2021 Final Research Report

from the

Saskatchewan Oat Development Commission

Project Title: Which Oat Varieties Hold It Together, When the Going Gets Tough

(ADOPT # 20200485)

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Project Identification

1. **Project Number:** ADOPT # 20200485
2. **Producer Group Sponsoring the Project:** Saskatchewan Oat Development Commission
3. **Project Location(s):** Yorkton, Indian Head, Melfort and Redvers, Saskatchewan
4. **Project start and end dates (month & year):** April 2021 to February 2022
5. **Project contact person & contact details:**

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Objectives and Rationale

6. **Project objectives:**

Many oat millers are not accepting oats treated with pre-harvest glyphosate. Losing this harvest management tool forces many producers to leave oats standing in the field for longer, creating a greater risk of poorer grain quality and higher harvest lost.

The objective of this project is to help producers select milling oat varieties that are more likely to maintain yield and grain quality when harvested late. Lodging, shatter loss, grain quality and yield between 6 commonly grown milling oats were compared between ideal and late harvest timings.

7. **Project Rationale:**

Producers know that timely harvest is key to producing quality milling oats. However, this is often not possible with ever-expanding operations and weather delays. Moreover, many millers will not accept oats treated with pre-harvest glyphosate. Without pre-harvest glyphosate producers must either swath their oats and risk weathering of the swaths or leave the field standing for longer periods of time to ripen. The longer the crop has to stand in the fall, the greater the chance for lodging, shattering and deterioration of grain quality. A quick search of agricultural forums will reveal that producers desire to know which oat varieties are more likely to maintain yield and quality with late harvest.

Methodology and Results

8. **Methodology:**

Trials were established near Yorkton, Indian Head, Melfort and Redvers. Each trial was a 2-order factorial with 4 replicates designed to evaluate ideal and late harvest timings on 6

oat varieties commonly grown for the milling market in eastern Saskatchewan. A complete treatment listing is found in Table 1. Plot size varied between site based on available equipment, but plots were relatively small (ie: 11 by 30 ft). Fertilizer was applied based on soil test recommendations and pesticides were applied at the site manager's discretion. Oat varieties were seeded at 300 viable seeds/m^2. Trials were seeded between May 3 to May 12 (Table 2). All plots were harvested standing using a small plot combine. Harvest timing of "ideal" occurred when grain moisture was 12.5 to 13.5%. Late season harvesting occurred 19 to 29 days later depending on location. Exact dates of all key operations are presented in Table 2.

Table 1. Treatment List for "Which oat varieties "hold it together", when the going gets tough" trial

Treatment #	**Harvest Timing**	**Variety**
1.	Ideal[a]	CDC Arborg
2.	Ideal[a]	CS Camden
3.	Ideal[a]	CDC Minstrel
4.	Ideal[a]	CDC Ruffian
5.	Ideal[a]	AAC Summit
6.	Ideal[a]	ORE3542M
7.	Late season[b]	CDC Arborg
8.	Late season[b]	CS Camden
9.	Late season[b]	CDC Minstrel
10.	Late season[b]	CDC Ruffian
11.	Late season[b]	AAC Summit
12.	Late season[b]	ORE3542M

[a]Ideal harvest timing will be when grain is close to 12.5-13.5% moisture
[b]Late season harvest will occur around early to mid-October well after the crop has matured

Table 2. Dates of operations in 2021 for the "Which Oat Varieties hold it together, when the going gets tough" trial

Activity	**----------Date----------**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Pre-seed Herbicide Application	May 11 (Roundup Weathermax)	May 14 (Glyphosate + Heat)	N/A	N/A
Seeding	May 7	May 12	May 11	May 3
Emergence Counts	June 3	June 2	June 4	May 27
In-crop Herbicide Application	June 13 (Prestige XL)	June 18 (Prestige XC)	June 1 (Buctril M)	June 7 (Prestige)
Fungicide Application	July 1 (Trivapro A + B)	N/A	N/A	N/A
Lodging Rating	Aug 5 & Sept 9	Aug 16 & Sept 14	Aug 31 & Sept 26	Aug 9
Ideal Harvest Timing	Aug 16	Aug 16	Aug 31	Aug 11
Late Harvest Timing	Sept 9	Sept 14	Sept 26	Aug 30

9. Results:

Growing Season Weather

Mean monthly temperatures and precipitation amounts with long term (1981-2010) averages for 4 sites are listed in Tables 3 for the 2021 growing season. The 2021 season was warmer than normal at all locations. Seasonal precipitation was quite low at Yorkton and Melfort were levels were only 54% and 61% of the long-term average, respectively.

