Project Identification

1. **Project title:** Improving Oat Yields with Intensive Agronomy
2. **Project Number:** 20170416
3. **Producer Group Sponsoring the Project:** Northeast Agriculture Research Foundation
4. **Project Location(s):** SE 30-44-18 W2 RM #428 of Star City
5. **Project Start and End Dates (Month & Year):** April 2018 to February 2019
6. **Project Contact Person & Contact Details:**

a. Jessica Pratchler
Research Manager
Box 1240
Melfort, SK
S0E 1A0
neag.agro@gmail.com
306.231.4797

b. Ken Hookway
Bookkeeper
Box 1240
Melfort, SK
S0E 1A0
khookway@sasktel.net

Objectives and Rationale

7. **Project Objectives:**

To demonstrate the relative contributions of the basic management decisions for oat yield and quality: seeding date, seeding rate, and nitrogen rate.

8. **Project Rationale:**

Oats can be a very profitable cereal option for the cooler, wetter regions of Saskatchewan, especially when milling grades can be consistently achieved. Oats are relatively inexpensive to grow and can add more diversity to grain operations. Oats are highly responsive to different management techniques and there are a number of basic factors that can have a large impact on yield and quality. These basic agronomic factors should be considered before additional inputs are sought after, as they can increase production costs and are often associated with a low probability of significant responses. Therefore, this demonstration will illustrate to current and new oat growers all the 'low hanging fruit' agronomic considerations for maximizing oat yields and quality.

Methodology and Results

9. **Methodology:** This small plot demonstration was set up with 12 treatments in a Split-block design with 4 replicates. The main factor was seeding date: early or late May. The sub-factors were seeding rate (200, 300, and 400 seeds/m2) and N Rate (70 and 120 kg N/ha) and randomized within seeding date. The treatments were as follows:

1. Early seeded, 200 seeds/m^2 + 70kg of N/ha
2. early seeded, 200 seeds/m^2 + 120kg of N/ha
3. early seeded, 300 seeds/m^2 + 70kg of N/ha
4. early seeded, 300 seeds/m^2 + 120kg of N/ha
5. early seeded, 400 seeds/m^2 + 70kg of N/ha
6. early seeded, 400 seeds/m^2 + 120kg of N/ha
7. late seeded, 200 seeds/m^2 + 70kg of N/ha
8. late seeded, 200 seeds/m^2 + 120kg of N/ha
9. late seeded, 300 seeds/m^2 + 70kg of N/ha
10. late seeded, 300 seeds/m^2 + 120kg of N/ha
11. late seeded, 400 seeds/m^2 + 70kg of N/ha
12. late seeded, 400 seeds/m^2 + 120kg of N/ha

Each plot was 2m by 7m with 6 rows, spaced 30.6cm apart. The early seeded treatments were seeded on May 15 and the late seeded treatments on June 7. Oats (var. Camden) were seeded as per protocol requirements and adjusted to account for germination (95%) and TKW (45.6g/1000 seeds). The test site was soil sampled for residual nutrient levels and used to determine fertilizer rates (Table 1). For treatments with 70 kg N/ha, 46-0-0 was side-banded at a rate of 157 kg/ha, while the 120kg N/ha treatments had 46-0-0 side-banded at 279 kg N/ha. All treatments received 58 kg/ha of 11-52-0 side-banded and 86 kg/ha of broadcasted 0-0-50-17. No seed treatments were applied.

Table 1. Residual soil nutrient levels (0-12') found in Busting bins and making the grade in agronomy basics, in Melfort 2018.

Residual Soil Levels			
Nitrogen (lb/ac)	*Phosphorus (ppm)*	*Potassium (ppm)*	*Sulphur (lb/ac)*
20	7	364	54

Prior to seeding, Glyphosate 540 at 0.51L/ac was applied for broad spectrum weed control on May 11th. Prestige XC was used as an in-crop herbicide to control broad-leaved weeds and was applied on June 14 at rates of 0.17L/ac of A and 0.8L/ac of B. Caramba fungicide was applied on July 13 to the early seeded treatments and on July 27 to the late seeded at 0.4L/ac for foliar disease control. Lastly, the early seeded plots were harvested on September 10 and the late seeded plots on September 28 with a plot combine.

10. Results:

May and June were warmer than normal, while July was similar, and August through October were cooler (Table 2). Every month during the growing season received less precipitation than normal, except September (Table 2). Yet, May through August were within 10 mm of the normal total precipitation received for those months. The harvest season began earlier than in previous years, however, periodic rain and snow in September resulted in harvest delays. Overall, the growing season was near normal, albeit 43 mm less rain on average.

Table 2: Mean temperatures and precipitation collected from the Environment Canada Weather Station at Melfort, SK., for May to October 2018.

