2022 Final Research Report

from the

Saskatchewan Oat Development Commission

Project Title: Resubmission: Are Oats Responding to Higher Levels of Macronutrients?

(ADOPT # 20211065)

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Project Identification

1. **Project Number:** ADOPT # 20211065
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 2022 to February 2023
5. **Project contact person & contact details:**

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Objectives and Rationale

6. **Project objectives:**

The objective of this project was to demonstrate the response of a modern oat variety to the historically recommended rate of 60 lb N/ac against the more recent recommendation of 90 lb N/ac and to determine the relative importance of combining phosphorus (P), potassium (K) and sulphur (S) with these different nitrogen (N) recommendations in eastern Saskatchewan. The influence of treatment on oat yield, lodging and test weight were determined.

7. **Project Rationale:**

There are a substantial number of oat producers that only apply 60 lb N/ac or less. This may be the right thing to do particularly for those that seed oats late or under low yielding conditions; however, recent research using modern varieties of oats suggests that this rate is on the low side. High yielding oat varieties that maintain adequate test weights at higher rates of N are available. The results of this demonstration may encourage producers who still apply low rates of N, to test those long held assumptions with strips of higher N rates in their fields. Phosphorus, potassium, and sulphur fertility may also have more importance in conjunction with higher rates of N. Producers have the most experience with their land, but varieties change and it is worth regularly testing these long held assumptions.

Methodology and Results

8. **Methodology:**

At each location, the trial was setup as a 4 x 3 factorial (RCBD) with 4 replications. The first factor evaluated different combinations of P,K, and S. The four PKS fertility regimes tested were:

1. PKS added (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)

2. Sulphur limited-PK added (40 lb P2O5/ac + 15 lb K2O)

3. Potassium Limited-PS added (40 lb P2O5/ac + 10 lb S/ac)

4. Phosphorus Limited- KS added (15 lb K2O + 10 lb S/ac)

The second factor evaluated N rates of 17, 60 and 90 lb/ac. Care was taken ensure N rates for each PKS fertility regime were balanced, by adjusting rates of urea to account for N contributions from P and S fertilizers. Factorial treatments along with a "no fertilizer check" are listed in Table 1. The check is not part of the factorial design and statistical analysis, but was included as a reference. Plot size varied by site to accommodate seeding and spraying equipment. Where possible, only the middle sections of plots were harvested with small plot combines to avoid edge effects. CDC Arborg oats were seeded to target 300-350 viable seeds/m^2 at each location. Dates of key operations for each site are listed in Table 2 and soil test results are presented in Table 3.

Table 1. Treatment List

Trt#	**Seed-placed box 1**	**Side-band box 1**	**Side-band box 2**	**Total N**
1	none	none	none	
Nitrogen response with full rates of PKS				
2	40 lb P2O5/ac	15 lb K2O/ac + 10 lb S/ac	0 lb N/ac	17 lb/ac
3	40 lb P2O5/ac	15 lb K2O/ac + 10 lb S/ac	43 lb N/ac	60 lb/ac
4	40 lb P2O5/ac	15 lb K2O/ac + 10 lb S/ac	73 lb N/ac	90 lb/ac
Nitrogen response with Sulphur limitation				
5	40 lb P2O5/ac	15 lb K2O/ac	8.5 lb N/ac	17 lb/ac
6	40 lb P2O5/ac	15 lb K2O/ac	51.5 lb N/ac	60 lb/ac
7	40 lb P2O5/ac	15 lb K2O/ac	81.5 lb N/ac	90 lb/ac
Nitrogen response with Potassium limitation				
8	40 lb P2O5/ac	10 lb S/ac	0 lb N/ac	17 lb/ac
9	40 lb P2O5/ac	10 lb S/ac	43 lb N/ac	60 lb/ac
10	40 lb P2O5/ac	10 lb S/ac	73 lb N/ac	90 lb/ac
Nitrogen response with Phosphorus limitation				
11	None	15 lb K2O/ac + 10 lb S/ac	8.5 lb N/ac	17 lb/ac
12	None	15 lb K2O/ac + 10 lb S/ac	51.5 lb N/ac	60 lb/ac
13	None	15 lb K2O/ac + 10 lb S/ac	81.5 lb N/ac	90 lb/ac

