2025 Project Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

and

Saskatchewan Barley Development Commission (SaskBarley)

Project Title: Plant Growth Regulator Mixes to Improve Crop Safety and Efficacy in Barley 2.0

Project #: 20241052 (ADOPT) and 5130 (SaskBarley)

Principal Investigator: Chris Holzapfel[1]
[1]Indian Head Agricultural Research Foundation, Indian Head, SK, S0G 2K0

Collaborators: Mitchell Japp[2], Brianne McInnes[3], Zoe Galbraith/Robin Lokken[4], and Jessica Enns[5]

[2]Saskatchewan Barley Development Commission, Saskatoon, SK, S7T 0J1
[3]Northeast Agriculture Research Foundation, Melfort, SK, S0E 1A0
[4]Conservation Learning Centre, Prince Albert, SK, S6V 6J9
[5]Western Applied Research Corporation, Scott, SK, S0K 4A0

Correspondence: cholzapfel@iharf.ca or (306) 695-7761

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: Plant Growth Regulator Mixes to Improve Crop Safety and Efficacy in Barley 2.0

Project Number: ADOPT #20241052; SaskBarley #5130

Producer Group Sponsoring the Project: Saskatchewan Barley Development Commission

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).* Indian Head (RM #156), Melfort (RM #428), Prince Albert (RM #461), and Scott (RM #380)

Project start date *(month & year):* 4/1/2025

Project end date *(month & year):* 3/31/2026

Project Manager Contact

Full Name: Mitchell Japp, Research and Extension Manager (Chris Holzapfel, IHARF, Project Lead)

Organization: Saskatchewan Barley Development Commission (SaskBarley)

Mailing Address: 225-415 Wellman Crescent, Saskatoon, SK, S7T 0J1

Phone Number: 1 (306) 535-4356

E-mail: mjapp@saskbarley.com

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.

Field trials with malting barley were conducted at four locations in 2025. The objective was to demonstrate varietal differences in response to plant growth regulator (PGR) products and mixes. The varieties were Synergy, Fraser, Connect and Churchill and, in addition to a control, the PGR options were Moddus® and Manipulator® applied both alone and in either half or full rate tank mixes. Moddus® reduced plant height more consistently and to a greater extent than Manipulator®. The tank-mix also effectively reduced height, especially at full rates. Lodging was not observed in any cases. The only significant effect on yield was, when averaged across locations, the full rate tank-mix reduced yields slightly. Effects on test weight were location dependent but negative when significant. Effects on seed weight and kernel plumpness were more general but also negative, albeit minor. Excluding the risky full-rate tank-mix, negative grain quality responses were less frequent or severe with Manipulator®; however, again, this treatment was also less likely to provide agronomic benefits. Overall, we recommend only applying PGR when moisture is not limiting and the risk of

Sustainable Canadian Agricultural Partnership Saskatchewan Canada lodging exists. Moddus® remains the more effective product and the potential benefits of tank-mixing with Manipulator® are insufficient to specifically recommend this practice. The project was featured at numerous field days and winter meetings, reaching nearly 700 agronomists and farmers at the time of writing.

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 overall project objective was to demonstrate the agronomic, yield and grain quality responses of four important malting varieties to registered plant growth regulator (PGR) options, alone and in combination. More specifically, we strove to demonstrate whether PGR applications can be used to help reach industry yield goals while maintaining malt quality through effects on plant height, lodging, yield, and grain characteristics. We also wished to explore whether applying the registered PGR options in combination have potential to increase crop tolerance and improve efficacy of these products for barley grown across a range of Saskatchewan field conditions.

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?

The availability and adoption of PGRs for use on barley is recent in Western Canada. Moddus[1] (trinexepac ethyl) was first available in 2021, and Manipulator[2] in 2020. Manipulator[2] (chlormequat chloride) is flagged by Keep it Clean due to some buyers restricting the use of the PGR on grain they purchase, but both products are registered and widely available. Prior to 2020, only Ethrel (ethephon) was available, but it is no longer registered for use on barley in Canada[3].

Manipulator has a limited effect on barley, compared to its efficacy in wheat, durum and oats. Moddus appears to be the more effective product in barley; however, overall PGR efficacy can be variety dependant[3,4,5]. To date, there has been limited research into lodging management with PGRs on barley in Western Canada. Recently, the Strategic Field Program and SaskBarley funded "Barley MAX" showed a significant reduction in lodging at sites with high yield potential, despite generally dry conditions throughout the study period[6].

Barley growers internationally have similar agronomic challenges with lodging compared to Canadian growers. In the high rainfall, high fertility production areas in Europe, PGRs are commonly applied to manage straw and lodging. We have recently learned that growers have adopted mixing Manipulator and Moddus with the goal of increased efficacy reducing plant height and lodging, while increasing crop safety. Manipulator works earlier in the gibberellin biosynthesis pathway compared with Moddus, so some synergies can be achieved[3]. Anecdotal reports suggest that Moddus causes yellowing in barley, increasing stress to the plant. Some Canadian seed growers may be adopting this practice.

Other researchers in Canada have begun exploring this practice in wheat. S. Strydhorst found that a tank mix increased the frequency of a height reduction compared to using either product alone. Along with increased frequency of height reductions, Strydhorst found larger height reductions with the tank mix. Consistent with a known varietal effect in the use of PGRs, the tank mix worked better for some varieties, while a single product was better for others[3].

The tank-mix is not specifically a registered option for Canadian growers currently; however, both Moddus and Manipulator allow for split applications at half rates for each split. Additionally, there are no anticipated risks to adjusting rates or combinations of PGRs, compared to what may occur in pesticides. The project is adapting a practice that is used elsewhere to explore the potential benefit for growers in Canada.

In 2024, the ADOPT and SaskBarley funded project "Plant Growth Regulator Products and Mixes to Improve Crop Safety and Efficacy in Barley" was conducted at four locations across Saskatchewan[7]. In this project, the Indian Head location had severe lodging and showed the full rate tank-mix to be extremely successful for reducing lodging and plant height. The ½ rate treatments were not sufficient to reduce lodging and were eliminated from the current project. The full rate Moddus was comparable to the ½ rate tank-mix for reducing height and lodging and the highest yields were achieved with this treatment. Similar PGR responses were observed at the other locations with respect to height reductions; however, there was no lodging and we occasionally saw negative effects on yield and quality, particularly with the full rate tank-mix.

