2018 Annual Report
for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Demonstrating the Nitrogen Rate Response of Contrasting Winter Wheat Classes

(Project #20170322)

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Project Identification

1. **Project Title:** Demonstrating the nitrogen rate response of contrasting winter wheat classes
2. **Project Number:** 20170322
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):** September-2017 to February-2019
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

The primary objective was to demonstrate the nitrogen (N) rate response of modern winter wheat varieties from contrasting classes to optimize yield and protein. The N in the current project was all side-banded which would not necessarily be recommended for winter cereals; however, the information was intended to help productions understand the importance of N fertilization in winter wheat and provides insights towards whether the two classes (CWRW and CWSP) should be managed differently for optimum yield and quality.

8. **Project Rationale:**

Compared to spring cereals, winter wheat has numerous rotational benefits including potentially less disease, better weed control, increased water and nutrient use, and improved habitat for water fowl. With producers looking for new cropping options to maintain healthy rotations, winter wheat is a good option to consider. However, since the 1980's, winter wheat production has evolved with higher potential yields and multiple classes where end use requirements and, potentially, N fertilizer recommendations may differ. Winter wheat often has lower protein content than spring wheat; however, protein is still important for milling (CWRW) varieties and N fertility recommendations should account for both yield and quality. The characteristics of special purpose (CWSP) varieties and their end use can vary but in many cases high protein is less important (i.e. ethanol markets); however, varieties from this class often yield higher than CWRW varieties and may require similar N rates to realize their potential yields. This demonstration was intended to help promote winter wheat as cereal option and demonstrate the yield and protein response of milling (CWRW) versus ethanol varieties to a wide range of N rates.

Methodology and Results

9. **Methodology:**

A field trial with winter wheat was initiated in the fall of 2017 near Indian Head, Saskatchewan (50.546 N, 103.571 W) to evaluate row spacing effects and potential interactions with seeding rates. This location 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 combination of six N fertilizer rates ranging from 7-250 kg N/ha and two contrasting varieties, Moats (CWRW) and Accipeter (CWSP). The twelve treatments were arranged in a Randomized Complete Block Design (RBCD) with four replicates and are listed in Table 1.

Table 1. Winter wheat class by N fertilizer rate treatments at Indian Head in 2017-18

#	Variety – Class	Nitrogen Rate
1	Moats - CWRW	7 kg N/ha
2	Moats - CWRW	50 kg N/ha
3	Moats - CWRW	100 kg N/ha
4	Moats - CWRW	150 kg N/ha
5	Moats - CWRW	200 kg N/ha
6	Moats - CWRW	250 kg N/ha
7	Accipeter - CWSP	7 kg N/ha
8	Accipeter - CWSP	50 kg N/ha
9	Accipeter - CWSP	100 kg N/ha
10	Accipeter - CWSP	150 kg N/ha
11	Accipeter - CWSP	200 kg N/ha
12	Accipeter - CWSP	250 kg N/ha

Selected agronomic information is provided in Table 2. The winter wheat was direct-seeded approximately 2 cm (0.75") deep into canola stubble with seeding rates adjusted for seed size and germination to target 400 viable seeds/m^2. Aside from N which was varied as per protocol, fertility was intended to be non-limiting with 7-35-48-16 kg N-P_2O_5-K_2O-S/ha supplied at seeding as side-banded monoammonium phosphate and potassium sulphate. Weeds were controlled using registered pre-emergent and in-crop herbicide applications and foliar fungicide was applied during heading to ensure disease was not a yield and quality limiting factor. No insecticides were required. Pre-harvest glyphosate was applied at physiological maturity and the centre five rows of each plot were straight-combined when it was fit to do so.

Various data were collected over the growing season and from the harvested grain samples. To assess initial emergence and overwinter survival, the number of plants in 2 x 1 m sections of crop row were counted after emergence was complete in the fall and again in the spring with the exact same plot areas assessed at both dates. The averaged values were converted to plants/m^2 and used to calculate over-winter mortality. Due to unusually high winter kill, NDVI measurements and additional visual ratings of percent winterkill were completed in June. Grain yields were determined from the harvested grain samples and are corrected for dockage and to a uniform moisture content of 14.5%. Test weight was measured using standard CGC methods with values expressed as g/0.5 l. Protein was determined for each plot using an NIR instrument by third party facility. Daily temperatures and precipitation were recorded at the Environment Canada weather station located approximately 6 km from the field site. All response data were analysed using the Mixed procedure of SAS with the effects of variety (VAR), nitrogen rate (NR) and their interaction (VAR × NR) considered fixed and replicate effects treated as random. Individual treatment means were separated using Fisher's protected LSD test and orthogonal contrasts were used to determine whether the observed responses to N rate were linear or quadratic (curvilinear) with separate contrasts used to describe the responses separately for each variety. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

Table 2. Selected agronomic information for the winter wheat N fertilizer response demonstration at Indian Head in 2017-18.

