (DTM) was noted by recording the day most plants in a plot reached the hard dough stage (Zadoks 87) and calculating the number of days from seeding to maturity. Grain yield was determined by weighing each harvested plot sample and converting the grams per plot to a kg/ha equivalent, while correcting for dockage and to a consistent moisture content of 14.5%. Test weights (TW) were determined by weighing the grams of seed in a 0.5-litre to the nearest hundredth of a gram. Thousand kernel weight (TKW) was determined by counting and weighing a minimum of 500 seeds per plot and converting the weight into grams per 1000 seeds. Protein was measured using NIR instruments. An economic analysis was completed for every site using January 2023 wheat prices and spring 2023 retail costs for Moddus and Manipulator. Change in profit was reported for PGR alone and by individual treatment (Variety and PGR) based on the income from each for the price for wheat, minus the cost in $/ha of Moddus or Manipulator. Change in profit did not account for other costs associated with PGR applications such as labour, fuel, and equipment depreciation. The decision to exclude application costs was justified by the fact that many producers will choose to tank-mix their PGRs with a herbicide, provided that the optimal timing of all products aligns reasonably well. Lastly, statistical analysis was completed for each site separately using split-plot analysis in Statistix 10.

Results *(you must provide the following information)*

Environmental Conditions:

The environmental conditions at all sites in 2023 were warmer than average (+1.4-1.9°C) with lower-than-normal cumulative precipitation (46-70%) (Table 2). Outlook had the highest average temperatures with an average of 18.0°C and +1.9°C of the long-term average. Outlook also had the least cumulative precipitation at 95mm and 46% of the long-term; however, the demonstration received an additional 245mm of irrigation water at this location. Scott had the lowest average temperature at 16.7°C, but Indian Head has the lowest average increase in temperature from the long-term at +1.4°C. Prince Albert and Scott had the greatest cumulative precipitation without irrigation at 168mm and 159mm, respectively. Despite conditions being hot and dry at all locations, the demonstration was established, and all data was collected at all locations.

Table 2. Environmental conditions from May to August of 2023 at all sites in the demonstration

	May	June	July	August	Total/Average
--Temperature (°C)--					
Melfort 2023	14.1	19.2	16.9	17.3	16.9 (+1.7)
Long-term[x]	10.7	15.9	17.5	16.8	15.2
Yorkton 2023	13.8	19.7	16.7	17.8	17.0 (+1.8)
Long-term[x]	10.4	15.5	17.9	17.1	15.2
Indian Head 2023	14	19.4	16.7	17.7	17.0 (+1.4)
Long-term[x]	10.8	15.8	18.2	17.4	15.6
Scott 2023	14.9	17.3	17.1	17.4	16.7 (+1.9)
Long-term[x]	10.8	14.8	17.3	16.3	14.8
Prince Albert 2023	14.4	18.8	16.6	17.1	16.8 (+1.6)
Long-term[x]	10.4	15.3	18	16.7	15.1
Outlook 2023	15.2	19.5	18.5	18.7	18.0 (+1.9)
Long-term[x]	11.5	16.1	18.9	18	16.1
--Precipitation (mm)--					
Melfort 2023	17.9	26.4	16.4	50	111 (49%)
Long-term[x]	42.9	54.3	76.7	52.4	226
Yorkton 2023	16.8	67.9	18	33.3	136 (50%)
Long-term[x]	51.3	80.1	78.2	62.2	272
Indian Head 2023	12.9	49.6	15.9	40.8	119 (49%)
Long-term[x]	51.7	77.4	63.8	51.2	244
Scott 2023	16.6	81.1	29.7	31.7	159 (70%)
Long-term[x]	38.9	69.7	69.4	48.7	227
Prince Albert 2023	22.8	52.8	40.8	51.2	168 (67%)
Long-term[x]	44.7	68.6	76.6	61.6	252
Outlook 2023	17.2	15.3	15.5	46.6	95 (46%)
Long-term[x]	42.6	63.9	56.1	42.8	205

[x]Long-term average is anywhere from the years 1980-2021, but exact range of years varies by site

[y]Outlook also received a total of 116mm in June, 86mm in July and 43mm in August of cumulative precipitation as irrigation

Plant Density:

Plant density differed between varieties at four of the six sites (Table 3). PGR had no effect on plant density at any site, as PGR was applied after plant density was determined. At NARF (p=0.0001) and WARC (p=0.0001) AAC Alida had significantly lower plant stands as compared to all other varieties. At NARF, AAC Alida had an average of 181 PPMS as compared to 217-241 PPMS for the other varieties, and at WARC AAC Alida had an average of 270 PPMS as compared to 292-307 PPMS for the other varieties. At IHARF (p=0.0032), AAC Alida (239 PPMS) also had significantly reduced plant density, but only as compared to AAC Redberry (277 PPMS). At ICDC (p=0.0238), AAC Alida (217 PPMS) and AAC Brandon (216 PPMS) had significantly reduced plant density as compared to AAC Redberry (265 PPMS). Across all treatments, average plant density was greatest at WARC (294 PPMS), followed by IHARF (257 PPMS), ECRF (249 PPMS), ICDC (229 PPMS), CLC (222 PPMS), and NARF (218 PPMS).

