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: 4R Management: Can split applications be managed in malt barley to reduce risk and maintain yield and quality?

Project Number: ADOPT 20241010

Producer Group Sponsoring the Project: Saskatchewan Barley Development Commission and The Brewing and Malting Barley Research Institute

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).* Swift Current (WCA RM #137), Redvers (SERF RM #61), Indian Head (IHARF RM #156), Scott (WARC RM #380), Melfort (NARF RM #428), Yorkton (ECRF RM #244), and Prince Albert (CLC RM #461)

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

Project end date *(month & year):* 2/15/2026

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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.

A small-plot randomized trial with four replications was conducted in SK to evaluate the response of malt barley to management of nitrogen (N). The locations were Swift Current (WCA), Redvers (SERF), Indian Head (IHARF), Scott (WARC), Melfort (NARF), Yorkton (ECRF), and Prince Albert (CLC). The management strategies used were top-dress and slow-release applications of N (ESN) as compared to side-banding urea. Top-dress applications were 25% of total N as UAN at early tiller, while ESN was blends of either 25%/75% or 75%/25% with urea. Data collection consisted of weather data, soil residual N, conditions at N applications, stand establishment, lodging, grain yield and quality. The conditions of 2025 were dry with near average temperatures at most locations, with conditions often quite dry in May and early June.

Stands were rarely affected by N management, while lodging was low overall, and was never significantly affected. Grain yield and protein were only significantly affected by N at 3 locations, where yield sometimes increased with N rate or with ESN, but was never significantly increased with top-dress applications at the same total N rate. Protein was increased with rate, but was inconsistently affected by ESN. Grain quality varied by site, but was quite consistent across treatments, suggesting N management did not affect quality.

Extension: NARF & AAFC Joint Field Day July 23, 2025 to 126 people, Sustaining Barley Webinar Series January 21, 2026 to unknown number of attendees, Indian Head Crop Management Field Day July 15, 2025 to 157 people, BASF Global Herbicide Group IHARF plot tour July 16, 2025 to 26 people, SIA NE Ag Update February 3, 2026 to ~80 people, and SERF Field Day July 10, 2025 to 80 people.

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 objective was to demonstrate non-traditional approaches to 4R nitrogen (N) management in malt barley that can maintain quality while managing risk and enhancing yield. This can be broken down into four primary objectives of the project:

1. To demonstrate 4R practices for N management in malt barley
2. To demonstrate the effect of split N applications on yield and quality of malt barley
3. To manage producer risk by reducing the requirement for N application at seeding
4. To create opportunities to increase yield potential with top-dress N applications when the weather is favourable.

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?

In-crop topdressing of nitrogen (N) fertilizer is common in annual grain crops in many growing areas of the western prairies (Top Crop Manager 2013). Split applications of N may be used to manage risk of early spring losses due to denitrification and/or leaching. Split applications are also economically advantageous in dry springs, as holding back N at seeding time allows producers to save money on initial fertilizer inputs if yield potential is low from lack of early season rainfall.

Previous research on the prairies has demonstrated top-dress N applications in other grain crops. Holzapfel et al. 2007 found that top-dress applications of N up to 30 days after seeding did not affect the yield of canola and wheat as compared to applying N in a band at seeding time. The only instance where yield was reduced was in wheat when growing season conditions were dry (Holzapfel et al. 2007). Additionally, an ADOPT project titled, "Managing drought risk with split applications of nitrogen in spring wheat," was conducted at multiple Agri-ARM sites in 2022 and found that early season (3-5 leaf crop stage) top-dress applications of nitrogen of 30lbs N/ac were often able to maintain yield as compared to applying all nitrogen in a band at seeding time (Hall et al. 2022).

Research on post-emergent applications of N in barley has been limited, however, a few recent studies in Alberta have investigated post-emergent N applications in feed barley (Perrott et al. 2018, Thompson et al. 2018). Perrott et al. 2018 found that across three irrigated and 11 dryland sites in Alberta from 2014 to 2016, that feed barley grain yield and protein content was significantly increased with post-emergent N. Applications were made of 30 and 60lbs N/ac at the beginning of stem elongation and increased grain yield by up to 19%. Although yields were increased, yield responses did tend to be limited to environments with high rainfall or irrigation. Thompson et al. 2018 conducted a study with advanced management (post-emergent N, PGRs, and fungicide) in feed barley as compared to standard management.

Advanced management increased yield an average of 9.3%, but because post-emergent N, PGR and fungicide were all applied in this treatment, it was hard to deduce the impact of each factor on yield.

Managing N in malt barley can be more challenging than other cereal crops, as high amounts of available nitrogen are needed for high yields, but can cause high protein, which is undesirable for malt. Agronomic decisions, such as top-dressing N, can allow producers to reduce the N applied at seeding, which may reduce N losses from denitrification or leaching in a wet spring. This practice is more frequently promoted in spring wheat; however, increasing grain protein is a benefit to spring wheat growers as opposed to being a concern for malt producers.

