

# Agricultural Demonstration of Practices and Technologies (ADOPT)

## **FINAL REPORT**

**20170418**

### **MANAGING FERTILIZER USE TO OPTIMIZE YIELD AND QUALITY OF OAT**

**Funded by: The Saskatchewan Ministry of Agriculture under the  
Canada-Saskatchewan Growing Forward bi-lateral agreement**

**March 2019**

**Prepared by: Saskatchewan Oat Development Commission**

# Managing Fertilizer Use to Optimize Yield and Quality of Oat

ADOPT#20170418

Final Report

February 2019

## Locations:

- Conservation Learning Centre (CLC), RM 461, SW 20-46-26-W2
- South East Research Farm (SERF), RM 61

**Site Managers:** Robin Brown (CLC) and Lana Shaw (SERF)

## Objective:

To demonstrate the effect of four rates of nitrogen fertility with and without potassium on yield, quality, and lodging of milling oat.

## Methods:

The two locations of this trial were set up as a two-factor RCBD with four replicates and 8 treatments as described in table 1.

**Table 1.** Treatments used to demonstrate the effects of nitrogen and potassium fertilizer on oat yield, lodging and quality.

Treatment	Nitrogen Rate (kg/ha)	Potassium Rate (kg/ha)
1	40	0
2	60	0
3	80	0
4	120	0
5	40	17
6	60	17
7	80	17
8	120	17

## CLC

Camden oats were seeded May 18, 2018 at a rate of 300 plants/m<sup>2</sup> using a Fabro small plot drill with double disc openers on 10 in row spacing. Plots were approximately 1.5 m by 7 m. Nitrogen fertilizer was side banded and potassium applied with the seed. Phosphorus was applied at a rate of 30 lb/ac. Soil test results collected prior to seeding can be found in table 2. Curtail M (active ingredient clopyralid + MCPA ester) was applied at a rate of 0.8 L/ac on June 13, 2018. No other crop protection products were applied throughout the growing season. Plots were weeded by hand for the remainder of the season.

**Table 2.** CLC Soil test results collected prior to seeding in the spring of 2018.

Depth	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 6	23	5	189	64	4	5.9	0.27
6 to 12	10			14		6.5	0.19
0 to 12	33						

Data collection included plant establishment by counting the number of plants in two 1m rows per plot 2 weeks after emergence. Plant height was the average of 5 randomly selected plants per plot. Plots were scouted weekly for disease and weed pressure. Lodging data was not collected, due to lack of lodging. Harvest occurred September 26, 2018 and weather-related conditions were monitored by the SRC climate station located within 1 km of the test plots. Yield, test weight and TKW were determined after harvest. Data was analysed using Statistix10.

## SERF

Camden oats were seeded May 8, 2018 at a rate of 300 plants/m<sup>2</sup> using a Seedmaster plot drill with 10-inch row spacing. Plots were approximately 3 m by 10 m. Nitrogen fertilizer and potassium were side-banded at treatment rates. Phosphorus was applied at a rate of 20 lb/ac with the seed. Soil test results collected prior to seeding can be found in table 2. Buctril M was applied on June 6, 2018. No other crop protection products were applied throughout the growing season. Plots were weeded by hand for a small amount of wild oat.

**Table 3.** SERF Soil test results collected prior to seeding in the spring of 2018.

Depth	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mmho/cm)
0 to 6	23	4	264	120	4	3.1	1.03
6 to 24	24			360			1.31
0 to 24	47						

Plant establishment was determined by counting the number of plants in two 1-meter rows per plot in late May after emergence. There was no lodging in this trial. Plant height measurements were not taken at Redvers. Plots were scouted for disease and there was none evident. The trial was harvested on August 20, 2018 during a long, hot dry period. The entire yield sample from 1.2M x 10M area was weighed, tested for moisture, and adjusted to 13% moisture. Test weight and thousand kernel weight (TKW) was determined after harvest.

## Results:

### CLC

At the CLC during seeding, soil conditions were still very dry from the previous fall. Conditions remained dry up until May 30, 2018 when the CLC received 7 mm of precipitation. Substantial precipitation did not occur until the end of June 2018. Overall the spring was very hot and dry, and the fall was very cool and damp (Table 3) resulting in a late harvest.

**Table 4.** Weather conditions over the 2018 growing season at the Conservation Learning Centre.

	May	June	July	August	September	October	Average/Total
--- Temperature (°C) ---							
<b>2018</b>	13.3	16.3	17.4	15.7	6.5	1.4	11.8
<b>2012-2017</b>	11.5	16.0	18.7	17.6	12.5	3.8	13.4
--- Precipitation (mm) ---							
<b>2018</b>	12.5	49.8	112.4	38.4	29.3	8.6	251.0
<b>2012-2017</b>	69.4	85.4	93.3	49.6	25.2	26.0	348.7

Differing N rates with and without the addition of K appeared to have no effect on any of the measurements at Prince Albert location (Table 4). Even yield did not show a yield response to increasing rates of fertilizer. Moisture was likely a limiting factor for this project, but overall yield was high. This oat crop was likely accessing deep subsoil moisture and nitrate due to the dry spring conditions. Potassium fertilizer was expected to aid with straw strength and prevent lodging, but unfortunately it was too dry for lodging to occur.