Factor / Field Operation	Indian Head 2017-18
Previous Crop	Canola
Pre-emergent herbicide	894 g glyphosate/ha + 5 g florasulam/ha Sep-17-2017
Seeding Date	Sep-18-2017
Seed Rate	400 seeds/m^2
kg P_2O_5-K_2O-S ha^{-1}	35-48-16
Fall Emergence	Oct-30-2018
Spring Emergence	May-9-2018
Winterkill Ratings	Jun-14-2018
NDVI	Jun-28-2018
In-crop Herbicide	280 g bromoxynil/ha + 280 g MCPA/ha + 15 g pyroxsulam/ha Jun-5-2018
Foliar Fungicide	100 g prothioconazole/ha + 100 g tebuconazole/ha Jul-2-2018
Pre-harvest herbicide	894 g glyphosate/ha Aug-10-2018
Harvest date	Aug-24-2018

10. Results:

Growing season weather and residual soil nutrients

The winter wheat was seeded into extremely dry soil but timely rains afterwards resulted in excellent initial germination and sustained growth through the fall. Still, conditions were considered dry going into winter and very little snow accumulated until March. Weather data for the 2018 growing season at Indian Head is presented with the long-term (1981-2010) averages in Table 3. While there was essentially no precipitation early in May, 24 mm was received towards the end of the month and, at 90 mm, total precipitation in June was 116% of the long-term (1981-2010) average. The remainder of the season was very dry with less than 50% of the long-term average in July and essentially no precipitation in August. Averaged over the four months (May-August), a total of 148 mm of rainfall was received, or 61% of the long-term average. Temperatures were well above average in May and, to a lesser extent, June but below average in July and approximately average in August. Averaged over the four months the mean temperature in 2018 was 16.4 °C compared to long-term average of 15.6 °C. Overall, it was a challenging season for winter cereals with substantial winter kill and early season drought stress that restricted spring growth and prevented the crop from compensating for the reduced stands as well as it might have under better conditions.

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

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 at the time of seeding (0-15 cm, 15-60 cm) and analyzed for basic properties and residual nutrient levels (Table 4). The field site had a relatively low organic matter for the region of 3.7% and residual N levels were extremely low with only 10 kg NO_3-N/ha measured in the 0-60 cm soil profile. Residual P was considered very low while K and S levels were higher; however, all nutrients other than N were intended to be non-limiting across treatments.

Table 4. Selected soil test results for winter wheat demonstration at Indian Head, Saskatchewan (2017-18).

Attribute / Nutrient	0-15 cm	15-60 cm	0-60 cm
pH	8.1	8.3	–
S.O.M. (%)	3.7	–	–
NO_3-N (kg/ha)[Z]	4	6	10
Olsen-P (ppm)	3	–	–
K (ppm)	387	–	–
S (kg/ha)	11	18	29

Field Trial Results

Results for the overall tests of fixed effects are presented in Table 5. The main effects of variety / class and N rate were significant in a few specific cases but no significant interactions between the two factors were detected for any variables (P = 0.277-0.922).

Table 5. Overall tests of fixed effects (variety, N rate and their interaction) for various winter wheat response variables. P-values greater than 0.05 indicate that an effect was not statistically significant.

Variable	Variety (VAR)	N Rate (NR)	VAR × NR
	------------------------------	p-values	------------------------------
Fall Plant Density	0.784	0.024	0.277
Spring Plant Density	0.305	0.504	0.777
Percent Winter-kill	0.189	0.673	0.901
NDVI	0.041	0.059	0.922
Grain Yield	0.002	<0.001	0.426
Test Weight	<0.001	0.302	0.706
Grain Protein	0.936	<0.001	0.545