Malt barley farmers are already using top-dressing as a tool to manage N application. Applying all N at the time of seeding is logistically challenging due to the large volumes required and the short time window for seeding. As such, many farmers have reverted to broadcasting N to improve seeding logistics. Demonstrating a practice that leading farmers are already using to improve their N management from logistic and risk management perspectives while aligning with 4R principles may lead to better N management compared to broadcast.

Farmers on the prairies spend the most money on N as compared to all other crop nutrients (Top Crop Manager 2016). The cost of urea is usually $0.4-0.5 per pound, or approximately $1 per pound of nitrogen (based on $1,110/MT spring 2023 Co-op pricing at Melfort, SK). At this price, every additional pound of applied N increases input costs by $1/ac, therefore, overapplying nitrogen with no yield improvement is lost profit. In addition to risk management, a split N application may improve resistance to lodging. Excess available N prior to stem elongation is associated with increased lodging; therefore, delaying a portion of the required N to be applied in-crop may reduce this risk (Mangin et al, 2022). These benefits may also be achieved in a single pass, with the use of slow-release N like polymer coated ESN.

With recent growing seasons being very dry in most growing regions of Saskatchewan, holding back fertilizer at seeding time is a smart financial decision for most producers, as dry spring conditions following seeding often mean yield potential will be reduced. When conditions are dry, the additional N put down at seeding time is often of no use to the crop and a negative return on investment. Holding back N at seeding time, with the option to top-dress later into the spring can be a great option to get the most out of N fertilizer in dry environments. However, with very little information available to producers of how this practice may affect barley yield and protein, there may be reluctance to adopt this practice. Demonstrating this in a small-plot demonstration allowed us to analyze the impacts of top dress and slow-release N in barley and provide the results to local growers in field days, meetings, and other extension events.

References

Hall, M., Holzapfel, C., Hnatowich, G., Singh, G., McInnes, B., Enns, J., Wall, B., and Wall, A., 2022. Managing drought risk with split application of nitrogen in spring wheat. ADOPT. https://neag.ca/wp-content/uploads/2023/08/Managing-drought-with-Split-application-of-Nitrogen-in-Spring-Wheat-Combined-final-report.pdf

Holzapfel, C.B., Lafond, G.P., Brandt, S.A., May, W.E., and Johnston, A.M. 2007. In-soil banded versus post-seeding liquid nitrogen applications in no-till spring wheat and canola. Can. J. Plant Sci. 87: 223-232

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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.

Small-plot field trials were conducted at seven locations with nitrogen (N) treatments completely randomized and replicated four times. The locations were Swift Current (WCA), Redvers (SERF), Indian Head (IHARF), Scott (WARC), Melfort (NARF), Yorkton (ECRF), and Prince Albert (CLC). There were six treatments that consisted of 75% or 100% of the N side-banded at seeding as either conventional urea (46-0-0) in treatments 1-4 or a blend of urea and polymer-coated urea (ESN: 44-0-0) in treatments 5-6 (Table 1). Treatments 3 and 4 included top-dress applications of N at 25% of the total applied N as dribble-banded UAN at early tiller development (GS 21-22).

Table 1. Treatments applied in ADOPT 20241010 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? In 2025.

TRT no.	TRT Name
1	75% N banded at seeding
2	100% N banded at seeding
3	75% N banded at seeding + 25% N top-dress
4	100% N at seeding + 25% top-dress
5	100% N banded at seeding (75% as urea, 25% as a slow-release N)
6	100% N banded at seeding (25% as urea, 75% as a slow-release N)

The 100% rate of N varied between sites, based on the anticipated barley yield potential of each location. The 100% N rate at each location included residual N from the 0-24 inch soil profile, from either late fall 2024 or early spring 2025 soil sampling. The absolute amount of N top-dressed was always based off the total (soil plus fertilizer) 100% N rate; therefore, the amounts of top-dressed N were 25, 30, and 32.5 lb N/ac for the low, mid, and high yielding zones, respectively. The rates of N applied at each location were as follows:

1. Low yield: Swift Current 100lbs/ac of soil + added N
2. Mid yield: Indian Head, Redvers and Scott 120lbs/ac of soil + added N
3. High yield: Yorkton, Prince Albert and Melfort: 130lbs/ac

Outside of the treatment factors, the demonstration was intended to be managed for best management practices at all locations. All dates of agronomic operations are reported in Table 11 of the Appendices. Fertility was applied at seeding time (Phosphorus, Potassium, and Sulphur) to be non-limiting based on soil residual levels at all participating sites. All soil information is provided in Table 12 of the Appendices. Herbicides, insecticides, and fungicides were applied to control pests at the discretion of each site manager, so yield potential was not adversely impacted by pest presence.