Literature Cited

1. Moddus product label
2. Manipulator 620 product label
3. **S. Stryhorst**. 2020. Investigating PGRs: Multiple modes, multiple rates and multiple species. Which combination is a winner? Top Crop Manager
4. **B.D. Tidemann, J.T. O'Donovan, M. Izydorczyk, T.K. Turkington, L. Oatway, B. Beres, R. Mohr, W.E. May, K.N. Harker, E.N. Johnson, and H. de Gooijer. 2020.** Effects of plant growth regulator applications on malting barley in western Canada. CJPS **100**:653-665.
5. **S. Strydhorst, L. Hall, and L. Thompson. 2019.** Plant Growth Regulators for Cereal Crops. Final Report to the Alberta Funding Consortium for project RES0041117 – AF819487.
6. **M. Japp, S. Chant, M. Hall, H. Sorestad, R. Lokken, B. McInnes, J. Enns, K. Slind, B. Nybo, and A. Wall. 2023.** Barley MAX Experiment 1. Unpublished report.
7. **C. Holzapfel, M. Japp, G. Singh, B. Boot, Z. Galbraith, and J. Enns. 2024.** Plant growth regulator products and mixes to improve crop safety and efficacy in barley. ADOPT 20230545/SaskBarley 5130 Project Report. Online [Available]: https://iharf.ca/wp-content/uploads/2025/04/Plant-Growth-Regulator-Products-and-Mixes-to-Improve-Crop-Safety-and-Efficacy-in-Barley.pdf (Feb. 13, 2026).

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.

In the spring of 2025, field trials with malting barley were established at four Saskatchewan locations; Indian Head (thin-Black soil zone, long-season), Melfort (moist-Black soil zone, short-season), Prince Albert (moist-Black soil zone, short-season), and Scott (Dark Brown soil zone). All the locations were dryland (i.e., non-irrigated). The treatments were a factorial combination of four malting varieties and five plant growth regulator (PGR) treatments, for a total of 20 treatments. The varieties were AAC Synergy, CDC Fraser, AAC Connect, and CDC Churchill. The PGR treatments were rates and combinations of Manipulator® 620 (620 g chlormequat chloride/L) and Moddus® (120 g Trinexapac-ethyl/L), applied at a target growth stage of Zadoks 30-32 (beginning of stem elongation up to two nodes detectable in main stem). The minimum solution volume was 94 l/ha; however, higher volumes were permitted. Greater details on the PGR treatments are in Table 1. The varieties were selected for their current or increasing popularity amongst growers and maltsters and are rated fair (F) to good (G) for lodging. There are currently no accepted malt varieties rated worse than F for lodging resistance. The treatments were arranged in a four replicate Randomized Complete Block Design (RCBD).

Table 1. Plant Growth Regulator (PGR) treatments for 2025 SaskBarley-ADOPT barley PGR mixing project. Each PGR treatment was evaluated for four varieties (AAC Synergy, CDC Fraser, AAC Connect, and CDC Churchill), for a total of 20 treatments.

#	Name	Litres product/ha	Treatment Details
1	1x Moddus®	1030 ml Moddus/ha	124 g trinexapac-ethyl/ha
2	1x Manipulator®	2301 ml Manipulator/ha	1426 g chlormequat chloride/ha
3	0.5x Moddus® + 0.5x Manipulator®	514 ml Moddus/ha + 1149 ml Manipulator/ha	62 g trinexapac-ethyl/ha + 713 g chlormequat/ha
4	1x Moddus® + 1x Manipulator®	1030 ml Moddus/ha + 2301 ml Manipulator/ha	124 g Trinexapac-ethyl/ha + 1426 g chlormequat/ha
5	UTC	Not applicable	No PGR applied

[Z] All PGR applications completed between Zadocks GS 30-32 (GS 32 is optimal and application will not be later than GS 39) in a minimum solution volume of 94 L/ha

Pertinent agronomic details along with dates of field operations and data collection activities are provided in Table 12 of the Appendices. Plot size was varied by location to accommodate seeding and spraying equipment. For all locations, the barley was direct seeded into canola stubble and all factors other than potentially lodging were intended to be as non-limiting as possible. Variety varied as per protocol and the target seeding rate was 300 viable seeds/m^2, adjusted for seed size and percent germination. All sites were advised by protocol to use a high nitrogen (N) of 185 kg N/ha (including residual soil NO_3-N) to promote lodging. Weeds, disease, and insects were controlled using registered pesticide options, at the discretion of individual site managers. No pre-harvest herbicides or desiccants were utilized, and the centre rows of each plot were harvested when it was fit to do so.

Various data were collected through the growing season and from the harvested grain samples. Emergence for each variety was estimated by counting the number of seedlings in 2 x 1 m sections of crop row (untreated control plots only). The values were averaged and converted to plants/m^2. Targeting 7 days after PGR applications, phytotoxicity/leaf burn was rated for each plot on a scale of 0-5 where 0 is no injury and 5 denotes severe leaf burn or other injury. After the stems were finished elongating (i.e. late milk/early dough stages), the total height for a minimum of eight plants per plot (four front, four back) was recorded and averaged. Between physiological maturity and harvest, each plot was rated on a scale of 1-9 for lodging where 1 is no lodging and 9 is severely lodged and essentially flat. Grain yields were determined from the harvested grain samples and are adjusted for dockage and to 13.5% seed moisture content. Test weights are expressed in g/0.5 l and were determined using standard CGC methods, a cleaned grain subsample, and two measurements per plot. Seed weight was determined by counting a minimum of 500 whole seeds per plot, weighing the counted seeds to the nearest 0.00 g, and calculating g/1000 seeds. Percent plump kernels were determined by hand sieving a 200 g sub-sample of cleaned seed and weighing the quantity of seed that stayed on top of a No. 6 (2.38 mm × 19.05 mm) slotted sieve. Percent grain protein was the average of two runs through an NIR instrument; however, the specific machine differed with location. Weather data was from the nearest ECCC weather station and mean monthly temperatures and precipitation totals are expressed relative to the long-term (1981-2010) average.

Response data were analysed using the generalized linear mixed model (GLIMMIX) procedure of SAS® Studio with, unless otherwise indicated, the effects of site (S), variety (VAR), PGR, and all possible interactions considered fixed and replicate effects (nested within site) considered random. The exception was for emergence, where only S, VAR, and S × VAR were included as a fixed effect. Heterogeneity amongst variance component estimates (by site) was tested for and permitted when significant and doing so improved model convergence. Where justified by the overall tests of fixed effects, Fisher's protected LSD test was used to separate treatment means. All comparisons were contained within sites and the slicediff statement was used to help identify differences in responses when interactions with site were detected. All treatment effects and differences between means were considered significant at $P \leq 0.05$; however, meaningful trends or p-values ≤ 0.10 may also be acknowledged.

Results *(you must provide the following information)*

Present and discuss any project results, including any data or measurements taken to evaluate the demonstration. Include things that didn't appear to work. These results are just as important to share. List extension activities such as field days or workshops. List the activity, the date it occurred, and the number of people who attended.

Soil and Weather Conditions

Soil characteristics for each location are provided in Table 2. The basic properties (i.e., pH, organic matter, cation exchange capacity) of the soil at each location were considered representative of the growing regions with which they corresponded. The Black soils at Indian Head, Melfort, and Prince Albert had intermediate to high organic matter and cation exchange capacity while these values tended to be lower with Scott's Dark Brown soil. Residual N was extremely high at Prince Albert; however, this was not a specific concern since all nutrients were intended to be non-limiting, and high N was recommended to promote lodging.