Table 3. Statistical analyses and treatment means for plant density (plants/m2) for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Plant Density (plants/m2)[z]			
PGR (p-value)	0.18	0.62	0.93	0.49	0.10	0.54
Variety (p-value)	0.0001***	0.14	0.0001***	0.75	0.0238*	0.0032**
Var*PGR (p-value)	0.40	0.81	0.21	0.75	0.39	0.26
Grand Mean	218	249	294	222	229	257
CV	11.96	11.91	6.27	12.98	18.57	8.78
Variety						
AAC Alida	181 B	259 A	270 B	217 A	217 B	239 B
AAC Brandon	217 A	233 A	305 A	228 A	216 B	254 AB
AAC Redberry	241 A	259 A	292 A	226 A	265 A	277 A
AAC Starbuck	233 A	246 A	307 A	219 A	220 AB	258 AB

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Crop Height:

Crop height was significantly different for PGR application at 4 sites and for variety at all 6 sites (Table 4). At NARF (p=0.0062), WARC (p=0.0006), ICDC (0.0174), and IHARF (p=0.0021) the application of Moddus and Manipulator significantly reduced crop height as compared to No PGR. There was no significant difference in the reduction in crop height between Moddus and Manipulator at any site, when averaged across all four varieties. Depending on site, the significant reduction in crop height ranged from 4-8cm. As for the variety effect, AAC Alida was the tallest at all sites and was significantly greater than all other varieties at NARF, ECRF, and IHARF. At both ICDC and WARC, AAC Alida had the greatest average height, but was not significantly greater than AAC Redberry. This was not surprising as AAC Alida and AAC Redberry were the varieties chosen for their taller height characteristics relative to the two other varieties. Across treatments, average crop height was greatest at ICDC (87cm), followed by IHARF (73cm), ECRF (72cm), CLC (72cm), WARC (70cm) and NARF (68cm).

Table 4. Statistical analyses and treatment means for crop height (cm) for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Crop Height (cm)[z]			
PGR (p-value)	0.0062**	0.06	0.0006***	0.56	0.0174*	0.0021**
Variety (p-value)	0.0001***	0.0002***	<0.0001***	0.0005***	0.0051**	<0.0001***
Var*PGR (p-value)	0.70	0.47	0.0007***	0.52	0.34	0.0019**
Grand Mean	68	72	70	72	87	73
CV	4.95	3.93	2.4	5.81	4.66	2.67
PGR						
Manipulator	65 B	68 A	69 B	71 A	86 B	69 B
Moddus	66 B	71 A	67 B	71 A	86 B	72 B
No PGR	72 A	77 A	74 A	73 A	90 A	77 A
Variety						
AAC Alida	72 A	76 A	72 A	74 AB	91 A	77 A
AAC Brandon	67 B	71 B	67 C	68 C	85 B	71 B
AAC Redberry	64 B	71 B	70 AB	76 A	87 AB	72 B
AAC Starbuck	66 B	70 B	70 B	70 BC	86 B	71 B

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

There was also a significant interaction of PGR and variety for crop height at WARC (p=0.0007) and IHARF (p=0.0019) (Table 5). At WARC, AAC Alida (tall) and AAC Starbuck (short) had significantly reduced height with Moddus as compared to the control, but not with Manipulator. At IHARF, AAC Alida was significantly reduced with both products, and AAC Starbuck was not significantly reduced with either PGR. At both WARC and IHARF, AAC Brandon (short) had significantly reduced height with Manipulator as compared to the control, but not with Moddus. Lastly, at WARC and IHARF AAC Redberry (tall) had significantly reduced height from the control with both PGR products. Based on these results there does not seem to be consistency in the differences in varietal responses to PGR amongst these two sites, except for AAC Brandon demonstrating better height reductions with Manipulator and AAC Redberry demonstrating height reduction with both products.

Table 5. Group means for height (cm) for the significant interaction of PGR and variety at WARC and IHARF for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

*PGR*Variety*	WARC		IHARF	
No PGR AAC Brandon	70	CDE	73	BCD
No PGR AAC Alida	76	AB	82	A
No PGR AAC Redberry	77	A	79	AB
No PGR AAC Starbuck	73	BC	73	CDE
Moddus AAC Brandon	66	EFG	72	CDE
Moddus AAC Alida	69	CDEF	76	BC
Moddus AAC Redberry	65	FG	69	EF
Moddus AAC Starbuck	68	DEFG	70	DEF
Manipulator AAC Brandon	65	G	67	F
Manipulator AAC Alida	72	BCD	73	CDE
Manipulator AAC Redberry	69	CDEFG	69	EF
Manipulator AAC Starbuck	70	CDEF	69	EF

Days to maturity:

Days to maturity was significant for PGR at one site and for variety at three sites (Table 6). For the effect of PGR, at IHARF (p=0.0184) Manipulator significantly increased days to maturity as compared to the control; however, the effect was too small to be of any agronomic concern. Days to maturity for Moddus was not significantly different than the control or Manipulator. For the effect of variety, at ECRF (p=0.0127) and ICDC (p<0.0001) AAC Starbuck had the longest days to maturity. At ECRF, AAC Starbuck only had significantly longer days to maturity compared to AAC Redberry. At ICDC, AAC Starbuck had significantly longer days to maturity as compared to all other varieties, and AAC Redberry and AAC Alida also had longer days to maturity than AAC Brandon. At IHARF (p<0.0001), days to maturity significantly differed between all varieties, where AAC Alida had the longest days to maturity followed by AAC Starbuck, AAC Brandon and AAC Redberry. Across treatments, ECRF (97 days) had the longest average days to maturity followed by NARF (94 days), ICDC (91 days), IHARF (89 days), WARC (89 days), and CLC (88 days). There were no significant interactions of PGR and variety for days to maturity at any of the sites.

