2016 Annual Report
for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Wheat and Barley Response to Phosphorus and Potassium Fertilization

(Project #20150391)

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Project Identification

1. **Project Title:** Wheat and barley response to phosphorus and potassium fertilization
2. **Project Number:** 20150391
3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156
5. **Project start and end dates (month & year):** Apr-2016 to Feb-2017
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

Fertilizer is often the most expensive input in crop production and, while nitrogen (N) is the most commonly deficient nutrient in most Saskatchewan soils, other nutrients, especially phosphorus (P), are also commonly limiting. While potassium (K) is much less likely to be deficient in most Saskatchewan soils than P, an appreciable amount of K fertilizer is applied on high K soils, sometimes for the chloride and usually with cereal crops. The objectives of this project were to demonstrate the yield and quality response of CWRS wheat and 2-row malting barley to P and K fertilizer applications and to provide a forum for discussing factors to consider when managing these nutrients.

8. **Project Rationale:**

Growers generally recognize the importance of fertilizer application in crop production; however, historically there has been less emphasis on P and K than for N which is usually the most limiting nutrient to crop production in Saskatchewan. That said, crop uptake and removal of both P & K is substantial and recent soil test information suggests that over 80% of Saskatchewan fields are deficient in P. While potassium (K) is much less likely to be deficient in our soils than P, many growers are interested in or currently applying KCl (0-0-60) on high K soils. Wheat requires a total of 1.6-2.0 lb K_2O/bu while barley requires 1.2-1.5 lb K_2O/bu; therefore a 60 bu/ac wheat crop requires 98-120 lb K_2O/ac while for 90 bu/ac of barley the amount is 108-131 kg K_2O/ac. While total uptake of K is high, a relatively small percentage is allocated to the grain; therefore most K is returned to the soil unless the straw is also baled and removed and long-term depletion of this nutrient tends to be less of a concern most grain farms. In contrast, while total P uptake is considerably lower (0.73-0.88 lb P_2O_5/bu for wheat and 0.67-0.82 lb/bu for barley), roughly 75% of the total P uptake is removed in the grain. Consequently, inadequate P management can deplete soil nutrients over time and subsequently reduce the overall productivity of our fields, especially since most Saskatchewan soils are already considered deficient.

While most growers do apply some P with their crops, it can be difficult to see short-term benefits to using higher rates and, particularly in recent years where yields have generally been above average, the commonly used rates have generally been insufficient to maintain P fertility over the long-term. That said, crops do often respond well to P fertilizer application, especially when residual P levels are low or when soils are cool and dry in the spring. In many cases, crop responses to P are most evident early in the season and tend to become less apparent as soils warm up and plant roots become more developed; yield responses as high as 15% are not uncommon at our location. Furthermore, to maintain soil fertility and productivity over the long-term, many growers and agronomists consider it a good strategy to match fertilizer rates with crop removal over the course of a rotation.

Again, with the exception of coarse textured or peat soils, K is not typically considered limiting in Saskatchewan soils and documented crop responses to potash applications are relatively rare. However, small but significant improvements in yield and quality with K fertilization in high K soils do occasionally occur and an appreciable number of growers in southeast Saskatchewan apply K fertilizer with some crops. While yield responses to K fertilization in high K soils are unlikely to be large, other benefits such as improved standability and grain quality (i.e. kernel plumpness) are sometimes touted as additional reasons for fertilization. When they do occur, K fertilizer responses in high K soils may be a result of physiological, environmental or disease effects. In addition, potash (KCl; 0-0-60) contains 47% chloride which can also be beneficial with certain crops and soils.

Methodology and Results

9. Methodology:

A field demonstration with wheat and barley was established near Indian Head, Saskatchewan (50.555º N, -103.607º W) in the spring of 2016. The treatments were arranged in split plot design with crop type as the main plot and P and K rates as the sub-plots. All treatments were replicated four times and included:

1. Wheat – 0 kg P_2O_5 ha^{-1} – 0 kg K_2O ha^{-1}
2. Wheat – 0 kg P_2O_5 ha^{-1} – 20 kg K_2O ha^{-1}
3. Wheat – 30 kg P_2O_5 ha^{-1} –0 kg K_2O ha^{-1}
4. Wheat – 30 kg P_2O_5 ha^{-1} – 20 kg K_2O ha^{-1}
5. Wheat – 60 kg P_2O_5 ha^{-1} –0 kg K_2O ha^{-1}
6. Wheat – 60 kg P_2O_5 ha^{-1} – 20 kg K_2O ha^{-1}
7. Barley – 0 kg P_2O_5 ha^{-1} – 0 kg K_2O ha^{-1}
8. Barley – 0 kg P_2O_5 ha^{-1} – 20 kg K_2O ha^{-1}
9. Barley – 30 kg P_2O_5 ha^{-1} –0 kg K_2O ha^{-1}
10. Barley – 30 kg P_2O_5 ha^{-1} – 20 kg K_2O ha^{-1}
11. Barley – 60 kg P_2O_5 ha^{-1} –0 kg K_2O ha^{-1}
12. Barley – 60 kg P_2O_5 ha^{-1} – 20 kg K_2O ha^{-1}

Pertinent agronomic information is provided in Table 1. Both crops were direct-seeded into canola stubble on May 5 using an 8-opener SeedMaster plot drill with eight openers on 30 cm row spacing. Nitrogen (46-0-0) and phosphorus (11-52-0) were side-banded (38 mm lateral × 19 mm vertical separation from seed-row) while potassium (0-0-60) was placed in the seedrow. The reason for seed-placing the K fertilizer rather than the P was to ensure that seedling toxicity would not be a confounding factor at the high P rates. The varieties chosen were CDC Utmost CWRS wheat and CDC Copeland 2-row malting barley while the target seeding rates were 325 and 250 seeds/m^2 respectively. For both crops seed was placed at a targeted depth of approximately 19 mm (3/4”). Weeds were controlled using registered pre-emergent and in-crop herbicide applications while registered fungicides were applied at both flag leaf and heading to ensure that disease was not a yield limiting factor. Pre-harvest glyphosate was applied to the spring wheat at physiological maturity and both crops were straight-combined as soon as it was fit to do so. Lodging was rated using the Belgian lodging scale which takes into account both the area affected (A) and lodging intensity (I) to calculate a lodging index ($LI = A \times I \times 0.2$). Yields were determined from the harvested grain samples which were corrected for dockage and to 14.5% seed moisture content for wheat and 13.5% for barley. Dockage and test weights were determined using standardized CGC methods and test weights are expressed as g 0.5 L^{-1}. Seed size was determined by mechanically counting and weighing a minimum of 1000 seeds and calculating g 1000 $seeds^{-1}$ (TKW). For the barley, percent plump and thin kernels were determined from a 100 g sub-sample. Plump kernels were defined as any which stayed on top of 6/64" slotted hand sieve while thin kernels were those which passed through a 5/64" slotted hand sieve. Weather data were estimated from a private weather station located approximately 2 km from the field trial site. To test for statistical significance of results, response data were analysed using the Mixed procedure of SAS with Fisher's protected LSD test to separate treatment means. Heterogeneous variance estimates were permitted for each crop type but only utilized when doing so improved convergence over the simpler model. Crop type, P rate, K rate and all possible interactions were considered fixed while replicate effects were random. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

Table 1. Selected agronomic information for ADOPT phosphorus and potassium fertility trial with wheat and barley at Indian Head in 2016.

Factor / Field Operation	Wheat	Barley
Pre-emergent herbicide	690 g triallate/ha + 276 g/trifluralin/ha (15-Oct-2015) + 894 g glyphosate/ha (9-May-2016)	690 g triallate/ha + 276 g/trifluralin/ha (15-Oct-2015) + 894 g glyphosate/ha (9-May-2016)
Seeding Date	5-May	5-May
Cultivar	CDC Utmost VB (CWRS)	CDC Copeland (2-row malt)
Seeding Rate	325 seeds/m^2 (137 kg/ha)	250 seeds/m^2 (125 kg/ha)
Row spacing	30 cm	30 cm
Nitrogen Rate	130 kg N/ha	90 kg N/ha
In-crop herbicide	2.5 g/ha florasulam/ha + 99 g fluroxypyr/ha + 356 g MCPA ester/ha + 15 g pyroxsulam/ha (7-Jun)	2.5 g/ha florasulam/ha + 99 g fluroxypyr/ha + 356 g MCPA ester/ha + 59 g pinoxaden/ha (7-Jun)
Flag-leaf fungicide	64 g pyraclostrobin + 49 g metconazole/ha (24-Jun)	64 g pyraclostrobin + 49 g metconazole/ha (28-Jun)
Heading fungicide	100 g prothioconazole/ha + 100 g tebuconazole/ha (6-Jul)	89 g metconazole/ha (9-Jul)
Pre-harvest herbicide	890 g glyphosate/ha (21-Aug)	–
Harvest date	21-Aug (centre 5 rows)	31-Aug (centre 5 rows)