	May	June	July	August	September	October	Average/Total
				--- Temperature (°C) ---			
2018	13.9	16.8	17.5	15.9	6.9	0.9	12.0
Long-Term[x]	10.7	15.9	17.5	16.8	10.8	3.3	12.5
				--- Precipitation (mm) ---			
2018	38.5	46.6	69.5	43.2	42.0	8.9	248.7
Long-Term[x]	42.9	54.3	76.7	52.4	38.7	27.9	292.9

[x] Long-Term Climate Normal from Melfort Environment Canada Weather Station (1981-2010)

Plant Density

Plant counts took place on June 4th for the early seeded oats and on June 26th for the late seeded, where two 1-meter long rows per plot were counted for the number of oat seedlings. Plant density was significantly affected by seeding date ($p=0.0149$*) and seeding rate + nitrogen rate ($p<0.0001$***). On average the early seeded oats had a plant density of 286 plants/m^2, which was significantly lower than the late seeded oats at 312 plants/m^2. Higher plant densities with later seeding date are often associated with warmer soil conditions and seed bed moisture at the time of emergence. There was a consistent trend for plant density to decline with the higher N rate across all seeding rates, although this effect was less evident in the lowest seeding rate treatment. Overall, increasing seeding rate increased plant density as expected.

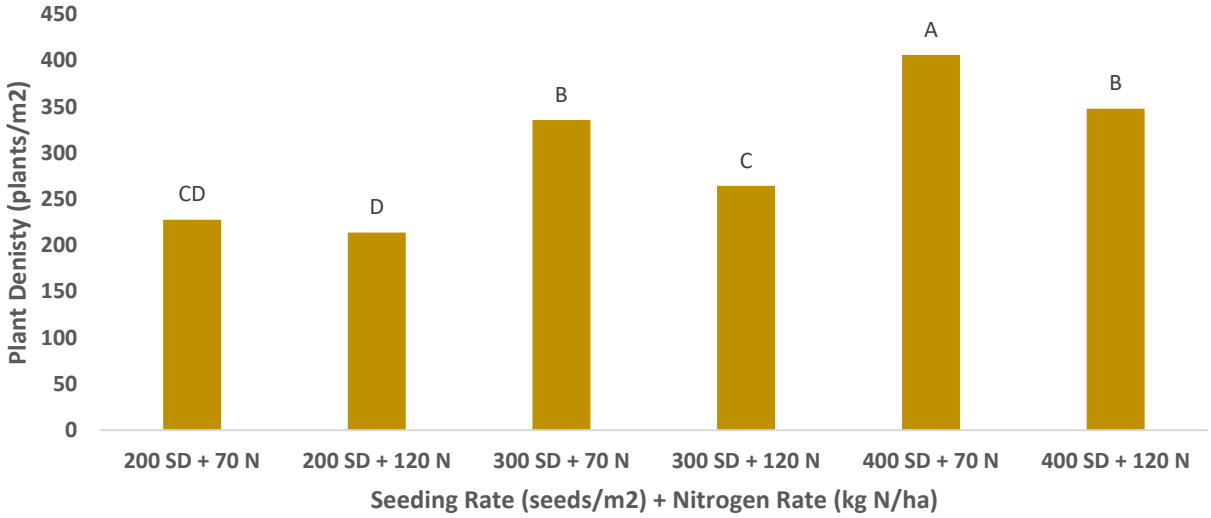

Figure 1: Seeding rate + nitrogen rate effects on oat plant density in Melfort, SK 2018.

Lodging & Wild Oat Ratings

Each plot was evaluated for lodging using the Belgian Lodging Scale (area (1-10)* intensity (1-5)* 0.2) on September 10th for the early seeded and September 28th for the late seeded. Despite, the less than ideal conditions in September prior to harvesting, all plots were rated as 0.2 (no lodging).

A scale of 0-9 was used to rate all plots for wild oat infestation severity on August 23rd. The highest rating was 5 and the lowest rating was 1, indicating that all plots were affected by wild oat populations to varying degrees. The only significance in wild oat infestations among treatments was

between the early and late seeded plots (p=0.0331*). The late seeded plots had an average wild oat rating of 3, which was significantly higher than the 1.4 average of the early plots. This result is expected, as earlier seeded oats have been found to be more competitive against wild oats, due to increased ground cover competition earlier in the growing season. Furthermore, one would have expected that the increasing seeding rate would have had an additive wild oat control effect. This is especially true in the late seeded oats, where there were significantly more wild oats present. This effect may not have been illustrated due to one missing seed row in the middle of each late seeded plot, which could have allowed wild oats to flourish and spread throughout all plots more evenly.