Table 6. Statistical analyses and treatment means for Days to maturity for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Maturity (Days to)[z]			
PGR (p-value)	0.41	0.80	0.35	0.81	1.00	0.0184*
Variety (p-value)	0.09	0.0127*	0.14	0.42	<0.0001***	<0.0001***
Var*PGR (p-value)	0.16	0.80	0.45	0.26	1.00	0.96
Grand Mean	94	97	89	88	91	89
CV	1.96	1.5	3.48	3.99	0	0.61
PGR						
Manipulator	95 A	97 A	88 A	89 A	91 A	90 A
Moddus	94 A	97 A	90 A	88 A	91 A	89 AB
No PGR	95 A	97 A	89 A	87 A	91 A	89 B
Variety						
AAC Alida	95 A	97 AB	91 A	88 A	91 B	91 A
AAC Brandon	94 A	97 AB	88 A	89 A	89 C	89 C
AAC Redberry	93 A	96 B	88 A	89 A	91 B	87 D
AAC Starbuck	95 A	98 A	89 A	87 A	93 A	91 B

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Lodging:

Lodging was significant for PGR and variety at two sites (Table 7). At both ECRF (p=0.0429) and IHARF (p=0.0081) the application of Manipulator and Moddus significantly reduced lodging as compared to No PGR. The degree of lodging at both sites was very small with ECRF having an average of 0.5 and IHARF 0.1 out of a score of 9. For the effect of variety at ECRF (p=0.0489) and IHARF (p=0.0029) results were not consistent between sites. At ECRF, AAC Alida (VG) had the greatest degree of lodging, which was significantly greater than AAC Brandon (G) and AAC Redberry (F). This is surprising as AAC Alida has the greatest varietal resistance to lodging as compared to all other varieties. At IHARF, AAC Redberry (F) had the greatest degree of lodging, which was significantly greater than AAC Alida (VG) and AAC Brandon (G). This result aligns with varietal characteristics as AAC Alida and AAC Brandon both have a greater varietal resistance to lodging than AAC Starbuck. NARF, WARC and ICDC all reported no crop lodging in any plots in this demonstration. CLC had an average lodging incidence of 0.3, but there were no significant effects of PGR or variety.

Table 7. Statistical analyses and treatment means for Lodging for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Lodging (0-9)[z]			
PGR (p-value)	--	0.0429*	--	0.38	--	0.0081**
Variety (p-value)	--	0.0489*	--	0.27	--	0.0029**
Var*PGR (p-value)	--	0.73	--	0.41	--	0.0169 *
Grand Mean	0	0.5	0	0.3	0	0.1
CV	--	88.58	--	186.67	--	164.91
PGR						
Manipulator	0 A	0.3 B	0 A	0.4 A	0 A	0.0 B
Moddus	0 A	0.3 B	0 A	0.3 A	0 A	0.0 B
No PGR	0 A	0.9 A	0 A	0.2 A	0 A	0.2 A
Variety						
AAC Alida	0 A	0.8 A	0 A	0.2 A	0 A	0.0 B
AAC Brandon	0 A	0.3 B	0 A	0.2 A	0 A	0.0 B
AAC Redberry	0 A	0.3 B	0 A	0.6 A	0 A	0.2 A
AAC Starbuck	0 A	0.6 AB	0 A	0.3 A	0 A	0.1 AB

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

There was also a significant interaction of PGR and variety for lodging at IHARF (p=0.0169). At IHARF, AAC Redberry was the only variety to demonstration a significant reduction in lodging when both Manipulator or Moddus were applied as compared to No PGR. This is not surprising as Redberry is a tall variety with low lodging resistance. There was no significant reduction in crop lodging for any other variety when either PGR was applied.

Table 8. Group means for lodging (0-9) for the significant interaction of PGR and variety at IHARF for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

*PGR*Variety*	IHARF	
No PGR AAC Brandon	0.1	B
No PGR AAC Alida	0.0	B
No PGR AAC Redberry	0.5	A
No PGR AAC Starbuck	0.3	AB
Moddus AAC Brandon	0.0	B
Moddus AAC Alida	0.0	B
Moddus AAC Redberry	0.1	B
Moddus AAC Starbuck	0.0	B
Manipulator AAC Brandon	0.0	B
Manipulator AAC Alida	0.0	B
Manipulator AAC Redberry	0.0	B
Manipulator AAC Starbuck	0.0	B

Grain Yield:

Grain yield was significant for PGR at one site and for variety at 4 sites (Table 9). At NARF (p=0.0122), Moddus significantly reduced crop yield as compared to No PGR by 15% or 542kg/ha. Manipulator reduced average yield from No PGR by 6% or 226kg/ha, but the difference was not significant. At WARC (p=0.0064), ICDC (p=0.0226) and IHARF (p<0.0001) AAC Brandon was the highest yielding variety, but at WARC and ICDC Brandon was only significantly higher yielding than AAC Alida. At IHARF, AAC Brandon was significantly higher yielding than both AAC Alida and AAC Redberry. At NARF (p=0.0244), AAC Bandon and AAC Starbuck were the highest yielding varieties, and both were significantly higher yielding than AAC Redberry. At ECRF and CLC there were no significant yield differences due to PGR or variety. Across treatments, yield was greatest at ICDC (7367kg/ha) followed by IHARF (5339kg/ha), ECRF (4293kg/ha), WARC (3914kg/ha), CLC (3544kg/ha) and NARF (3403kg/ha). Lastly, there were no significant interactions between PGR and variety on grain yield at any of the locations.