Data collection consisted of soil sampling for soil residual N, conditions at treatment applications (seeding and top-dressing time), stand establishment, lodging, grain yield, grain quality and weather data. Soil sampling was completed by collecting soil cores from the trial area in either the fall of 2024 or spring of 2025 from 0-15cm and 15-60cm depths for determination of soil residual N levels. These values were used to correct applied N rates at each site based on their targeted total N. Regarding conditions at seeding, each site manager was asked to provide a recommendation of whether a full rate of N at seeding time could be justified based on current moisture conditions, and whether they would suggest a top-dress application based on moisture conditions and the current forecast at tillering. This was done to evaluate whether N management recommendations based on moisture conditions at the current point in time would translate to the anticipated crop response (i.e., no yield response to high N if soil conditions at seeding time were dry, and the agronomic recommendation was to hold back on N). Stand establishment was evaluated by counting the number of plants in 2 x 1-meter sections of crop row at the 1 to 2-leaf stage. These values were then converted into plants/m² equivalents. Lodging was evaluated using a scale of 0-9 prior to harvest, where 0 equated to no lodging and 9 equated to the whole plot laying flat. Grain yield was documented by harvesting and weighing every plot with a plot combine, adjusting for dockage, and correcting to 13.5% moisture. Grain yield was reported in kg/ha. Grain quality consisted of protein (%) analysis of every plot using NIR at each site. Further grain quality analysis was done on composite samples for each treatment by the Canadian Malting Barley Technical Centre (CMBTC) for test weight (kg/hL), plumps (%), and thousand-seed weight (g/1000 seeds). Lastly, monthly precipitation (mm) and temperatures (°C) were reported for each site from May to August from a nearby weather station.

Applicable response data was analyzed at each site separately using Randomized Complete Block in Statistix 10 version 10.0. Treatment means were compared at $p<0.05$ using Tukey's HSD.

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.

Environmental Conditions:

The environmental conditions of 2025 varied across locations, but conditions were typically drier than normal, with average temperatures near or above long-term climate averages (Table 13 of Appendices). Scott, Melfort, and Prince Albert experienced very dry and warm conditions in May, with cumulative precipitation ranging from 2-12mm, and temperatures increased by 0-3.7°C. In contrast, Indian Head, Redvers, Swift Current, and Yorkton had higher levels of precipitation in May, ranging from 24-65mm, with warmer temperatures up to 2°C above long-term averages. At the sites where May precipitation was lower than normal (Scott, Melfort and Prince Albert), June precipitation was well above average, ranging from 93-138mm, with temperatures near normal at Scott and Melfort, but much cooler at Prince Albert (-3.3°C). At Indian Head, Redvers, Swift Current and Yorkton, where May precipitation was greater in contrast, although still below average in some cases, June rainfall was more moderate, with totals ranging from 27-63mm, with temperatures near or slightly below long-term averages. July was cooler at all sites with below average precipitation, except for Redvers (+14mm) and Swift Current (+22mm). August was warmer at all sites, except for Redvers, while precipitation was above average at all locations, except for Redvers and Indian Head.

Soil Residual N:

Soil residual N levels were relatively low at Indian Head (19 lbs/ac), Melfort (21 lbs/ac), Scott (29 lbs/ac), and Redvers (30lbs/ac), moderate to high at Yorkton (60 lbs/ac) and Swift Current (67lbs/ac) and extremely high at Prince Albert (102lbs/ac) (Table 2). While residual levels varied drastically across sites, the fact that there was no absolute control in this trial limited the effect this may have on treatment responses. Applied rates of N were much higher at the sites with low residual N, however, total N was balanced across treatments to meet the initial 75% and 100% N rates. Low N rates diminish the potential influence of slow-release ESN, and spatial variability in soil NO_3-N can be a concern; however, high residual N coupled with dry spring conditions do present a good opportunity for top-dressing applications to make sense.

Table 2. Residual N and applied rates of N based on soil sample results for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? In 2025.

Yield Potential	Site	Residual N (0-24"; lbs/ac)	Target N (lbs/ac)	Applied rates of N for 100% (lbs/ac)
Low	Swift Current	67	100	33
Mid	Redvers	30	120	90
Mid	Indian Head	19	120	101
Mid	Scott	29	120	91
High	Yorkton	60	130	70
High	Prince Albert	102	130	28
Hight	Melfort	21	130	109

Conditions at treatment applications:

Overall, moisture conditions were good early on in the season (early May), to where most sites would have recommended a full N rate, however, as drier conditions persisted into late May and June at many of the sites, top-dress applications were rarely recommended due to the anticipation that there were minimal spring losses from side-banded N (Table 3). Some sites had a lot of rain in the forecast near top-dress timing, however, because of how dry spring conditions were at these sites at the time, a top-dress application was still rarely recommended.

Table 3. Agronomic recommendations from each site lead for applying N at seeding and top-dress timing based on moisture conditions for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? In 2025.

