2018 Annual Report
for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Oats: Busting Bins & Making the Grade with Agronomy Basics

(Project #20170408)

Principal Applicant: Chris Holzapfel, MSc, PAg

Indian Head Agricultural Research Foundation, Box 156, Indian Head, SK, S0G 2K0

Correspondence:

Project Identification

1. **Project Title:** Oats: Busting bins and making the grade with agronomy basics
2. **Project Number:** 20170408
3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
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5. **Project start and end dates (month & year):** April-2018 to February-2019
6. **Project contact person & contact details:**

Chris Holzapfel, Research Manager
Indian Head Agricultural Research Foundation
P.O. Box 156, Indian Head, SK, S0G 2K0
Phone: 306-695-4200
Email:

Objectives and Rationale

7. **Project objectives:**

The objective of this project was to demonstrate the relative impacts of basic management decisions on oat yield and quality. The factors that were varied were seeding date, seed rate and N fertilizer rate.

8. **Project Rationale:**

Oats can be quite a profitable cereal option for the cooler, wetter regions of Saskatchewan, especially if milling grades can be consistently achieved. While not a particularly high input crop, oats are quite responsive to management and there are a number of basic factors that may have substantial impacts on yield and quality. Farmers are always looking for ways to grow bigger, better crops – while technology and novel inputs undoubtedly have a role to play, the most basic management decisions and fundamental inputs along with good timing go a long way towards producing top yields and quality for most crops, especially oats. Before seeking out novel inputs that increase costs and may come with a relatively low probability of response, both current and new oat growers alike should ensure that they have secured all the 'low hanging fruit' for maximizing yields and quality with this crop.

All of the factors evaluated in this project have been extensively researched in western Canada with sites throughout eastern Saskatchewan and Manitoba. At Indian Head, Melfort and Brandon, May et al. (2004) compared seeding dates from mid-May through mid-June and found that earlier seeding led to 76% higher yields, 10% larger seeds, 13% higher test weight and an 11% increase in the proportion of plump seeds. The negative impacts of delayed seeding on yield and grain quality were partly attributed to increased crown rust infection. A major deterrent to seeding early is that doing so often makes it impossible to control wild oats with pre-emergent glyphosate prior to crop emergence. Wild oats tend to emerge relatively late in the spring with an optimum soil temperature for germination of 16-22 ºC. May et al. (2009) found that wild oat pressure was consistently higher with early compared to delayed seeding but also showed that attempting to manage this by delaying seeding is not recommended due to the negative impacts on yield and quality.

The best way to make tame oats compete with wild oats without sacrificing yield and/or quality is to get the crop up ahead of the weeds and utilize higher seeding rates to accelerate canopy closure. May et al. (2009) showed that, as seeding rate is increased, wild oat biomass, panicle density and seed in the harvested grain sample were all reduced. The study also found that oat quality (test weight, plump seed, groat yield) could be increased with higher seeding rates; however, this was most evident when combined with later seeding. That being said, late seeding still always resulted in the lowest quality oats regardless of seeding rate. Tame oat yield was optimized at a relatively high rate of 350 seeds/m^2 and was negatively affected by wild oats regardless of seeding rate; however, the yield difference between low and high wild oat densities was larger at the lower seeding rates.

Focussing on N fertility, May et al. (2004b) found that, on average, yields were optimized at modest rates of 40-80 kg N/ha and that stronger responses to N (and correspondingly higher yields) were generally observed with early seeding. Importantly, oat quality decreased as N rates were increased, thereby suggesting that growers must strike a balance between maximizing yield and maintaining test weight and other important quality parameters. The specific effects of increasing N rate on oat quality were lower test weight, kernel size and groat yield, fewer plump seeds and more thin seeds. More recently, Lafond et al. (2013), varied N rates from 20-120 kg N/ha along with row spacing (30-41 cm). While row spacing did not affect any of the quality parameters measured, the effects of N rate on seed size, test weight and percent plump and thin kernels were consistent with previous research.

The current project was initiated to demonstrate seeding date, seed rate, and N fertility effects on oat yield and quality, reinforcing the importance of basic management considerations for milling oat production under local field conditions.

Lafond, G., May, W. and C. Holzapfel. 2013. Row Spacing and Nitrogen Fertilizer Effect on No-Till Oat Production. Agron. J. **105:** 1-10.

