2018 Research Report

from the

Saskatchewan Barley Development Commission

Project Title:
Malt versus Feed Barley Management

(ADOPT# 20170366)

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Project Identification

1. **Project Number:** 20170366
2. **Producer Group Sponsoring the Project:** Saskatchewan Barley Development Commission
3. **Project Location(s):** Yorkton, Indian Head, Melfort, Prince Albert, Redvers, Outlook, and Scott Saskatchewan.
4. **Project start and end dates (month & year):** April 2018 to February 2019
5. **Project contact person & contact details:**

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Objectives and Rationale

6. **Project Objectives:**

The objectives of this project are:

- To demonstrate that newer malt varieties can provide comparable yield to the best feed varieties
- To demonstrate the importance of adequate plant populations for yield and malt acceptance
- To demonstrate the differences in N management for malt versus feed barley

7. **Project Rationale:**

Malt barley breeders have been developing new varieties which have increased yields to compete with higher yielding feed varieties. As higher yielding malt varieties come into the market place, producers must be aware that continuing to grow feed varieties may result in missed opportunities with maltsters. The past recommendation was to grow a feed variety if a producer only makes malting quality 50% of the time. However, as higher yielding malt barley varieties become accepted, feed barley does not appear as rewarding. Producers need to be aware of the importance of seeding rate and nitrogen management for malt and feed varieties. Higher seeding rates of 300 seeds/m^2 maximize yield and improve acceptance for malt. Work by John O'donovan determined 300 seeds/m^2 was the optimum seeding rate for malt barley. This typically results in a plant stand around 220 plants/m^2. Increased tillering resulting from lower seeding rates leads to uneven maturity and non-uniform kernels which is undesirable to maltsters. Increasing seeding rates to 300 seeds/m^2 may slightly reduce kernel plumpness, but produces more uniform kernels which is a better trade-off. Using a higher seeding rate also has the advantage of hastening maturity by 2 to 3 days and slightly lowers protein. For feed barley, the optimum seeding rate is somewhat higher than it is for malt.

Managing nitrogen is particularly important for malt barley because protein levels must

stay between 11-12.5% to be accepted. High protein barley means there is less carbohydrate for the malting process which may result in cloudy beer. Nitrogen rates for feed barley can be higher as high protein is desirable. In order to determine how much N to apply to new malt varieties, producers will need to consider the likelihood of being selected for malt and the price differential that can occur if malt is not met. This project will demonstrate basic agronomic practices for newer malt versus feed varieties to help barley producers stay competitive in a changing market.

Methodology and Results

8. Methodology:

Below is a list of the treatments that were established at Yorkton, Prince Albert, Indian Head, Melfort, Redvers, Outlook and Scott. The treatments were a 3 order factorial arranged in a 4 replicate RCBD. The first factor compared the malt variety CDC Bow against the feed variety CDC Austenson. The second factor contrasted seeding rates of 200 and 300 seeds/m^2. The 3rd factor examines increasing nitrogen rates of 50, 75 and 100 lbs N/ac.

Treatment List

1) CDC Bow (Malt); 200 seeds/m2; 50 lbs N/ac
2) CDC Bow (Malt); 200 seeds/m2; 75 lbs N/ac
3) CDC Bow (Malt); 200 seeds/m2; 100 lbs N/ac
4) CDC Bow (Malt); 300 seeds/m2; 50 lbs N/ac
5) CDC Bow (Malt); 300 seeds/m2; 75 lbs N/ac
6) CDC Bow (Malt); 300 seeds/m2; 100 lbs N/ac
7) CDC Austenson (Feed); 200 seeds/m2; 50 lbs N/ac
8) CDC Austenson (Feed); 200 seeds/m2; 75 lbs N/ac
9) CDC Austenson (Feed); 200 seeds/m2; 100 lbs N/ac
10) CDC Austenson (Feed); 300 seeds/m2; 50 lbs N/ac
11) CDC Austenson (Feed); 300 seeds/m2; 75 lbs N/ac
12) CDC Austenson (Feed); 300 seeds/m2; 100 lbs N/ac

Plot sized varied across locations based on seeding and spraying equipment. Dates of operations for all sites are found in Table 1.

Table 1. Dates of operations in 2018 for the Malt versus Feed Barley Management at Yorkton

	----------Date----------						
Activity	**Indian Head**	**Melfort**	**Outlook**	**Redvers**	**Prince Albert**	**Scott**	**Yorkton**
Pre-seed Herbicide Application	May 11 (Weathermax 540)	May 18 (Glyphosate 540)		May 8 (Glyphosate and Buctril M)		May 19 (Glyphosate and AIM)	
Seeding	May 7	May 15	May 22	May 6		May 19	May 9
Emergence Counts	May 29	June 4		May 20	June 15	June 13	May 28
In-crop Fungicide Application	June 5 (Quilt)	July 13 (Caramba)	none	none	none	none	June 21 (Twinline)
In-crop Herbicide Application	June 7 (Buctril M and Axial BIA)	June 6 (Buctril M)	July 21 (Buctril M and Assert)	May 28 (Infinity)	June 13 (Curtail M)	June 8 (Buctril M and Axial)	(Prestige and Axial in separate passes)
Lodging Ratings		Aug 20		Aug 18		July 27 and Aug 23	
Harvest	Aug 9	Aug 20	Aug 15	Aug 13	Sept 10	Sept 8	August 17

9. Results:

Growing Season Weather

The summer of 2018 was warmer than normal and seasonal precipitation was below the long-term average at all locations (Tables 2 and 3). Conditions were particularly dry at Indian Head and Outlook where precipitation was only 61, and 42% of the long-term average. Of course this was not an issue at Outlook as the trial was under irrigation. Conditions were better at Melfort, Prince Albert, Scott and Yorkton where precipitation was 87, 85, 88 and 72% of the long-term average, respectively. Scott experienced hail (July 21) and heavy winds (157km/hr on June 9) which may have affected crop yield and protein.