	Swift Current	Redvers	Indian Head	Scott	Melfort	Yorkton	Prince Albert
Recommend full N rate at seeding time	Yes	Yes	Yes	Yes	Yes	Yes	No
Recommend Top-dress	No	No	No	No	No	No	Yes

Stand establishment:

Stand establishment was not significantly affected by N rate or product at any site, except for Melfort (p=0.03). Overall, stand establishment was greater at sites with more May precipitation and lower at sites with limited precipitation (<12mm). Stands were greatest at Redvers (240 plants/m²) followed by Indian Head (230 plants/m²), Yorkton (220 plants/m²), Prince Albert (186 plants/m²) Swift Current (172 plants/m²), Melfort (169 plants/m²) and Scott (108 plants/m²) (Table 4). At Melfort, the significant treatment response was that stands were sometimes reduced when 100% compared to where 75% of the N was side-banded or ESN was applied, potentially due to a higher risk of ammonium toxicity.

Table 4. Results of the Analysis of Variance and treatment means for plant density (plants/m²) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025. Letters signify treatments that are significantly different at p<0.05 using Tukey's HSD.

	Swift Current		**Redvers**		**Indian Head**		**Scott**		**Melfort**		**Yorkton**		**Prince Albert**	
p-value	1.00		0.72		0.64		0.62		0.03		0.98		0.27	
Grand mean	172		242		230		108		169		220		186	
CV	16.8		10.6		8.4		4.3		9.7		10.8		13.9	
Treatment														
75% N banded at seeding	172	A	237	A	218	A	105	A	160	AB	219	A	203	A
100% N banded at seeding	169	A	250	A	226	A	109	A	150	B	225	A	194	A
75% N banded at seeding + 25% N top-dress	174	A	251	A	234	A	108	A	188	A	226	A	191	A
100% N at seeding + 25% top-dress	166	A	237	A	240	A	108	A	158	AB	215	A	162	A
100% N banded at seeding (75% urea, 25% ESN)	176	A	227	A	227	A	109	A	173	AB	216	A	172	A
100% N banded at seeding (25% urea, 75% ESN)	173	A	249	A	236	A	111	A	184	AB	219	A	194	A
Standard Error of a Mean	14		13		10		2		8		12		13	
Std Error (Diff of 2 Means)	20		18		14		3		12		17		18	

Lodging:

Crop lodging was low at all sites in 2025, and there were never significant treatment differences at any location. Swift Current, Indian Head, Redvers, and Yorkton had no lodging and gave all plots a value of 0. Melfort, Prince Albert and Scott had low levels of lodging, but still recorded average values of 1.3, 1.3, and 0.1, respectively (Table 5). There were never any significant treatment differences at these locations, not unexpectedly considering the low level of lodging overall.

Table 5. Results of the Analysis of Variance and treatment means for lodging (0-9) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025. Letters signify treatments that are significantly different at p<0.05 using Tukey's HSD.

	Swift Current	Redvers	Indian Head	Scott		Melfort		Yorkton	Prince Albert	
p-value	--	--	--	0.45		0.29		--	0.45	
Grand mean	0	0	0	0.1		1.3		0	1.3	
CV	--	--	--	309.8		32.4		--	19.4	
Treatment										
75% N banded at seeding	0	0	0	0.0	A	1	A	0	1.3	A
100% N banded at seeding	0	0	0	0.0	A	1	A	0	1.5	A
75% N banded at seeding + 25% N top-dress	0	0	0	0.3	A	1.5	A	0	1.3	A
100% N at seeding + 25% top-dress	0	0	0	0.3	A	1.25	A	0	1.3	A
100% N banded at seeding (75% urea, 25% ESN)	0	0	0	0.0	A	1.5	A	0	1.3	A
100% N banded at seeding (25% urea, 75% ESN)	0	0	0	0.0	A	1.5	A	0	1.5	A
Standard Error of a Mean	--	--	--	0.1		0.2		--	0.1	
Std Error (Diff of 2 Means)	--	--	--	0.2		0.3		--	0.2	

Grain Yield:

Grain yield (kg/ha) was only significantly different across treatments at Redvers (p=0.02), Indian Head (p=0.02), and Scott (p<0.01). Grain yield was greatest at Indian Head (6475 kg/ha) followed by Melfort (5522 kg/ha), Yorkton (5208 kg/ha), Prince Albert (4695 kg/ha), Redvers (4390 kg/ha), Scott (3649 kg/ha) and Swift Current (1896 kg/ha) (Table 6). This is in line with the yield that was expected for every site based on location, except for Indian Head, which had the highest yield, and was expected to be a moderately yielding site. As for the significant yield response at Indian Head, grain yield was significantly increased (+623 kg/ha) when a nitrogen rate of 125% of the recommended N rate was applied (100% side-band + 25% top-dress) as compared to when 75% of N was applied. There was never a significant yield response to top-dress or ESN applications at Indian Head. At Redvers, yield appeared to be increased from 100% N at seeding (+284 kg/ha) as compared to 75% N at seeding, with very little response to top-dress or ESN applications; however, Tukey's HSD found no significant pairwise groups, regardless of the p-value being less than 0.05 for grain yield. Lastly, at Scott, yield was not significantly increased with higher N rates or top-dress applications, but was significantly increased with a high blend of ESN (75%) as compared to 100% N as urea at seeding.