May, W., Mohr, R., Lafond, G., Johnston, A. and C. Stevenson. 2004a. Early seeding dates improve oat yield and quality in the eastern prairies. Can. J. Plant Sci. **84:** 431-442.

May, W., Mohr, R., Lafond, G., Johnston, A. and C. Stevenson. 2004b. Effect of nitrogen, seeding date and cultivar on oat quality and yield in the eastern Canadian Prairies. Can. J. Plant Sci. **84:** 1025-1036.

May, W., Shirtliffe, S., McAndrew, D., Holzapfel, C. and G. Lafond. 2009. Management of wild oat (*Avena sativa* L.) in tame oat (*Avena sativa* L.) with early seeding dates and high seeding rates. **89:** 763-773.

Methodology and Results

9. Methodology:

A field trial with oats was initiated in the spring of 2018 near Indian Head, Saskatchewan (50.546 N, 103.569 W) to evaluate seeding date, seed rate, and N fertilizer rate effects on oat yield and quality. Indian Head is situated in the thin-Black soil zone of southeast Saskatchewan and the soil is classified as an Indian Head clay with typical organic matter concentrations of 4.5-5.5%. The treatments were a factorial combination of two seeding dates (early versus late May), three seed rates (200, 300 and 400 seeds/m^2), and two N fertility levels (70 versus 120 kg N/ha). The twelve treatments were arranged in a four replicate, split plot design with seeding dates as the main plots (Table 1).

Table 1. Treatment list for oat agronomy demo at Indian Head, Saskatchewan (2018)

#	Seeding Date (main plot)	Seed Rate (sub-plot)	Nitrogen Rate (sub-plot)
1	Early May	200 seeds/m^2	70 kg N/ha
2	Early May	200 seeds/m^2	120 kg N/ha
3	Early May	300 seeds/m^2	70 kg N/ha
4	Early May	300 seeds/m^2	120 kg N/ha
5	Early May	400 seeds/m^2	70 kg N/ha
6	Early May	400 seeds/m^2	120 kg N/ha
7	Late May	200 seeds/m^2	70 kg N/ha
8	Late May	200 seeds/m^2	120 kg N/ha
9	Late May	300 seeds/m^2	70 kg N/ha
10	Late May	300 seeds/m^2	120 kg N/ha
11	Late May	400 seeds/m^2	70 kg N/ha
12	Late May	400 seeds/m^2	120 kg N/ha

Selected agronomic information is provided in Table 2. All major field operation (i.e. pesticide applications, harvest, etc.) dates were tailored to the two seeding dates. CDC Ruffian oats were direct-seeded approximately 2.5 cm (1”) deep into canola stubble with seed rates adjusted for seed size and germination but varied as per protocol. In addition to N which was side-banded urea with rates adjusted as per protocol, 30-15-15 kg P_2O_5-K_2O-S/ha supplied as side-banded monoammonium phosphate, potash, and ammonium sulphate. Weeds were controlled using registered pre-emergent and in-crop herbicides. foliar fungicide was applied at the flag leaf stage to ensure disease did not become a yield limiting factor. No insecticides were required. No desiccants or harvest aids were used and the centre five rows of each plot were straight-combined when the oats were mature and dry.

Various data were collected over the growing season and from the harvested grain samples. To assess overall establishment, the number of plants in 2 x 1 m sections of crop row per plot were counted after emergence was complete and the values were averaged and converted to plants/m^2. In late July, overall wild oat pressure was rated on a scale of 0-9 where a rating of 0 indicated no wild oats whatsoever and a rating of 9 indicated ≥ 90% of the plot area was affected by wild oats. Lodging was rated just prior to harvest on a scale of 0-9 where 0 indicated no lodging and 9 indicated severe lodging across the entire plot area. Grain yields were determined by weighing the harvested grain samples and are corrected for dockage and to a uniform moisture content of 14%. Test weight was measured using standard CGC methods with values expressed as g/0.5 l. Thousand kernel weight was calculated for each plot from a subsample of 500-1000 seeds. Percent plump and thin kernels were determined from 100 g subsamples and were the proportion of seeds that either stayed on top of a 5.5/64” x 3/4” hand sieve or passed through a 5/64” x 3/4” hand sieve, respectively.