Table 2. Dates of Operations in 2022				
Activity	**------------------------------------Date--------------------------------------**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Pre-seed/pre-emergent Herbicide Application	Roundup Weathermax 0.67 L/ac -May 22 & May 27	Roundup Weathermax 0.67 L/ac -May 21	None	None
Seeding	May 24	May 23	June 5	May 9
Emergence Counts	June 13	June 16	June 16	June 2
In-crop Herbicide Application	Prestige XC 0.85 L/ac -June 19	Prestige XC- June 28	Buctril M- June 19	Prestige XC – June 6
In-crop Insecticide	None	Decis – June 16 cutworms Cygon -Aug 8 Aphid	None	None
Lodging Rating	September 3	September 2	September 2	August 22
Harvest	September 16	September 2	September 21	September 8 & 9

Table 3. Soil Test Results for the "Resubmission: Are Oats Responding to Higher Levels of Macronutrients?" trial				
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
Nitrogen (lb N/ac)				
0-6"	2	39	11	23
6-12"		30		
6-24"	12		51	81
Phosphorus Olsen (ppm)	5	13	8	10
Potassium (ppm)	572	453	243	238
Sulphur (lb S/ac)				
0-6"	10	32	?	36
6-12"		44		
6-24"	48		?	72

9. Results:

Growing Season Weather

Mean monthly temperatures and precipitation amounts with long-term (1981-2010) averages for 4 sites are listed in Tables 4 for the 2022 growing season. In season temperatures and precipitation were above the long-term historic average at all locations. Yorkton received heavy hail damage on June 23.

Table 4. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) normals for the 2022 growing seasons at 4 sites in Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
		---------------------*Mean Temperature (°C)* --------------------				
Indian Head	2022	10.9	16.1	18.1	18.3	15.8
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Melfort	2022	9.9	15.2	18.2	18.7	15.5
	Long-term	***10.7***	***15.9***	***17.5***	***16.8***	***15.2***
Redvers	2022	10.2	16.3	19.2	18.9	16.1
	Long-term	***11.1***	***16.2***	***18.7***	***18.0***	***16.0***
Yorkton	2022	10.6	15.7	18.6	18.9	16
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
		---------------------------- *Precipitation (mm)* --------------------				
Indian Head	2022	97.7	27.5	114.5	45.9	285.6
	Long-term	***51.7***	***77.4***	***63.8***	***51.2***	***241.4***
Melfort	2022	90.8	78.1	34.9	36.5	240.3
	Long-term	***42.9***	***54.3***	***76.7***	***52.4***	***226.3***
Redvers	2022	121	75	259	25	480
	Long-term	***60.0***	***85.2***	***65.5***	***46.6***	***272***
Yorkton	2022	137.9	57.9	38.4	90.8	325
	Long-term	***51***	***80***	***78***	***62***	***272***

Previous Study Results

The current study is a resubmission of an adopt study conducted in 2021. In 2021, drought was widespread in Saskatchewan and oat yield potentials were low. The highest yield achieved at Indian Head, Melfort, Redvers and Yorkton was 98 bu/ac, 105 bu/ac, 84 bu/ac and 61 bu/ac, respectively. In addition, background levels of soil N (top 24 inches) were relatively high at Melfort, Redvers and Yorkton. As a result, the most economic rate of applied N was only 17 lb/ac for these locations. Background soil N was much lower at Indian Head (18 lb N/ac) and 60 lb/ac of applied N proved to be most economic. Since yields were low and unresponsive to added N in 2021, the study was conducted again in 2022.

Current Study Results

Crop emergence varied between locations, averaging 250, 184, 308 and 255 plants/m^2 at Yorkton, Melfort, Indian Head and Redvers, respectively. Interactions between the level of PKS and N rate were not significant at any site, allowing the discussion to focus on main effects only. Levels of PKS did not significantly affect emergence at Indian head or Yorkton (Table 5). At Melfort, emergence was significantly less by about 20 plants/m^2 for the full rate of PKS and the sulphur limited treatments. The reason for this is unclear and may be the result of random variation. However, the difference is not likely to have had significant agronomic consequences. At Redvers, emergence was lower by about 30 plants/m^2 for the potassium limited treatments. Perhaps the chloride from the potash reduced seedling disease and improved emergence. Increasing N did not statistically affect crop emergence at any site except Redvers, where adding 60 lb N/ac significantly increased crop emergence before significantly reducing it with a further increase to 90 lb N/ac. If crop emergence was being reduced at this location by increasing salt and ammonia toxicity issues, it is unclear why emergence improved with the addition of 60 lb N/ac before decreasing with 90 lb N/ac.