Table 2. Mean monthly temperatures amounts along with long-term (1981-2010) normals for the 2018 growing seasons at 7 sites in Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
		----------*Mean Temperature (°C)* ----------				
Indian Head	2018	13.9	16.5	15.4	17.6	15.8
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Melfort	2018	13.9	16.8	17.5	15.8	16.0
	Long-term	***10.7***	***15.9***	***17.5***	***16.8***	***15.2***
Outlook	2018	14.8	17.4	18.5	17.5	17.1
	Long-term	***11.5***	***16.1***	***18.9***	***18.0***	***16.1***
Prince Albert	2018	13.2	16.6	17.4	15.1	15.6
	Long-term	***10.4***	***15.3***	***18.0***	***16.7***	***15.1***
Redvers	2018	15.2	18.3	18.6	17.8	17.5
	Long-term	**-**	**-**	**-**	**-**	**-**
Scott	2018	13.6	16.6	17.5	15.9	15.9
	Long-term	***10.8***	***14.8***	***17.3***	***16.3***	***14.8***
Yorkton	2018	13.9	17.6	18.3	18.1	17.0
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***

Table 3. Precipitation amounts along with long-term (1981-2010) normals for the 2018 growing seasons at 7 sites in Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
		---------- *Precipitation (mm)* ----------				
Indian Head	2018	23.7	90	30.4	3.9	148
	Long-term	***49***	***77.4***	***63.8***	***51.2***	***241.4***
Melfort	2018	38.5	46.6	69.5	43.2	196.8
	Long-term	***42.9***	***54.3***	***76.7***	***52.4***	***226.3***
Outlook	2018	24.9	12.9	35.2	12.6	85.6
	Long-term	***42.6***	***63.9***	***56.1***	***42.8***	***205.4***
Prince Albert	2018	20.6	41.0	112.4	42.2	216.2
	Long-term	***44.7***	***68.6***	***76.6***	***61.6***	***251.5***
Redvers	2018	21.1	137.2	48.3	9.9	216.5
	Long-term	***-***	***-***	***-***	***-***	***-***
Scott	2018	35.6	58	85.8	20.2	199.6
	Long -term	***38.9***	***69.7***	***69.4***	***48.7***	***226.7***
Yorkton	2018	0.8	120.1	53.8	21.1	196.1
	Long-term	***51***	***80***	***78***	***62***	***272***

Spring residual soil nitrate levels are presented in Table 4. Nitrate levels were relatively high at Redvers, moderate at Yorkton, Prince Albert, Melfort and Outlook and low at Indian Head, and Scott.

Table 4. Soil Test Nitrate Levels for each location.							
Nitrate Levels (lbs NO_3-N/ac)	**Yorkton**	**Melfort**	**Redvers**	**Scott**	**Prince Albert**	**Indian Head**	**Outlook**
0-15 (0-6)	10	10	31	8	25	5.5	15
15-30 (6-12)	15	10			17		11
15-60 (6-24)			45	9		8	
30-60 (12-24)							12
Total (0-24)	37.5[a]	30[a]	76	17	42	13.5	38

[a]Estimated value for 0 to 24 inches based on 0-12 sample.

Tables 5-13 showing the complete analysis for all locations are found in the appendices.

The target seeding rates for CDC Bow and CDC Austenson were either 200 or 300 seeds/m^2 depending on the treatment. Averaged across location, 200 and 300 seeds/m^2 resulted in plant emergence of 183 and 241 plants/m^2, respectively. However, this did vary between locations with populations being relatively low at Scott and Prince Albert compared to the other locations (Table 5). For the most part, emergence was very similar for CDC Bow and CDC Austenson at each location and emergence tended to decline modestly with increasing nitrogen rate.

Overall, the feed barley variety CDC Austenson yielded significantly more than the malt barley variety CDC Bow at all locations, except Prince Albert (Tables 6 and 7). When averaged across seeding rate, nitrogen rate, and location, CDC Austenson yielded 8% more than CDC Bow and this difference in yield was maintained as rates of applied N were increased (Figure 1). However, the yield difference between varieties varied from as little as 1.9% at Prince Albert to as high as 11% at Redvers. Yield differences between the varieties were more modest at Prince Albert, Indian Head and Scott compared to the other locations (Figures 2 and 3). Indian Head was very dry and yields were low. Prince Albert had little precipitation up until the end of June which resulted in reduced yields. Scott also had low yields due to a significant hail and wind storms. Sites receiving more rainfall or irrigation were more responsive to added nitrogen (as expected) and had larger yield differences between the varieties. The overall yield difference of 8% between varieties is consistent with variety results published in 2018 Saskatchewan Seed Guide. In this guide, yields of CDC Austenson and CDC Bow are compared to AC Metcalfe. From these relative comparisons it can be inferred that CDC Austenson should be yielding between 4 to 9% more than CDC Bow depending on the region.