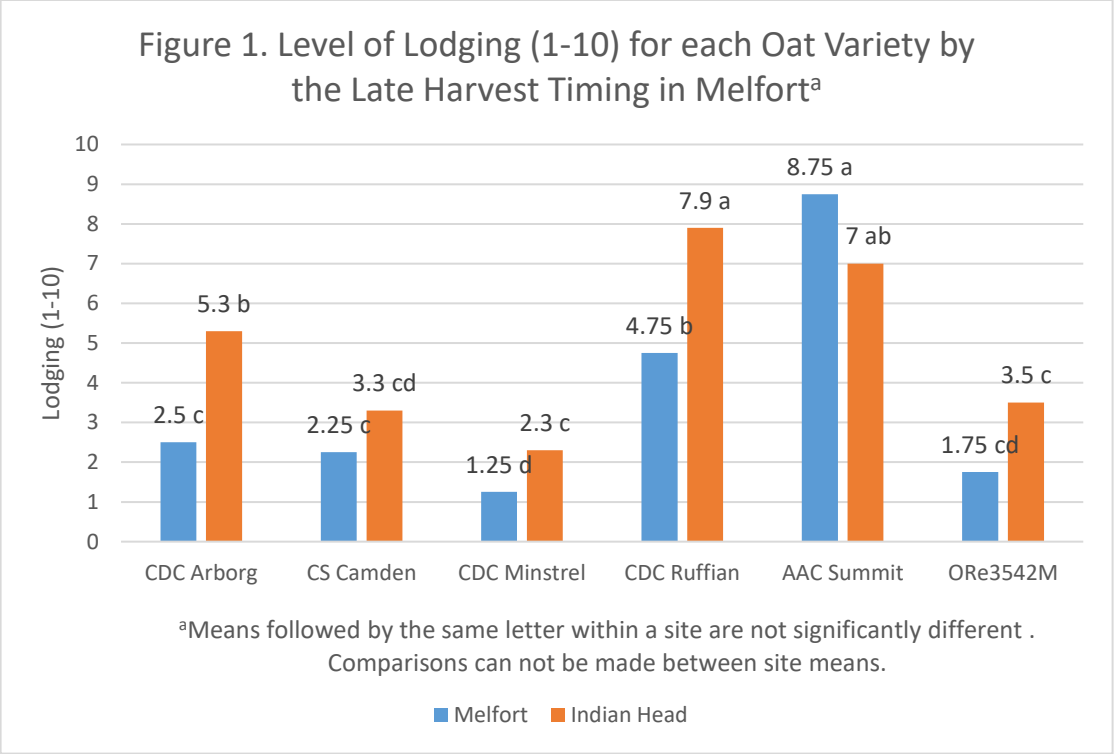
Table 3. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) normals for the 2021 growing seasons at 4 sites in Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
		----------*Mean Temperature (°C)* ----------				
Indian Head	2021	9.0	17.7	20.3	17.1	16.0
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Melfort	2021	9.6	18.2	20.1	16.9	16.2
	Long-term	***10.7***	***15.9***	***17.5***	***16.8***	***15.2***
	Long-term	***10.4***	***15.3***	***18.0***	***16.7***	***15.1***
Redvers	2021	10.0	18.7	20.8	17.5	16.8
	Long-term	***11.1***	***16.2***	***18.7***	***18.0***	***16.0***
Yorkton	2021	8.9	19.1	21.0	17.3	16.5
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
		---------- *Precipitation (mm)* ----------				
Indian Head	2021	81.6	62.9	51.2	99.4	295.1
	Long-term	***51.7***	***77.4***	***63.8***	***51.2***	***241.4***
Melfort	2021	31.4	37.6	0.2	69.3	138.5
	Long-term	***42.9***	***54.3***	***76.7***	***52.4***	***226.3***
Redvers	2021	41.4	95.2	38.4	71.1	247
	Long-term	***60.0***	***95.2***	***65.5***	***46.6***	***267***
Yorkton	2021	24.6	18.1	35.2	69.7	147.6
	Long-term	***51***	***80***	***78***	***62***	***272***

Crop emergence was good at all sites averaging 266, 246, 261 and 226 plants/m^2 at Redvers, Yorkton, Indian Head and Melfort, respectively. Ideal and late harvest timings are obviously not going to have an effect on emergence and no differences were detected at any site. Emergence did not statistically differ between varieties at Redvers, Yorkton and Indian Head, which is desirable as the goal was to establish uniform stands between varieties. Emergence did significantly vary at Melfort, with CDC Arborg and AAC Summit having somewhat lower populations compared to the other varieties (Table 4). However, the differences were probably of minor agronomic significance.

Due to early maturity and rapid dry down caused by dry conditions, the ideal and late harvest timings were much earlier in the season than anticipated (Table 2). At Indian Head and Melfort the ideal harvest date was August 16 and their respective late timings were Sept 9 and Sept 14, respectively. Yorkton was even earlier with an ideal harvest date of August 11 and a late harvest date of Aug 30. Drought induced early ripening was an issue at Yorkton. At Redvers, harvest dates were later, with the ideal date being August 31 and late harvest being Sept 26. The number of days separating ideal and late harvest timings were 19, 24, 26 and 29 for Yorkton, Indian Head, Redvers and Melfort, respectively.

By the late harvest timing, the level of lodging had increased significantly at all locations, except Yorkton, where the late harvest ratings were missed (Table 5). Lodging was significantly higher with late harvest at Redvers, but the intensity and differences were still small at this location. No interactions were detected between harvest date and variety for the lodging data at Redvers. This means the relative level of lodging between varieties did not vary between ideal and late harvest dates. At the Melfort and Indian Head sites, lodging was more intense, and there was a significant interaction between harvest timing and variety. While no significant differences in lodging at Melfort or Indian Head were apparent for any variety at the ideal harvest date, there were extreme differences in lodging by late harvest (Table 6, Figure 1). Lodging was particularly severe for AAC Summit at both locations. Lodging for CDC Ruffian was severe at Indian Head and moderate at Melfort. Lodging was also moderate for CDC Arborg at Indian Head with a rating of 5.3 out of 9 and CDC Ruffian had a severe level of lodging (7.9 out of 9). Lodging ratings for the rest of the varieties were substantially lower which supports regional trial information, where both AAC Summit and CDC Ruffian are only rated as having “Good” resistance to lodging; whereas, all other varieties are rated as “Very Good”.



Prior to each harvest, shelling ratings were taken all locations except Yorkton. At Redvers, visual rating of shattering increased significantly from 0% at the ideal harvest timing to 24.8% by the late harvest timing. At Melfort, shattering significantly increased from 2 to 6.5% as harvest was delayed. At Indian Head, the rating was based on 1 to 10 scale, where shattering significantly increased from 2.0 to 3.2 as harvest was delayed. However, no significant differences in shatter was observed between varieties for any of the locations (data not shown).