Table 6. Results of the Analysis of Variance and treatment means for Grain Yield (kg/ha) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025. Letters signify treatments that are significantly different at p<0.05 using Tukey's HSD.

	Swift Current		**Redvers**		**Indian Head**		**Scott**		**Melfort**		**Yorkton**		**Prince Albert**	
p-value	0.47		0.02		0.02		0.00		0.42		0.85		0.07	
Grand mean	1896		4390		6475		3649		5522		5208		4695	
CV	13.9		9.1		3.4		2.9		6.7		12.8		3.6	
Treatment														
75% N banded at seeding	1820	A	3824	A	6126	B	3710	AB	5386	A	5081	A	4479	B
100% N banded at seeding	1990	A	4682	A	6410	AB	3548	B	5333	A	4999	A	4721	AB
75% N banded at seeding + 25% N top-dress	1750	A	3990	A	6483	AB	3508	B	5370	A	5471	A	4904	A
100% N at seeding + 25% top-dress	2066	A	4632	A	6749	A	3546	B	5805	A	5104	A	4699	AB
100% N banded at seeding (75% urea, 25% ESN)	1972	A	4474	A	6515	AB	3696	AB	5580	A	5473	A	4647	AB
100% N banded at seeding (25% urea, 75% ESN)	1778	A	4735	A	6567	AB	3886	A	5658	A	5124	A	4720	AB
Standard Error of a Mean	132		200		108		53		184		333		84	
Std Error (Diff of 2 Means)	187		282		153		75		260		471		119	

Grain Protein:

Grain protein (%) was only significantly different between treatments at Redvers (p<0.01), Melfort (p<0.01), and Indian Head (p=0.04). Grain protein was greatest at Swift Current (15.7%), followed by Prince Albert (14.2%), Scott (13.6%), Yorkton (11.7%), Indian Head (11.5%), Melfort (9.8%) and Redvers (9.6%) (Table 7). At Redvers, grain protein was significantly greater (10.5%), when a high blend of ESN:Urea (75%:25%) was applied at seeding time as compared to a low ESN:Urea (25%:75%) blend (9.3%), 75% N as urea at seeding (9.1%), and 100% N as urea at seeding (9.4%). Protein was numerically reduced, but not significantly with top-dress applications at this site. At Indian Head, protein was greatest when 100% N was side-band as urea at seeding (11.8%), and with a low ESN: Urea (25%:75%) blend (11.8%), but were only significantly greater than when 75% N was side-band as urea at seeding (10.9%). All other top-dress and slow-release N treatments at this site had comparable protein to when 100% N was side-band at seeding. At Melfort, grain protein significantly increased as total applied N increased regardless of placement or product. At Melfort, 125% N (10.4%) was significantly greater than 100% N (10.0%), which was also significantly greater than 75% N (9.3%). Additionally, at Melfort, top-dress applications at 100% N had similar protein as to when all N was applied at seeding, however, when a high ESN:Urea (75%:25%) blend was used, protein was significantly decreased (9.5%) as compared to 100% side-banded N (10.0%). This result is unexpected but interesting, as yields were not significantly different between these treatments, but protein was able to be reduced, which is desirable for malt.

Table 7. Results of the Analysis of Variance and treatment means for protein (%) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025. Letters signify treatments that are significantly different at p<0.05 using Tukey's HSD.

	Swift Current		Redvers		Indian Head		Scott		Melfort		Yorkton		Prince Albert	
p-value	0.91		0.00		0.04		0.22		0.00		0.87		0.60	
Grand mean	15.7		9.6		11.5		13.6		9.8		11.7		14.2	
CV	3.9		4.6		3.4		1.5		1.7		6.3		2.5	
Treatment														
75% N banded at seeding	15.5	A	9.1	B	10.9	B	13.5	A	9.3	D	11.7	A	14.3	A
100% N banded at seeding	15.8	A	9.4	B	11.8	A	13.6	A	10.0	B	12.0	A	14.1	A
75% N banded at seeding + 25% N top-dress	15.8	A	9.6	AB	11.7	AB	13.8	A	9.7	BC	11.8	A	14.0	A
100% N at seeding + 25% top-dress	15.9	A	10.1	AB	11.5	AB	13.8	A	10.4	A	11.9	A	14.4	A
100% N banded at seeding (75% urea, 25% ESN)	15.8	A	9.3	B	11.8	A	13.7	A	9.8	BC	11.4	A	14.2	A
100% N banded at seeding (25% urea, 75% ESN)	15.6	A	10.5	A	11.6	AB	13.5	A	9.5	CD	11.7	A	14.3	A
Standard Error of a Mean	0.3		0.2		0.2		0.1		0.1		0.4		0.2	
Std Error (Diff of 2 Means)	0.4		0.3		0.3		0.1		0.1		0.5		0.2	