Although conditions at seeding were extremely dry, there was sufficient precipitation in in late September/early October for excellent initial emergence of the winter wheat. Fall plant populations were similar for the two varieties but, on average declined linearly with increasing N rate (Fig. 1). The response was similar for both varieties but, even at the highest N rates, initial plant populations were considered more than adequate for optimizing yield averaging 358 plants/m^2. Unfortunately, the combination of dry soils going into winter, well below normal snow pack, and extreme temperatures led to higher than usual over-winter mortality and plant populations were variable and much lower in the spring Fig. 2). When the plots were assessed in May, the overall average plant populations (across all treatments) were only 195 plants/m^2 compared to 374 plants/m^2 in the late fall. While the average populations in the spring were still reasonably high, the overall variability combined with the dry conditions prevented the crop from recovering the to the extent were yields were unlikely to be compromised. Despite the significant N rate effect detected in the fall, spring plant populations were not affected by variety (P = 0.305) or N rate (P = 0.504). To assess whether the treatments affected the crop's ability to survive the winter under the stressful conditions encountered, fall and spring plant densities were used to calculate percent over-winter mortality (Fig. 3). Percent mortality was not affected by either variety (P = 0.189), N rate (P = 0.673), or their interaction (P = 0.901). Averaged across varieties and N rates, 48% of the plants established in the fall did not survive the winter. NDVI was used an objective indicator of overall canopy densities later in the spring but prior to heading (Fig. 4). With a variable stand and dry early spring weather, the values were generally low but NDVI of Accipiter CWSP was slightly higher (0.26) than that of Moats CWRW (0.23). While NDVI tended to be highest at the relatively modest 50 kg/ha N rate, the p-values associated with both the overall F-test and quadratic orthogonal contrast were only marginally significant (P = 0.058-0.059).

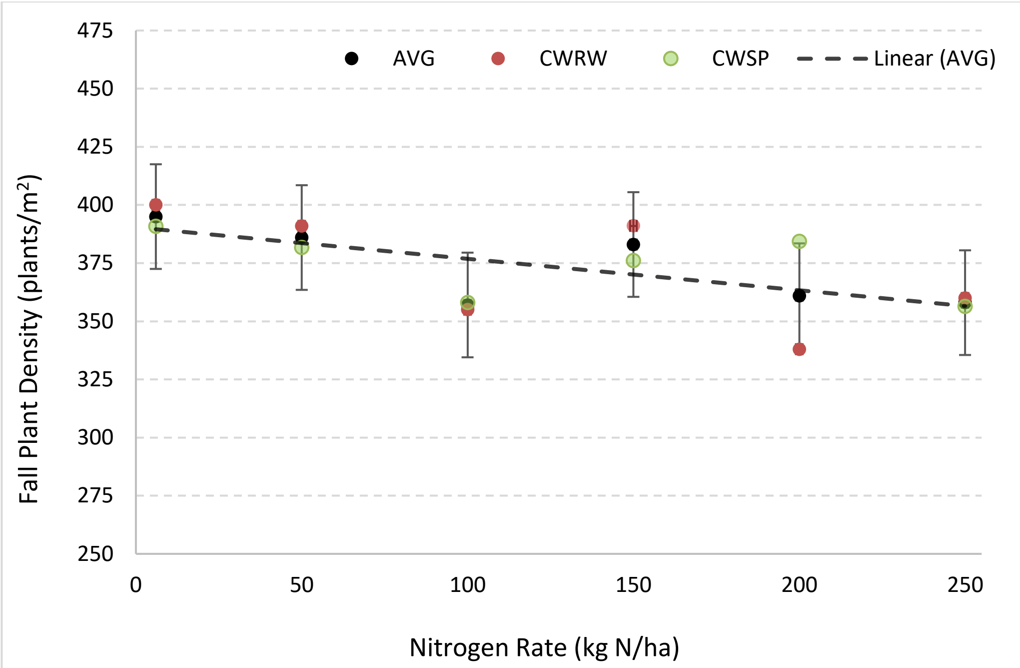

Figure 1. Side-banded N rate effects on winter wheat plant populations in the fall of 2017 at Indian Head. The main effect of N rate was significant ($P = 0.024$) but there was no variety effect ($P = 0.784$) or interaction ($P = 0.277$) detected. Error bars are the standard error of the treatment means (S.E.M.).