At Indian Head and Redvers, the level of PKS had no significant effect on crop maturity (Table 6). However, increasing N significantly delayed maturity by a couple of days. At Melfort and Yorkton, there was a significant interaction between the level of PKS and the rate of N. At both these sites, delayed maturity in response to added N did not consistently occur as expected between the different levels of PKS (data not shown). It is difficult to account for this, but differences were small and all treatments matured within a couple days of each other.

Lodging did not occur at Melfort or Yorkton (Table 7). At Indian Head and Redvers, lodging increased with added N but was not affected by the level of P, K, or S. Despite statistically significant differences, lodging was very minor for all treatments at Indian Head and would not have affected yield. Lodging was more moderate at Redvers and may have had minor effects on yield for the high rate of N.

Yields were high at all locations. The lowest average yields of 5378 kg/ha (141 bu/ac) and 5348 kg/ha (140 bu/ac) were obtained at Yorkton and Indian Head, respectively. The Redvers site had an average yield potential of 5968 kg/ha (156 bu/ac) and Melfort achieved 7048 kg/ha (185 bu/ac). No interactions between the level of PKS and N rate were detected at any location, allowing the discussion to focus on main effects. While yield did not statistically respond to P, K or S at any of the sites, it did significantly increase in response to added N at all sites except Yorkton (Table 8). The lack of a response to added N at Yorkton was likely related to a high residual soil N (104 lb N/ac) and heavy hail damage lowering yield potential. For the other sites, increasing N rate from 17 lb/ac to 90 lb/ac significantly increased yield by 34%, 14% and 17% at Indian Head, Melfort, and Redvers, respectively. Background soil N was very low at Indian Head (14 lb N/ac), medium at Redvers (62 lb N/ac) and high at Melfort (104 lb N/ac) (Table 3). A response to added N at Melfort was observed despite high residual soil N because the yield potential at Melfort was very high.

Limitations of P, K or S did not significantly affect yield at any location (Table 8). A lack of response to P was unexpected at Indian Head and Redvers where soil test levels (Olsen method) were categorized as low (5 ppm) and medium (8 ppm), respectively. At Yorkton and Melfort, levels of soil P were categorized as medium (10 ppm) and high (13 ppm), respectively[1]. Even at medium to high levels of soil P, a response to added phosphorus would be expected in approximately 50% of cases[2]. Although sites were unresponsive to added P, it is still important to maintain or increase residual levels of soil P to maximize yield. Past study has found the yield on soils testing low for phosphorous can not be maximized by applying high rates of seed placed P in-season[3]. To maximize yield soil reserves of P must be maintained, as plants obtain a substantial portion of their P requirement from the entire soil volume that they occupy. In other words, crops respond to both P fertilizer and background P fertility. The yields at all sites were unresponsive to added K as background soil K tested very high. Soil K above 160 ppm is considered very high, and soils tested 572 ppm, 453 ppm, 243 ppm, and 238 ppm at Indian Head, Melfort, Redvers, and Yorkton, respectively. Oat yields were also unresponsive to added sulphur in this study, which is not uncommon for cereals in Saskatchewan. However, a response was most likely to occur at Indian Head where soils contained at low-medium level of S (58 lb S/ac in the top 24 inches). Soils at Yorkton and Melfort tested high for sulphur. Sulphur was not part of the soil test at Redvers. Oat yield may still respond to added S in soils testing high for S, as the level of this nutrient can vary substantially within a field. However, the yield results from this trial would indicate that soil S was not limiting at any site.

Increasing rate of N is well known to reduce test weight in Oats. This certainly was the trend at Indian Head and was statistically significant at the other locations (Table 9). While increasing N to 90 lb/ac reduced test weights below the discount level of 245 g/0.5 l at Indian Head and Yorkton, test weights were still well above the rejection level of 230 g/0.5 l. At Melfort, there was an interaction and the effect of increasing N on test weight varied between levels of PKS (data not shown). For some unknown reason, test weights were higher for the P limited treatments and increasing N under a P limitation caused a very sharp decline in test weight. For the remaining sites, the level of PKS did not have a significant effect on test weight. Percent thins were well below 5% regardless of treatment for all locations (Table 10). In other words, thins were not a grading issue. At Redvers % thins differed statistically between levels of PKS but differences were very small and inconsequential. Increasing N significantly increased % thins but again differences were small. No statistical differences were observed at Yorkton and values from Indian Head and Melfort were based on bulked samples across replicates for each treatment (no statistics). However, it would appear there was a trend for increasing thins with increasing N at Indian Head.