Grain Quality:

Test weight (kg/hL), plumps (% >6/64") and thousand seed weight (g/1000 seeds) were completed on composite samples for each treatment at every site (Tables 8 to 10). Test weight was quite comparable across sites, ranging from an average of 62.9 to 70.3 kg/hL. Test weight was greatest at Indian Head (70.3 kg/hL), followed by Melfort (69.0 kg/hL), Scott (67.8 kg/hL), Yorkton (66.9 kg/hL), Redvers (65.9 kg/hL), Prince Albert (62.9 kg/hL) and Swift Current (61.0 kg/hL). Plumps was more variable across sites, ranging from 77.1% to 99.0%. Plumps was greatest at Yorkton (99.0%), followed by Melfort (98.9%), Redvers (98.2%), Indian Head (98.0%), Scott (97.8%), Swift Current (87.1%), and Prince Albert (77.1%). Overall, most sites had a high percentage of plumps, except for Prince Albert, which would not make malt standards of >80% plumps, according to the CMBTC. Lastly, thousand-seed weight also varied by site, ranging from 40.1 to 52.6 g/1000 seeds. Seed weight was greatest at Yorkton (52.6g) followed by Scott (51.3g), Melfort (51.2g), Indian Head (50.5g), Redvers (49.2g), Prince Albert (44.6g), and Swift Current (40.1g). Again, seed weight fell within a pretty narrow range at most site, with the exception of Prince Albert and Swift Current, where seed weight was quite a bit lower in comparison. According to the CMBTC, seed weight must be greater than 40 g/1000 seeds, as a high seed weight is associated with a higher starch content, which is needed for malt. Based on these parameters, all sites would make malt for seed weight, except for a few treatments (75% N, 75% N + 25% Top-dress, 100% N + 25% Top-dress, and 100% N (75% ESN/25% Urea)) at Swift Current. At Swift Current, high N at seeding (100% N) and low slow-release N (25% ESN: 75% Urea blend) were the only treatments to have >40g seed weights. Overall, when comparing the quality parameters across treatments at each site, there was very little deviation from the mean, suggesting treatment effects were minimal; however, because statistical analysis could not be conducted, as measurements were taken from a composite sample, significant treatment results cannot be identified.

Table 8. Results for test weight (kg/hL) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025

Treatment	Swift Current	Redvers	Indian Head	Scott	Melfort	Yorkton	Prince Albert
75% N banded at seeding	60.5	65.6	70.0	67.8	68.7	66.7	61.5
100% N banded at seeding	61.9	65.8	70.0	67.5	68.9	66.7	63.4
75% N banded at seeding + 25% N top-dress	60.9	65.7	70.2	67.9	68.8	67.3	63.2
100% N at seeding + 25% top-dress	61.0	66.1	70.5	67.6	69.3	67.3	62.2
100% N banded at seeding (75% urea, 25% ESN)	60.6	66.2	70.6	67.9	69.0	67.5	63.3
100% N banded at seeding (25% urea, 75% ESN)	61.3	66.2	70.6	67.9	69.3	65.9	63.5
Mean	61.0	65.9	70.3	67.8	69.0	66.9	62.9

Table 9. Results for plumps (% >6/64”) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025.

Treatment	Swift Current	Redvers	Indian Head	Scott	Melfort	Yorkton	Prince Albert
75% N banded at seeding	86.7	99.0	98.1	97.9	98.8	99.1	73.1
100% N banded at seeding	87.4	98.3	98.4	97.9	98.9	98.9	78.9
75% N banded at seeding + 25% N top-dress	86.3	97.9	97.5	97.4	98.7	99.2	78.6
100% N at seeding + 25% top-dress	86.0	98.0	98.1	97.7	99.2	99.1	74.6
100% N banded at seeding (75% urea, 25% ESN)	88.5	98.6	97.7	97.9	99.0	99.2	78.4
100% N banded at seeding (25% urea, 75% ESN)	87.8	97.4	98.3	97.9	98.9	98.7	78.9
Mean	87.1	98.2	98.0	97.8	98.9	99.0	77.1

Table 10. Results for thousand seed weight (g/1000 seeds) for 4R Management: Do split applications of nitrogen influence the yield and quality of malt barley? in 2025.