10. Results:

Growing Season Weather & Soil Test Information

Mean monthly temperatures and precipitation amounts for the 2016 growing season at Indian Head along with the long-term averages for Indian Head (1981-2000) are presented in Table 2. The season was initially dry but with excellent conditions for planting and good subsurface moisture. While May was initially warm and dry, large amounts of precipitation were received late in the month and amounted to 140% of the long-term average. Total precipitation for June was 81% of average while July was wet (177%) and August was relatively dry (58%) compared to the long-term average. The total amount of precipitation from April 1 through August 31 was 292 mm (11.7"), 9% above the 20-year average. Temperatures were higher than normal for May and June and approximately normal in July and August. Unfortunately, the plots were damaged by hail on July 15 (mid-late heading) with the surrounding barley fill crop incurring estimated losses of approximately 20% (according to 3rd party insurance adjusters). The damage was considered uniform across the study area and therefore the trial was still considered viable despite the negative impacts on yield.

Table 2. Mean monthly temperatures and precipitation amounts along with long-term averages (LT; 1981-2010) averages for the 2016 growing season at Indian Head, Saskatchewan.

Year	April	May	June	July	August	Avg/Tot
	--- Mean Temperature (°C) ---					
2016	3.8	14.0	17.5	18.5	17.2	14.2
LT [Z]	4.2	10.8	15.8	18.2	17.4	13.3
	--- Precipitation (mm) ---					
2016	13.9	72.6	63	112.8	29.8	292
LT [Z]	22.6	51.8	77.4	63.8	51.2	267

A composite soil sample for the study area was collected prior to seeding and submitted to AgVise Laboratories for various analyses (Table 3). Soil pH for the upper 15 cm was 7.2 with 6.0% organic matter and a relative high cation exchange capacity of 40.3 Meq. Residual soil P was relatively low at 8 ppm Olsen P, or approximately 14 kg/ha available P while K, as expected at this location, was extremely high (771 ppm or 1376 kg/ha for the 0-15 cm soil profile).

Table 3. Soil test results for the 2016 wheat/barley phosphorus and potassium response ADOPT demonstration at Indian Head, Saskatchewan.

Soil Depth	pH	O.M.	NO_3-N	Olsen-P	K	S	C.E.C.
(cm)		---- % ----	- ppm [Z] -	-- ppm --	-- ppm --	-- ppm --	-- Meq --
0-15	7.2	6.0	6	8	771	7	40.3
15-60	8.0	–	2	–	–	8	–
kg/ha	–	–	23	14	1376	61	–

[Z] Based on estimated soil bulk density and observed soil test ppm values

Crop Response to Phosphorus and Potassium Fertilization

Tests of all fixed effects for lodging, grain yield, test weight, TKW and plump/thin kernels (barley only) are presented in Table 4. In these tests, p-values of 0.05 or less indicate statistical significance and suggest that observed differences are due to treatment effects as opposed to random and naturally occurring variability. Main effect treatment means are presented in Table 5 and significant treatment effects will be discussed separately for each response variable.

Table 4. Overall F-test results for the effects of crop type (C), phosphorus rate (P) and potassium rate (K) and their interactions for selected response data at Indian Head (2016). P values less than or equal to 0.05 are considered statistically significant.

Source	Lodging Index	Grain Yield	Test Weight [z]	1000 Kernel Weight [z]	Plump Seeds	Thin Seeds
	------	------	------ p-values	------	------	------
Crop Type (C)	0.347	**< 0.001**	**< 0.001**	**< 0.001**	–	–
P_2O_5 Rate (P)	**<.001**	**<0.001**	0.410	0.579	0.601	0.970
K_2O (K)	0.275	0.325	0.933	0.244	0.686	0.429
C × P	0.063	0.091	0.644	0.146	–	–
C × K	0.737	0.922	0.275	0.239	–	–
P × K	0.775	**0.001**	0.489	0.894	0.494	0.163
C × P × K	0.459	**<0.001**	0.886	0.970	–	–

[z] Heterogeneous variance estimates for each crop type utilized to improve model convergence

While early season crop biomass was not formally measured, plants in the treatments where P fertilizer was applied were visibly larger and growing more vigorously than those which did not receive any P fertilizer. This effect was most apparent prior to the in-crop herbicide applications and was observed for both wheat (Fig. 1) and barley (Fig. 2).