Figure 1. Yield Response of CDC Bow and CDC Austenson to Added Nitrogen Rate, Averaged over Seeding Rate and Location

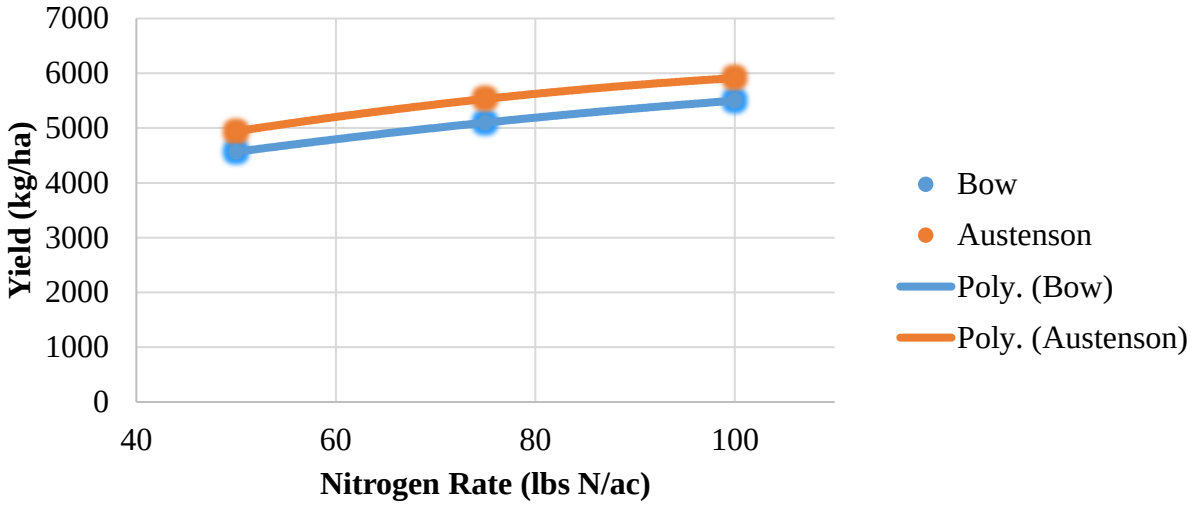


Figure 2. Yield Response of CDC Bow and CDC Austenson to Nitrogen Rate Averaged over Seeding Rate

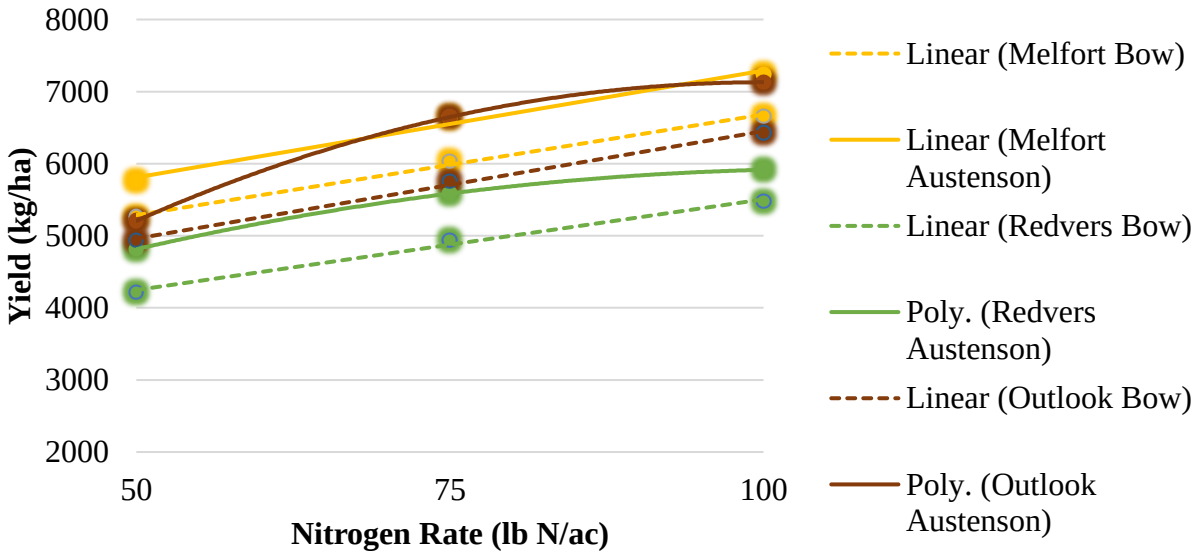
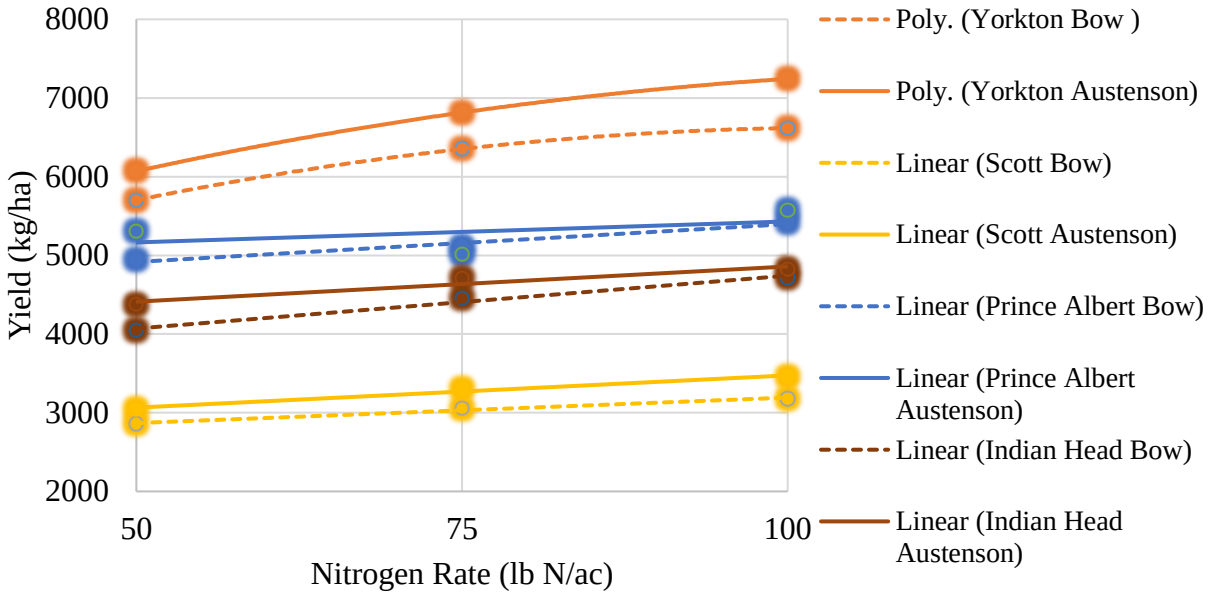