Main effects of harvest timing and variety on oat yield are presented in Table 7. At Yorkton, yield was significantly higher (11.6%) with late harvest. This was unexpected and may be related to greater seed filling within immature secondary tillers. Drought followed by late season rainfall tends to cause the production of immature secondary tillers. Anecdotally, shattering loss was not a perceived issue at either harvest date, which may be related to early season harvest dates at Yorkton due to drought. In contrast to Yorkton, oat yields were significantly lower when harvested late at Redvers, (-24%), Indian Head (-25.6%), and Melfort (-20.6%). These differences are substantial and are likely related to shelling loss at all locations and potentially lodging issues for some varieties at Melfort.

No interactions for the yield data were detected between harvest timing and oat variety at Redvers, Yorkton, or Melfort. In other words, there was no evidence from these locations to suggest the relative yield performance between varieties differed between harvest timings. For these locations, the discussion can focus on the main effects of variety. Despite some large numerical differences at Yorkton and Redvers, yields did not statistically differ between varieties due to variable data. At Yorkton variability was caused by drought induced soil moisture extremes. At Melfort, AAC Summit and ORe3542M were significantly lower yielding than all the other varieties.

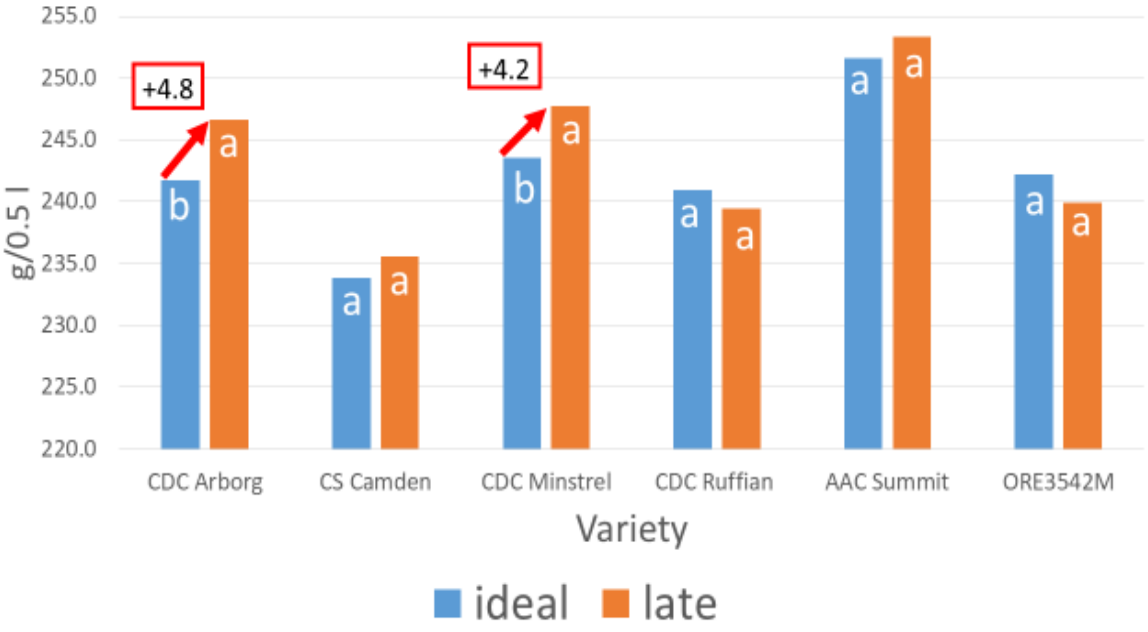
At Indian Head, an interaction between harvest timing and variety was significant at p=0.069 for the yield data (Table 7). While all varieties yielded significantly less when harvested late, the relative loss varied between varieties (Table 8, Figure 2). The relative decline was as low as 618 kg/ha and 602 kg/ha for CDC Arborg and CS Camden, respectively, and as high as 1100 kg/ha for CDC Minstrel or 1206 kg/ha for ORe3542M. This suggests there may have been greater shelling with CDC Minstrel or ORe3542M compared to CDC Arborg or CS Camden. Lodging was not severe enough to cause a yield loss at this site.

Figure 2 Effect of Harvest Timing on Oat Variety Yield at Indian Head

Test weights were relatively high at Indian Head and Melfort averaging 243 g/0.5l and 245 g/0.5l, respectively. These levels are still acceptable for milling. Test weights were much lower at Yorkton and Redvers averaging 230 g/0.5l and 211 g/0.5l, respectively. Test weights below 230 g/0.5l are generally not acceptable for milling. The impact of late harvest on varietal test weight varied at all locations, as significant interactions between these factors were detected (Table 9 and 10). However, trends were not consistent between locations. At Indian Head, CDC Arborg and CDC Minstrel had significantly higher test

weights when harvested late (Table 10, Figure 3). However, test weights did not significantly differ between harvest timings for the rest of the varieties.

Figure 3 Effect of Harvest Timing on Oat Variety Test Weight at Indian Head



At Melfort, large reductions in test weight were observed for every variety when harvested late (Figure 4, Table 10). At Yorkton, a large and significant increase in test weight occurred with CS Camden when harvest date was delayed (Table 10, Figure 5). However, no significant differences were detected for the remaining varieties. At Redvers, late harvest test weights were only significantly lower for CDC Minstrel and ORe3542M (Table 10, Figure 6).