Table 9. Statistical analyses and treatment means for Grain Yield (kg/ha) for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Grain Yield (kg/ha)[z]			
PGR (p-value)	0.0122*	0.42	0.20	0.98	0.92	0.25
Variety (p-value)	0.0244*	0.32	0.0064**	0.27	0.0226*	<0.0001***
Var*PGR (p-value)	0.44	0.21	0.56	0.61	0.71	0.61
Grand Mean	3403	4293	3914	3544	7367	5339
CV	11.15	11.41	4.33	15.57	4.35	2.13
PGR						
Manipulator	3433 A	4204 A	3973 A	3506 A	7367 A	5434 A
Moddus	3117 B	4082 A	3860 A	3559 A	7331 A	5312 A
No PGR	3659 A	4594 A	3911 A	3566 A	7405 A	5271 A
Variety						
AAC Alida	3326 B	4278 A	3801 B	3790 A	7199 B	5287 BC
AAC Brandon	3568 A	4431 A	4027 A	3403 A	7564 A	5503 A
AAC Redberry	3139 B	4080 A	3840 B	3590 A	7233 B	5189 C
AAC Starbuck	3579 A	4384 A	3990 B A	3391 A	7475 B A	5376 B A

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Test weight:

Test weight was significant for PGR at two sites and at five sites for variety (Table 10). PGR significantly affected test weight at both NARF (p=0.0153) and IHARF (p=0.008). At both sites, Manipulator significantly reduced test weight as compared to Moddus and the untreated control. Variety significantly affected test weight at ECRF (p=0.0004), WARC (p<0.0001), CLC (p=0.0004), ICDC (p<0.0001), and IHARF (p<0.0001). AAC Redberry had the greatest test weight at WARC, ICDC and IHARF and AAC Brandon had the lowest test weight at all sites. AAC Alida and AAC Starbuck had moderate test weights that were sometimes significantly greater than AAC Brandon and less than AAC Redberry, but significance varied by site. Across sites, test weight was greatest at IHARF (411.9g/0.5L) followed by NARF (409.7g/0.5L), ICDC (405.7g/0.5L), WARC (405.4g/0.5L), ECRF (392.1g/0.5L) and CLC (358.8g/0.5L). Lastly, there were no significant interactions of PGR and variety that significantly affected test weight at any of the sites.

Table 10. Statistical analyses and treatment means for Test weight (g/0.5L) for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Test weight (g/0.5L)[z]			
PGR (p-value)	0.0153*	0.18	0.11	0.77	0.14	0.008**
Variety (p-value)	0.12	0.0004***	<0.0001***	0.0004***	<0.0001***	<0.0001***
Var*PGR (p-value)	0.89	0.38	0.21	0.65	0.25	0.46
Grand Mean	409.7	392.1	405.4	385.8	405.7	411.9
CV	0.73	1.00	0.36	1.04	0.56	0.31
PGR						
Manipulator	407.8 B	391.6 A	404.3 A	385.2 A	405.1 A	410.8 B
Moddus	410.6 A	394.5 A	407.3 A	385.7 A	407.0 A	412.8 A
No PGR	410.7 A	390.2 A	404.5 A	386.4 A	405.0 A	412.3 A
Variety						
AAC Alida	409.8 A	395.9 A	406.3 B	388.0 A	403.1 C	413.0 AB
AAC Brandon	408.0 A	387.9 B	400.6 C	380.8 B	403.3 C	408.5 C
AAC Redberry	411.0 A	391.9 AB	408.9 A	387.8 A	410.0 A	414.2 A
AAC Starbuck	410.0 A	392.8 A	405.8 B	386.4 A	406.4 B	412.1 B

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Thousand Kernel Weight:

Thousand kernel weight (TKW) was not significant for PGR at any site, but was significant for variety at all six sites (Table 11). AAC Alida had the greatest TKW at all sites. At all other sites, AAC Starbuck had the second greatest TKW, except for CLC where AAC Redberry had the second greatest TKW. At IHARF, WARC, NARF, ICDC, and ECRF, AAC Redberry and AAC Brandon had the lowest TKW. Across treatments, ICDC (39.9g) had the greatest TKW followed by NARF (38.2g), ECRF (36.0g), IHARF (35.8g), WARC (35.8g), and CLC (32.9g).

Table 11. Statistical analyses and treatment means for Thousand Kernel Weight (g/1000 seeds) for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Thousand Kernel Weight (g/1000 seeds)[z]			
PGR (p-value)	0.09	0.95	0.94	0.09	0.27	0.11
Variety (p-value)	<0.0001***	<0.0001***	<0.0001***	0.0013**	<0.0001***	<0.0001***
Var*PGR (p-value)	0.62	0.93	0.07	0.40	0.011*	0.19
Grand Mean	38.2	36.0	35.8	32.9	39.9	35.8
CV	1.72	2.92	1.77	4.92	1.62	2.34
PGR						
Manipulator	38.0 A	36.1 A	35.7 A	31.9 A	39.7 A	35.5 A
Moddus	37.9 A	35.9 A	35.9 A	33.8 A	39.5 A	35.8 A
No PGR	38.6 A	36.0 A	35.7 A	32.9 A	41.0 A	36.0 A
Variety						
AAC Alida	40.2 A	38.3 A	37.7 A	34.3 A	40.6 A	37.3 A
AAC Brandon	38.2 B	35.5 B	34.6 C	31.8 B	39.8 B	35.1 B
AAC Redberry	34.6 C	32.9 C	34.3 C	33.4 AB	38.9 C	34.0 C
AAC Starbuck	39.6 A	37.3 A	36.5 B	31.9 B	40.3 AB	36.6 A

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

There was also a significant interaction of variety and PGR at ICDC (p=0.011) (Table 12). The significant interaction was that AAC Redberry had significantly reduced TKW with both Moddus and Manipulator as compared to no PGR.