Table 2. Selected soil test analyses results for barley PGR mixing demonstration conducted at Indian Head (IH), Melfort (ME), Prince Albert (PA), and Scott (SC) in 2025. Unless otherwise indicated, all measurements are representative of the 0-15 cm soil profile.

Parameter	IH-25	ME-25	PA-25	SC-25
pH	7.8	6.6	6.0	6.8
Organic Matter (%)	4.9	7.4	5.1	3.5
CEC (meq)	50.8	36.0	22.2	16.8
NO_3-N (kg/ha) [Z]	21	24	114	32
Olsen-P (ppm)	9	13	12	17
K (ppm)	679	377	254	218
kg S/ha (kg/ha) [Z]	34	96	74	177

[Z] Values for residual NO_3-N and S are for the 0-60 cm soil profile

Mean monthly temperatures and precipitation totals for the four-month (May through August) growing season are presented in Tables 3 and 4, respectively. Over the four-month growing season, temperature trends varied widely by site being about average at Indian Head, above-average at Melfort and Scott, and considerably cooler than average at Prince Albert. Despite these discrepancies, May and August were warmer than average at all locations while June and July were cooler, but to a much greater extent at the more northern, short-season locations. Looking at precipitation, Indian Head was the driest location with only 136 mm over the season (56% of average). Melfort, Prince Albert, and Scott received 200-237 mm, 79-105% of average; however, the patterns differed in that conditions at these more northern sites were initially dry but turned wet while, at Indian Head, the season started wetter but became progressively drier.

Table 3. Mean monthly temperatures along with long-term (LT; 1981-2010) averages for the 2025 growing season at Indian Head (IH), Melfort (ME), Prince Albert (PA), and Scott (SC), Saskatchewan.

Year	May	June	July	August	May-Aug
	Mean Temperature (°C)				
IH-25	12.7	15.3	17.0	17.8	15.7 (+0.1)
IH-LT	10.8	15.8	18.2	17.4	15.6
ME-25	13.8	15.0	17.0	18.0	16.0 (+0.8)
OL-LT	10.7	15.9	17.5	16.8	15.2
PA-25	11.2	12.7	14.9	17.1	14.0 (-0.9)
PA-LT	10.4	15.3	18.0	16.7	15.1
SC-25	12.9	14.6	15.8	17.4	15.2 (+0.4)
SC-LT	10.8	14.8	17.3	16.3	14.8

Table 4. Total monthly precipitation amounts along with long-term (LT; 1981-2010) averages for the 2025 growing season at Indian Head (IH), Melfort (ME), Prince Albert (PA), and Scott (SC), Saskatchewan.

Year	May	June	July	August	May-Aug
	--- Total Precipitation (mm) ---				
IH-25	42.6	39.4	27.1	26.9	136 (56%)
IH-LT	51.7	77.4	63.8	51.2	244
ME-25	4.8	93.2	25.9	113.5	237 (105%)
ME-LT	42.9	54.3	76.7	52.4	226
PA-25	2.2	137.6	8.6	51.2	200 (79%)
PA-LT	44.7	68.6	76.6	61.6	252
SC-25	11.8	103.7	28.7	64.5	209 (92%)
SC-LT	38.9	69.7	69.4	48.7	227

The overall tests of fixed effects are presented in Table 13 of the Appendices. Primarily a function of soil/environmental conditions and management, the overall site (S) effects were highly significant for all variables ($P < 0.001$-0.003) and all means for this main effect are presented in Table 5 below. With target seeding rates of 300 viable seeds/m^2, overall seedling mortality was lowest at Indian Head and Scott (206-236 plants/m^2), intermediate at Melfort (179 plants/m^2), and highest at Prince Albert (143 plants/m^2). Relative to the averages of 75 cm for the corresponding varieties in the 2026 Saskatchewan Seed Guide (https://saskseed.ca/seed-guides), the barley was shorter than average at all locations but highest at Indian Head (66 cm), followed by Prince Albert (62 cm), Scott (60 cm), and Melfort (54 cm). Yields were exceptionally high at Indian Head (6903 kg/ha), more intermediate at Melfort (5528 kg/ha) and lowest at Scott and Prince Albert (4449-4730 kg/ha). Test weights were excellent at Indian Head and Melfort (334-336 g/0.5 L) and more typical at Scott (327 g/0.5 L), while kernel plumpness (95-98%) and seed weights (47-52 g/1000 seeds) were high at these sites. At Prince Albert, test weights (288 g/0.5 L), seed weight (39 g/1000 seeds), and kernel plumpness (64%) were all low. Grain protein was generally within the optimal range (11.4-12.6%) at Indian Head, Melfort, and Scott, but relatively high at Prince Albert (14.8%).

Table 5. Overall location means for selected barley response variables. Means within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; $P \leq 0.05$) and values in parentheses are the standard error of the treatment mean (S.E.M.) when heterogeneity between sites was significant.

Location	Plant Density	Plant Height	Seed Yield	Test Weight	Seed Weight	Grain Protein	Plump Kernels
	- plants/m^2 -	----- cm -----	--- kg/ha ---	--- g/0.5 L ---	--- g/1000 ---	------- % -------	------- % -------
IH-25	236 A	66 A	6903 A	336 A (1.4)	48.8 B (0.51)	12.1 C (0.10)	95.4 B (0.75)
ME-25	179 B	54 D	5528 B	334 A (0.5)	52.0 A (0.26)	11.4 D (0.06)	96.5 AB (0.75)
PA-25	143 C	62 B	4449 C	288 C (3.7)	39.1 D (1.62)	14.8 A (0.55)	64.3 C (7.1)
SC-25	206 AB	60 C	4730 C	327 B (0.5)	46.6 C (0.47)	12.6 B (0.16)	97.8 A (0.75)
S.E.M.	9.9	0.55	145.7	–	–	–	–