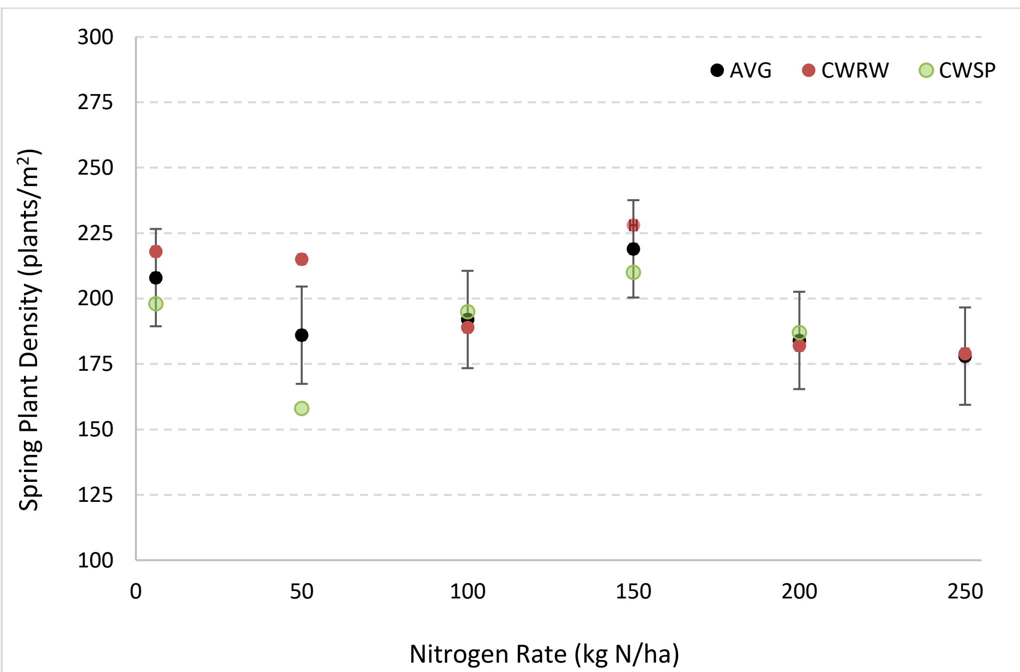

Figure 2. Side-banded N rate effects on winter wheat plant populations in the spring of 2018 at Indian Head. Neither of the main effects or their interaction were significant ($P = 0.305$-0.777). Error bars are the standard error of the treatment means (S.E.M.).

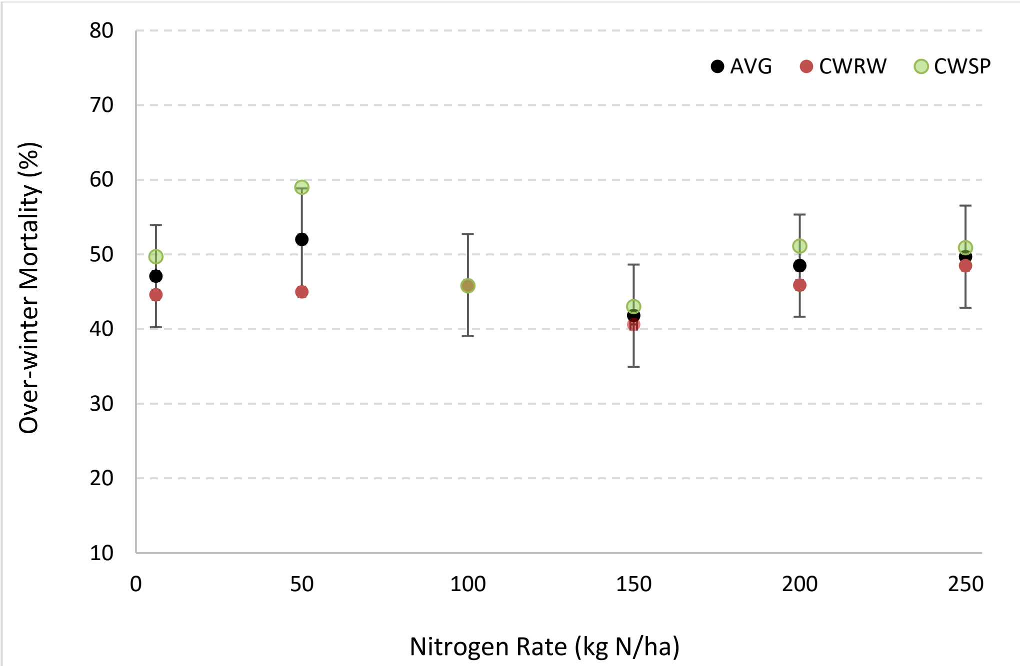

Figure 3. Side-banded N rate effects on over-winter mortality in winter wheat (based on fall and spring plant counts) at Indian Head (2017-18). Neither of the main effects nor their interaction were significant (*P* = 0.189-0.901). Error bars are the standard error of the treatment means (S.E.M.).