Table 12. Group means for Thousand kernel weights (g/1000 seeds) for the significant interaction of PGR and variety at ICDC for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

*PGR*Variety*	ICDC	
No PGR AAC Brandon	39.5	BCD
No PGR AAC Alida	41.2	A
No PGR AAC Redberry	40.4	AB
No PGR AAC Starbuck	41.1	A
Moddus AAC Brandon	40.0	AB
Moddus AAC Alida	40.3	AB
Moddus AAC Redberry	38.5	CD
Moddus AAC Starbuck	40.1	AB
Manipulator AAC Brandon	39.9	ABC
Manipulator AAC Alida	40.3	AB
Manipulator AAC Redberry	37.9	D
Manipulator AAC Starbuck	39.8	ABC

Protein:

Protein was significant for PGR at two sites and for variety at five sites (Table 12). At NARF (p=0.0001) protein was significantly reduced from No PGR with both applications of Moddus and Manipulator; however, Manipulator also significantly reduce protein as compared to Moddus. At IHARF (p=0.004), protein was significantly reduced from No PGR with Manipulator, but not with Moddus. While the yield response to PGR at IHARF was not statistically significant, the lower protein with Manipulator may have been attributable to this as mean yields with Manipulator consistently trended higher for all four varieties at this location. Past work has shown that when yield increases with PGR occur, protein is often negatively affected. The effect of variety varied by site, where AAC Brandon had the highest protein at ECRF, which was significantly greater than AAC Redberry and AAC Alida. At IHARF all varieties had similar protein except AAC Redberry which was significantly lower than all other varieties. At WARC and ICDC, AAC Alida had the greatest protein, which was significantly higher than AAC Brandon at WARC and AAC Brandon and AAC Starbuck at ICDC. At CLC, AAC Redberry that the greatest protein that was significantly greater than all other varieties. Across treatments, CLC (16.4%) had the greatest protein followed by WARC (14.4%), ECRF (14.2%), IHARF (12.8%), ICDC (12.4%), and NARF (11.8%). Lastly, there were no significant interactions of PGR and variety that significantly affected protein at any location.

Table 13. Statistical analyses and treatment means for Protein (%) for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023. Means within a column followed by the same letter do not significantly differ (Tukey-Kramer, P ≤ 0.05).

Main effect	NARF	ECRF	WARC	CLC	ICDC	IHARF
			Protein (%)[z]			
PGR (p-value)	0.0001** *	0.54	0.40	0.49	0.5133	0.004**
Variety (p-value)	0.20	0.0055**	0.0288*	0.0002***	0.002* *	<0.0001***
Var*PGR (p-value)	0.75	0.93	0.56	0.83	0.26	0.41
Grand Mean	11.8	14.2	14.4	16.4	12.4	12.8
CV	10.52	1.44	2.8	2.79	1.76	1.03
PGR						
Manipulator	11.2 C	14.1 A	14.3 A	16.5 A	12.3 A	12.6 B
Moddus	11.8 B	14.2 A	14.3 A	16.2 A	12.5 A	12.9 A
No PGR	12.3 A	14.2 A	14.5 A	16.6 A	12.4 A	12.9 A
Variety						
AAC Alida	12.1 A	14.0 B	14.7 A	16.2 B	12.6 A	12.9 A
AAC Brandon	12.0 A	14.3 A	14.2 B A	16.4 B	12.3 C A	12.9 A
AAC Redberry	11.1 A	14.1 B A	14.3 B A	17.0 A	12.5 B	12.4 B
AAC Starbuck	11.9 A	14.1 B	14.3 B	16.2 B	12.3 BC	12.8 A

[z]Significance level of the p-value: *p<0.05, ** p<0.01, *** p<0.001

Economic Analysis:

The results of the economic analysis were determined using January 2023 prices for wheat and spring 2023 retail prices for Manipulator and Moddus. Results of the economic analysis are reported in Table 16-18 of the appendices. When economics were analyzed based on PGR applications alone (no PGR, Moddus or Manipulator), IHARF was the only site to have a gain in net profit when a PGR was applied (Table 16). At IHARF, Manipulator resulted in a positive net profit of $6.83/ha. When analyzing the economics of all treatments (variety and PGR) there were no instances where applying a PGR resulted in a positive net profit at NARF and ECRF (Table 17). When Manipulator was profitable it was at WARC for AAC Alida ($9.41/ha), CLC ($102.43/ha) and IHARF ($42.21/ha) for AAC Brandon, and IHARF ($6.52/ha) and ICDC ($2.89/ha) for AAC Redberry. When Moddus was profitable it was at CLC for AAC Brandon ($65.87/ha) and at ICDC ($30.69/ha) and IHARF ($4.73/ha) for AAC Redberry. Applying a PGR was never profitable at any sites for AAC Starbuck.