Economics

Application of PKS did not statistically increase oat yield. However, there were some numeric yield losses when limiting various nutrients. Even if these reductions are assumed to be real, an economic analysis revealed there were only a few instances where the addition of P, K or S provided economic returns. The economic analysis of adding PKS at rates of 40 lb P_20_5/ac, 15 lb K_20/ac and 10 lb S/ac on oat returns assumed prices of \$0.85/lb P_20_5, \$0.54/lb K_20 and \$0.51/lb S, respectively. Assuming a crop value of \$6/bu (2022 Saskatchewan Crop Planning Guide), an economic response to added P of \$4.43/ac was determined at Melfort despite high soil test P. There was no economic benefit from applying K or S at Melfort. Even though soil test K was very high, economic responses to the added K of \$11.59/ac and \$4.03/ac were observed at Yorkton and Redvers, respectively. However, there was no economic benefit from applying P or S at these locations. At Indian Head, the application of S provided an economic return of \$7.81/ac but the application of P and K provided no economic benefit. The lack of an economic response to P at Indian Head was unexpected as the soil test for P was low.

Based on assumptions from the 2022 Saskatchewan Crop Planning Guide, a value of \$6/bu for oats and price of \$1.33/ lb N were used to determine the economics of increasing N from a base rate of 17 lb N/ac (Table A). At Indian Head, the most economic rate of N was 90 lb/ac. This site was very responsive to added N because soil reserves were very low (14 lb N/ac). At Melfort, 90 lb N/ac was also the most economic rate of applied N despite a high reserve of soil N (104 lb N/ac), as the site had a very high yield potential (up to 198 bu/ac). At Redvers, 60 lb N/ac was most economical. At Yorkton, increasing N beyond 17 lb/ac reduced economic returns, despite the decent yield potential of this site (141 bu/ac). The lack of an economic response to added N at Yorkton can be attributed to high reserves of soil N (104 lb N/ac) and hail damage on June 23 which reduced yield potential by potentially 20 to 30 percent.

Table A. Additional income generated ($/ac) by increasing N above 17 lb/ac[1]				
Lb N/ac	Indian Head	Melfort	Redvers	Yorkton
17	$0	$0	$0	$0
60	$123	$43	$109	-$75
90	$152	$53	$47	-$80
Background N	14 lb/ac	104 lb/ac		104 lb/ac
[1]Values assume $6/bu of oats; $1.33/lb N; no discounts due to low test weight. Values in green would have received an additional discount due to low test weight.				

[1]https://www.agvise.com/wp-content/uploads/2020/08/guide-soil-interpretation-report-2019.pdf

[2]Hedlin, R. A. 1962. Developments in the use of routine soil analysis as a means of predicting fertilizer requirements. Proc. Manitoba Society of Soil Science Proceedings, Winnipeg, MB

[3]Wagar, B., Stewart, J. and Henry, J. 1986a. Comparison of single large broadcast and small annual seed-placed phosphorus treatments on yield and phosphorus and zinc contents of wheat on Chernozemic soils. Canadian Journal of Soil Science 66(2):237-248.

Extension

- A video covering the results from this study are available on youtube.

https://www.youtube.com/watch?v=9w6KaIx6Ao0

- Results were presented at the SaskOats meeting in Saskatoon on January 11, 2022.
- Project may have been discussed at various Agri-Arm field days.

10. Conclusions and Recommendations

In conclusion, some economic responses to added P, K and S were observed in this study but they weren't large, consistent or would have been predicted by soil test results. Despite a lack of response to P, it is still important to maintain or build soil test levels towards 15 ppm, as deficiency can not be compensated for by seed-placed P alone. Test weights were not significantly or consistently affected by P, K or S. In contrast, test weights were consistently reduced with added N. Increasing N did push test weights into the discount range at 2 locations but test weights were still well above the rejection mark for milling oats. If background soil N is low or yield potential is very high then 90 lb N/ac is likely to be more economical than 60 lb N/ac. However, these conditions are not always present. Soil testing for N will help to determine proper rates. In this study, lodging was never a significant issue, even with high rates of soil + fertilizer N. Our trials are not typically seeded in low lying areas of the field which are more prone to lodging. Therefore, the risk of lodging to the producer with higher rates of N is likely greater. However, it may be possible to manage this risk in the field with variable rate N.

Supporting Information

11. Acknowledgements:

This project was funded by the Agricultural Demonstration of Practices and Technologies (ADOPT) and Saskatchewan Oat Development Commission.