Grain Yield

Grain yield was determined by recording a clean weight from each combined sample, drying to an equal moisture content, and then converting these weights into bu/ac, and corrected for 13.5% moisture. Overall yield was very high, indicating that the growing conditions were favorable for oat production. There were significant differences between the seeding date treatments (p=0.0162*) with the earlier seeded treatments yielding significantly less than the late treatments (174vs 187 bu/ac, respectively). There was also a significant difference between the various seeding rate + nitrogen rate treatments (p=0.0006**). Seeding rate had minimal effect on yield as all three seeding rates had similar yields, while adding 50 kg N/ha extra resulted in a 7 to 9% yield increase (Figure 2). There was also a significant two-way interaction on oat yield (p=0.0075**). On average, the late seeded oats once again had a yield advantage over the early seeded treatments (Figure 3). In the early seeded treatments, nitrogen rate impact yield across all seeding rates, while this effect was not as evident in the late seeded treatments. This suggests that earlier seeded oat crops are much more responsive to fertilizer nitrogen rate than late seeded oats. Furthermore, oat yields were relatively unresponsive to seeding rate. This may be confounded by the lack of additional wild oat control and lodging, which was noted earlier.

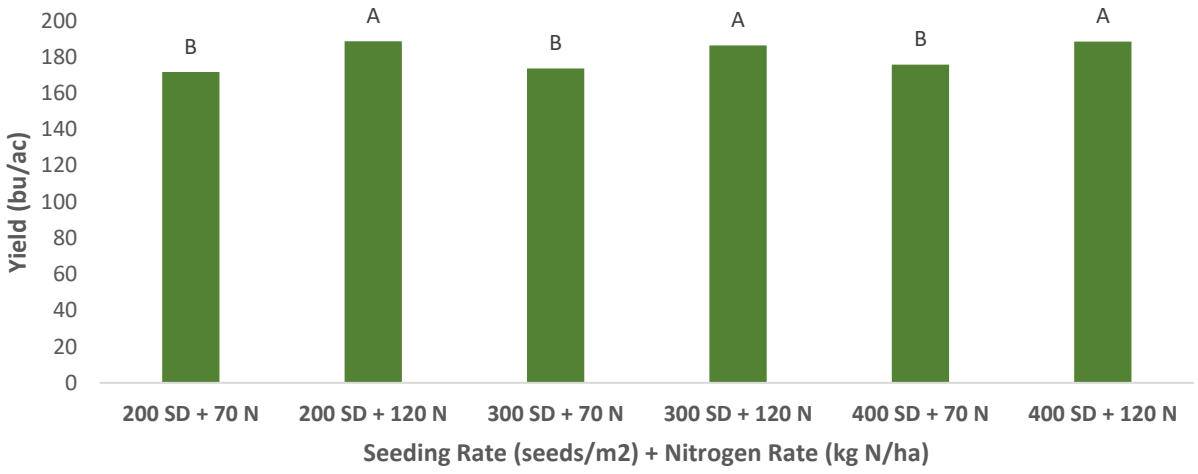

Figure 2: Seeding rate + nitrogen rate effects on oat yield at Melfort, SK 2018.

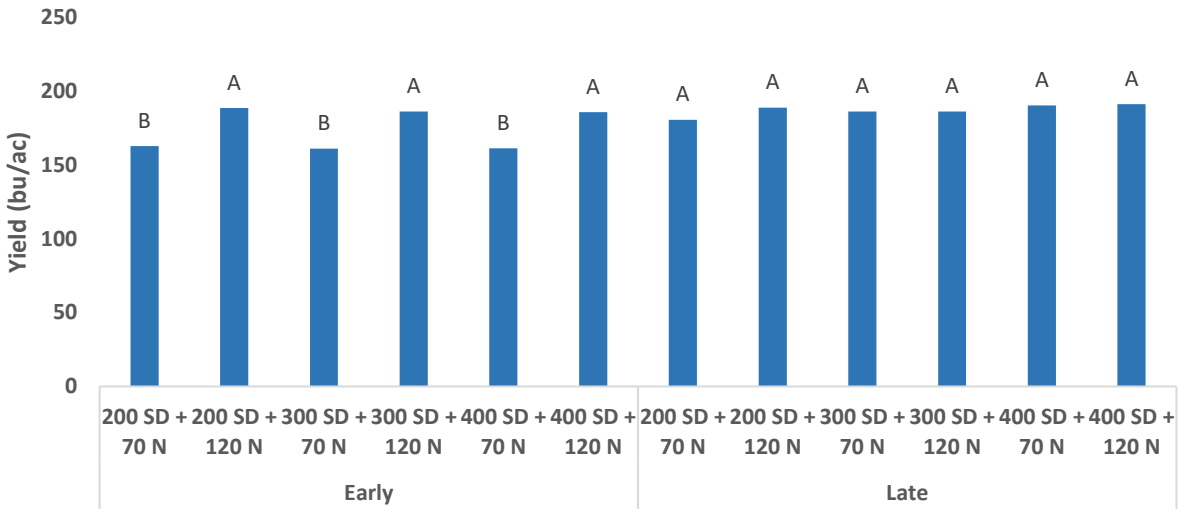

Figure 3: Seeding date and nitrogen rate effects on Oat yield at Melfort, SK 2018.