Extension:

This demonstration was toured during the NARF Field Day on July 26, 2023. There was no formal presentation, but the project was passed by with funder and individual treatment signage. It was attended by 70 people including agronomists, producers, and other industry personnel. The project was presented by NARF at the ECRF field tour on July 21st with 80 people in attendance. The project was also presented at the Irrigation Conference to 250+ people, at the CLC crop talk to 40 people, and at the Indian Head Crop Management Field Day on July 18 to 160 people. Chris Holzapfel presented results from Indian Head at the IHARF Winter Seminar and AGM in Balgonie on February 7, attended by approximately 150 farmers, agronomists, and industry representatives. Chris Holzapfel also presented results at the ICAN Conference in Moose Jaw on February 8, attended by an estimated 40 agronomists. The final project report will be made available on all participating sites websites.

Conclusions and Recommendations

Describe what was learned from the demonstration. Highlight any significant conclusions and provide recommendations for the application and adoption of the project results. Be sure that you have presented the relevant data to support your conclusions. Identify any further research, development and communication needs, if applicable.

Despite the dry and hot conditions at all sites, in 2023 the demonstration was successfully established, and all data was collected. Results varied by site, but when PGR was significant, applying a PGR reduced crop height, prolonged days to maturity and reduced crop lodging. When PGR product was significant, Moddus reduced grain yield and test weight, and Manipulator prolonged maturity and reduced test weight and grain protein. Both products reduced crop height at four sites by an average of 4-8cm. At WARC and IHARF, AAC Redberry had significant height reductions with both products, but AAC Brandon only had significant height reductions with Manipulator. Lodging was minimal at all sites in 2023, and when lodging was recorded, a score of greater than 1 was rarely given. When lodging was reduced, it was reduced by an average of 0.2-0.6. At IHARF there was a significant varietal response to PGR for lodging, where AAC Redberry (fair lodging & tall) was the only variety to demonstrate significant reductions in lodging when a PGR was applied. Days to maturity was only prolonged at IHARF with an application of Manipulator. Redberry was, essentially, the only variety where any lodging whatsoever occurred at IHARF and, even there, it was extremely minor and would not have resulted in any challenges with harvest. Maturity was only prolonged by an average of 1 day. Grain yield was not affected by PGR application at five of the sites, but at NARF yield was significantly reduced with Moddus. At IHARF, Manipulator reduced test weight and protein and at NARF, Manipulator reduced test weight, and both Moddus and Manipulator reduced protein. Variety was often significant for the data collected in the demonstration, and varieties often performed similar to their listed characteristics in the Saskatchewan Seed Guide, where varieties with greater height were often taller, and varieties with greater seed weight had higher TKW. Applying a PGR was often not economical in this demonstration due to the lack of yield response to applying PGRs. When applying a PGR was profitable the only consistencies across sites were for both PGRs for AAC Redberry and Manipulator for AAC Brandon at two of the six sites. Lastly, there were very few differences in varietal response to PGR at all sites in this demonstration, suggesting that these varieties responded similar to both PGR's in this one-year demonstration. Furthermore, as PGRs often work better under high yielding conditions of high moisture and high fertility, and the conditions of 2023 were hot and dry, it may be beneficial to repeat this demonstration under more favorable conditions for applying PGRs.

Sustainable Canadian Agricultural Partnership (Sustainable CAP) Performance Indicators

a) List of performance indicators

Sustainable CAP Indicator	Total Number
Scientific publications from this project (List the publications under section b)	
• Published	0
• Accepted for publication	0
HQPs trained during this project	
• Master's students	0
• PhD students	0
• Post docs	0
Knowledge transfer products developed based on this project (presentations, brochures, factsheets, flyers, guides, extension articles, podcasts, videos). List the knowledge transfer products under section ©	

[1] Please only include the number of unique knowledge transfer products.

b) List of scientific journal articles published/accepted for publication from this project.

Title	Author(s)	Journal	Date Published or Accepted for Publication	Link (if available)

c) List of knowledge transfer products/activities developed from this project.

Knowledge Transfer Product or Activity	Event/Location Where Knowledge Transfer Was Conducted	Estimated Number of Producers Participated In Knowledge Transfer	Link (if available)
NARF & AAFC Joint Field Day	Melfort Research Farm, Melfort, SK	70	
ECRF Field Tour	Yorkton, SK	80	
Irrigation Conference (ICDC)	TCU Place, Saskatoon, SK	>250	
Crop Talk	Prince Albert	40	
Indian Head Crop Management Field day	Indian Head	160	

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Appendices

Identify any changes expected to industry contributions, in-kind support, collaborations or other resources.

Table 14. Dates of operation and agronomic information at Melfort (NARF), Yorkton (ECRF), Scott (WARC), Prince Albert (CLC), Outlook (ICDC), and Indian Head (IHARF) in the demonstration.