Plant Height, Phytotoxicity, and Lodging

In addition to the site effects, barley height was affected by both variety (VAR; $P < 0.001$) and PGR ($P < 0.001$), while the effects of both factors varied with site ($P < 0.001$). The main effect means for individual sites and on average are presented in Table 6. Synergy was amongst the tallest varieties in all cases while Churchill was consistently amongst the shortest. Heights of Fraser and Connect were intermediate and ranked less consistently. Averaged across locations, Synergy was tallest (63 cm), followed by Connect (61 cm), Fraser (60 cm), and Churchill (58 cm). This variation was mostly consistent with the Saskatchewan Seed Guide. The S x PGR interaction revealed that PGR affected barley height at Indian Head, Melfort, and Prince Albert ($P < 0.001$), but not Scott ($P = 0.141$). Of the responsive sites, the control (UTC) was always tallest while the full rate mixture of both PGR products (1x – Mix) was shortest. Of the PGR applications, the tallest plants always occurred with chlormequat chloride applied alone (CC) and this treatment did not differ from the control at Indian Head or Prince Albert. Despite always being taller than in the 1x-MIX treatment, the full rate of trinexapac-ethyl (TXP) consistently resulted in shorter plants than CC. The half rate tank-mix (½x-MIX) performed similarly but not better than TXP. The lack of response at Scott may be attributable to drought-stress at the time of the PGR applications (i.e., Fig. 1, Appendices). While not significant, there was also a trend for shorter plants in the 1x-MIX treatment at Scott. Across locations, the barley was tallest in the UTC (64.3 cm), followed by CC (63.1 cm), TXP and ½-MIX (59.6-60.3 cm), and 1x-MIX (55.7 cm). Individual treatment means within and across sites for height are in Table 15 of the Appendices; however, with no VAR x PGR or S x VAR x PGR interactions, they will not be discussed in detail. The observed height responses were largely consistent with results of previous field trials.

Potentially meaningful phytotoxicity was only rated at Indian Head where slightly more initial leaf/surfactant burn occurred in the 1x-MIX treatment relative to other treatments (data not shown); however, the injury was extremely minor averaging only 0.3/5 compared to 0.1 for other treatments, including the UTC. Similarly, the only site that reported any lodging whatsoever was Scott where any meaningful lodging was reported; however, this variable was not affected by any of the treatments and averaged only 1.4/9 across all plots (data not shown).

Table 6. Variety and PGR effects on barley plant height for individual sites and averaged across sites. For each main effect, values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05).

Variety/PGR	Indian Head	Melfort	Prince Albert	Scott	Average
	---------- Plant Height (cm) ----------				
Synergy	68.8 a	55.5 a	66.1 a	62.7 a	63.3 A
Fraser	64.2 c	52.5 c	63.1 b	59.8 b	59.9 C
Connect	66.7 b	54.6 ab	62.4 b	61.2 ab	61.2 B
Churchill	63.1 c	53.6 bc	58.1 c	57.2 c	58.0 D
S.E.M	0.78	0.78	0.78	0.78	0.39
	---------- Pr > F (p-value) ----------				
Effect Slice	<0.001	0.008	<0.001	<0.001	–
1x-TXP	65.6 b	50.7 c	61.7 c	60.6 a	59.6 C
1x -CC	68.4 a	59.2 b	63.9 ab	60.8 a	63.1 B
½x -MIX	65.8 b	51.6 c	62.7 bc	60.9 a	60.3 C
1x-MIX	58.4 c	47.0 d	58.8 d	58.6 a	55.7 D
UTC	70.3 a	61.9 a	65.0 a	60.1 a	64.3 A
S.E.M.	0.84	0.84	0.84	0.84	0.42
	---------- Pr > F (p-value) ----------				
Effect Slice	<0.001	<0.001	<0.001	0.141	–

Effects on Grain Yield

Grain yield was affected by S (*P* < 0.001), VAR (*P* < 0.005), and PGR (*P* = 0.024) with significant S x VAR (*P* < 0.001) but not S x PGR (*P* = 0.117) interactions were detected (Table 13; Appendices). The relative variety rankings varied amongst sites but, on average, showed slightly higher yields for Synergy and Churchill (5521-5575 kg/ha) compared to Fraser and Connect (~5258 kg/ha) (Table 7). The lack of an S x PGR interaction suggests that the PGR affected yield similarly across sites; however, Melfort and Scott appeared to be the most sensitive sites. The overall PGR effects showed that 1x-MIX yielded less than all other PGR treatments, which were statistically similar. Beyond this, there were some inconsistencies amongst sites with some PGR treatments tending to increase yields relative to UTC at Indian Head and Scott but reducing yields at Melfort. The lack of significant VAR x PGR (*P* = 0.438) or S x VAR x PGR (*P* = 0.304) effects does not warrant further discussion; however, individual treatment means for yield are in Table 16 of the Appendices.

Table 7. Variety and PGR effects on barley grain yield for individual sites and averaged across sites. With no significant S x PGR interaction for this variable, individual site means for PGR are presented solely for the sake of interest and transparency. For each main effect, values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05).

Variety/PGR	Indian Head	Melfort	Prince Albert	Scott	Average
	Seed Yield (kg/ha)				
Synergy	7231 a	5537 b	4726 a	4806 abc	5575 A
Fraser	6557 c	5282 b	4583 a	4608 bc	5258 B
Connect	6831 bc	5341 b	4291 b	4564 c	5257 B
Churchill	6996 ab	5950 a	4197 b	4941 a	5521 A
S.E.M	170.1	170.1	170.1	170.1	85.1
	Pr > F (p-value)				
Effect Slice	<0.001	<0.001	<0.001	0.032	–
1x-TXP	7019	5355	4465	4840	5420 A
1x -CC	6932	5729	4438	4895	5498 A
½x -MIX	6911	5560	4453	4706	5408 A
1x-MIX	6816	5181	4444	4530	5243 B
UTC	6840	5813	4446	4678	5444 A
S.E.M.	177.5	177.5	177.5	177.5	88.8
	Pr > F (p-value)				
Effect Slice [Z]	–	–	–	–	–

[Z] Effect slices are only presented when doing so is justified by a corresponding interaction with site

Effects on Grain Quality

In addition to the site differences, test weight was affected by variety and PGR with both the S x VAR and S x PGR interactions also being significant (*P* < 0.001; Table 13). Variety effects on test weight were significant at all locations individually, but the relative rankings were inconsistent (Table 8). When averaged across locations, Synergy had the highest test weight (324 g/0.5 L), followed by Connect (322 g/0.5 L), and then Fraser and Churchill (319-320 g/0.5 L). The S x PGR interaction showed that PGR affected test weight at Indian Head and Melfort, but not Prince Albert or Scott. At Indian Head, only the 1x-MIX treatment (332 g 0.5/L) significantly reduced test weight relative to the UTC (338 g/0.5 L). At Melfort, test weights were higher with ½x-MIX (333 g/0.5 L) than 1x-MIX (328 g/0.5 L), but neither differed from TXP (330 g/0. L) and all were less than the UTC and CC treatments (339-340 g/0.5 L). Averaged across locations and varieties, we see the highest test weights in the UTC (324 g/0.5 L), no effect with CC (323 g/0.5 L), a slight reduction with TXP and ½x-MIX (320-321 g/0.5 L), and the greatest reduction with 1x-MIX (318 g/0.5 L). Individual treatment means for test weight are in Table 17 (Appendices), but with no VAR x PGR (*P* = 0.711) nor S x VAR x PGR (*P* = 0.369) interactions, will not be discussed further.