Test weight

Test weight was calculated by determining the weight of seed in a 0.5L cup. The average test weight was 244.1g/0.5L. The only significance difference between the test weight of the treatments was between the late and early seeded plots (p=0.0069**). The early seeded plots had a significantly lower test weight (241.6g/0.5L) compared to the late seeded plots (246.6g/0.5L). Both seeding rate and nitrogen rate had no effect on test weight (p=0.3669).

Kernel size

Kernel size or TKW (thousand kernel weight) was calculated by counting and weighing 1000 seeds. The average weight per 1000 seeds was 38.5g. TKW was found to be very consistent across all treatments as there were no significant differences between seeding date (p=0.076), seeding rate + nitrogen rate (p=0.6888), and their interaction (p=0.2924).

Plump and Thins

Plumps and thins was calculated by weighing the amount of seed that falls through a 5.5/64 slotted sieve (thins) and the amount of seed that stays on top of the sieve (plumps) of a 100g sample. On average there was 96% plump and 1% thins across treatments, while both were only significantly affected by seeding date (0.0061** and 0.0008**, respectively). Earlier seeding resulted in a 1% increase in plumps and subsequent 0.5% decrease in thins. Although this effect was detected as statistically significant, it is of little agronomic importance as the rates of plumps was over 96%.

11. Conclusion and Recommendations:

As expected, seeding date significantly impacted nearly all the measured variables. Early seeding resulted in reduced plant populations, increased wild oat control, reduced yields, lowered test weight, and increased the percentage of plumps. Not all these effects were as anticipated, as one would have expected greater plant populations and yields due to access to early season moisture. Seeding rate only had a significant impact on plant population, while nitrogen rate significant decreased plant populations and increased yield. The combination of seeding date, seeding rate + nitrogen rate only had a significant effect on yield. Later seeded oats had overall greater yield and were not as responsive to seeding +

nitrogen rate as the early seeded. The earlier seeded oats were much more impacted by seeding + nitrogen rate, with increased nitrogen rates resulting in similarly higher yields across seeding rates. Overall, the basic agronomic practices for increasing oat yields were effective, although not always as expected. This likely reflects the growing season conditions, with moisture being somewhat limited in the earlier part of the season and more bountiful in the later part, which is not typical of the past.

Supporting Information:

12. Acknowledgements: The Northeast Agriculture Research Foundation would like to express our gratitude to the Saskatchewan Ministry of Agriculture's ADOPT program for funding this demonstration and for providing signage. We would also like to thanks SaskOats for administrating and support of this demonstration.

13. Abstract and Summary:

Oats can be a very profitable cereal option for the cooler, wetter growing regions of Saskatchewan, especially when milling grades can be consistently achieved. Oats are highly responsive to different management techniques and there are a number of basic factors that can have a large impact on yield and quality. It is important that these basic factors be considered before additional inputs are considered, as they can increase production costs and are often associated with a low probability of significant responses. To illustrate the relative contributions of the most basic management decisions to oat yield and quality: seeding date, seeding rate, and nitrogen rate were manipulated. This small plot demonstration was set up with 12 treatments in a Split-block design with 4 replicates. The main factor was seeding date: early or late May. The sub-factors were seeding rate (200, 300, and 400 seeds/m2) and N Rate (70 and 120 kg N/ha) and randomized within seeding date. As expected, seeding date significantly impacted nearly all the measured variables. Early seeding resulted in reduced plant populations, increased wild oat control, reduced yields, lower test weight, and higher percentage of plumps. Not all these effects were as anticipated, as one would have expected greater plant populations and yields due to access to early season moisture. Seeding rate only had a significant impact on plant population, while nitrogen rate significant decreased plant populations and increased yield. The combination of seeding date, seeding rate + nitrogen rate only had a significant effect on yield. Later seeded oats had overall greater yield and were not as impacted by seeding + nitrogen rate. The earlier seeded oats were much more impacted by seeding + nitrogen rate, with increased nitrogen rates resulting in greater yields across seeding rates. Overall, the basic agronomic components for increasing oat yields were effective towards increasing yield and quality, although not exactly as one would expect.