Figure 3. CDC Bow and CDC Austenson's Yield Response to Nitrogen Rate Averaged over Seeding Rate



Increasing seeding rate from 200 to 300 seeds/m^2, tended to reduce yield at all locations except Outlook; however, for most individual sites the response was not significant. The effect was almost statistically significant at Prince Albert (p=0.062) and was statistically significant at Scott (Table 6). Increasing seeding rate decreased yield by 4.4 and 3.8 % at Scott and Prince Albert, respectively. Conditions were dry at most locations. As a result, increasing seeding rates increased inter-plant competition for soil moisture and reduced yield at all dryland sites. The only site where increasing plant populations increased yield was under irrigation at Outlook. Inter-plant competition for moisture as seeding rate was increased did not limit yield at this site.

The selection of barley for malt is based on measuring a number of parameters such as germination, sprouting, moisture content, peeled and broken kernels, plumpness and protein. The treatment results for these parameters are listed by location in Table 9 and are based on one bulk sample from the 4 replicates. Germination must exceed 95% and this was achieved regardless of seeding or nitrogen rate at all locations. Levels of sprouting were low at all locations and within acceptable limits as conditions prior to harvest were dry. Moisture content should be no higher than 13.5% otherwise storage may become an issue. Grain moisture was excessively high at Prince Albert, but harvesting later in favourable conditions may have addressed this issue. Peeled and broken kernels should be less than 5% as they interfere with the uniformity of germination during malting. This was only exceeded at Outlook and could have been addressed by adjusting combine settings. Malsters are also looking for plump kernels of uniform size. A plump kernel contains more starch and gives a higher percent of extract. The exact requirement may vary with the malster, but barley selected for malt typically has around 92% plump seed. This level was exceeded at every location regardless of treatment with the exception of CDC Bow seeded at 300 seeds/m^2 and with 100 lb N/ac at Yorkton. Protein must be between 11 and 12.5% to be accepted

for malt. This varied greatly with nitrogen rate and location. By using site as replication, the plumps, protein, thousand kernel weight, and test weight data was statistically analysed. Kernel plumpness and protein did not significantly differ between seeding rates. However, kernel plumpness did significantly decrease from 96.3 to 95.1% and protein significantly increased from 11.1 to 12.0% as nitrogen rate was increased from 50 to 100 lbs N/ac (data not shown). Thousand kernel weight (Table 10) and test weights (table 11) were also measured, although malsters place less value on these parameters. Increasing seeding rate was found to significantly reduce thousand kernel weight from 49.5 to 48.8 grams however, test weights were unaffected. This decrease in thousand kernel weight is not agronomically significant. Increasing nitrogen did not significantly impact either thousand kernel weight or test weight.

The exact amount of nitrogen required to maximize yield and still provide an acceptable level of protein varied greatly between locations. Applying 100 lbs N/ac proved to be the best nitrogen rate for maximizing yield and maintaining protein levels below the maximum allowable limit of 12.5% at all locations, except Scott. Scott's yields were low and protein levels were too high for malt even with only 50 lbs N/ac. The reason for the high protein level is uncertain but may have been related to poor yields caused by extreme wind and hail events. At Melfort, Redvers and Outlook, nitrogen rates should have been increased beyond 100 lbs N/ac as yields were still increasing sharply and protein levels were low. This was particularly true at Outlook as even the highest rate of N did not result in protein levels above the 11% minimum (Table 9).

Table 12 and 13 shows the economic analysis used to determine the value of growing CDC Bow for malt vs CDC Austenson for feed based on 2017 and 2018 pricing, respectively. As seeding rate had little effect on the yield or protein of barley, the economic comparison of growing the feed variety CDC Austenson against the malt variety CDC Bow is based on yields averaged over seeding rate and prices obtained from the Saskatchewan Crop Planning Guide. For the black soil zone in 2017, the guide used prices of $5.44 and $3.22/bu for malt and feed barley, respectively. In 2018, the guide used a narrower range of $4.68 and $3.70/bu for malt and feed, respectively. The Crop Planning Guide calculates total variable expenses for malt and feed barley to be $252.22 and $206.75/ac, respectively in 2018. However, the economic analysis for this study will assume production costs are equal as fertility and chemical costs for our comparisons did not differ between the varieties in our study. Economic comparisons were made at 100 lbs N/ac at all sites except Scott where the comparison was made at 50 lbs N/ac because further increases in N just continued to increase protein levels beyond acceptable levels for malt.

When averaged over seeding rate, CDC Austenson yielded more than CDC Bow at every location. However, the gross returns for selling CDC Bow for malt were greater than selling CDC Austenson for feed regardless of location and whether 2017 or 2018 pricing was used (Tables 12 and 13). Selling CDC Austenson for feed generated more income than selling CDC Bow for feed at every location as yield for CDC Austenson was always higher. The probability for making malt that is required to justifying growing CDC Bow instead of CDC Austenson was determined by comparing the relative value of selling CDC Bow for malt or feed against selling CDC Austenson for feed. To justifying growing CDC Bow, the required probability for making malt varied from as low as 1% at Prince Albert and as high as 16% at Outlook based on 2017 pricing (Table 12). When considering the narrower pricing difference of 2018, the required

probability of making malt needed to justify growing CDC Bow jumped to 2% at Prince Albert and 41% at Outlook (Table 13). Based on these results, there was virtually no reason to grow CDC Austenson at Prince Albert because the yield difference between varieties was very small. CDC Bow essentially provided the same feed returns with the possibility of selling for higher returns as malt. Based on results from Outlook, growing CDC Bow for malt should only be considered if the chance of obtaining malt is very high (over 41%) or the price differential between malt and feed is high. This is because CDC Austenson was considerably higher yielding (+11%) than CDC Bow at Outlook. When averaged across all locations, there needed to be more than a 10% or 27% chance of making malt to justifying growing CDC Bow over CDC Austenson based on 2017 and 2018 pricing, respectively. These probabilities may be a little low when considering feed yields could have been pushed higher with rates of N beyond 100 lbs/ac. However, the required probability of making malt to justify growing the malt variety CDC Bow would still be low.