Thousand kernel weight (TKW) was affected by site, VAR, and PGR with a significant S x VAR interaction (*P* < 0.001; Table 13). Varietal differences in TKW occurred at all sites with Connect consistently having amongst the highest seed weights and Churchill having amongst the lowest, but subtle inconsistencies with Synergy and Fraser (Table 9). Across locations and PGR, TKW were highest with Connect (48.0 g/1000 seeds), intermediate with Synergy and Fraser (47.0 g/1000 seeds), and lowest with Churchill (44.6 g/1000 seeds). The PGR effect was due to the UTC having the highest TKW (47.4 g/1000 seeds), 1x-MIX having the lowest (45.3 g/1000 seeds), and more intermediate values with the remaining treatments (46.5-47.2 g/1000 seeds). However, only TXP and 1x-MIX had significantly lower TKW than the UTC. The lack of any S x PGR effect (*P* = 0.157) indicates that PGR effects were reasonably consistent and any discrepancies between sites were not significant. Individual treatment means are deferred to the Appendices (Table 18), but neither the VAR x PGR nor S x VAR x PGR interactions were significant (*P* = 0.648-0.850).

Table 8. Variety and PGR effects on barley test weight for individual sites and averaged across sites. For each main effect, values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05).

Variety/PGR	Indian Head	Melfort	Prince Albert	Scott	Average
			Test Weight (g/0.5 L)		
Synergy	341 a	336 a	295 a	324 d	324 A
Fraser	329 c	329 b	290 b	326 bc	319 C
Connect	339 a	334 a	289 b	325 cd	322 B
Churchill	334 b	336 a	278 c	331 a	320 C
S.E.M	1.6	0.9	3.8	0.9	1.1
			Pr > F (p-value)		
Effect Slice	<0.001	<0.001	<0.001	<0.001	–
1x-TXP	336 a	330 cd	287 a	326 a	320 B
1x -CC	338 a	339 a	289 a	327 a	323 A
½x -MIX	335 a	333 bc	289 a	327 a	321 B
1x-MIX	332 b	328 d	286 a	325 a	318 C
UTC	338 a	340 a	289 a	327 a	324 A
S.E.M.	1.7	1.0	3.8	1.0	1.1
			Pr > F (p-value)		
Effect Slice	<0.001	<0.001	0.165	0.615	–

Table 9. Variety and PGR effects on barley kernel weight for individual sites and averaged across sites. With no significant S x PGR interaction for this variable, individual site means for PGR are presented solely for the sake of interest and transparency. For each main effect, values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05).

Variety/PGR	Indian Head	Melfort	Prince Albert	Scott	Average
			Thousand Kernel Weight (g/1000 seeds)		
Synergy	49.1 b	51.8 b	40.8 a	46.1 b	47.0 B
Fraser	49.6 ab	52.9 ab	37.6 b	48.1 a	47.0 B
Connect	50.7 a	53.3 a	40.2 a	47.7 a	48.0 A
Churchill	46.0 c	50.1 c	37.9 b	44.6 c	44.6 C
S.E.M	0.64	0.47	1.67	0.61	0.49
			Pr > F (p-value)		
Effect Slice	<0.001	<0.001	<0.001	<0.001	–
1x-TXP	48.6	52.1	39.0	46.4	46.5 B
1x -CC	49.6	53.1	39.4	46.6	47.2 AB
½x -MIX	48.9	51.7	39.9	47.0	46.9 AB
1x-MIX	47.1	49.9	37.9	46.3	45.3 C
UTC	50.0	53.4	39.4	46.9	47.4 A
S.E.M.	0.68	0.53	1.69	0.65	0.50
			Pr > F (p-value)		
Effect Slice [Z]	–	–	–	–	–

[Z] Effect slices are only presented when doing so is justified by a corresponding interaction with site

Main effect means for grain protein are in Table 10. The overall tests of fixed effects revealed responses to both VAR and PGR ($P < 0.001$), both of which varied with site ($P < 0.001$), but not one another ($P = 0.248$-0.661). Variety affected protein at Melfort and Prince Albert ($P < 0.001$-0.009) but not Scott ($P = 0.195$) while the response at Indian Head was marginally significant ($P = 0.056$; Table 10). With inconsistencies across varieties, the overall average means should be interpreted cautiously but showed Connect having the highest protein (12.9%), followed by Churchill (12.8%), Fraser (12.7%), and, finally, Synergy (12.5%). The S x PGR interaction was due to protein being affected by PGR at Melfort (*P* <

0.001), but no other sites (*P* = 0.441-0.611). The response at Melfort was related to yield in the expected manner whereby the highest yielding treatments (UTC and CC) had the lowest protein (10.8-11.1% versus 11.6-11.9% in TXP, ½x-MIX, and 1x-MIX). The trends were similar for the overall means with TXP, ½x-MIX, and 1x-MIX generally having the highest protein (12.8-12.9%) and UTC/CC having the lowest (12.5-12.6%); however, these discrepancies were largely driven by the response at Melfort. Individual treatment means for protein are provided in Table 19 (Appendices) but, with no VAR x PGR nor S x VAR x PGR interactions, will not be discussed further.

Table 10. Variety and PGR effects on barley grain protein concentrations for individual sites and averaged across sites. For each main effect, values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05).

Variety/PGR	Indian Head	Melfort	Prince Albert	Scott	Average
	------------ Grain Protein (%) ------------				
Synergy	11.82 b	11.18 c	14.33 a	12.58 a	12.48 C
Fraser	12.11 ab	11.74 a	14.57 a	12.45 a	12.72 B
Connect	12.30 a	11.52 ab	15.10 b	12.78 a	12.92 A
Churchill	12.04 ab	11.32 bc	15.11 b	12.68 a	12.79 AB
S.E.M	0.149	0.124	0.557	0.195	0.155
	------------ Pr > F (p-value) ------------				
Effect Slice	0.056[Z]	0.009	<0.001	0.286	–
1x-TXP	12.09 a	11.91 a	14.92 a	12.43 a	12.84 A
1x -CC	11.94 a	10.76 b	14.68 a	12.56 a	12.48 C
½x -MIX	12.05 a	11.63 a	14.67 a	12.79 a	12.78 AB
1x-MIX	12.24 a	11.78 a	14.80 a	12.69 a	12.88 A
UTC	12.02 a	11.10 b	14.82 a	12.64 a	12.64 BC
S.E.M.	0.161	0.138	0.561	0.205	0.158
	------------ Pr > F (p-value) ------------				
Effect Slice	0.611	<0.001	0.671	0.441	–

[Z] With an effect slice p-value ≥ 0.05, the reported difference was not significant at the desired probability

Table 11. Variety and PGR effects on barley kernel plumpness for individual sites and averaged across sites. With no significant S x PGR interaction for this variable, individual site means for PGR are presented solely for the sake of interest and transparency. For each main effect, values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05).