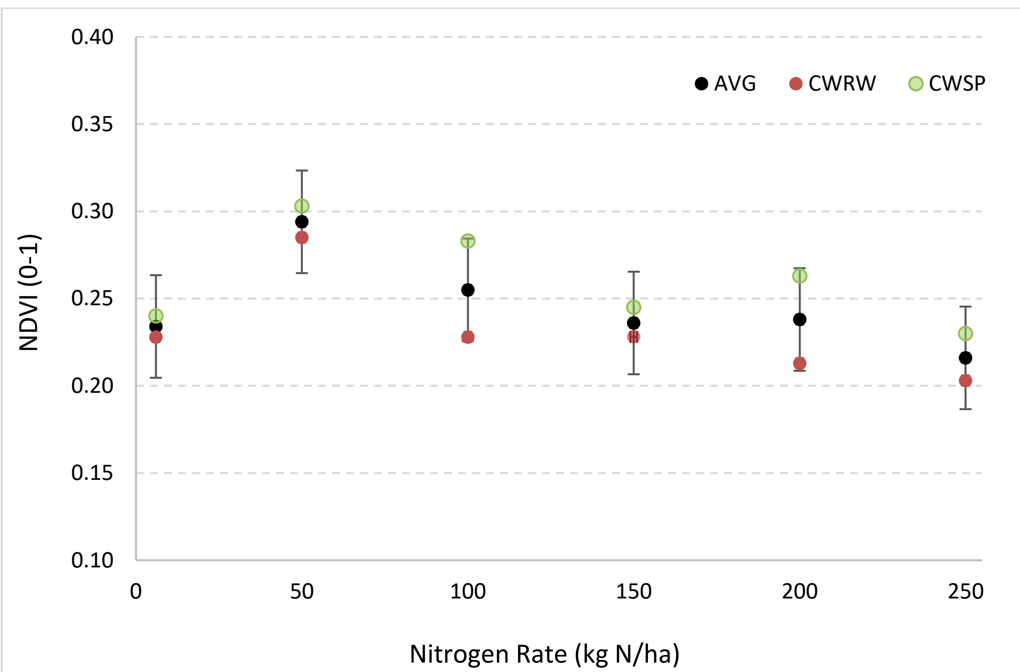

Figure 4. Side-banded N rate effects on winter wheat NDVI (June 28) at Indian Head (2017-18). The mean NDVI of the two classes differed (*P* = 0.041) but the overall N response was only marginally significant (*P* = 0.059) and neither the interaction nor any orthogonal contrasts were significant (*P* = 0.095-0.922). Error bars are the standard error of the treatment means (S.E.M.)

Not unexpectedly given the challenging environmental conditions and over-winter mortality, yields were below average overall (Fig. 5); however, both variety ($P = 0.002$) and N rate ($P < 0.001$) effects were detected. There was no significant interaction between the two factors ($P = 0.426$) for grain yield. Averaged across N rates, Accipiter (3180 kg/ha) yielded 321 kg/ha, or 11%, higher than Moats CWRW (2859 kg/ha). Averaged across varieties, the control (2353 kg/ha) yielded significantly lower than all fertilizer treatments which ranged from 2973-3343 kg/ha. Significant differences amongst the fertilized treatments were rare; however, yields were highest at the fairly modest rate of 100 kg N/ha and tended to level off or even decline slightly with further increases in N rate.

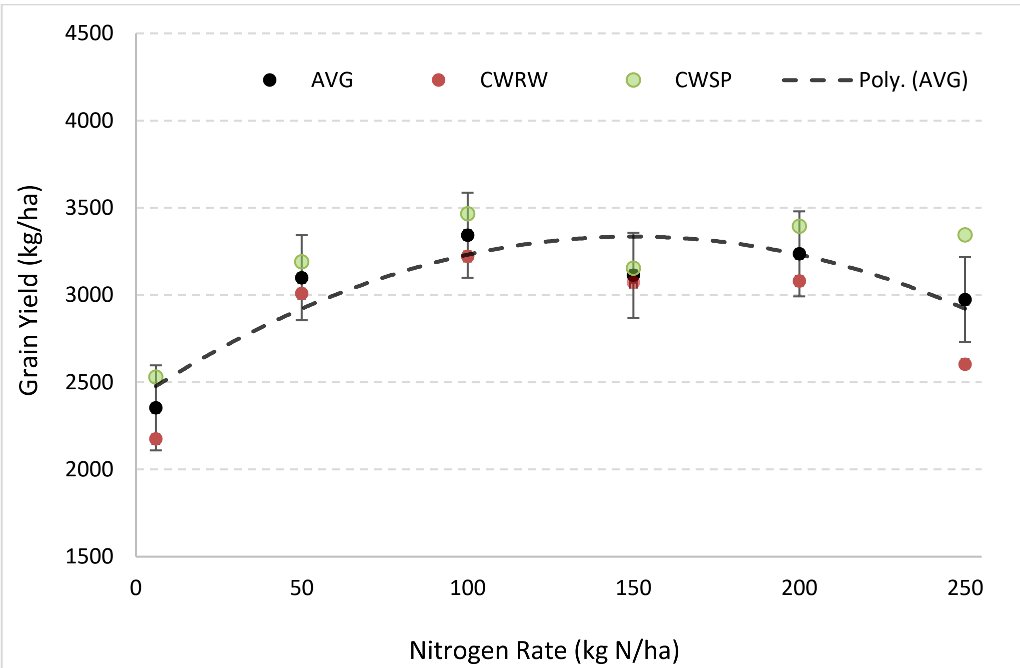

Figure 5. Side-banded N rate effects on winter wheat grain yield at Indian Head (2017-18). The mean yields of the two classes differed slightly in favour of the CWSP variety ($P = 0.002$) and the overall quadratic response to N was highly significant ($P < 0.001$) with no interaction between main effects ($P = 0.426$). Error bars are the standard error of the treatment means (S.E.M.).