Figure 1. Early season vegetative response to phosphorus fertilization in CDC Utmost CWRS wheat at Indian Head (2016). Unfertilized control (right) versus 60 kg/ha of side-banded P_2O_5 (left).

Figure 2. Visible, early season vegetative response to P fertilization in CDC Copeland 2-row barley at Indian Head (2016). Untreated control (right) versus 60 kg/ha of side-banded P_2O_5 (left).

Lodging index (LI) was similar, and relatively high, for both crop types (C) with average values of 4.0-4.3 (maximum of 10) where a value of 10 would indicate that the entire crop was completely flat. The only factor that affected crop lodging was P rate (P) whereby lodging was least severe when no P was applied (2.4) but increased as the P rate was increased to 30 (4.5) and 60 kg P_2O_5/ha (5.5). While K fertilization is sometimes suggested to improve straw strength in cereal crops, no effect of K on lodging was detected for either crop in the current study. There were no significant interactions between factors detected for lodging.

Grain yield was affected by crop type and P rate and the P × K and C × P × K interactions were also significant. The overall average barley yield of 5467 kg/ha was higher than wheat (4514 kg/ha) but, for both crops, the response to P was negative and unexpected. Averaged across crop types, yields were 4939 kg/ha with P fertilizer and 3% lower than yields in the plots where no P fertilizer was applied (5094 kg/ha). This response was consistent for both wheat (where yields were 2% lower with P fertilizer) and barley (4% lower yields with P fertilizer; Table 6) and unexpected considering the low residual soil P levels and observed early season response. The observed impacts on yield were likely due to the observed lodging to a large extent. When lodging occurs too early in the season yield losses can occur and, regardless of the impact on yield, lodging creates significant harvest challenges and loss in efficiency. In small plot trials, lodging can also increase yield variability due to potential effects on the accuracy of harvest area. The P × K interaction (data not shown) was primarily a result of the C × P × K interaction as it only occurred with barley. Rather difficult to explain, this interaction was due to an inconsistent response to K fertilizer depending on the P rate. With no P fertilizer, K did not affect barley yield while, at 30 kg P_2O_5, a 7% yield increase with K was observed and the opposite (7% yield reduction) with K was observed when 60 kg P_2O_5 was applied (Table 7). For wheat, the addition of 20 kg K_2O/ha did not affect yield regardless of P fertilizer rate.

Table 5. Treatment means for crop type (C), P_2O_5 rate (P) and K_2O (K) effects on selected response variables at Indian Head (2016). Main effect means followed by the same letter do not significantly differ according to Fisher's protected LSD test (*P* ≤ 0.05).

Main Effect (C/P/K)	Lodging Index	Grain Yield	Test Weight [Z]	1000 Kernel Weight [Z]	Plump Seeds [Y]	Thin Seeds [Y]
	---- 1-10 ----	--- kg/ha ---	--- g/0.5 l ---	g/1000 seeds	------ % ------	------ % ------
Wheat	4.33 a	4514 b	377.2	30.5 b	–	–
Barley	3.99 a	5467 a	309.1	42.9 a	–	–
S.E.M.	0.212	31.5	0.90/1.19	0.21/0.35	–	–
0 kg P_2O_5 ha^{-1}	2.39 c	5094 a	343.3	36.5 a	91.7 a	1.2 a
30 kg P_2O_5 ha^{-1}	4.45 b	4971 b	342.3	36.7 a	91.3 a	1.2 a
60 kg P_2O_5 ha^{-1}	5.53 a	4907 b	343.8	36.9 a	92.3 a	1.2 a
S.E.M.	0.193	31.5	1.02	0.29	0.98	0.21
0 kg K_2O ha^{-1} [Y]	4.25 a	4975 a	343.1 a	36.5 a	91.6 a	1.3 a
20 kg K_2O ha^{-1}	4.06 a	5007 a	343.2 a	36.9 a	91.9 a	1.1 a
S.E.M.	0.173	27.1	0.89	0.25	0.91	0.20

[Z] Heterogeneous variance estimates for each crop type utilized to improve model convergence
[Y] Percent plump and thin kernels were only determined for barley

Test weight was affected by crop type but not by any of the P or K fertilizer treatments alone or in combination. The overall mean test weights achieved were relatively low at 377 g/0.5 l (58.5 lb/W. bu) for wheat and 309 g/0.5 l (48.0 lb W./bu) for barley (Table 5).