10. Conclusions and Recommendations

The first objective of this study was to demonstrate that newer malt varieties could provide yields comparable to the best feed variety CDC Austenson. This was not achieved when comparing with CDC Bow. When averaged across location CDC Austenson yielded 8% more than CDC Bow. To justify growing CDC Bow the chance of making malt had to be better than 10% based on 2017 pricing and 27%, based on the narrower price difference of 2018. When the price differential between malt and feed barley is fairly high, many areas could justify taking a chance on growing CDC Bow for malt as the downside for selling CDC Bow for feed is fairly small compared to the upside of making malt. However, producers need to have a realistic expectation for making malt to choose between the varieties. According to the Canadian Grain Commission, only 20% of malting barley production in Saskatchewan is actually selected each year for malting. Future study should compare AAC Synergy versus CDC Austenson as yield difference between these two varieties should be minimal based on variety information in Saskatchewan Seed Guide. The Saskatchewan Barley Development Commission is also impressed by AAC Synergy as it yielded better than expected under the dry conditions of 2018. When malt varieties provide comparable yields to the best feed varieties and are widely accepted by malsters, there will be little reason to grow feed varieties.

The 2nd objective was to demonstrate the benefit of higher seeding rates for yield and malt quality. For the most part this was not demonstrated at the dryland farming sites because soil moisture was limiting. Increasing seeding rate from 200 to 300 seeds/m^2 increased inter-plant competition for moisture and decreased yield, although for most individual sites the response was not significant. The only exception to this occurred under irrigation at Outlook. At Outlook yields increased with increasing seeding rate. Increasing seeding rate had no significant effect on malt quality parameters in this study. It was found to decrease thousand kernel weight slightly, but malsters are more concerned with kernel plumpness. These results may have differed under more typical, or wetter, conditions

The 3rd objective was to demonstrate how nitrogen management differed between malt and feed varieties. This was somewhat accomplished, but differences would have been clearer if an additional, higher, rate of N was included in the study. While the feed variety CDC Austenson was higher yielding, its response to added nitrogen was very similar to the malt variety CDC Bow. When averaged across location, the protein of malt barley was nearing the borderline of 12.5% protein with 100 lbs N/ac. This means there was not much room to increase the yield of CDC Bow without risking rejection for malt based on excessive protein. However, the yield and economic benefit of growing CDC Austenson for feed could have been pushed higher with rates beyond 100 lbs N/ac at most sites. In other words, target nitrogen rates for CDC Austenson should be higher than CDC Bow.

Supporting Information

11. Acknowledgements:

This project was funded through the Saskatchewan Barley Development Commission and Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during annual tours.

12. Appendices:

Table 5. Main effects of variety, seeding rate and nitrogen rate on barley emergence at multiple locations in 2018.							
Main effect	**Emergence**						
	Yorkton	**Melfort**	**Redvers**	**Scott**	**Prince Albert**	**Indian Head**	**Outlook**
Variety	---------- plants m^{-2} ----------						
CDC Bow	230 a	262 a	212 a	193 b	180 a	249 a	215 a
CDC Austenson	228 a	255 a	239 b	170 a	151 a	235 a	209 a
LSD	NS	NS	15.9	10	NS	NS	NS
Seeds/m^2							
200	195 a	222 a	194 a	158 a	139 a	190 a	183 a
300	262 b	296 b	257 b	204 b	193 b	294 b	241 b
LSD	16.4	15.3	15.9	10	21.6	14.7	21.8
lbs N/ac							
50	231 a	271 a	229 a	190 b	169 a	246 a	211
75	231 a	253 a	225 a	180 ab	163 a	238 a	218
100	224 a	253 a	224 a	173 a	166 a	242 a	207
LSD	NS	NS	NS	12.6	NS	NS	NS

Table 6. Significance of variety, seeding rate and nitrogen fertilizer effects on barley yield at multiple locations in 2018.

	Yield						
	Yorkton	**Melfort**	**Redvers**	**Scott**	**Prince Albert**	**Indian Head**	**Outlook**
Effect	----------p-values [z] ----------						
Variety (V)	0.0003	<0.0001	<0.0001	<0.0001	Ns	0.0005	0.0002
Seeds/m^2 (S)	Ns	Ns	Ns	0.0084	0.062	Ns	Ns
V x S	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Nitrogen rate (R)	<0.0001	<0.0001	<0.0001	<0.0001	0.014	<0.0001	<0.0001
V x R	Ns	Ns	Ns	Ns	Ns	Ns	Ns
S x R	Ns	Ns	Ns	Ns	Ns	Ns	Ns
V x S x R	Ns	Ns	Ns	Ns	Ns	Ns	Ns

[z] p-values ≤ 0.05 indicate that a treatment effect was significant and not due to random variability