Figure 4 Effect of Harvest Timing on Oat Variety Test Weight at Melfort

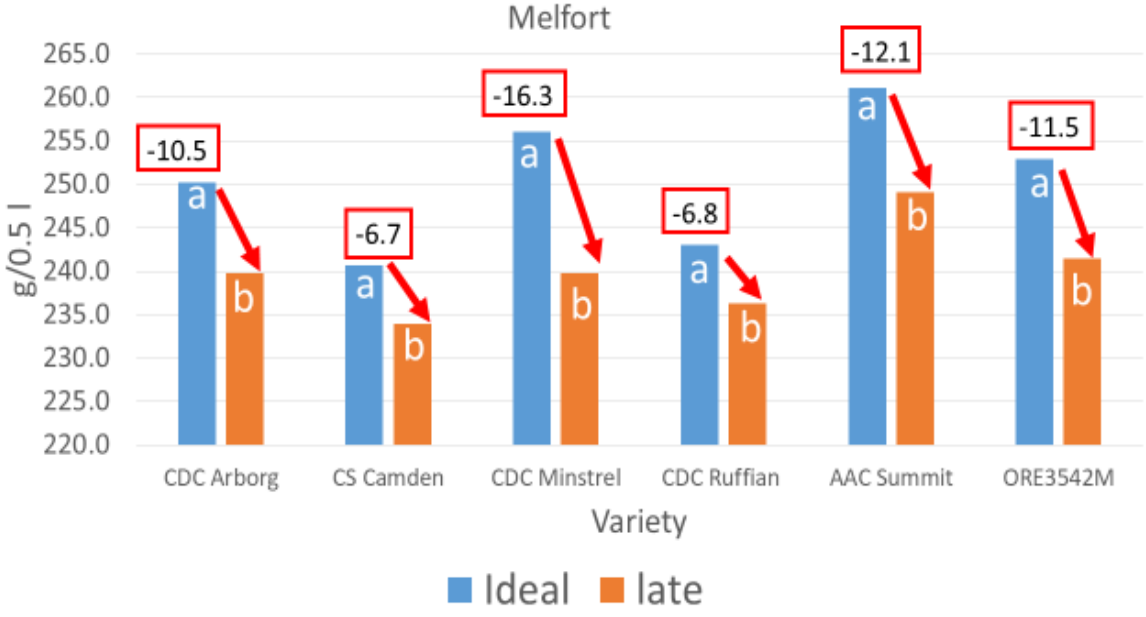
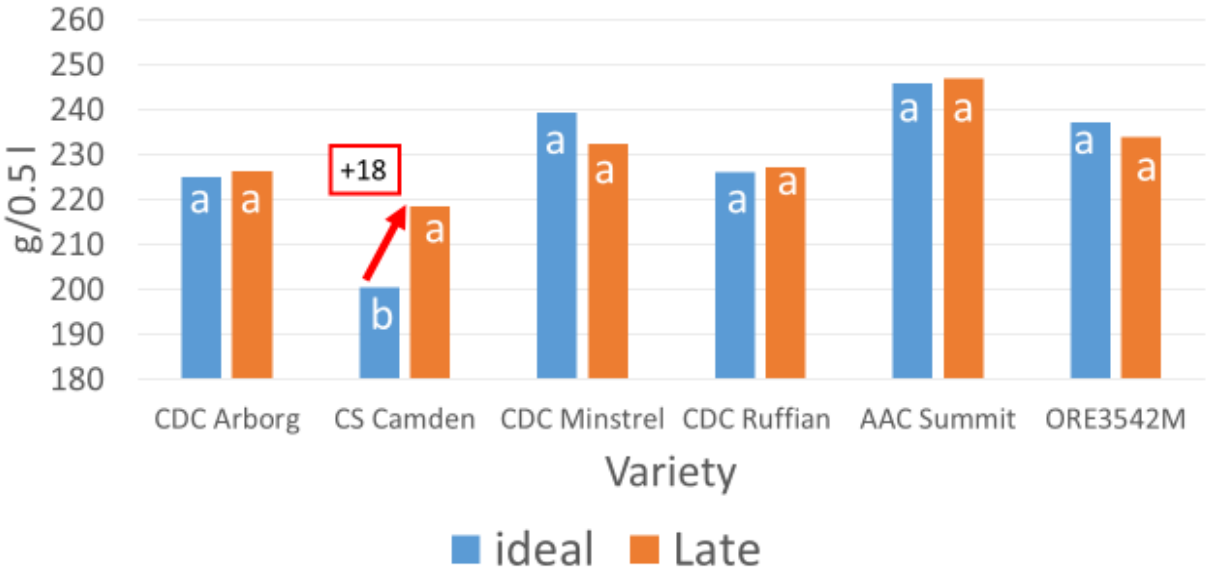
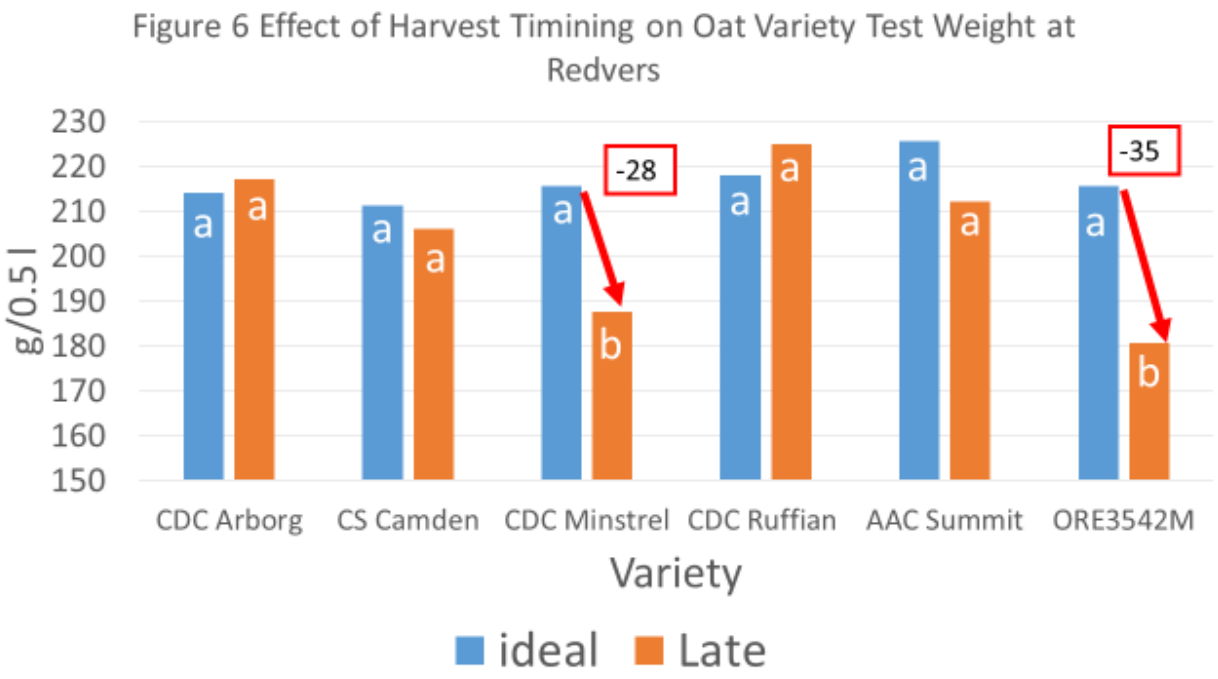