All response data were analysed using the Mixed procedure of SAS with the effects of seeding date

(SD), seed rate (SR), N rate (NR) and all possible interactions (SD × SR, SD × NR, SR × NR, and SD ×SR ×NR) considered fixed and replicate effects treated as random. All means were separated using Fisher's protected LSD test and orthogonal contrasts were used to determine whether the observed responses to seeding rate were linear or quadratic (curvilinear) with additional contrasts used to describe the responses separately for each seeding date. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

Table 2. Selected agronomic information for oat agronomy demo at Indian Head, Saskatchewan (2018).

Factor / Field Operation	Indian Head 2018
Previous Crop	Canola
Pre-emergent herbicide	894 g glyphosate/ha May 11 (early) and May 27 (late)
Seeding Dates	May 4 (early) and May 28 (late)
kg P_2O_5-K_2O-S ha^{-1}	30-15-15
Emergence Counts	May 28 (early) and June 12 (late)
In-crop Herbicide	280 g bromoxynil/ha + 280 g MCPA/ha June 6 (early) and June 18 (late)
Lodging Ratings	August 2 (early) and August 22 (late)
Wild Oat Ratings	July 18 (both seeding dates)
Foliar Fungicide	75 g azoxystrobin/ha + 125 g propiconazole/ha June 25 (early) and July 7 (late)
Harvest date	August 10 (early) and August 24 (late)

10. Results:

Growing season weather and residual soil nutrients

Weather data for the 2018 growing season at Indian Head is provided with the long-term (1981-2010) averages in Table 3. Although there was less initial sub-soil moisture than previous seasons, the oats at both seeding dates were seeded into adequate soil moisture and, generally speaking, timely late-May/early-June rains got crops in the area off to a strong start. For May and June combined, precipitation was 88% of the long-term (1981-2010) average; however, July and August were much drier with only 34 mm of total precipitation, or 30% of the long-term average. As a result, late-season drought stress resulted in aborted florets, premature maturity and below average yields for the oats at both seeding dates. Temperatures for the 2018 growing season were well above average in May and, to a lesser extent, June but below average in July and approximately average in August. Over the four-month period the mean temperature was 16.4 °C compared to a long-term average of 15.6 °C.

Table 3. Mean monthly temperatures and precipitation amounts along with long-term (LT; 1981-2010) averages for the 2018 growing season at Indian Head, Saskatchewan.

Year	May	June	July	August	Avg. / Total
	------------ Mean Temperature (°C) ------------				
IH-2018	13.9	16.5	17.5	17.6	16.4
IH-LT	10.8	15.8	18.2	17.4	15.6
	------------ Precipitation (mm) ------------				
IH-2018	23.7	90.0	30.4	3.9	148
IH-LT	51.8	77.4	63.8	51.2	244

A composite soil sample was collected on May 4 (0-15 cm, 15-60 cm) and analyzed for basic properties and residual nutrient levels (Table 4). The site had a fairly typical organic matter of 5.2% and residual N levels were also relatively low with 24 kg NO_3-N/ha measured in the 0-60 cm soil profile. Residual (Olsen) P was considered very low while K and S levels were higher; however, all nutrients other than potentially N were intended to be non-limiting across treatments.

Table 4. Selected soil test results for oat agronomy demon at Indian Head, Saskatchewan (2018).

Attribute / Nutrient	0-15 cm	15-60 cm	0-60 cm
pH	7.6	7.9	–
C.E.C. (meq/100g)	43.7	–	–
S.O.M. (%)	5.2	–	–
NO_3-N (kg/ha)^Z	12	12	24
Olsen-P (ppm)	6	–	–
K (ppm)	693	–	–
S (kg/ha)	30	24	54

Field Trial Results

Results of the tests of fixed effects are presented in Table 5 with main effect means in Tables 6-7 followed by significant interactions and individual treatment means in Tables 8-11 of the Appendices. The discussion will focus on the main effects and significant interactions. The three-way (SD × SR × NR) interactions were not significant in any cases.

Table 5. Overall tests of fixed effects seeding date (SD), seed rate (SR), and N rate (NR) along with their interactions. Probability values less than 0.05 indicate that an effect was not statistically significant.