Thousand kernel weight (TKW) is an important yield component and, similar to test weight, was affected by crop type but not any of the fertilizer treatments. For wheat, the overall mean TKW was 30.5 g/1000 seeds and, for barley, the observed mean was 42.9 g/1000 seeds (Table 5). Typical TKW values for CWRS wheat and 2-row barley range from about 31-38 g/1000 seeds and 40-50 g/1000 seeds, respectively; thus, the seed weights in this case (similar to test weight) were considered relatively low for the region.

Percent plump and thin kernels were only measured for the barley and were not affected by the P and K fertilizer treatments alone or combined. While not official grading factors, these measures can be important to end users who desire both high percent plump and low percent thin kernels. In the current study, overall averages of 91.8% plump and 1.2% thin kernels were achieved.

Table 6. Treatment means for crop type (C) interactions with P_2O_5 rate (P) and K_2O rate (K) for selected response variables at Indian Head (2016). Means followed by the same letter do not significantly differ according to Fisher's protected LSD test (*P* ≤ 0.05).

Interaction (C × P)	Lodging Index	Grain Yield	Test Weight [Z]	1000 Kernel Weight [Z]	Plump Seeds	Thin Seeds
kg P_2O_5/ha	---- 1-10 ----	--- kg/ha ---	--- g/0.5 l ---	g/1000 seeds	------ % ------	------ % ------
Wheat – 0 P	2.31 d	4569 c	377.5 a	29.9 c	–	–
Wheat – 30 P	4.70 bc	4534 cd	376.9 a	30.8 b	–	–
Wheat – 60 P	5.96 a	4440 d	377.3 a	30.8 b	–	–
Barley – 0 P	2.48 d	5619 a	309.2 b	43.1 a	–	–
Barley – 30 P	4.41 c	5408 b	307.7 b	42.5 a	–	–
Barley – 60 P	5.09 b	5375 b	310.4 b	43.0 a	–	–
S.E.M.	0.273	44.5	1.09/1.72	0.24/0.53	–	–
kg K_2O/ha	---- 1-10 ----	--- kg/ha ---	--- g/0.5 l ---	g/1000 seeds	------ % ------	------ % ------
Wheat – 0 K	4.39 a	4500 b	377.7 a	30.5	–	–
Wheat – 20 K	4.26 a	4529 b	376.7 a	30.5	–	–
Barley –0 P	4.12 a	5450 a	308.5 b	42.5	–	–
Barley – 20 P	3.87 a	5485 a	309.6 b	43.3	–	–
S.E.M.	0.245	38.4	1.00/1.48	0.22/0.45	–	–

[Z] Heterogeneous variance estimates for each crop type utilized to improve model convergence

Table 7. Least squares means for individual crop type (C), P_2O_5 rate (P) and K_2O rate (K) treatments for selected response variables at Indian Head (2016). Means followed by the same letter do not significantly differ according to Fisher's protected LSD test ($P \leq 0.05$).

Crop × P × K	Lodging Ratings	Grain Yield	Test Weight [z]	Kernel Weight [z]	Plump Seeds	Thin Seeds
kg P_2O_5-K_2O/ha	---- 1-10 ----	--- kg/ha ---	--- g/0.5 l ---	g/1000 seeds	------ % ------	------ % ------
Wheat – 0 – 0	2.45 d	4567 c	378.6 a	29.9 c	–	–
Wheat – 0 – 20	2.18 d	4570 c	376.5 a	29.9 c	–	–
Wheat – 30 – 0	4.70 bc	4544 cd	376.8 a	30.7 b	–	–
Wheat – 30 – 20	4.70 bc	4524 cd	376.9 a	30.8 b	–	–
Wheat – 60 – 0	6.03 a	4388 d	377.8 a	30.8 b	–	–
Wheat – 60 – 20	5.90 a	4492 cd	376.8 a	30.7 b	–	–
Barley – 0 – 0	2.48 d	5564 a	309.1 b	42.9 a	92.2 a	1.2 a
Barley – 0 – 20	2.48 d	5673 a	309.3 b	43.4 a	91.3 a	1.2 a
Barley – 30 – 0	4.78 bc	5216 b	306.0 b	42.1 a	90.6 a	1.5 a
Barley – 30 – 20	4.05 c	5600 a	309.3 b	43.0 a	92.0 a	0.9 a
Barley – 60 – 0	5.10 ab	5569 a	310.4 b	42.7 a	92.0 a	1.1 a
Barley – 60 – 20	5.08 ab	5181 b	310.3 b	43.4 a	92.5 a	1.3 a
S.E.M.	0.345	59.3	1.31/2.29	0.28/0.73	1.19	0.26