Figure 5 Effect of Harvest Timining on Oat Variety Test Weight at Yorkton





It is unclear what is causing test weights to move up or down with late harvest. Late harvest caused lower yields at Indian Head, Melfort and Redvers, implying that shattering was an issue at these locations. However, test weights went up for a couple varieties at Indian Head, but down for a couple varieties at Redvers and down for all varieties at Melfort. Melfort also suffered lodging for a few varieties, but a relationship between increasing lodging and decreasing test weight is not always apparent when looking across varieties. For example, AAC Summit suffered severe lodging and CDC Minstrel hardly lodged at all when harvest was delayed (Table 6), and yet both varieties experienced large declines in test weight (Table 10). Moreover, CS Camden and CDC Ruffian, which experienced the smallest declines in test weight from late harvest, had very different lodging ratings of 2.25 and 4.75, respectively (Figure 1). Again, it is unclear what is causing inconsistent changes in test weight with late harvest.

Despite a relatively large drop in test weight for AAC Summit, in response to late harvest, this variety continued to have the highest test weight for both harvest dates at Melfort. In contrast, CS Camden continued to have the lower test weight for both harvest dates despite a smaller decline in test weight with late harvest. This supports past research, which has identified AAC Summit as a high test weight variety and CS Camden as a low test weight variety under a broad range of conditions.

Values for other seed quality parameters such as “Thins” (Tables 11 and 12), “Darks” (Tables 13 and 14) and “Brokens” (Tables 15 and 16) are based on single treatment samples bulked over 4 replicates. Thus no statistics can be applied to these values and this is just a discussion of perceived trends. Percent thins were low at Indian Head and Melfort and did not vary much between harvest dates. Only Arborg had a level above 5% at Indian

Head. Percent thins were higher at Redvers, with all varieties exceeding 5% thins when averaged across harvest dates. Overall, percent thins only went up slightly with delayed harvest date. At Yorkton, the percent thins were substantially higher for CDC Arborg and CS Camden for both harvest dates. Percent darks were fairly low at all sites. When averaged across variety, there was a slight increase with delayed harvest at Redvers, Melfort, and Yorkton. A few varieties had some large changes in % darks between the harvest dates, but the changes were not consistent between locations and levels were still low. Percent brokens is not really a good parameter to measure to determine differences between varieties because combine settings are not changed to accommodate every variety. Level of brokens were relatively high at Redvers, Indian Head and Yorkton for both harvest dates, indicating combine settings may have been a little aggressive at those locations.

10. Conclusions and Recommendations

The objective of this study was to find varieties which "held together" better when harvested late. However, all varieties had strengths and weaknesses, which differed based on the parameter measured. In terms of lodging, there were some issues for CDC Ruffian and AAC Summit at Melfort and Indian Head. While most varieties were still standing well by late harvest at Melfort, lodging was moderate for CDC Ruffian and severe for AAC Summit. At Indian Head, lodging was severe for both these varieties and at a medium level for CDC Arborg. Lodging was not an issue at the other locations; however, AAC Summit also had the highest lodging rating at Yorkton.

Yield wise, harvesting late resulted in significantly lower yields at all locations except Yorkton where yields significantly increased. Lower yields were likely the result of greater shattering loss and lodging. The higher yield at Yorkton might be related to improved seed filling of immature tillers when harvest was delayed. There was no evidence to suggest the relative performance of varieties differed between harvest dates at Yorkton, Redvers or Melfort (ie: no significant interactions). Yield did not significantly differ between varieties at Redvers and Yorkton. At Melfort, AAC Summit and Ore3542M were the lowest yielding varieties. Indian Head was the only site that observed differences in the amount of yield loss between varieties, when harvest was delayed. In response to late harvest, CDC Arborg and CS Camden had lower yield losses and maintained better yields compared to CDC Minstrel and Ore3542M at this site.

In terms of test weight, varietal responses to late harvest varied at all locations. At Indian Head and Yorkton, the test weight of varieties was not adversely affected by late harvest. However, only CDC Minstrel, ORe3542M, and AAC Summit maintained adequate, albeit discounted test weights at Yorkton. At Indian Head, CS Camden produced the lowest test weight, which was close to the rejection level. At Melfort, AAC Summit and Ore3542M maintained higher tests weights than CS Camden and CDC Ruffian, even though the former

varieties experienced a greater drop in test weight. At Redvers, the worst varieties for maintaining test weight were CDC Minstrel and Ore3542M. No consistency between sites was apparent in regards to test weight.