Variable	SD	SR	NR	SD×SR	SD×NR	SR×NR	SD×SR× NR
	---------- p-values ----------						
Plant Density	0.291	**<0.001**	0.244	0.347	0.065	0.284	0.133
Lodging Rating	**0.003**	**<0.001**	0.559	**<0.001**	0.559	0.708	0.708
Wild Oat Rating	0.664	0.561	0.566	0.561	0.255	0.561	0.561
Grain Yield	0.559	0.055	**<0.001**	**<0.001**	**0.046**	0.399	0.762
Test Weight	**0.002**	0.148	0.174	**<0.001**	0.374	**0.017**	0.900
TKW	**0.047**	**<0.001**	**<0.001**	**0.001**	0.687	0.679	0.275
Percent Plump	0.144	**0.045**	**0.009**	**<0.001**	0.991	0.131	0.354
Percent Thin	0.134	0.222	**0.037**	**0.038**	0.678	0.392	0.954

Plant density was affected by seed rate (P < 0.001) but not seeding date (P = 0.291) or N rate (P = 0.244) and there were no significant interactions (P = 0.07-0.35). For both seeding dates and regardless of N rate, emergence was excellent with averages of 214, 299, and 380 seeds/m^2 for the 200, 300, and 400 seeds/m^2 seed rates (Table 6).

As a result of the dry conditions late in the season, there was essentially no lodging in any treatments. While there were statistically significant effects of seeding date (P = 0.003) and seed rate (P < 0.001) with an SD × SR interaction (P < 0.001), the differences were of no practical importance since the values were so low. On a scale of 0-9, the average lodging rating was 0.4 for early seeded oats versus 0.0 for late seeded oats. Lodging was reduced at the lowest seeding rate, but only when combined with early seeding as all recorded values were zero at the later seeding date (Tables 6 and 10).

Wild oat ratings were completed in late July under the assumption that pressure may be higher with early seeding and/or low seeding rates; however, weed pressure was low and there were no significant treatment effects or interactions detected for these ratings (Table 5). Since there were no differences observed amongst the treatments, means are not presented. As an indication of the observed wild oat pressure, the overall mean rating for the site was only 0.4 on a scale of 0-9.

With an overall mean of 4757 kg/ha, oat yields were considered below average but still appreciable considering the dry conditions. Effects on grain yield were not significant for seeding date (P = 0.559), marginally significant for seed rate (P = 0.055) and highly significant for N rate (P < 0.001). Significant

SD × SR ($P < 0.001$) and SD × NR ($P = 0.046$) interactions were also detected. While only marginally significant, yields were highest at the 300 seeds/m^2 rate and lowest at 200 seeds/m^2; however, the SD × SR interaction occurred because the seed rate responses were essentially opposite depending on seeding date. When combined with early seeding, oat yields tended to be highest at 200-300 seeds/m^2 while, with late May seeding, yields were significantly lower at 200 seeds/m^2 compared the higher rates. It is not clear why the responses differed between seeding dates. Both dates were seeded into moisture and benefited from the late May/early June rains and both suffered drought stress and premature senescence towards the end of the season. The dry weather and low wild oat pressure likely resulted in less potential benefit, or even drawbacks, to the highest plant populations compared to previous studies. While the specific seed rate effects on yield were somewhat unexpected, the results suggest that higher rates may be more beneficial when combined with later seeding which is not inconsistent with previous research. Although the difference was a modest 238 kg/ha, or 5%, oat grain yields were significantly higher at the 120 kg/ha N rate compared to 70 kg N/ha when averaged across seeding dates and seed rates. The trend was similar for both seeding dates; however, the SD × NR interaction occurred because the yield increase with higher N rates was only 3% with early seeding (not statistically significant) compared to 7% with late seeding (Table 9). This interaction was also somewhat unexpected as previous research has suggested stronger responses to N with earlier seeding.

Table 6. Main effect means for seeding date, seed rate and N rate effects on oat emergence, lodging, wild oat ratings and grain yield. Means for each main effect within a column followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Main Effect	Plant Density	Lodging	Wild Oat Ratings	Grain Yield
Seeding Date	---- plants/m^2 ----	------ 0-9 ------	-------- 0-9 --------	------- kg/ha -------
Early May	290 a	0.35 a	0.5 a	4789 a
Late May	305 a	0.00 b	0.4 a	4724 a
S.E.M.	8.6	0.03	0.13	80.3
Seed Rate				
200 seeds/m^2	214 c	0.06 b	0.5 a	4671 b
300 seeds/m^2	299 b	0.25 a	0.3 a	4815 a
400 seeds/m^2	380 a	0.22 a	0.4 a	4783 ab
S.E.M.	10.3	0.03	0.14	72.3
Nitrogen Rate				
70 kg N/ha	305 a	0.17 a	0.4 a	4637 b
120 kg N/ha	291 a	0.19 a	0.5 a	4875 a
S.E.M.	8.5	0.03	0.12	67.9