Variety/PGR	Indian Head	Melfort	Prince Albert	Scott	Average
	------------ Plump Kernels (%) ------------				
Synergy	96.2 a	97.3 a	71.3 a	97.6 a	90.6 A
Fraser	97.2 a	98.0 a	54.6 c	98.6 a	87.1 B
Connect	96.3 a	96.1 a	62.0 b	97.6 a	88.0 B
Churchill	91.9 b	94.6 a	69.3 a	97.7 a	88.4 B
S.E.M	1.49	1.49	7.20	1.49	1.91
	------------ Pr > F (p-value) ------------				
Effect Slice	0.060 [Z]	0.384	<0.001	0.959	–
1x-TXP	95.7	95.1	64.5	97.6	88.3 ABC
1x -CC	96.2	98.5	65.7	97.9	89.6 AB
½x -MIX	95.1	96.0	63.8	97.6	88.1 BC
1x-MIX	92.7	94.5	59.2	97.9	86.1 C
UTC	97.3	98.4	68.3	98.1	90.5 A
S.E.M.	1.67	1.67	7.24	1.67	1.95
	------------ Pr > F (p-value) ------------				
Effect Slice	–	–	–	–	–

[Z] With an effect slice p-value ≥ 0.05, the reported difference was not significant at the desired probability

Extension Activities

This project was a scheduled stop during the Indian Head Crop Management Field Day, held on July 15, 2025 (160 attendees) where Mitchell Japp (SaskBarley) and Chris Holzapfel (IHARF) explained the project and objectives in addition to presenting results from 2024 and other pertinent projects. On July 16, 2025, the project was shown to a group of nearly 30 global BASF scientists and agronomists. Mitchell Japp also discussed the project at the CLC Field Day in Prince Albert on July 29, 2025 (85 attendees) and the NARF & AAFC Joint Annual Field Day on July 24th, 2025 (126 attendees). Chris Holzapfel presented highlights from the project at the IHARF Winter Seminar and AGM, held in Balgonie on February 4, 2026 with 185 attendees), This technical report will be freely available online and we will continue to share the results through oral presentations and extension materials, as opportunities arise.

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 lack of lodging, this project demonstrated frequent, often substantial height reductions with plant growth regulator (PGR) applications and differences between products and mixes that are largely consistent with past field trials. Past work has shown that this can be variety dependant; however, there was no evidence that the four varieties evaluated in the current project (AAC Synergy, CDC Fraser, AAC Connect, and CDC Churchill) differed in their responses to PGR under the conditions encountered. While the full rate tank-mix (1x-MIX) of chlormequat chloride (CC) and trinexapac-ethyl (TXP) provided the greatest height reductions, it also came with the greatest risk of negative effects on yield or grain quality. When applied alone, TXP was consistently more effective than CC and, while the half rate tank-mix (½x-MIX) treatment performed well, it was not generally advantageous over TXP alone with respect to either yield or crop safety. Apart from the 1x-MIX treatment resulting in an overall yield reduction and occasional negative effects on grain quality (i.e., test weight, TKW, and kernel plumpness), negative responses to the other PGR treatments were rare. When they did occur, negative responses were generally more apparent with TXP than CC; however, TXP was also the more effective product for reducing plant height and, potentially, lodging. Importantly, CC is currently flagged through the 'Keep it Clean' initiative as a potential concern for barley with growers advised to check with grain buyers to confirm contract obligations and acceptance. From an agronomic perspective, barley growers are advised to exercise caution and only apply a PGR when there is a substantial risk of lodging and low risk of crop injury or negative impacts on yield or quality. Lodging is most likely when early-season environmental conditions promoting lush vegetative growth are combined with high fertility and varieties that are potentially prone to lodging. Under such conditions, the potential agronomic benefits can be substantial but, without lodging, are much less likely and, if PGR are applied under stressful conditions, responses could even be negative. When growing conditions are favourable and the decision to apply a PGR is justified, TXP is the product most likely to be effective and the risk of injury will be low if label recommended rates are applied. While the ½x-MIX has performed well, it has not been sufficiently advantageous over TXP alone to recommend as being more effective for to reducing height/lodging, improving yields, or reducing the potential for crop injury.

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
Highly Qualified Personnel (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)[1]. List the knowledge transfer products under section (c)	6+

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

b) List of scientific journal articles published/accepted for publication from this project. Please ensure that each line includes the following: **Title, Author(s), Journal, Date Published or Accepted for Publication and Link to Article (if available).** *Add additional lines as needed*.

1. Not applicable. No scientific journal articles have been submitted for peer-review or publication.

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)
C. Holzapfel (IHARF) and M. Japp (SBDC) plot tour / presentation	Indian Head Crop Management Field Day (Indian Head, Jul-15-2025)	157	https://iharf.ca/indian-head-crop-management-field-day/
C. Holzapfel (IHARF) plot tour	BASF Global Herbicide Group / IHARF Plot Tour. (Indian Head, Jul-16-2025)	26	n/a
Chris Holzapfel (IHARF) Presentation	IHARF Soil & Crop Management Seminar. (Balgonie, Feb-04-2026)	185	https://iharf.ca/iharf-soil-and-crop-management-seminar-agm/
M. Japp (SBDC) presentation	CLC Field Day (Jul-29-2025, Prince Albert)	85	
M. Japp (SBCD) presentation	NARF & AAFC Joint Annual Field Day (Jul-24-2025)	126	
M. Japp (SBDC)	Top Crop Summit (Saskatoon, Feb 26, 2026)	100	
Final project report	IHARF Website (online)	unknown	https://iharf.ca/full-reports/

Acknowledgements

Include actions taken to acknowledge support by the Ministry of Agriculture, the Canadian Agriculture Partnership (for projects approved between 2017 and 2023) and the Sustainable Canadian Agriculture Partnership (for projects approved between 2023 and 2028).

Financial support for this demonstration was provided under the Sustainable Canadian Agricultural Partnership, a federal-provincial-territorial initiative. Co-funding was provided by the Saskatchewan Barley Development Commission (SaskBarley). Signs were in-place for any plot tours to acknowledge the funding sources and appropriate acknowledgements will be made in all written communications, oral presentations, or other printed materials pertaining to the project. We would like to acknowledge the Boards of Directors for the participating organizations in addition to the many technical and support staff who worked on the project. Several of the crop protection products that were utilized were provided as in-kind donations. IHARF, NARF, and WARC have strong working relationships and memorandum of understanding with Agriculture and Agri-Food Canada, and all participating organizations have received funding for infrastructure and basic operating expenses from the Saskatchewan Ministry of Agriculture and several other producer/commodity groups, all of which has helped to make work like this possible.

Sustainable Canadian Agricultural Partnership
Saskatchewan
Canada

Appendices

Include any additional materials supporting the previous sections, e.g. detailed data tables, maps, graphs, specifications, literature cited (Use a consistent reference style throughout).

Table 12. Pertinent agronomic information for 2025 barley PGR mixing demonstrations conducted at Indian Head, Melfort, Prince Albert, and Scott, Saskatchewan in 2025.