Conclusions regarding varietal differences between ideal and late harvest timings will largely focus on sites where significant main effects and interactions were detected. No one variety stood out as having the best of all attributes when harvested late. However, CDC Arborg probably had the least number of major concerns. It was resistant to lodging at Melfort but had a moderate level of lodging at Indian Head. It maintained yield potential at Indian Head and generally had a test weight in the middle of the pack. For CS Camden, low test weight was a major concern. It consistently had the lowest test weight of any variety. However, it showed good lodging resistance at Melfort and Indian Head and maintained yield at Indian Head with late harvest. The relative test weight of CDC Minstrel varied between locations. It showed excellent lodging resistance at Melfort and Indian Head but a rather sharp decline in yield at Indian Head with late harvest. CDC Ruffian showed moderate lodging at Melfort but severe lodging at Indian Head. It maintained a relatively good yield potential at Indian Head. Test weight of CDC Ruffian was variable across locations but was generally on the low side. AAC Summit frequently had the highest test weight regardless of harvest timing. Unfortunately, the yield tended to be on the low side. It was significantly lower yielding than most varieties at Melfort and was one of the lower yielding varieties at Indian Head. The biggest issue with AAC Summit was lodging, as it severely lodged at Melfort and Indian Head. Despite severe lodging, it still maintained the highest test weight. ORe3542M had excellent lodging resistance at Melfort but had a high yield decline at Indian Head. It was also significantly lower yielding than all varieties except AAC Summit at Melfort. It had a test weight that was generally in the middle of the pack but did show a significant and substantial decline with late harvest at Redvers.

Supporting Information

11. Acknowledgements:

This project was funded by the Agricultural Demonstration of Practices and Technologies (ADOPT) and Saskatchewan Oat Development Commission. Special thanks to Grain Millers out of Yorkton for the seed testing results.

12. Appendices

Table 4. Main effects of harvest timing and variety on oat emergence at multiple locations in 2021.

Main effect	**Emergence (plants/m^2)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	262.6 a	218.3 a	267.6 a	247.1 a
Late	259.4 a	233.5 a	264.8 a	244.2 a
LSD	NS	NS	NS	NS
P-values[z]	NS	NS	NS	NS
Variety (V)				
CDC Arborg	280.4 a	185.6 b	243.9 a	223.4 a
CS Camden	268.3 a	248.5 a	264.1 a	232.5 a
CDC Minstrel	261.4 a	246.5 a	265.8 a	270.0 a
CDC Ruffian	255.3 a	245.9 a	285.5 a	238.3 a
AAC Summit	238.9 a	200.9 b	246.9 a	247.8 a
ORe3542M	262.0 a	228.1 ab	291.0 a	262.1 a
LSD	NS	27.8	NS	NS
P-values[z]	NS	0.000077	NS	NS
HD by V P-values[z]	NS	NS	NS	NS

[Z] p-values $\leq$ 0.05 indicate that a treatment effect was significant and not due to random variability

Table 5. Main effects of harvest timing and variety on oat lodging at multiple locations in 2021.

Main effect	**Lodging (0-9)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	1.3 b	1.0 b	1.0 b	0.6 a
Late	4.9 a	3.5 a	1.3 a	0.8 a
LSD	0.42	0.33	0.2	NS
P-values[z]	<0.00001	0.00059	0.0048	NS
Variety (V)				
CDC Arborg	3.3 b	1.8 c	1.3 a	1.3 b
CS Camden	2.6 bc	1.6 cd	1.1 a	0.1 d
CDC Minstrel	1.6 d	1.1 d	1.0 a	0.0 d
CDC Ruffian	4.6 a	2.9 b	1.3 a	0.6 c
AAC Summit	4.1 a	4.9 a	1.3 a	2.3 a
ORe3542M	2.3 cd	1.4 cd	1.0 a	0.0 d
LSD	0.72	0.58	NS	0.39
P-values[z]	<0.00001	<0.00001	NS	<0.00001
HD by V P-values[z]	<0.00001	<0.00001	NS	NS

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

Table 6. Individual treatment means for harvest timing and variety effects on oat lodging at multiple locations in 2021.

Harvest Timing x Variety	**Lodging (0-9)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
1. Ideal x CDC Arborg	1.3 ef	1.0 d	1.0 a	1.0 a
2. Ideal x CS Camden	2.0 ef	1.0 d	1.0 a	0.3 a
3. Ideal x CDC Minstrel	1.0 f	1.0 d	1.0 a	0.0 a
4. Ideal x CDC Ruffian	1.3 ef	1.0 d	1.0 a	0.3 a
5. Ideal x AAC Summit	1.3 ef	1.0 d	1.0 a	2.3 a
6. Ideal x Ore3542M	1.0 f	1.0 d	1.0 a	0.0 a
7. Late x CDC Arborg	5.3 b	2.5 c	1.5 a	1.5 a
8. Late x CS Camden	3.3 cd	2.3 c	1.3 a	0.0 a
9. Late x CDC Minstrel	2.3 de	1.3 d	1.0 a	0.0 a
10. Late x CDC Ruffian	7.9 a	4.8 b	1.5 a	1.0 a
11. Late x AAC Summit	7 ab	8.8 a	1.5 a	2.3 a
12. Late x Ore3542M	3.5 c	1.8 cd	1.0 a	0.0 a
LSD	1.02	0.8	NS	NS

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

Table 7. Main effects of harvest timing and variety on oat yield at multiple locations in 2021.