	NARF	ECRF	WARC	CLC	ICDC	IHARF
Stubble	Canola	Canola	Canola	Canola	Canola	Canola
Row spacing	0.3048m	0.3048m	0.254m	0.254m	0.254m	0.3m
Plot size	14.0m^2	30.6m2	12.2m2	10.7m^2	12m2	25.6m^2
Fertility (N-P2O5-K2O-S kg/ha)	197-56-17-11	167-58-0-0	124-28-11-6	205-26-0-0	150-30-0-0	175-54-20-20
Seeding date	17-May	16-May	12-May	05-Jun	11-May	10-May
Pre-emergent herbicide	1L/ac Glyphosate540 19-May	None	1L/ac Glyphosate540 & 35mL/ac AIM May 11	Prepass XC A (100mL/ha) & B (940mL/ha) May 26	None	None
Plant counts	02-Jun	01-Jun		23-Jun	June 12	30-May
Post-emergent herbicide	Prestige Xl 947mL/ac June 2 Axial 0.5L/ac June 20	Simplicity June 7 Axial June 12	0.5L/ac Axial & 0.33L/ac Infinity June 2 0.4L/ac Buctril M June 13	None	Buctril M & Simplicity on June 8	0.45L/ac Octain XL & 28g/ac Simplicity GoDRI June 8
PGR Application	13-Jun	14-Jun	16-Jun	June 28	08-Jun	16-Jun
Fungicide	Caramba 0.4L/ac July 17	Prosaro XTR July 5	0.4L/ac Caramba July 5	None	Matador May 30th	0.304L/ac Prosaro PRO June 30
Insecticide	Decis 5EC 60ml/ac June 23 for grasshoppers	None	Decis 5EC 60mL/ac July 7	None		33.3mL/ac Coragen Max June 22 for Grasshoppers
Heights	31-Jul	August 21?	27-Jul	13-Sep	July 27	July 28
Lodging	29-Aug	21-Aug	25-Aug	13-Sep	July 27	10-Aug

Maturity	August 17-21	August 17-24	August 7 - 16	August 28-September 7	August 8-12	August 5-10
Desiccant	None	None	Glyphosate 1L/ac, Heat LQ 59mL/ac & Merge 200mL/ac August 15	None		0.67L/ac RoundUp Weathermax August 12
Harvest	29-Aug	28-Aug	28-Aug	14-Sep	16-Aug	18-Aug

Table 15. Residual nutrients and soil characteristics for Melfort (NARF), Yorkton (ECRF), Scott (WARC), Prince Albert (CLC), Outlook (ICDC), and Indian Head (IHARF) in the demonstration.

Depth	NO3-N (kg/ha)	Olsen-P (ppm)	K (ppm)	S (kg/ha)	pH	Organic Matter (%)	Salts (mmho/cm)
	NARF						
0-15cm	17	9	401	36	6.4	7.6	0.48
15-60cm	27			61	7.3		0.54
	ECRF						
0-15cm	18	16	353	6	6.8	7.8	0.44
15-30cm	19			16	7.7		0.36
	WARC						
0-15cm	7	19	314	34	6.4	4	0.23
15-60cm	38			29	7.6		0.27
	IHARF						
0-15cm	6	7	576	20	7.7	5.5	0.57
15-60cm	10			40	8.2		0.57
	ICDC						
0-15cm	4	6	317	18	7.7	2.7	0.26
15-60cm	18			18	7.9		0.2
	CLC						
0-15cm	31	22	162	25	5.7	4	0.13
15-30cm	29			18	6.4		0.18

Table 16. Economic analysis for the main-plot of PGR applications at all sites for Standing up with your own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023

Site	PGR	Grain yield	Moddus Cost[z]	Manipulator cost[z]	HRS Wheat price[a]	Net profit	Change in profit from No PGR[c]
		kg/ha	$/ha	$/ha	$/kg	$/ha	
NARF	Manipulator	3433	$32.25	$44.61	$0.32	$ 1,036.79	-$115.77
	Moddus	3117			$0.32	$ 949.51	-$203.04
	No PGR	3659			$0.32	$ 1,152.55	$0.00
ECRF	Manipulator	4204	$32.25	$44.61	$0.32	$ 1,279.68	-$167.27
	Moddus	4082			$0.32	$ 1,253.58	-$193.37
	No PGR	4594			$0.32	$ 1,446.95	$0.00
WARC	Manipulator	3973	$32.25	$44.61	$0.32	$ 1,206.73	-$25.33
	Moddus	3860			$0.32	$ 1,183.49	-$48.57
	No PGR	3911			$0.32	$ 1,232.06	$0.00
CLC	Manipulator	3506	$32.25	$44.61	$0.32	$ 1,059.75	-$63.41
	Moddus	3559			$0.32	$ 1,088.77	-$34.39
	No PGR	3566			$0.32	$ 1,123.16	$0.00
ICDC	Manipulator	7367	$32.25	$44.61	$0.32	$ 2,275.97	-$56.52
	Moddus	7331			$0.32	$ 2,276.89	-$55.59
	No PGR	7405			$0.32	$ 2,332.48	$0.00
IHARF	Manipulator	5434	$32.25	$44.61	$0.32	$ 1,667.10	$6.83
	Moddus	5312			$0.32	$ 1,640.87	-$19.40
	No PGR	5271			$0.32	$ 1,660.27	$0.00

[a]price of wheat is for no. 1 grade CWRS on January 31, 2024. Saskatchewan's Dashboard - Wheat 1CWRS

[b]Price for Moddus and Manipulator based on spring 2023 prices per jug (10L) and provided by the Prairie North Co-op in Melfort, SK; $/ha accounts for each product application rate

[c]Only accounts for the difference in the cost of the PGR product versus the net profit from grain yield and does not include the associated costs for labour and other operational expenses.