Test weight, an important grading factor for milling oats, was affected by seeding date ($P = 0.002$) with significant SD × SR ($P < 0.001$) and SR × NR ($P = 0.046$) interactions but no effect of seed rate or N rate as main effects (P = 0.148-0.174). Seeding date had the greatest impact on test weight with 246 g/0.5 l (42.6 lb/bu) observed with early (May 4) seeding compared to 238 g/0.5 l (41.4 lb/bu) at the May 28 seeding date (Table 7). Notably, and consistent with previous research, the SD × SR interaction was due to test weights increasing linearly as seed rate was increased with late seeding but not when the oats were seeded early. The SR × NR interaction occurred because increasing N rate resulted in a slight reduction in test weight at the highest seed rate but not at 200-300 seeds/m^2 (Table 9). The reasons behind this specific interaction are unclear but it is well documented that excessive N rates can reduce test weight in milling oats.

While not a grading factor in milling oats, seed size, often expressed as TKW, is a yield component with larger seeds invariably contributing to higher yields and therefore being desirable. TKW was affected by each of the main effects (P < 0.001-0.047) with a significant SD × SR interaction (P = 0.001). In contrast to test weight, TKW was slightly higher with late seeding (31.3 g 1000/seeds) compared to early seeding (30.3 g/1000 seeds). Averaged across seeding dates and N rates, seed size decreased linearly with increasing seed rates but only from 31.4 g/1000 seeds at 200 seeds/m^2 to 30.1 g/1000 seeds at 400 seeds/m^2. Increasing the N fertilizer rate from 70 to 120 kg N/ha increased TKW from 30.4 to 31.2 g/1000 seeds. Notably, the SD × SR interaction was such that TKW only decreased with increasing seed rate (linearly, P < 0.001) when combined with early seeding (Table 8).

Percent plump kernels was not affected by seeding date (P = 0.144) but was affected by seed rate (P = 0.045) and N rate (P = 0.009) along with a significant SD × SR interaction (P < 0.001). The overall effect of seed rate showed a linear decline in percent plump kernels with increasing seed rate but, similar to the results observed for TKW, this only occurred at the early seeding date with no observed effect when seeding was delayed. Despite the interaction, percent plump kernels were never lower with early seeding and, on average, tended to be higher.

Percent thin kernels were not affected by seeding date (P = 0.134) or seed rate (P = 0.222), but responded to N rate (P = 0.037) and the SD × SR interaction was significant (P = 0.038). Opposite to what was observed for plump kernels but with similar quality implications, percent thin kernels increased with increasing seeding rate when averaged across seed dates and N rates; however, the interaction revealed that this only occurred with the early seeding date (Table 8). It is important to note that percent thin kernels were not high enough to be of concern for milling quality in any treatments.

Table 7. Main effect means for seeding date, seed rate and N rate effects on oat test weight, thousand kernel weight, percent plump, percent thin kernels. Means for each main effect within a column followed by the same letter do not significantly differ (Fisher's protected LSD test, $P \leq 0.05$).

Main Effect	Test Weight	Thousand Kernel Weight	Plump Kernels	Thin Kernels
Seeding Date	------ g/0.5 l ------	-- g/1000 seeds --	--------- % ---------	--------- % ---------
Early May	246.4 a	30.3 a	90.0 a	2.3 a
Late May	238.3 b	31.3 b	87.9 a	3.2 a
S.E.M.	1.11	0.23	0.78	0.29
Seed Rate				
200 seeds/m^2	241.6 a	31.4 a	90.2 a	2.5 a
300 seeds/m^2	242.2 a	30.8 b	88.6 ab	2.9 a
400 seeds/m^2	243.1 a	30.1 c	88.1 b	3.0 a
S.E.M.	1.12	0.22	0.72	0.28
SR – linear	0.056	<0.001	0.018	0.110
SR - quadratic	0.735	0.776	0.454	0.510
Nitrogen Rate				
70 kg N/ha	241.9 a	30.4 b	88.0 b	3.1 a
120 kg N/ha	242.8 a	31.2 a	89.9 a	2.5 b
S.E.M.	1.08	0.19	0.64	0.24

Extension Activities and Dissemination of Results

This project was discussed and the plots were toured by approximately 200 guests at the Indian Head Crop Management Field Day on July 17, 2018. In addition to showing the treatments and discussing the specific project objectives there was a general discussion of oat agronomy and results from previous IHARF and AAFC oat research. The full project report will be made available online on the IHARF website (www.iharf.ca) and potentially elsewhere in the winter of 2018-19. Results may also be made available through a variety of other media (i.e. oral presentations, popular agriculture press, fact sheets, etc.) as opportunities arise and where appropriate.