Main effect	**Yield (kg/ha @13.5%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	3502.3 a	3261.2 b	2376.0 a	2335.4 b
Late	2602.0 b	2588.2 a	1815.4 b	2607.4 a
LSD	134.6	158.9	363.0	258.2
P-values[z]	0.000888	0.003349	0.0037	0.04
Variety (V)				
CDC Arborg	3260.5 a	3087.6 a	2093.9 a	2694.0 a
CS Camden	3181.1 ab	3217.3 a	2185.2 a	2422.3 a
CDC Minstrel	2973.5 bc	2949.3 a	2038.9 a	2385.3 a
CDC Ruffian	3399.8 a	2970.4 a	2541.3 a	2704.5 a
AAC Summit	2839.9 cd	2657.9 b	1865.9 a	2435.6 a
ORe3542M	2670.1 d	2665.8 b	1849.0 a	2186.8 a
LSD	233.2	275.3	NS	NS
P-values[z]	<0.00001	0.000864	NS	NS
HD by V P-values[z]	0.069	NS	NS	NS

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

Table 8. Individual treatment means for harvest timing and variety effects on oat yield at multiple locations in 2021.

Harvest Timing x Variety	**Yield (kg/ha @13.5%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
1. Ideal x CDC Arborg	3569.5 ab	3325.8 a	1998.9 a	2511.8 a
2. Ideal x CS Camden	3482.0 b	3476.0 a	2439.3 a	2053.5 a
3. Ideal x CDC Minstrel	3523.3 b	3247.5 a	2441.6 a	2502.5 a
4. Ideal x CDC Ruffian	3875.0 a	3470.3 a	2614.5 a	2489.8 a
5. Ideal x AAC Summit	3290.5 b	3110.5 a	2401.0 a	2175.0 a
6. Ideal x Ore3542M	3273.3 bc	2937.3 a	2361.0 a	2279.8 a
7. Late x CDC Arborg	2951.5 cd	2849.5 a	2188.8 a	2876.3 a
8. Late x CS Camden	2880.3 d	2958.5 a	1931.1 a	2791.0 a
9. Late x CDC Minstrel	2423.8 e	2651.0 a	1636.2 a	2268.0 a
10. Late x CDC Ruffian	2924.5 d	2470.5 a	2468.2 a	2919.3 a
11. Late x AAC Summit	2389.3 e	2205.3 a	1330.9 a	2696.3 a
12. Late x Ore3542M	2067.0 f	2394.3 a	1337.0 a	2093.8 a
LSD	329.8	NS	NS	NS
P-values[z]	0.069	NS	NS	NS

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

Table 9. Main effects of harvest timing and variety on oat test weight at multiple locations in 2021.

Main effect	**Test Weight (g/0.5L)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	242.3 a	250.7 a	261.6 a	229.0 a
Late	243.8 a	240.1 b	204.7 b	230.8 a
LSD	NS	1.6	7.11	NS
P-values[z]	NS	0.000927	0.0018	NS
Variety (V)				
CDC Arborg	244.2 b	245.0 c	215.5 ab	225.6 c
CS Camden	234.7 d	237.4 d	208.6 bc	209.5 d
CDC Minstrel	245.6 b	247.9 b	201.5 c	235.8 b
CDC Ruffian	240.2 c	239.6 d	221.5 a	226.6 c
AAC Summit	252.5 a	255.1 a	218.8 ab	246.3 a
ORe3542M	241.1 c	247.2 bc	198.0 c	235.5 b
LSD	2.7	2.8	12.3	6.4
P-values[z]	<0.00001	<0.00001	0.0019	<0.00001
HD by V P-values[z]	0.061	0.014	0.0078	0.0096

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

Table 10. Individual treatment means for harvest timing and variety effects on oat test weight at multiple locations in 2021.

Harvest Timing x Variety	**Test Weight (g/0.5L)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
1. Ideal x CDC Arborg	241.8 ef	250.2 c	214.0ab	225.1de
2. Ideal x CS Camden	233.8 h	240.7 d	211.3 ab	200.5f
3. Ideal x CDC Minstrel	243.5 de	256.1 b	215.5 ab	239.3abc
4. Ideal x CDC Ruffian	241.0 ef	243.0 d	218.0 ab	226.0de
5. Ideal x AAC Summit	251.6 ab	261.2 a	225.5 a	245.7ab
6. Ideal x Ore3542M	242.2 ef	252.9 bc	215.5ab	237.2bc
7. Late x CDC Arborg	246.6 cd	239.8 de	217.0 ab	226.2 de
8. Late x CS Camden	235.6 gh	234.0 f	206.0 b	218.5 e
9. Late x CDC Minstrel	247.8 bc	239.8 de	187.5c	232.2cd
10. Late x CDC Ruffian	239.4 fg	236.3 ef	225.0 a	227.1de
11. Late x AAC Summit	253.3 a	249.1 c	212.0 ab	246.9a
12. Late x Ore3542M	239.9 ef	241.4 d	180.5 c	233.8 cd
LSD	3.8	4.0	17.4	9.1
P-values[z]	0.061	0.014	0.0078	0.0096

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

Table 11. Main effects of harvest timing and variety on oat thins at multiple locations in 2021.

Main effect	**Thins (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	2.63	1.76	5.25	4.73
Late	2.71	1.48	6.96	4.42
LSD	NA	NA	NA	NA
P-values[z]	NA	NA	NA	NA
Variety (V)				
CDC Arborg	5.25	2.7	6.9	7.2
CS Camden	3.15	1.9	6.35	10.35
CDC Minstrel	1.35	1	6.45	2.61
CDC Ruffian	2.65	1.7	5.25	2.91
AAC Summit	2.55	1.55	6.1	2.3
ORe3542M	1.1	0.9	5.6	2.1
LSD	NA	NA	NA	NA
P-values[z]	NA	NA	NA	NA
HD by V P-values[z]	NA	NA	NA	NA

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

Table 12. Individual treatment means for harvest timing and variety effects on oat thins at multiple locations in 2021.