Operation / Activity	Indian Head	Melfort	Prince Albert	Scott
Previous Crop	Canola	Canola	Canola	Canola
Row Spacing (cm)	30.5	30.5	25.4	25.4
Fertilizer Application (kg N-P_2O_5-K_2O-S	170-40-20-20	161-56-11-6	50-31-11-0	151-22-26-8
Seeding Date	May-10	May-12	May-22	May-10
Plant Density	May-30	May-28	Jun-13	May-28
PGR Applications	Jun-12	Jul-1	Jun-14	Jun-11
Plant Height	Jul-29	Aug-5	Aug-13	Aug-7
Lodging	Aug-13	Sep-10	Sep-12	Aug-18
Harvest Date	Aug-23	Sep-10	Sep-12	Sep-3

Table 13. Overall tests of fixed effects for selected response variables in barley PGR mixing demonstrations conducted in 2025 at Indian Head (IH-25), Melfort (ME-25), Prince Albert (PA-25), and Scott (SC-25). Data were analyzed using the generalized linear mixed model (GLIMMIX) procedure of SAS® Studio with the effects of site (S), variety (VAR), PGR, and all possible interactions considered fixed. Replicate effects (within site) were considered random. Heterogeneity of variance components was tested for and permitted when significant at *P* ≤ 0.05.

Source	Plant Density	Plant Height	Seed Yield	Test Weight	Seed Weight	Grain Protein	Plump Kernels
	------- Pr > *F* (p-values) -------						
S	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
VAR	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.009
S x VAR	0.174	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
PGR	–	<0.001	0.024	<0.001	<0.001	<0.001	0.003
S x PGR	–	<0.001	0.117	<0.001	0.157	<0.001	0.720
VAR x PGR	–	0.438	0.373	0.711	0.850	0.248	0.493
S x VAR x PGR	–	0.322	0.304	0.369	0.648	0.661	0.368
Common Var.	0.116	0.779	0.703	0.001	0.013	0.001	<0.001

Table 14. Variety effects on barley plant density for individual sites and averaged across sites. Values within a column followed by the same letter do not significantly differ (Fisher's Protected LSD test; *P* ≤ 0.05). The LSD values are 27.2 to compare means within sites and 13.6 for comparing the overall (across site) averaged values; however, these should only be applied for pre-determined comparisons or when the effect slice or overall test of fixed effect is significant.

Variety	Indian Head	Melfort	Prince Albert	Scott	Average
	------- Plant Density (plants/m^2) -------				
AAC Synergy	249 a	205 a	144 ab	206 a	201 A
CDC Fraser	219 a	160 b	118 b	197 a	173 B
AAC Connect	243 a	176 b	144 ab	196 a	190 A
CDC Churchill	234 a	178 ab	167 a	224 a	201 A
S.E.M	12.9	12.9	12.9	12.9	6.4

Table 15. Variety by PGR effects on barley plant height for individual sites and averaged across sites. With no significant VAR x PGR or SITE x VAR x PGR interactions, these means are presented solely for the sake of interest and transparency.

Variety	PGR	Indian Head	Melfort	Prince Albert	Scott	Average
		Plant Height (cm)				
AAC Synergy	1x-TXP	70.5	51.8	65.4	63.0	62.7
	1x -CC	70.7	58.9	67.9	65.5	65.7
	½x -MIX	68.9	54.4	65.7	62.6	62.9
	1x-MIX	60.0	47.7	62.7	59.3	57.4
	UTC	73.9	64.9	68.9	63.0	67.7
CDC Fraser	1x-TXP	62.4	50.2	62.0	60.5	58.8
	1x -CC	67.6	58.1	64.2	59.2	62.3
	½x -MIX	65.6	47.2	64.2	61.7	59.7
	1x-MIX	58.7	45.1	58.6	58.9	55.3
	UTC	66.9	62.1	66.4	58.6	63.5
AAC Connect	1x-TXP	65.5	48.8	61.3	61.3	59.2
	1x -CC	72.2	60.7	65.0	60.8	64.7
	½x -MIX	66.0	54.4	62.9	62.2	61.4
	1x-MIX	58.2	48.5	58.2	60.4	56.3
	UTC	71.6	60.6	64.7	61.5	64.6
CDC Churchill	1x-TXP	63.8	51.9	58.2	57.8	57.9
	1x -CC	63.1	59.1	58.7	57.7	59.6
	½x -MIX	62.7	50.3	58.1	57.3	57.1
	1x-MIX	56.8	46.7	55.7	55.8	53.7
	UTC	69.0	59.9	60.0	57.3	61.5
S.E.M		1.50	1.50	1.50	1.50	0.75

Table 16. Variety by PGR effects on barley grain yield for individual sites and averaged across sites. With no significant VAR x PGR or SITE x VAR x PGR interactions, these means are presented solely for the sake of interest and transparency.

Variety	PGR	Indian Head	Melfort	Prince Albert	Scott	Average
		Seed Yield (kg/ha)				
AAC Synergy	1x-TXP	7597	5135	4781	5017	5633
	1x -CC	7220	5529	4711	5148	5652
	½x -MIX	7221	6111	4630	4572	5633
	1x-MIX	6950	4881	4782	4439	5263
	UTC	7166	6030	4726	4855	5694
CDC Fraser	1x-TXP	6565	5331	4799	4635	5333
	1x -CC	6615	5589	4686	4610	5375
	½x -MIX	6630	4803	4390	4752	5143
	1x-MIX	6685	4990	4560	4802	5259
	UTC	6289	5697	4483	4244	5178
AAC Connect	1x-TXP	6701	5070	4282	4671	5181
	1x -CC	7038	5431	4345	4560	5343
	½x -MIX	6815	5364	4166	4676	5255
	1x-MIX	6941	5413	4312	4338	5251
	UTC	6659	5428	4349	4577	5253
CDC Churchill	1x-TXP	7214	5885	4000	5037	5534
	1x -CC	6855	6366	4008	5262	5623
	½x -MIX	6980	5964	4627	4826	5599
	1x-MIX	6686	5440	4122	4543	5198
	UTC	7246	6096	4228	5035	5651
S.E.M		264.6	264.6	264.6	264.6	132.3

Table 17. Variety by PGR effects on barley test weight for individual sites and averaged across sites. With no significant VAR x PGR or SITE x VAR x PGR interactions, these means are presented solely for the sake of interest and transparency.