Treatment	Swift Current	Redvers	Indian Head	Scott	Melfort	Yorkton	Prince Albert
75% N banded at seeding	39.1	48.2	53.0	51.1	50.5	52.1	44.4
100% N banded at seeding	40.7	48.6	48.7	50.1	51.3	51.7	43.4
75% N banded at seeding + 25% N top-dress	39.7	48.7	50.0	53.3	50.8	52.7	46.9
100% N at seeding + 25% top-dress	38.9	49.8	51.8	50.8	52.1	53.5	44.1
100% N banded at seeding (75% urea, 25% ESN)	42.2	49.2	49.0	51.3	51.2	53.8	43.8
100% N banded at seeding (25% urea, 75% ESN)	39.9	50.6	50.5	51.3	51.5	51.9	44.7
Mean	40.1	49.2	50.5	51.3	51.2	52.6	44.6

Extension:

The trial was presented by Mitchell Japp of SaskBarley at the NARF & AAFC Joint Annual Field tour at Melfort, SK on July 23rd, 2024 to 126 attendees. The trial was presented in Indian Head at the Indian Head Crop Management Field Day on July 15, 2025 to 157 people and at the BASF Global Herbicide Group/IHARF Plot Tour on July 16, 2025 to 26 people. The trial was presented near Redvers at the SERF Field Day July 10, 2025 to 80 people. The trial results were shared via Webinar on January 21, 2026 during the Sustaining Barley Webinar Series: Optimizing Nitrogen and at the SIA Northeast Ag Update on February 3, 2026 at Melfort, SK.

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.

Although conditions varied across sites, the response of malt barley to different N management strategies was generally quite low. Plant densities were rarely affected by N management, however, when they were, results suggested that higher N rates have the potential to reduce stands. Lodging only occurred at 3 out of 7 locations, and when it did, the degree of lodging was very low (0.1-1.3 out of 9) and not affected by N treatments. Grain yield and protein responses only occurred at 3 of the 7 sites, where yield and protein were often increased with higher N rates, but not with top-dress applications. Yield and protein were often maintained with top-dress applications as compared to applying all N at seeding, suggesting that top-dress applications were not necessarily a ‘bad’ management strategy, but they were not efficient at building yield as compared to applying all N at seeding time. Furthermore, as there was no yield or protein response to N management at 4 of the sites, this suggests that yield was not significantly increased beyond 75% of the N recommendation, making holding back N at seeding time a good decision at the majority of sites in 2025. Furthermore, the sites (Indian Head and Redvers) that had significant yield responses to rate were the locations with the highest May precipitation (>42mm). Lastly, responses to ESN were rare, but at Scott, a high blend of ESN (75%) did significantly increase yield, while decreasing protein at Melfort and increasing protein at Redvers. While positive responses to ESN were unlikely given the drier conditions of 2025, the slow-release nature of ESN did not negatively impact barley in comparison to straight urea. Because the drier conditions of 2025 impacted the response of barley to top-dress and slow-release N, another year of evaluation of these N management strategies in higher moisture conditions would be desirable.

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.
2.
3.
4.

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 Annual Field tour	Melfort Research Farm July 23, 2025	126	NA
Sustaining Barley Webinar Series: Optimizing Nitrogen	Online	Unsure	https://ambainc.org/event.php?id=69262680e0c11
SIA Northeast Ag Update on February 3, 2026	Kerry Vickar Centre, Melfort, SK	~80	NA
C. Holzapfel (IHARF) and M. Japp (SBDC) Plot tour/presentation	Indian Head Crop Management Field Day (July 15, 2025)	157	https://iharf.ca/indian-head-crop-management-field-day/
C. Holzapfel (IHARF) plot tour	BASF Global Herbicide Group/IHARF Plot Tour (July 16, 2025)	26	NA
SERF Field day 10 July 2025	South East Research Farm, Redvers	80	NA

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Sustainable Canadian Agricultural Partnership

Saskatchewan

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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 11. Agronomic information and dates of operations for 4R Management: Can split applications be managed in malt barley to reduce risk and maintain yield and quality? in 2025