Table 7. Main effects of variety, seeding rate and nitrogen rate on barley yield at multiple locations in 2018.							
Main effect	**Yield**						
	Yorkton	**Melfort**	**Redvers**	**Scott**	**Prince Albert**	**Indian Head**	**Outlook**
Variety	---------- kg ha^{-2} ----------						
CDC Bow	6224 a	5984 a	4876 a	3031 a	5156 a	4406 a	5706 a
CDC Austenson	6710 b	6550 b	5438 b	3270 b	5256 a	4635 b	6328 b
LSD	247	223	202	104	Ns	123	310
Seeds/m^2							
200	6544 a	6310 a	5160 a	3221 a	5308 a	4535 a	5870 a
300	6390 a	6224 a	5153 a	3079 b	5105 a	4506 a	6164 a
LSD	Ns	Ns	Ns	104	NS	Ns	Ns
lbs N/ac							
50	5886 a	5111 a	4515 a	2952 a	5123 a	4210 a	5072 a
75	6584 b	6341 b	5261 b	3179 b	5061 a	4582 b	6201 b
100	6931 c	6950 c	5694 c	3319 c	5497 b	4770 c	6778 c
LSD	311	280	254	131	271	155	390

Table 8. Variety by Seeding rate by N fertilizer rate interactions on barley yield at multiple locations in 2018.

Main effect	**Yield**						
	Yorkton	**Melfort**	**Redvers**	**Scott**	**Prince Albert**	**Indian Head**	**Outook**
V × S x R	---------- Kg ha^{-2} ----------						
CDC Bow – 200 seeds/m2 – 50 lbs N/ac	5786	5249	4095	2867	5096	4091	4773
CDC Bow – 200 seeds/m2 – 75 lbs N/ac	6260	6110	4982	3034	5159	4443	5512
CDC Bow – 200 seeds/m2 – 100 lbs N/ac	6636	6690	5424	3336	5523	4807	6178
CDC Bow – 300 seeds/m2 – 50 lbs N/ac	5618	5272	4338	2848	4785	4000	5101
CDC Bow – 300 seeds/m2 – 75 lbs N/ac	6444	5963	4893	3072	5058	4468	5996
CDC Bow – 300 seeds/m2 – 100 lbs N/ac	6601	6623	5525	3027	5320	4628	6675
CDC Austenson – 200 seeds/m2 – 50 lbs N/ac	6254	5806	4751	3102	5455	4205	5196
CDC Austenson – 200 seeds/m2 – 75 lbs N/ac	7051	6545	5813	3443	5163	4742	6580
CDC Austenson – 200 seeds/m2 – 100 lbs N/ac	7277	7462	5898	3547	5450	4924	6981
CDC Austenson – 300 seeds/m2 – 50 lbs N/ac	5887	5718	4876	2992	5158	4545	5219
CDC Austenson – 300 seeds/m2 – 75 lbs N/ac	6580	6745	5358	3167	4866	4674	6715
CDC Austenson – 300 seeds/m2 – 100 lbs N/ac	7211	7026	5931	3367	5446	4721	7278
L.S.D.	816	735	667	345	711	406	1021

Table 9. Quality Parameters for Malt Barley								
Treatment	**Sprouted %**	**Plump %**	**Thins %**	**Foreigh %**	**Peeled/Broken %**	**Moisture %**	**Protein %**	**Germ %**
Yorkton								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0	96.1	0.4	0.1	4.1	12.7	10.2	100
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0	93.7	0.6	0.1	4.3	12.6	10.5	100
3. CDC Bow – 200 seeds/m2 – 100s lb N/ac	0	92.4	0.9	0.1	4.3	12.7	12.3	98
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0	95	0.4	0.1	2.9	12.6	9.8	100
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0	92	1.2	0.1	2	12.6	10.9	98
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0	88	2.7	0.1	2.3	12.6	11.4	100
Melfort								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0.0	96.4	0.2	0.2	2.7	9.1	10.4	100.0
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0.0	95.2	0.2	0.2	1.9	8.9	10.6	99.0
3. CDC Bow – 200 seeds/m2 – 100 lbs N/ac	0.0	93.0	0.4	0.3	1.6	9.2	10.8	99.0
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0.1	98.2	0.1	0.1	4.4	8.9	10.1	100.0
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0.1	95.5	0.3	0.2	2.8	9.0	10.8	99.0
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0.0	95.4	0.2	0.1	3.1	9.1	11.3	98.0

Table 9 Continued. Quality Parameters for Malt Barley								
Treatment	**Sprouted %**	**Plump %**	**Thins %**	**Foreigh %**	**Peeled/Broken %**	**Moisture %**	**Protein %**	**Germ %**
Scott								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0	96	0.2	0	0.9	10.6	13.1	100
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0	95	0.2	0.1	0.9	10.5	13.5	98
3. CDC Bow – 200 seeds/m2 – 100 lbs N/ac	0	95	0.2	0	0.4	10.6	13.4	98
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0	96	0.1	0.05	0.8	10.5	12.6	99
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0	96	0.1	0.05	0.6	10.5	13.3	99
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0	94	0.2	0	0.5	10.5	13.7	99
Prince Albert								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0.2	98	0.2	0.1	0.3	17.8	11.6	96
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0.2	98.4	0.2	0.1	0.3	18.4	11.3	98
3. CDC Bow – 200 seeds/m2 – 100s lb N/ac	0.2	98.2	0.2	0.1	0.2	18.1	12.2	97
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0.2	98.4	0.1	0.1	0.2	17.7	11.7	99
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0.1	98.2	0.1	0	0.2	17.7	12.1	98
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0.1	98	0.1	0	0.3	18.1	12.5	98