Although standards for minimum test weight are less stringent for CWSP than for CWRW, test weight of the Accipiter was significantly ($P < 0.001$) higher than that of the Moats (Fig. 6). However, at 390 versus 395 g/0.5 l, the differences were negligible in practical terms and all individual treatments exceeded the minimum requirement of 386 g/0.5 l for #1 CWRW. The effect of N rate on test weight was not significant ($P = 0.302$) and none of the orthogonal contrasts indicated any relationship between N fertility and test weight ($P = 0.151$-0.983).

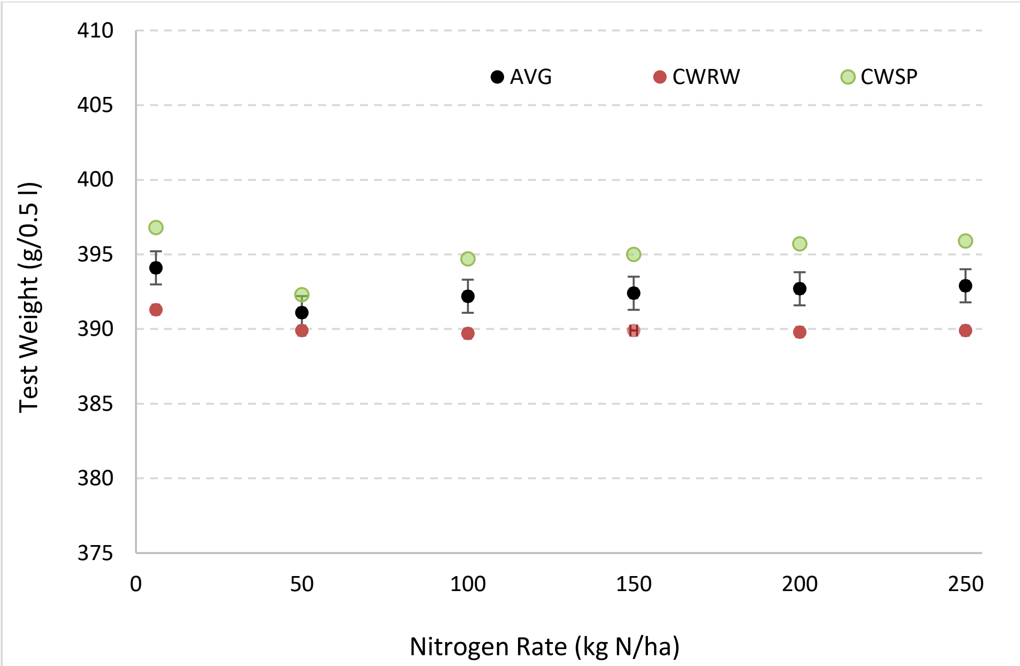

Figure 6. Side-banded N rate effects on winter wheat test weight at Indian Head (2017-18). While test weights differed between classes (*P* < 0.001), neither N rate effect nor the interaction were significant (*P* = 0.302-0.706). Error bars are the standard error of the treatment means (S.E.M.).

Grain protein concentrations were affected by N rate (*P* < 0.001) but not variety (*P* < 0.936) and there was no interaction between the two factors (*P* = 0.545). Averaged across varieties, percent grain protein ranged from 9.2% in the control to 12.4% at the highest rate; however, the response was quadratic (*P* < 0.001) with the greatest gains when N was increased from 6-100 kg/ha and no statistically significant differences amongst N rates ranging from 100-250 kg N/ha (Fig. 7; Table 8). For each of the two varieties/classes individually, the range was 9.1-9.3% in the control to 12.3-12.4% at 250 kg N/ha and the values did not differ between varieties at any individual N rate (Fig.7; Table 9). Although small, insignificant increases in protein were observed as the N rate was increased past 100 kg N/ha, both yield and protein were maximized at similar N rates. It is likely that the responses would have differed to some extent under more optimal conditions when other factors were less limiting to yield.

A basic marginal economic analyses was completed from the actual yields and assumed grain prices of $169/tonne for CWRW and $166/tonne for CWSP along with an N price of $1.02/kg N or $470/Mt bulk urea. Revenues do not take into account any potential protein premiums and the marginal profits calculated do not take all expenses into account (Table 10). The values presented illustrate how the optimum economic N rate tends to be lower than the rate where yields are maximized with the highest profits at a modest 50 kg N/ha but relatively little change in profitability as that rate was increased to 100 kg N/ha. Further additions of N (i.e. 150-250 kg N/ha became increasingly less profitable. The values presented show slightly higher profits for CWSP compared CWRW wheat however, the actual results may vary depending on the premium associated with milling wheat as well as the performance of individual varieties.