Conclusions and Recommendations

Despite the dry weather and somewhat lower than average yield potential, this project demonstrated basic agronomy and seeding date, seed rate, and N fertility effects on milling oat yield and quality under the specific conditions encountered. Initial soil moisture and seeding conditions were excellent for establishment regardless of seeding date and both plant populations and grain yields were similar for early versus late seeding; however, late seeding resulted in lower test weights and a tendency for fewer plump kernels and more thin kernels. Seeding rate had an obvious and expected impact on plant densities but somewhat inconsistent effects on yield and quality measures. The oats tended to yield highest at more modest seeding rates when combined with early seeding but this could likely be explained in part by the drought conditions late in the season and low wild oat pressure. Generally speaking, the late seeded oats were more sensitive to seeding rate effects on quality and benefited more from higher seeding rates than with early seeding. The oats responded well to the higher N fertilizer rates with significant yield increases and none of the negative impacts on quality that can sometimes be associated with excess N fertility. It is likely the higher N rates used were not necessarily particularly excessive considering the low residual NO_3-N levels and presumably low mineralization of organic N late in the season under the dry conditions.

Supporting Information

11. Acknowledgements:

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Crop protection products were provided in-kind by Bayer CropScience and Syngenta. IHARF also has a strong working relationship and memorandum of understanding with Agriculture & Agri-Food Canada.

12. Appendices

Table 8. Significant seeding date (SD) by seed rate (SR) interactions for oat yield, test weight, thousand kernel weight, percent plump, and percent thin kernels. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Treatment (SD – SR)	Grain Yield	Test Weight	1000 Kernel Weight	Plump Kernels	Thin Kernels
	---- kg/ha ----	---- g/0.5 l ----	g/1000 seeds	------ % ------	------ % ------
Early – 200	4894 a	247.7 a	31.5 a	93.1 a	1.6 b
Early – 300	4794 ab	245.9 a	30.1 b	89.5 b	2.4 ab
Early – 400	4677 bc	245.5 a	29.2 c	87.5 b	3.1 a
Early-SR – lin	0.016	0.057	<0.001	<0.001	0.005
Early-SR quad	0.906	0.428	0.370	0.415	0.842
Late – 200	4447 c	235.6 d	31.3 a	87.2 b	3.3 a
Late – 300	4836 ab	238.5 c	31.6 a	87.7 b	3.4 a
Late – 400	4888 ab	240.8 b	31.1 a	88.7 b	2.9 a
Late-SR – lin	<0.001	<0.001	0.507	0.194	0.474
Late-SR quad	0.029	0.750	0.198	0.808	0.464
S.E.M.	94.1	1.11	0.31	1.02	0.39

Table 9. Significant seeding date (SD) by N rate (NR) interactions for oat grain yield and seed rate (SR) by N rate interactions for test weight. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Treatment (SD – NR)	Grain Yield	Treatment (SR – NR)	Test Weight
	---- kg/ha ----		---- g/0.5 l ----
Early – 70	4721 ab	200 – 70	241.7 b
Early – 120	4856 a	200 – 120	241.6 b
Late – 70	4554 b	300 – 70	241.7 b
Late – 120	4894 a	300 – 120	242.7 b
–	–	400 – 70	244.9 a
–	–	400 – 120	241.4 b
S.E.M.	87.5		1.25