Table 9 Continued. Quality Parameters for Malt Barley								
Treatment	**Sprouted %**	**Plump %**	**Thins %**	**Foreigh %**	**Peeled/Broken %**	**Moisture %**	**Protein %**	**Germ %**
Indian Head								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0.2	95.6	0.2	0.4	1.1	9.6	10.7	100
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0	95.1	0.2	0.1	1	9.7	11.5	99
3. CDC Bow – 200 seeds/m2 – 100 lbs N/ac	0	95.7	0.2	0.1	0.8	9.8	12.6	100
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0	95.3	0.2	0.2	3.6	9.7	10.3	99
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0	93.6	0.2	0.2	3	9.7	11.3	100
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0	93.2	0.2	0.2	2.8	9.6	12.3	100
Outlook								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0	98.8	0.1	0.1	8	10.9	9.5	98
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0	99.0	0.1	0.1	6.4	10.9	9.5	98
3. CDC Bow – 200 seeds/m2 – 100 lbs N/ac	0	99.0	0.1	0.1	4.4	11	10.6	96
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0	98.8	0.1	0.1	5.9	10.8	9.6	95
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0	99.1	0.1	0.1	5.7	10.9	9.5	100
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0	98.9	0.1	0.1	6	11	10.5	97

Table 9 Continued. Quality Parameters for Malt Barley								
Treatment	**Sprouted %**	**Plump %**	**Thins %**	**Foreigh %**	**Peeled/Broken %**	**Moisture %**	**Protein %**	**Germ %**
Redvers								
1. CDC Bow – 200 seeds/m2 – 50 lbs N/ac	0	98.3	0.1	0.05	0.2	12.3	10.4	100
2. CDC Bow – 200 seeds/m2 – 75 lbs N/ac	0	98.4	0.1	0.05	0.7	12.4	10.5	100
3. CDC Bow – 200 seeds/m2 – 100 lbs N/ac	0	98	0.1	0	0.8	12.1	11.7	100
4. CDC Bow – 300 seeds/m2 – 50 lbs N/ac	0	98	0.1	0	0.4	12.3	9.7	100
5. CDC Bow – 300 seeds/m2 – 75 lbs N/ac	0	98.4	0.1	0	0.5	12.2	10.8	100
6. CDC Bow – 300 seeds/m2 – 100 lbs N/ac	0	97.6	0.1	0.05	0.2	12.1	11.9	99

Table 10. Thousand Kernel Weights for Malt and Feed Barley

Treatments	Yorkton	Melfort	Redvers	Scott	Prince Albert	Indian Head	Outlook
Thousand Kernel Weights (g)							
1. CDC Bow (Malt); 200 seeds/m^2; 50 lbs/ac N	48.5	48.4	50.8	44.6	52.8	45.4	49.9
2. CDC Bow (Malt); 200 seeds/m^2; 75 lbs/ac N	46.9	47.7	52.2	43.6	56.4	45.4	50.2
3. CDC Bow (Malt); 200 seeds/m^2; 100 lbs/ac N	46.7	47.0	52.9	45.2	56.0	46.0	50.8
4. CDC Bow (Malt); 300 seeds/m^2; 50 lbs/ac N	48.3	44.5	50.3	44.4	56.0	45.2	49.5
5. CDC Bow (Malt); 300 seeds/m^2; 75 lbs/ac N	47.7	48.7	49.4	43.8	56.8	44.9	49.4
6. CDC Bow (Malt); 300 seeds/m^2; 100 lbs/ac N	47.6	48.1	50.6	44.6	56.4	44.8	50.9
7. CDC Austenson (Feed); 200 seeds/m^2; 50 lbs/ac N	50.8	50.5	49.5	47.6	56.4	43.2	51.5
8. CDC Austenson (Feed); 200 seeds/m^2; 75 lbs/ac N	50.3	50.3	49.4	47.8	57.6	43.7	53.8
9. CDC Austenson (Feed); 200 seeds/m^2; 100 lbs/ac N	50.6	49.4	49.6	48.8	55.2	43.5	53.4
10. CDC Austenson (Feed); 300 seeds/m^2; 50 lbs/ac N	48.2	49.8	49.4	48.2	54.8	44.2	51.2
11. CDC Austenson (Feed); 300 seeds/m^2; 75 lbs/ac N	43.7	50.5	49.1	46.4	52.8	42.9	52.3
12. CDC Austenson (Feed); 300 seeds/m^2; 100 lbs/ac N	48.0	50.0	48.3	47.8	55.2	41.9	53.0

Table 11. Test Weights for Malt and Feed Barley

Treatments	Yorkton	Melfort	Redvers	Scott	Prince Albert	Indian Head	Outlook
Test Weight (g/0.5 l)							
1. CDC Bow (Malt); 200 seeds/m^2; 50 lbs/ac N	333	330	332	327	305.6	328	313
2. CDC Bow (Malt); 200 seeds/m^2; 75 lbs/ac N	332	328	335	328	311.4	325	309
3. CDC Bow (Malt); 200 seeds/m^2; 100 lbs/ac N	328	325	334	329	310.1	325	309
4. CDC Bow (Malt); 300 seeds/m^2; 50 lbs/ac N	328	333	329	329	308.7	328	320
5. CDC Bow (Malt); 300 seeds/m^2; 75 lbs/ac N	330	330	330	329	310.5	326	309
6. CDC Bow (Malt); 300 seeds/m^2; 100 lbs/ac N	329	328	336	328	314.3	326	309
7. CDC Austenson (Feed); 200 seeds/m^2; 50 lbs/ac N	343	346	335	335	326.3	334	322
8. CDC Austenson (Feed); 200 seeds/m^2; 75 lbs/ac N	342	344	336	336	319.8	330	322
9. CDC Austenson (Feed); 200 seeds/m^2; 100 lbs/ac N	342	339	333	334	320.1	327	320
10. CDC Austenson (Feed); 300 seeds/m^2; 50 lbs/ac N	339	344	336	337	321.8	336	322
11. CDC Austenson (Feed); 300 seeds/m^2; 75 lbs/ac N	337	348	333	334	323.8	330	322
12. CDC Austenson (Feed); 300 seeds/m^2; 100 lbs/ac N	337	345	334	336	320.2	325	313