Factor/Field Operation	Swift Current	Redvers	Indian Head	Scott	Melfort	Yorkton	Prince Albert
Pre-emergent Herbicide	RoundUp Transorb 0.5L/ac April 18	RoundUp 540 0.67L/ac May 13	0.67L/ac RoundUp Weathermax May 13	Glyphosate 540 1L/ac & AIM 35mL/ac May 9	Avadex 1.2L/ac & StartUp 0.67L/ac May 15	1L/ac RoundUp Transorb May 22	Glyphosate 0.88L/ac & Heat 29mL/ac May 10
Stubble	Durum	Mustard	Canola	Canola	Canola	Canola	Canola
Row Spacing	21cm	30 cm	30cm	25cm	30cm	30cm	25cm
Cultivar	AAC Connect	AAC Connect	AAC Connect	AAC Connect	AAC Connect	CDC Fraser	AAC Connect
Seeded	25-Apr	13-May-25	10-May-25	10-May	12-May	26-May-25	22-May-25
PKS kg/ha applied	43-16-6	40-14-0	2045-10-10	18-0-0	56-11-6	29-17-0	31-0-0
in-crop herbicide	Liquid Achieve 0.2L/ac & Buctril M 0.4L/ac June 4	Buctril M 0.4L/ac June 11 & Puma Advance 413mL/ac June 18	0.95L/ac Prestige XL & 0.5L/ac Axial June 9	Axial Xtreme 0.5L/ac & Buctril M 0.4L/ac June 16	Puma Advance 413mL/ac June 11; Momentum 0.45L/ac and MCPA 0.38L/ac June 20	Prestige XL 900mL/ac June 16 & Axial 0.5L/ac June 18 & 27	None
Plant counts	22-May	06-Jun-25	30-May	02-Jun	28-May-25	06-Jun-25	13-Jun-25
Top-dress application	02-Jun	20-Jun-25	06-Jun	10-Jun	11-Jun-25	12-Jun-25	16-Jun-25
Fungicides	None	None	0.4l/ac Trivapro A & 0.12L/ac Trivepro B July 1	Caramba 0.4L/ac July 9	None	Miravis ACE 404mL/ac July 8	None
Insecticides	None	None	None	None	None	None	None
Lodging	25-Jul	25 Aug	13-Aug	18-Aug	04-Sep-25	09-Sep	12-Sep-25
Desiccant	None	None	None	None	None	None	None
Harvest date	01-Oct	26-Aug-25	22-Aug	21-Sep	08-Sep-25	09-Sep-25	12-Sep-25

Table 12. Soil sample information from each site in 4R Management: Can split applications be managed in malt barley to reduce risk and maintain yield and quality? in 2025

Swift Current							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15		18	110	6	2.7	7.3	0.28
15 to 60						7.5	1.47
Redvers							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15	9	5	178	18	2.3	7.9	0.32
15 to 60	21			324		8.7	0.57
Indian Head							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15	7	12	649	14	5	7.8	0.62
15 to 60	12			24		8.1	0.63
Scott							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15	14	17	218	80	3.5	5.3	0.28
15 to 60	15			78		7.7	0.29
Melfort							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15	12	13	377	62	7.4	6.6	0.68
15 to 60	9			54		7.3	0.51
Yorkton							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15	19	9	260	58	5.8	7.8	0.46
15 to 60	41			120+		7.9	1.59
Prince Albert							
Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 15	36	12	254	22	5.1	6.0	0.22
15 to 60	66			54		7.8	0.29

Table 13. Total monthly growing season precipitation (mm) and average temperatures (°C) at all sites in 2025.

Location	Year	May	June	July	August	Total
		--- Total Precipitation (mm) ---				
Swift Current	2025	34.2	31.3	78.2	92.6	236.3 (120%)
	Long-term	47.5	56.0	56.3	38.0	197.8
Redvers	2025	65.0	27.0	80.0	40.0	212.0 (79%)
	Long-term	60.0	95.2	65.5	46.6	267.3
Indian Head	2025	42.6	39.4	27.1	26.9	136.0 (55%)
	Long-term	51.7	77.4	63.8	51.2	244.1
Scott	2025	11.8	103.7	28.7	64.5	208.7 (92%)
	Long-term	38.9	69.7	69.4	48.7	226.7
Melfort	2025	4.8	93.2	25.9	113.5	237.4 (104%)
	Long-term	33.4	79.5	69.6	45.9	228.4
Yorkton	2025	23.6	63.4	36.8	71.2	195.0 (72%)
	Long-term	51.0	80.0	78.0	62.0	272.0
Prince Albert	2025	2.2	137.6	8.6	51.2	199.6 (96%)
	Long-term	36.5	66.8	61.3	43.6	208.2
		--- Mean Temperature (°C) ---				AVG
Swift Current	2025	13.1	15.9	18.0	19.0	16.5
	Long-term	11.9	16.4	19.1	18.7	16.5
Redvers	2025	13.1	16.2	17.5	17.9	16.2
	Long-term	11.1	16.2	18.7	18.0	16.0
Indian Head	2025	12.7	15.3	17.0	17.8	15.7
	Long-term	10.8	15.8	18.2	17.4	15.6
Scott	2025	12.9	14.6	15.8	17.4	15.2
	Long-term	10.8	14.8	17.3	16.3	14.8
Melfort	2025	13.8	15.0	17.0	18.0	16.0
	Long-term	10.1	15.2	17.8	16.7	15.0
Yorkton	2025	12.4	15.7	17.5	18.3	16.0
	Long-term	10.4	15.5	17.9	17.1	15.2
Prince Albert	2025	11.2	12.7	14.9	17.1	14.0
	Long-term	11.2	16.0	18.3	16.7	15.6

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.

See attached Excel spreadsheet.