Harvest Timing x Variety	**Thins (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
1. Ideal x CDC Arborg	5	2.8	6.6	6.4
2. Ideal x CS Camden	3	2.2	6.7	12.7
3. Ideal x CDC Minstrel	1.5	1.0	4.9	2.1
4. Ideal x CDC Ruffian	2.5	2.0	4.9	2.92
5. Ideal x AAC Summit	2.4	1.6	3.8	2.2
6. Ideal x Ore3542M	1.4	1.0	4.6	2.1
7. Late x CDC Arborg	5.5	2.6	7.2	8
8. Late x CS Camden	3.3	1.6	6	8
9. Late x CDC Minstrel	1.2	1.0	8	3.12
10. Late x CDC Ruffian	2.8	1.4	5.6	2.9
11. Late x AAC Summit	2.7	1.5	8.4	2.4
12. Late x Ore3542M	0.8	0.8	6.6	2.1

Table 13. Mean oat darks for contrasting harvest timing and varieties at multiple locations in 2021.

Main effect	**Darks (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	0.35	0.17	0.73	0.3
Late	0.3	0.33	1.2	0.41
LSD	NA	NA	NA	NA
P-values[z]	NA	NA	NA	NA
Variety (V)				
CDC Arborg	0.2	0.2	0.5	0.1
CS Camden	0.2	0.2	0.9	0.3
CDC Minstrel	0.4	0.3	1.25	0.5
CDC Ruffian	0.3	0.2	0.55	0.45
AAC Summit	0.55	0.25	1.45	0.45
ORe3542M	0.3	0.35	1.15	0.35
LSD	NA	NA	NA	NA
P-values[z]	NA	NA	NA	NA
HD by V P-values[z]	NA	NA	NA	NA

[Z] Statistical analyses were not completed for this variable because the results were based on treatment composites

Table 14. Mean oat darks for harvest timing by variety treatments at multiple locations in 2021.

Harvest Timing x Variety	**Darks (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
1. Ideal x CDC Arborg	0.2	0.1	0.2	0.2
2. Ideal x CS Camden	0.2	0.1	0.6	0
3. Ideal x CDC Minstrel	0.6	0.2	0.5	0.5
4. Ideal x CDC Ruffian	0.2	0.1	0.4	0.4
5. Ideal x AAC Summit	0.5	0.2	2	0.1
6. Ideal x Ore3542M	0.4	0.3	0.7	0.6
7. Late x CDC Arborg	0.2	0.3	0.8	0
8. Late x CS Camden	0.2	0.3	1.2	0.6
9. Late x CDC Minstrel	0.2	0.4	2	0.5
10. Late x CDC Ruffian	0.4	0.3	0.7	0.5
11. Late x AAC Summit	0.6	0.3	0.9	0.8
12. Late x Ore3542M	0.2	0.4	1.6	0.1

Table 15. Mean percent broken oats for contrasting harvest timing and variety treatments at multiple locations in 2021.

Main effect	**Broken (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Harvest Date (HD)				
Ideal	8.4	3.2	8.2	8.7
Late	8.1	4.7	10.0	6.1
LSD	NA	NA	NA	NA
P-values[z]	NA	NA	NA	NA
Variety (V)				
CDC Arborg	9.15	4.45	9.15	7.75
CS Camden	8.1	4.05	7.4	19.7
CDC Minstrel	7.95	3.25	11.7	2.35
CDC Ruffian	8.1	3.95	10.25	6.7
AAC Summit	7.45	3	7.15	3.4
ORe3542M	8.85	5	8.9	4.8
LSD	NA	NA	NA	NA
P-values[z]	NA	NA	NA	NA
HD by V P-values[z]	NA	NA	NA	NA

[z]Statistical analyses were not completed for this variable because the results were based on treatment composites

Table 16. Mean percent broken oats for harvest timing by variety treatments at multiple locations in 2021.

Harvest Timing x Variety	**Broken (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
1. Ideal x CDC Arborg	10	3.8	8.5	9.5
2. Ideal x CS Camden	9.6	3.5	8.3	24.1
3. Ideal x CDC Minstrel	7.6	2.6	6.3	2.2
4. Ideal x CDC Ruffian	8.8	3.0	10.4	6.8
5. Ideal x AAC Summit	7.3	2.6	6.4	3.2
6. Ideal x Ore3542M	7.2	3.7	9.1	6.9
7. Late x CDC Arborg	8.3	5.1	9.8	6
8. Late x CS Camden	6.6	4.6	6.5	15.3
9. Late x CDC Minstrel	8.3	3.9	17.1	2.5
10. Late x CDC Ruffian	7.4	4.9	10.1	6.6
11. Late x AAC Summit	7.6	3.4	7.9	3.6
12. Late x Ore3542M	10.5	6.3	8.7	2.7

Abstract

13. Abstract/Summary:

Trials were established at Yorkton, Indian Head, Redvers and Melfort to determine the effect of ideal and late harvest timings on yield and grain quality of 6 commonly grown milling oat varieties. The varieties compared were CDC Arborg, CS Camden, CDC Minstrel, CDC Ruffian, AAC Summit, and Ore3542M. Harvest dates varied between locations, with harvest dates being relatively early for Yorkton due to drought induced ripening and later at Redvers. However, good separation between ideal and late harvest timings of 19, 24, 26 and 29 days were achieved at Yorkton, Indian Head, Redvers and Melfort, respectively. No variety maintained the best of all attributes when harvested late; however, CDC Arborg had the least number of major concerns. It resisted lodging, maintained a high yield potential and had a reasonable test weight in the middle of the pack. Lodging was an issue for CDC Ruffian and a major concern for AAC Summit at the Melfort site. AAC Summit, CDC Minstrel and Ore3542M tended to have the lowest yields when harvested late at Indian Head. Across locations, test weights were consistently low for CS Camden and high for AAC Summit.