Table 12. Economic Analysis for Growing CDC Bow for Malt over CDC Austenson for Feed[1]

	Yorkton	**Melfort**	**Prince Albert**	**Indian Head**	**Outlook**	**Redvers**	**Scott**	**All sites**
	----------bu/ac----------							
CDC Bow -100 lbs N/ac (averaged over seeding rate)	123.1	123.8	100.8	87.7	119.5	101.8	Na	
CDC Austenson -100 lbs N/ac (averaged over seeding rate)	134.7	134.7	101.3	89.7	132.6	110.0	Na	
CDC Bow -50 lbs N/ac (averaged over seeding rate)	Na	Na	Na	Na	Na	Na	53.1	
CDC Austenson -50 lbs N/ac (averaged over seeding rate)	Na	Na	Na	Na	Na	Na	56.7	
	----------$/ac----------							
Gross $ selling CDC Bow for malt	670	673	549	477	650	554	289	552
Gross $ selling CDC Bow for feed	396	399	325	283	385	328	171	327
Gross $ selling CDC Austenson for feed	434	434	326	289	427	354	183	349
Value of selling CDC Bow for malt over CDC Austenson for feed	236	240	222	188	223	200	106	202
Value of selling CDC Austenson for feed over CDC Bow for feed	37	35	2	6	42	26	12	23
	---------- %----------							
Percent chance of making malt that is required to justify growing CDC Bow over CDC Austenson	14	13	1	3	16	12	10	10

[1]Economic analysis is based on 2017 selling price for malt and feed barley of $5.44 and $3.22/bushel, respectively.

Table 13. Economic Analysis for Growing CDC Bow for Malt over CDC Austenson for Feed[1]

	Yorkton	**Melfort**	**Prince Albert**	**Indian Head**	**Outlook**	**Redvers**	**Scott**	**All sites**
	----------bu/ac----------							
CDC Bow -100 lbs N/ac (averaged over seeding rate)	123.1	123.8	100.8	87.7	119.5	101.8	Na	
CDC Austenson -100 lbs N/ac (averaged over seeding rate)	134.7	134.7	101.3	89.7	132.6	110.0	Na	
CDC Bow -50 lbs N/ac (averaged over seeding rate)	Na	Na	Na	Na	Na	Na	53.1	
CDC Austenson -50 lbs N/ac (averaged over seeding rate)	Na	Na	Na	Na	Na	Na	56.7	
	----------$/ac----------							
Gross $ selling CDC Bow for malt	576	579	472	411	559	476	249	475
Gross $ selling CDC Bow for feed	455	458	373	325	442	377	197	375
Gross $ selling CDC Austenson for feed	498	498	375	332	491	407	210	402
Value of selling CDC Bow for malt over CDC Austenson for feed	78	81	97	79	69	70	39	73
Value of selling CDC Austenson for feed over CDC Bow for feed	43	40	2	7	48	30	13	26
	---------- %----------							
Percent chance of making malt that is required to justify growing CDC Bow over CDC Austenson	36	33	2	8	41	30	25	27

[1]Economic analysis is based off a 2018 selling price for malt and feed barley of $4.68 and $3.70/bushel, respectively.

Abstract

13. Abstract/Summary:

A study was conducted at 7 locations across Saskatchewan to determine the effect of seeding rate (200 vs 300 seeds/m^2) and nitrogen rate (50, 75 and 100 lbs N/ac) on the yield of the malt variety CDC Bow and the feed variety CDC Austenson. Treatment effects on grain quality for malt were also measured. Increasing seeding rate increased inter-plant competition for moisture and reduced yield at the dryland sites since precipitation was well below average at all locations; however, the effects on yield were rarely significant at individual sites. Increasing seeding rate only resulted in more yield at Outlook under irrigation. When averaged across locations, increasing seeding rate decreased thousand kernel weight. However, it did not decrease kernel plumpness which is of more concern to malsters. No other quality parameters were influenced by seeding rate. While the yield response to added nitrogen was similar between the varieties, CDC Austenson was 8% higher yielding than CDC Bow when averaged over treatments and location. However, the yield difference between varieties varied from as low as 1.9% at Prince Albert to as high as 11% at Redvers. Increasing nitrogen significantly increased protein. For most sites, protein stayed below the maximum limit even at the highest nitrogen rate of 100 lbs N/ac. The exception to this was at Scott where acceptable protein levels for malt were exceeded even with 50 lbs N/ac. As a result, the economic analysis for growing CDC Bow for malt or feed against CDC Austenson for feed were made at 100 lbs N/ac for all locations except Scott where comparisons were made at 50 lbs N/ac. The economic analysis was based on yields obtained for these nitrogen rates and pricing obtained from Saskatchewan Crop Planning Guide. The 2017 values were $5.44 and $3.22/bu for malt and feed barley, respectively. In 2018, the prices used narrowed to $4.68 and $3.70/bu for malt and feed barley, respectively. Based on 2017 and the narrower 2018 pricing, the likelihood of achieving malt with CDC Bow has to be greater than 10 or 27%, respectively to justify growing it instead of CDC Austenson for feed. The values would be a little higher if one considers the yield of the feed variety CDC Austenson could have been pushed higher with increasing N beyond 100 lbs/ac at most sites. While the chance of obtaining malt may be high for some producers, one must recognize that only 20% of malting barley is actually selected according to the Canadian Grain Commission. However, as even higher yielding malt varieties such as AAC Synergy gain acceptance in the market place, there may be little reason to grow feed varieties in the future.