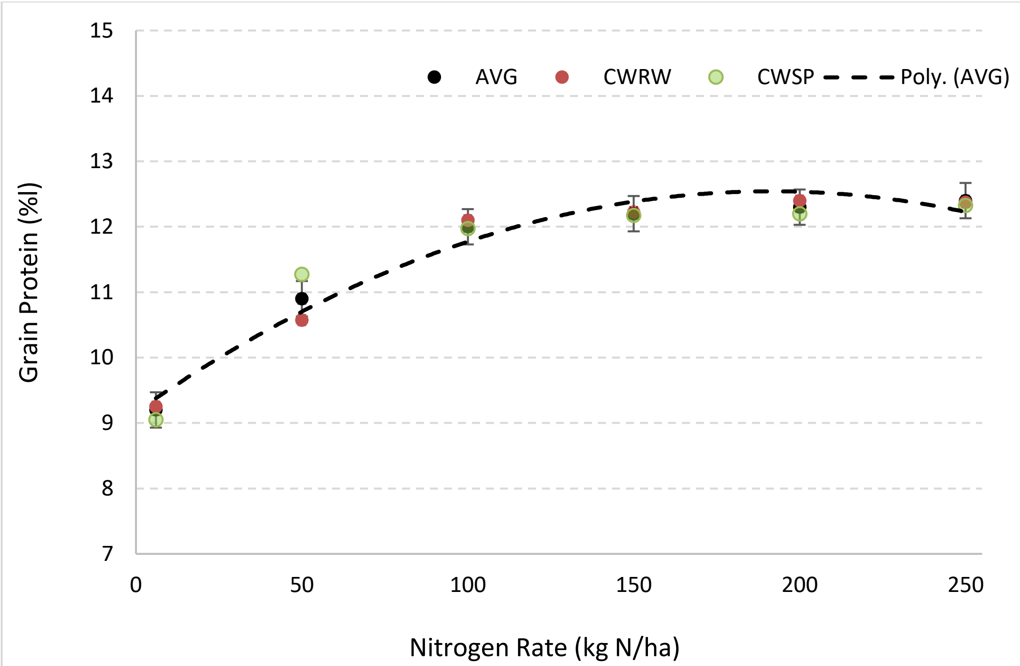

Figure 7. Side-banded N rate effects on winter wheat grain protein concentration at Indian Head (2017-18). Percent protein did not differ between classes (*P* = 0.936) and there was no interaction (*P* = 0.545) but the N response was significant (*P* < 0.001). Error bars are the standard error of the treatment means (S.E.M.).

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 Chris Holzapfel introducing the project and discussing the specific objectives, SCIC staff led an in-depth discussion of the potential for winter kill, assessing winter cereal crops in the spring and insurance options for winter cereals. 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

With the compromised stand and dry weather, conditions were, unfortunately, not ideal for assessing the potential winter wheat yield and protein response to a wide range of N fertilizer rates. However, the conditions encountered did provide a unique opportunity to discuss assessing winter cereal establishment in the spring and investigate potential differences in winter-kill across classes and N fertility levels. While there was a slight decline in fall plant populations with increasing N rates, the magnitude was small and the risk of injury was higher than in our clay soils under the extremely dry seeding conditions. Although winter kill was relatively severe, it did not appear to be affected by side-banded N rate and was similar for both varieties; however, it would still generally not be recommended to apply the extremely high rates evaluated in the current project during seeding with winter cereals. Despite the challenging conditions, there was still a 34% yield increase with N fertilizer when averaged across varieties and N rates; however, yields were maximized at relatively modest rates compared to what might be expected under more optimal conditions. Although test weight was not affected by N fertilizer, percent protein increased quadratically with N rate from approximately 9.2% in the control to

120-12.4% at N rates of 100 kg N/ha and beyond. Both the absolute values and the nature of the response to N for protein were similar for both varieties/classes. Overall, producers are advised to consider soil test information, soil/environmental conditions, past yield potential and protein requirements when deciding upon appropriate winter wheat N rates. Depending on the rates, environmental conditions, and field characteristics (i.e. drainage), it may be preferable to defer a portion of the N requirements until early spring in order to reduce potential N losses prior to peak crop uptake. The economic optimum rate is typically lower than that required to maximize yield; however, profits are generally reasonably well buffered between these two rates.