[z] Heterogeneous variance estimates for each crop type utilized to improve model convergence

Extension and Acknowledgement

This demonstration was featured at the Indian Head Crop Management Field Day in 2016 (July 19, 219 registered guests) where Chris Holzapfel (IHARF) and Dr. Brian Beres (AAFC-Lethbridge) led the cereal crop segment of the tour and discussed short and long-term P fertility strategies and the potential merits (or lack thereof) of K fertilization in high K soils during this segment. The trial was also highlighted on a tour co-hosted with Arysta Lifesciences (July 26, 2016, 45 guests). In addition to these formal tours, the site was visited by numerous growers, agronomists and researchers over the season. A summary of this work will be included in the 2016 IHARF Annual Report which, in addition to the full report, will be available online. Results will also be made available through a variety of other media (i.e. oral presentations, popular agriculture press, social media, fact sheets, etc.) as opportunities arise.

11. Conclusions and Recommendations

This project was initiated to demonstrate the response of CWRS wheat and 2-row malting barley to P and K fertilization on a site that was low in residual P but high in K. A secondary objective was to provide a forum for the discussion of P management strategies and to encourage growers to think about their long-term objectives and fertilize accordingly. While the actual responses to P in the current trial were unexpectedly negative, it is not uncommon for yield responses to P to be elusive, particularly when residual levels are high or in high organic matter soils. That said, P fertilization can often be highly beneficial in the early spring and maintaining (or in many cases building) residual P levels is considered important by many from long-term soil productivity/fertility perspective. The potential merits of K fertilization in Saskatchewan, particularly in high K soils, are less well understood. The most common and economical form of K fertilizer is KCl (0-0-60). Some crops (i.e. canaryseed) have been proven to respond well specifically to the Cl component of this product. The Cl in potash has also been suggested to suppress certain soil-borne diseases but field trials in western Canada have not been able to validate this. Sufficient potassium nutrition results in stronger straw and improved seed filling while deficiency can result in stunted growth, delayed maturity, lodging and lower bushel weight. Due to its low mobility, K can theoretically be limiting in cold, dense soils (even with high residual K); however most research in western Canada has shown similar responses to K (in most cases no response) regardless of seeding date. In the current trial, KCl application did not affect crop lodging or any of the grain quality parameters measured and yield responses were not significant in wheat and inconsistent in barley. Consequently, there was no compelling evidence that K was limiting or that fertilizer application was agronomically benefit in this particular trial. Fertilizer applications and appropriate rates for both P and K should be based on known soil properties, residual nutrient levels and long-term soil fertility goals.

Supporting Information

12. 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. Acknowledgement of the Saskatchewan Ministry of Agriculture’s support for this demonstration will be included as part of all written reports and oral presentations that arise from this work. The crop protection products evaluated in this demonstration were provided in-kind by BASF, Bayer CropScience and Syngenta. The technical, administrative and professional support of Danny Petty, Dan Walker, Karter Kattler, Carly Miller, Andrea De Roo and Christiane Catellier is greatly appreciated.

13. Appendices

<u>Abstract</u>

14. Abstract/Summary:

A field trial with CWRS wheat and 2-row barley was initiated at Indian Head in 2016 to demonstrate crop response to P fertilizer (11-52-0) rates and KCl (0-0-60) application. In the first week of May, the plots were direct-seeded into canola stubble managed under a no-till continuous cropping system with all aspects other than P and K fertility intended to be non-limiting. Early in the season (i.e. in-crop herbicide time), the plots where P fertilizer was applied were visibly more vigorous; however, under the conditions encountered during heading this extra growth led to more lodging and, unexpectedly, slightly but significantly lower yields for both crops. Phosphorus rate did not affect any of the grain quality parameters or yield components measured for either crop. In the case of wheat, yields were 2% lower with P fertilizer while barley yields were 4% lower with P fertilizer. Potassium application did not affect any of the response variables evaluated with the exception of an inconsistent and difficult to explain interaction between crop type, P rate and K rate. The interaction was due to effects on barley where K application either had no effect, increased yield or decreased yield depending on the P rate. This demonstration was highlighted during two formal field tours and multiple smaller private tours with a total of over 300 farmers and agronomists visiting the site.