12. Appendices

Table 5. Main effects of fertilizer on oat emergence at multiple locations in 2022.				
Main effect	**Emergence (plants/m^2)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
No Fertilizer[y]	287	197 a	248	234
<u>Levels of PKS (PKS)</u>				
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	302	172 b	260 a	250
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	317	172 b	259 a	265
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	306	195 a	234 b	234
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	315	193 a	269 a	256
<u>LSD</u>	NS	19.9	22	NS
<u>P-values[z]</u>	NS	0.028	0.016	NS
<u>Nitrogen Rate (N)</u>				
17 lb N/ac	303	186	255 ab	252
60 lb N/ac	313	186	267 a	251
90 lb N/ac	314	178	244 b	251
<u>LSD</u>	NS	NS	18.9	NS
<u>P-values[z]</u>	NS	NS	0.057	NS
<u>PKS by N P-values[z]</u>	NS	NS	NS	NS

[Y]No fertilizer check is for reference and is not part of statistical analysis

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

Table 6. Main effects of fertilizer on oat date of maturity at multiple locations in 2022.				
Main effect	**Date of Maturity (Julian)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
No Fertilizer[y]	235.0	241.0	243.0	238.8
Levels of PKS (PKS)				
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	235.8	240.0	244.4	238.2
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	235.7	240.0	244.4	237.7
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	236.0	239.8	244.2	238.3
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	235.9	240.6	243.3	238.0
LSD	NS	NS	NS	NS
P-values[z]	NS	NS	NS	NS
Total Nitrogen (N)				
17 lb/ac	234.7 c	240.4	242.9 b	238.4 a
60 lb/ac	236.0 b	239.7	244.3 a	237.6 b
90 lb/ac	236.9 a	240.1	245.0 a	238.0 ab
LSD	0.61	NS	0.95	0.54
P-values[z]	<0.0001	NS	0.0005	0.017
PKS by N P-values[z]	NS	0.046	NS	0.036

[Y]No fertilizer check is for reference and is not part of statistical analysis

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

Table 7. Main effects of fertilizer on oat lodging at multiple locations in 2022.				
Main effect	**Lodging (1-10)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
No Fertilizer[y]	1	1	1.75	1
Levels of PKS (PKS)				1
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	1.3	1	2.7	1
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	1.2	1	2.0	1
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	1.2	1	2.6	1
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	1.3	1	1.9	1
LSD	NS	NS	NS	NS
P-values[z]	NS	NS	NS	NS
Total Nitrogen (N)				
17 lb/ac	1.0 c	1	1.0 c	1
60 lb/ac	1.2 b	1	2.5 b	1
90 lb/ac	1.5 a	1	3.4 a	1
LSD	0.14	NS	0.85	
P-values[z]	<0.0001	NS	<0.0001	NS
PKS by N P-values[z]	NS	NS	NS	NS

[Y]No fertilizer check is for reference and is not part of statistical analysis

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

Table 8. Main effects of fertilizer on oat yield at multiple locations in 2022.				
Main effect	**Yield (kg/ha @ 13.5%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
No Fertilizer[y]	4178	6065	4394	5385
Levels of PKS (PKS)				
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	5470	7189	6094	5367
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	5388	7220	6121	5372
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	5518	7164	6017	5242
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	5410	6945	6167	5530
LSD	NS	NS	NS	NS
P-values[z]	NS	NS	NS	NS
Total Nitrogen (N)				
17 lb/ac	4538 c	6600 c	5443 b	5379
60 lb/ac	5681 b	7238 b	6498 a	5268
90 lb/ac	6121 a	7551 a	6358 a	5487
LSD	143	285	198	NS
P-values[z]	<0.0001	<0.0001	<0.0001	NS
PKS by N P-values[z]	NS	NS	NS	NS

[Y]No fertilizer check is for reference and is not part of statistical analysis

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

Table 9. Main effects of fertilizer on oat test weight at multiple locations in 2022.				
Main effect	**Test Weight (g/0.5L)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
No Fertilizer[y]	242.1	256.3	253.0	250.9
Levels of PKS (PKS)				
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	244.0 a	255.7 ab	246.5 a	245.9 a
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	243.8 a	255.5 ab	247.2 a	243.1 a
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	245.7 a	254.2 b	248.3 a	246.8 a
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	244.5 a	257.1 a	246.3 a	248.4 a
LSD	NS	1.89	NS	NS
P-values[z]	NS	0.036	NS	NS
Total Nitrogen (N)				
17 lb/ac	245.4 a	256.8 a	250.1 a	249.8 a
60 lb/ac	244.8 a	255.1 b	245.4 b	245.8 b
90 lb/ac	243.4 a	255.0 b	245.8 b	242.5 b
LSD	NS	1.64	2.1	3.43
P-values[z]	NS	0.55	<0.0001	0.0006
PKS by N P-values[z]	NS	0.035	NS	NS