Variety	PGR	Indian Head	Melfort	Prince Albert	Scott	Average
		---------- Test Weight (g/0.5 L) ----------				
AAC Synergy	1x-TXP	342	333	294	324	323
	1x -CC	343	339	295	323	325
	½x -MIX	340	337	296	326	325
	1x-MIX	336	329	293	323	320
	UTC	343	343	297	323	327
CDC Fraser	1x-TXP	330	328	293	327	319
	1x -CC	330	334	294	326	321
	½x -MIX	329	326	290	329	319
	1x-MIX	328	323	284	324	315
	UTC	328	335	292	327	321
AAC Connect	1x-TXP	339	329	288	324	320
	1x -CC	343	339	292	325	325
	½x -MIX	339	333	289	325	322
	1x-MIX	334	330	286	325	319
	UTC	341	340	288	326	324
CDC Churchill	1x-TXP	335	331	273	331	318
	1x -CC	334	344	276	332	321
	½x -MIX	333	334	280	330	319
	1x-MIX	329	330	282	329	317
	UTC	338	342	278	334	323
S.E.M		2.5	2.1	4.2	2.1	1.4

Table 18. Variety by PGR effects on barley thousand kernel weight for individual sites and averaged across sites. With no significant VAR x PGR or SITE x VAR x PGR interactions, these means are presented solely for the sake of interest and transparency.

Variety	PGR	Indian Head	Melfort	Prince Albert	Scott	Average
		---------- Thousand Seed Weight (g/1000 seeds) ----------				
AAC Synergy	1x-TXP	49.6	51.3	40.3	45.6	46.7
	1x -CC	50.4	52.3	40.4	46.2	47.3
	½x -MIX	49.7	52.6	41.9	47.0	47.8
	1x-MIX	46.2	49.7	39.8	45.7	45.4
	UTC	49.9	53.2	41.8	46.3	47.8
CDC Fraser	1x-TXP	49.4	52.5	39.4	47.8	47.2
	1x -CC	50.3	54.0	38.7	48.6	47.9
	½x -MIX	50.0	52.0	37.5	48.1	46.9
	1x-MIX	48.0	51.3	34.5	47.4	45.3
	UTC	50.3	54.7	37.7	48.8	47.9
AAC Connect	1x-TXP	50.3	52.5	39.8	47.4	47.5
	1x -CC	51.8	54.4	41.0	46.7	48.5
	½x -MIX	50.5	53.6	41.5	48.2	48.4
	1x-MIX	49.0	52.2	38.5	48.4	47.0
	UTC	51.9	54.0	39.9	47.9	48.4
CDC Churchill	1x-TXP	45.3	52.1	36.7	44.8	44.7
	1x -CC	46.1	51.8	37.4	45.0	45.1
	½x -MIX	45.5	48.7	38.6	44.9	44.4
	1x-MIX	45.1	46.5	38.7	43.7	43.5
	UTC	47.9	51.7	38.0	44.6	45.5
S.E.M		1.10	1.02	1.90	1.09	0.66

Table 19. Variety by PGR effects on barley grain protein concentrations for individual sites and averaged across sites. With no significant VAR x PGR or SITE x VAR x PGR interactions, these means are presented solely for the sake of interest and transparency.

Variety	PGR	Indian Head	Melfort	Prince Albert	Scott	Average
		Grain Protein (%)				
AAC Synergy	1x-TXP	11.60	11.60	14.60	12.50	12.57
	1x -CC	11.74	10.50	14.22	12.30	12.19
	½x -MIX	11.83	11.50	14.36	12.85	12.64
	1x-MIX	12.22	11.08	14.33	12.73	12.59
	UTC	11.71	11.20	14.16	12.53	12.40
CDC Fraser	1x-TXP	12.21	12.45	14.35	12.35	12.84
	1x -CC	11.81	10.73	14.33	12.25	12.28
	½x -MIX	12.03	11.43	14.54	12.65	12.66
	1x-MIX	12.36	12.83	14.86	12.43	13.12
	UTC	12.17	11.25	14.75	12.58	12.69
AAC Connect	1x-TXP	12.55	11.60	15.10	12.38	12.91
	1x -CC	12.16	10.98	14.99	12.98	12.77
	½x -MIX	12.29	11.88	15.08	12.78	13.00
	1x-MIX	12.16	11.60	15.05	12.95	12.94
	UTC	12.33	11.55	15.31	12.80	13.00
CDC Churchill	1x-TXP	12.00	12.00	15.64	12.50	13.04
	1x -CC	12.05	10.83	15.17	12.73	12.69
	½x -MIX	12.04	11.73	14.70	12.88	12.84
	1x-MIX	12.24	11.63	14.97	12.65	12.87
	UTC	11.86	10.40	15.07	12.65	12.50
S.E.M		0.288	0.276	0.610	0.315	0.199

Table 20. Variety by PGR effects on barley grain protein concentrations for individual sites and averaged across sites. With no significant VAR x PGR or SITE x VAR x PGR interactions, these means are presented solely for the sake of interest and transparency.

Variety	PGR	Indian Head	Melfort	Prince Albert	Scott	Average
		Plump Kernels (%)				
AAC Synergy	1x-TXP	96.1 a	96.3 a	69.5 b	98.0 a	90.0 AB
	1x -CC	97.2 a	98.5 a	73.0 ab	97.0 a	91.4 AB
	½x -MIX	95.6 a	97.0 a	68.1 b	98.5 a	89.8 AB
	1x-MIX	94.4 a	95.9 a	66.6 b	97.0 a	88.5 B
	UTC	97.7 a	98.8 a	79.4 a	97.3 a	93.3 A
CDC Fraser	1x-TXP	97.5 a	97.7 a	63.8 a	99.0 a	89.5 A
	1x -CC	98.2 a	99.2 a	57.1 ab	98.8 a	88.3 A
	½x -MIX	97.7 a	97.8 a	50.1 b	97.8 a	85.8 AB
	1x-MIX	94.6 a	96.3 a	40.1 c	98.0 a	82.2 B
	UTC	97.9 a	99.3 a	61.9 a	99.3 a	89.6 A
AAC Connect	1x-TXP	96.0 a	94.4 a	66.4 a	96.5 a	88.3 A
	1x -CC	97.2 a	98.3 a	64.4 a	98.5 a	89.6 A
	½x -MIX	96.9 a	95.8 a	60.6 a	96.8 a	87.5 A
	1x-MIX	93.5 a	94.4 a	59.3 a	98.8 a	86.5 A
	UTC	98.0 a	97.9 a	59.3 a	97.5 a	88.2 A
CDC Churchill	1x-TXP	93.3 a	92.2 a	58.4 b	97.0 a	85.2 B
	1x -CC	92.3 a	97.9 a	68.4 a	97.5 a	89.0 AB
	½x -MIX	90.0 a	93.5 a	76.4 a	97.3 a	89.3 AB
	1x-MIX	88.3 a	91.6 a	70.8 a	98.0 a	87.2 AB
	UTC	95.8 a	97.7 a	72.7 a	98.5 a	91.2 A
S.E.M		3.34	3.34	7.80	3.34	2.43

Figure 1. Drought stressed barley at Scott on June 11, 2025, prior to plant growth regulator (PGR) treatment applications.

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.

Provided in a separate Excel workbook and available upon request.