**Table 5.** The effects of nitrogen rates and the addition of potassium on a milling oat (Camden) at the Conservation Learning Centre near Prince Albert. Results are expressed as means of 4 replicates.

Treatment		Emergence	Plant height	TKW	Test weight	Yield	
N rate kg/ha	K rate kg/ha	Plants/m <sup>2</sup>	Cm	G	g/0.5L	kg/ha	bu/ac
40	0	256	76	35.0	239.9	6057	158.9
60		260	78	35.7	241.0	5800	152.2
80		304	79	35.5	235.2	6256	164.1
120		237	82	36.5	238.2	7180	188.4
40	17	259	80	39.0	237.3	6424	168.5
60		290	77	35.5	234.5	6198	162.6
80		258	77	35.7	234.9	6014	157.8
120		262	78	37.0	236.4	6443	169.0
<i>(P values for N x K)</i>		0.25	0.22	0.07	0.76	0.376	
40	All	257	77.9	37.0	238.6	6240	163.7
60	All	275	77.4	35.6	237.7	5999	157.4
80	All	281	77.9	35.6	235.1	6135	161.0
120	All	250	80.5	36.8	237.3	6811	178.7
<i>(P values for N)</i>		0.39	0.36	0.21	0.67	0.1631	
All	0	264	78.4	35.7	239	6323	
All	17	267	78.3	36.8	236	6270	
<i>(P values for K)</i>		0.84	0.97	0.07	0.19	0.839	

#### SERF

After a relatively dry start to the growing season, Redvers received enough rain in June to establish a good crop. The crop was relatively free of weeds and disease for the whole season. On August 11 and 12, daytime highs were over 35°C, which hastened maturity of the oats.

**Table 6.** Weather conditions for 2018 growing season at South East Research Farm

	May	June	July	August	Sept	Average/Total
	--- Temperature (°C) ---					
<b>2018</b>	15.2	18.3	18.7	17.8	9.0	15.8
<b>2012-2017</b>	n/a	n/a	n/a	n/a	n/a	n/a
	--- Precipitation (mm) ---					
<b>2018</b>	21.1	137.1	48.	9.9	65.5	282.3
<b>2012-2017</b>	n/a	n/a	n/a	n/a	n/a	n/a

**Table 7.** The effects of nitrogen rates and the addition of potassium on a milling oat (Camden) at the South East Research Farm near Redvers. Results are expressed as means of 4 replicates.

Treatment		Emergence	TKW	Test weight	Yield	
N rate (kg/ha)	K rate (kg/ha)	Plants/m <sup>2</sup>	g	g/0.5L	kg/ha	bu/ac
40	0	330	37.0	255.0	4604	120.5
60		339	38.6	255.0	5201	136.1
80		361	37.3	252.8	5470	143.2
120		351	38.1	254.3	5603	146.7
40	17	316	39.6	258.8	4879	127.7
60		320	38.8	257.8	5297	138.7
80		304	37.5	254.8	5754	150.6
120		339	37.3	251.5	5397	141.3
<i>(P values for N x K)</i>		0.73	0.11	0.64	0.62	
40	All	323	38.3	256.9	4741	124.1
60	All	329	38.7	256.4	5249	137.4
80	All	332	37.4	253.8	5612	146.9
120	All	345	37.7	252.9	5500	144.0
<i>(P values for N)</i>		0.81	0.25	0.39	<0.01	
All	0	345	37.7	254.3	5219	136.6
All	17	319	38.3	255.7	5332	139.6
<i>(P values for K)</i>		0.12	0.24	0.47	0.46	

At Redvers, the highest yielding treatment had 80 kg/ha of N and 17 kg/ha K applied. The lowest yielding treatment had no K and only 40 kg/ha of N applied. There was a significant effect of N rate ( $P < 0.01$ ) on oat yield for Redvers, but no significant effect of the K rate factor or the interaction of N and K. Oats responded to N fertilization, but high rates of N application were not necessary. There was no significant effect of N fertilization or K fertilization on quality (TKW or test weight).

### Discussion and Conclusion

This demonstration showed a positive effect of N fertilization on yield at one of two locations and this yield increases were achieved at the 40, 60, and 80 kg/ha rate, but not at the 120 kg/ha rate. Previous research has shown that excess N fertilizer application could have a detrimental effect on quality (William May, AAFC Indian Head). This demonstration did not find a significant treatment effect on quality but may have under wetter conditions.

**Extension:**

This project was presented at the Conservation Learning Centre's Annual Field Day held July 26, 2018 with 70 people in attendance. It was also shared with 40 attendees at the South East Research Farm tour on July 25, 2018.

**Abstract:**

Four rates of N fertilizer (40, 60, 80, 120 kg/ha) on oat were evaluated at Redvers and near Prince Albert in 2018. Each N fertilizer rate was also compared with and without K fertilizer at 17 kg/ha for a total of 8 treatments. At Redvers, there was a significant N fertilizer response but no K response for yield. At the Prince Albert location, there were no significant treatment effect on yield, despite high yields. There were no significant effects on test weight or seed weight (TKW) at either location. No lodging occurred at either site due to hot, dry conditions during much of the summer.