Table 10. Individual seeding date (SD) by seed rate (SR) by N rate (NR) treatment means for oat emergence, lodging, wild oat ratings and grain yield. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Treatment (SD – SR – NR)	Plant Density	Lodging	Wild Oat Ratings	Grain Yield
	---- plants/m^2 ----	------- 0-9 -------	------- 0-9 -------	------ kg/ha ------
Early – 200 – 70	221 e	0.13 b	0.5 ab	4834 a-e
Early – 200 – 120	209 e	0.13 b	0.8 a	4953 abc
Early – 300 – 70	304 cd	0.50 a	0.3 ab	4676 de
Early – 300 – 120	254 de	0.50 a	0.5 ab	4913 a-d
Early – 400 – 70	399 ab	0.38 a	0.3 ab	4652 e
Early – 400 – 120	352 bc	0.50 a	0.5 ab	4703 de
Late – 200 – 70	222 e	0.00 b	0.3 ab	4238 f
Late – 200 – 120	206 e	0.00 b	0.5 ab	4657 cde
Late – 300 – 70	331 c	0.00 b	0.5 ab	4655 cde
Late – 300 – 120	307 cd	0.00 b	0.0 b	5017 a
Late – 400 – 70	351 bc	0.00 b	0.5 ab	4769 b-e
Late – 400 – 120	416 a	0.00 b	0.5 ab	5007 ab
S.E.M.	20.5	0.06	0.26	111.5

Table 11. Individual seeding date (SD) by seed rate (SR) by N rate (NR) treatment means for oat test weight, thousand kernel weight, percent plump, and percent thin kernels. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test, $P \leq 0.05$).

Treatment (SD – SR – NR)	Test Weight	Thousand Kernel Weight	Plump Kernels	Thin Kernels
	------ g/0.5 l ------	-- g/1000 seeds --	-------- % --------	-------- % --------
Early – 200 – 70	248.0 a	31.1 bc	92.5 ab	1.9 bc
Early – 200 – 120	247.3 a	32.0 ab	93.7 a	1.4 c
Early – 300 – 70	245.5 ab	29.9 de	87.7 de	2.9 ab
Early – 300 – 120	246.3 ab	30.3 cde	91.3 abc	2.0 bc
Early – 400 – 70	247.7 a	28.8 f	87.2 de	3.0 ab
Early – 400 – 120	243.3 bc	29.7 ef	87.8 de	3.1 ab
Late – 200 – 70	235.3 f	30.7 cde	85.2 e	3.7 a
Late – 200 – 120	235.8 f	31.9 ab	89.2 bcd	2.8 abc
Late – 300 – 70	237.9 ef	30.9 bcd	86.6 de	3.9 a
Late – 300 – 120	239.1 de	32.3 a	88.9 bcd	2.9 ab
Late – 400 – 70	242.1 cd	31.0 bcd	89.1 bcd	3.1 ab
Late – 400 – 120	239.5 de	31.2 bc	88.3 cde	2.8 abc
S.E.M.	1.48	0.41	1.30	0.51

Figure 1. Relative maturity of May 4 seeded oats on July 26 at Indian Head in 2018.

Figure 2. Relative maturity of May 28 seeded oats on July 26 at Indian Head in 2018.

Abstract

13. Abstract/Summary:

A field trial was established near Indian Head, Saskatchewan to demonstrate the response of milling oats to contrasting seeding dates (May 4 versus May 28), a range of seed rates (200, 300, or 400 seeds/m^2) and two distinct N fertility levels (70 or 120 kg N/ha). The variety CDC Ruffian was direct seeded into canola stubble, weeds and disease were managed using registered crop protection products, no harvest aids were used and the plots were straight-combined when mature and dry. Various data were collected with a focus on yield and grain quality characteristics. Overall, the oats got off to a strong start with good initial seeding conditions and adequate early-season precipitation; however, the weather was dry for the latter half of the season and drought was a yield limiting factor for both seeding dates in the end. There was essentially no lodging and wild oat pressure was negligible. Establishment and overall yields were similar for both seeding dates but early seeding resulted in higher test weights and a tendency for more plump/fewer thin kernels. Seed rate effects were somewhat inconsistent, especially depending on seeding date as there were numerous seeding date by seed rate interactions. In general, late seeded oats benefitted more from higher seeding rates than early seeded oats. Unexpectedly and presumably due to the dry and weed free conditions, early seeded oats performed better at the lower seeding rates. Nitrogen fertility generally had a positive effect on both yield and quality, regardless of seeding date or seed rate. All factors considered, the most consistent yields and quality were achieved with early seeding, moderate seed rates (i.e. 300 seeds/m^2) and higher N fertility. Caution and soil testing is advised with determining appropriate N rates as previous work has shown that excessive N fertility can reduce oat quality. Approximately 200 guests toured the site at the Indian Head Crop Management Field Day with a discussion on the specific project objectives in addition to past results from IHARF and AAFC oat agronomy work.