Table 17. Economic analysis broken down for every individual treatment at NARF, ECRF and WARC for Standing up with you own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023

Site	Treatment	Grain yield	Moddus Cost	Manipulator cost	HRS Wheat price	Net profit	Change in profit from No PGR
		Kg/ha	$/ha	$/ha	$/kg	$/ha	
NARF	1	3757			$0.32	$1,183.30	$0.00
	2	3445			$0.32	$1,085.05	$0.00
	3	3451			$0.32	$1,086.91	$0.00
	4	3984			$0.32	$1,254.90	$0.00
	5	3722		$44.61	$0.32	$1,127.70	-$55.60
	6	3517		$44.61	$0.32	$1,063.12	-$21.93
	7	3196		$44.61	$0.32	$962.04	-$124.87
	8	3298		$44.61	$0.32	$994.29	-$260.60
	9	3225	$32.25		$0.32	$983.53	-$199.77
	10	3016	$32.25		$0.32	$917.89	-$167.16
	11	2770	$32.25		$0.32	$840.43	-$246.48
	12	3455	$32.25		$0.32	$1,056.14	-$198.76
ECRF	1	4781			$0.32	$1,505.98	$0.00
	2	4742			$0.32	$1,493.64	$0.00
	3	4227			$0.32	$1,331.38	$0.00
	4	4625			$0.32	$1,456.75	$0.00
	5	4358		$44.61	$0.32	$1,328.22	-$177.76
	6	4466		$44.61	$0.32	$1,362.09	-$131.55
	7	3965		$44.61	$0.32	$1,204.24	-$127.14
	8	4028		$44.61	$0.32	$1,224.18	-$232.57
	9	4153	$32.25		$0.32	$1,275.82	-$230.16
	10	3625	$32.25		$0.32	$1,109.66	-$383.98
	11	4050	$32.25		$0.32	$1,243.47	-$87.91
	12	4500	$32.25		$0.32	$1,385.38	-$71.37
WARC	1	4041			$0.32	$1,272.79	$0.00
	2	3746			$0.32	$1,179.83	$0.00
	3	3816			$0.32	$1,202.13	$0.00
	4	4043			$0.32	$1,273.55	$0.00
	5	4110		$44.61	$0.32	$1,250.07	-$22.72
	6	3917		$44.61	$0.32	$1,189.25	$9.41
	7	3810		$44.61	$0.32	$1,155.64	-$46.50
	8	4053		$44.61	$0.32	$1,231.96	-$41.58
	9	3929	$32.25		$0.32	$1,205.39	-$67.40
	10	3741	$32.25		$0.32	$1,146.07	-$33.76
	11	3894	$32.25		$0.32	$1,194.42	-$7.71
	12	3874	$32.25		$0.32	$1,188.00	-$85.55

Table 18. Economic analysis broken down for every individual treatment at CLC, ICDC and IHARF for Standing up with you own stalk: Do the plant growth regulators available for spring wheat improve the productivity of current CWRS varieties? in 2023

Site	Treatment	Grain yield	Moddus Cost	Manipulator cost	HRS Wheat price	Net profit	Change in profit from No PGR
		Kg/ha	$/ha	$/ha	$/kg	$/ha	
CLC	1	3144			$0.32	$990.30	$0.00
	2	3961			$0.32	$1,247.84	$0.00
	3	3809			$0.32	$1,199.96	$0.00
	4	3348			$0.32	$1,054.56	$0.00
	5	3611		$44.61	$0.32	$1,092.73	$102.43
	6	3645		$44.61	$0.32	$1,103.57	-$144.27
	7	3261		$44.61	$0.32	$982.67	-$217.29
	8	3507		$44.61	$0.32	$1,060.00	$5.45
	9	3455	$32.25		$0.32	$1,056.17	$65.87
	10	3763	$32.25		$0.32	$1,153.06	-$94.78
	11	3699	$32.25		$0.32	$1,133.03	-$66.93
	12	3318	$32.25		$0.32	$1,012.89	-$41.67
ICDC	1	7558			$0.32	$2,380.71	$0.00
	2	7308			$0.32	$2,302.08	$0.00
	3	7116			$0.32	$2,241.60	$0.00
	4	7637			$0.32	$2,405.56	$0.00
	5	7676		$44.61	$0.32	$2,373.17	-$7.53
	6	7171		$44.61	$0.32	$2,214.19	-$87.89
	7	7267		$44.61	$0.32	$2,244.50	$2.89
	8	7354		$44.61	$0.32	$2,272.00	-$133.56
	9	7457	$32.25		$0.32	$2,316.74	-$63.97
	10	7116	$32.25		$0.32	$2,209.42	-$92.67
	11	7316	$32.25		$0.32	$2,272.29	$30.69
	12	7433	$32.25		$0.32	$2,309.11	-$96.45
IHARF	1	5381			$0.32	$1,694.95	$0.00
	2	5262			$0.32	$1,657.62	$0.00
	3	5096			$0.32	$1,605.27	$0.00
	4	5344			$0.32	$1,683.23	$0.00
	5	5656		$44.61	$0.32	$1,737.16	$42.21
	6	5355		$44.61	$0.32	$1,642.15	-$15.47
	7	5258		$44.61	$0.32	$1,611.79	$6.52
	8	5466		$44.61	$0.32	$1,677.31	-$5.93
	9	5473	$32.25		$0.32	$1,691.68	-$3.27
	10	5243	$32.25		$0.32	$1,619.23	-$38.39
	11	5214	$32.25		$0.32	$1,610.00	$4.73
	12	5317	$32.25		$0.32	$1,642.57	-$40.66

Expenditure Statement

You must provide an expenditure statement showing how ADOPT funds were used. Expenditures must be reported using the budget categories shown in Appendix B of your contract. We recommend that you report your expenditures using the Excel spreadsheet we have developed for this purpose (ADOPT Expenditure Statement.xls). That spreadsheet is available from the research branch project manager or the evaluation coordinator.
Note that the ADOPT contract requires you to retain all receipts and financial records relating to the project for at least six years after the project is completed.

Expenditure statement provided separately in excel spreadsheet