[Y]No fertilizer check is for reference and is not part of statistical analysis

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

Table 10. Main effects of fertilizer on % oat thins at multiple locations in 2022.				
Main effect	**Thins (%)**			
	Indian Head	**Melfort**	**Redvers**	**Yorkton**
No Fertilizer[y]	1.1	1.6	1.15	2.4
<u>Levels of PKS (PKS)</u>				
Full rates of PKS (40 lb P2O5/ac + 15 lb K2O + 10 lb S/ac)	1.2	1.87	1.78 a	3.4 a
Sulphur limited-Full rates of PK (40 lb P2O5/ac + 15 lb K2O)	1.0	1.33	1.48 bc	3.3 a
Potassium Limited-Full rates PS (40 lb P2O5/ac + 10 lb S/ac)	1.0	1.73	1.38 c	3.0 a
Phosphorus Limited-Full rates of KS (15 lb K2O + 10 lb S/ac)	1.2	1.63	1.68 ab	3.0 a
<u>LSD</u>	No stats	No stats	0.27	NS
<u>P-values[z]</u>	No stats	No stats	0.03	NS
<u>Total Nitrogen (N)</u>				
17 lb/ac	0.9	1.60	1.38 b	2.7 a
60 lb/ac	1.1	1.70	1.68 a	3.3 a
90 lb/ac	1.3	1.63	1.68 a	3.5 a
<u>LSD</u>	No stats	No stats	0.24	NS
<u>P-values[z]</u>	No stats	No stats	0.019	NS
<u>PKS by N P-values[z]</u>	No stats	No stats	NS	NS
[Z] Statistical analyses were not completed for this variable because the results were based on treatment composites				

Abstract

13. Abstract/Summary:

Trials were conducted at Yorkton, Indian Head, Melfort and Redvers to demonstrate the response of a modern oat variety to the historically recommended rate of 60 lb N/ac against the more recently suggested recommendation of 90 lb N/ac. The trials were also designed to determine the relative importance of adding phosphorus (P), potassium (K) and sulphur (S) for these different nitrogen (N) recommendations in eastern Saskatchewan. Applying 90 lb/ac of N was the most economical rate at Indian Head and Melfort. Increasing added N from 17 lb/ac to 90 lb/ac at Indian Head and Melfort increased yield by 34% and 14%, respectively. Indian Head site was highly responsive as soil reserves of N were very low (18 lb N/ac). Despite very high residual N at Melfort (104 lb N/ac), this site was also reasonably responsive to added N due to its very high yield potential. At Redvers, 60 lb N/ac was the most economic rate of N which increased yield by 19% compared to the 17 lb N/ac rate. In contrast, the most economical rate of N at Yorkton was only 17 lb/ac. Despite a high yield potential, the Yorkton site was unresponsive to added N, which was likely the result of high reserves of soil N (104 lb N/ac) and hail damage reducing yield potential. While increasing rates of N to 90 lb/ac reduced test weights into the discount range at Yorkton and Indian Head, discounts were not applied to the economic analysis as low test weight may not have been a reality for producers who may blow more light seed out the back of the combine than what we do with plot work. No significant yield responses to added P, K or S occurred at any site even though yield potentials were high. However, there were some numeric yield losses when limiting various nutrients that lead to reductions in net returns. An economic response to 40 lb P_20_5/ac was observed at Melfort despite high levels of soil test P. At Yorkton and Redvers, economic responses to 15 lb K_20/ac were achieved despite very high soil test K at both locations. At Indian Head, the application of 10 lb S/ac proved economical but the application of P did not despite soils testing low for P. Added P, K or S did not have significant or consistent effects of test weight. In conclusion, the application of 90 lb N/ac can be the most economical if soil reserves of N are low (<30 lb N/ac) or the yield potential of oats is very high. Lodging was not substantial problem in this study but producers must still consider this risk based on their own field experience. Responses to P, K, S were variable and would not have always been predicted based on soil test results. The response of oats to added N was not influenced by the level of P, K and S.