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 Dow Agrosciences and Bayer CropScience. IHARF also has a strong working relationship and memorandum of understanding with Agriculture & Agri-Food Canada.

12. Appendices

Table 6. Main effect means and orthogonal contrast results for variety and N rate effects on winter wheat emergence, winter survival and NDVI. 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	Fall Plant Density	Spring Plant Density	Winter Mortality	Late-Spring NDVI
Wheat Class	---- plants/m^2 ----	---- plants/m^2 ----	--------- % ---------	-------- 0-1 --------
CWRW	372 a	202 a	45.1 a	0.230 b
CWSP	375 a	188 a	49.9 a	0.260 a
S.E.M.	21.1	12.6	3.82	0.0259
N Rate				
7 kg N/ha	395 a	208 a	47.1 a	0.234 b
50 kg N/ha	386 ab	186 a	52.0 a	0.294 a
100 kg N/ha	357 c	192 a	45.9 a	0.255 ab
150 kg N/ha	383 abc	219 a	41.8 a	0.236 b
200 kg N/ha	361 bc	184 a	48.5 a	0.238 b
250 kg N/ha	358 c	178 a	49.7 a	0.216 b
S.E.M.	22.5	18.6	5.24	0.0294
NR-linear	0.007	0.372	0.954	0.058
NR-quadratic	0.488	0.542	0.382	0.170

Table 7. Treatment means and orthogonal contrast results for individual variety × N rate effects on winter wheat emergence, winter survival and NDVI. 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).

Individual Treatment	Fall Plant Density	Spring Plant Density	Winter Mortality	Late-Spring NDVI
Class – N Rate	--- plants/m^2 ---	--- plants/m^2 ---	------- % -------	------- 0-1 -------
CWRW – 7 kg N/ha	400 a	218 a	44.6 a	0.228 bcd
CWRW – 50 kg N/ha	391 ab	215 a	45.0 a	0.285 ab
CWRW – 100 kg N/ha	355 bc	189 a	45.9 a	0.228 bcd
CWRW – 150 kg N/ha	391 ab	228 a	40.6 a	0.228 bcd
CWRW – 200 kg N/ha	338 c	182 a	45.9 a	0.213 cd
CWRW – 250 kg N/ha	360 bc	179 a	48.5 a	0.203 d
NR – linear	0.008	0.207	0.749	0.095
NR - quadratic	0.469	0.706	0.614	0.532
CWSP – 7 kg N/ha	390.8 ab	198 a	49.7 a	0.240 a-d
CWSP – 50 kg N/ha	381.8 ab	158 a	59.0 a	0.303 a
CWSP – 100 kg N/ha	358.0 bc	195 a	45.8 a	0.283 abc
CWSP – 150 kg N/ha	376.1 abc	210 a	43.0 a	0.245 a-d
CWSP – 200 kg N/ha	384.3 ab	187 a	51.1 a	0.263 a-d
CWSP – 250 kg N/ha	356.4 bc	177 a	50.9 a	0.230 bcd
NR – linear	0.213	0.994	0.688	0.294
NR - quadratic	0.798	0.627	0.462	0.185
S.E.M.	24.5	25.1	6.84	0.0341

Table 8. Main effect means and orthogonal contrast results for variety and N rate effects on winter wheat grain yield, test weight, and grain protein. 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	Grain Yield	Test Weight	Grain Protein
Wheat Class	------- kg/ha -------	------ g/0.5 l ------	--------- % ---------
CWRW	2859 b	390.1 b	11.5
CWSP	3180 a	395.1 a	11.5
S.E.M.	225.5	0.85	0.23
N Rate			
7 kg N/ha	2353 c	394.1 a	9.2 c
50 kg N/ha	3099 ab	391.1 a	10.9 b
100 kg N/ha	3343 a	392.2 a	12.0 a
150 kg N/ha	3113 ab	392.4 a	12.2 a
200 kg N/ha	3236 ab	392.7 a	12.3 a
250 kg N/ha	2973 b	392.9 a	12.4 a
S.E.M.	243.8	1.11	0.27
NR-linear	0.002	0.983	<0.001
NR-quadratic	<0.001	0.151	<0.001

Table 9. Treatment means and orthogonal contrast results for individual variety × N rate effects on winter wheat grain, test weight and protein concentration. 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).

Individual Treatment	Grain Yield	Test Weight	Grain Protein
Class – N Rate	----- kg/ha -----	----- g/0.5 l -----	------- % -------
CWRW – 7 kg N/ha	2175 c	391.3 cd	9.3 d
CWRW – 50 kg N/ha	3008 ab	389.9 d	10.6 c
CWRW – 100 kg N/ha	3221 a	389.7 d	12.1 a
CWRW – 150 kg N/ha	3071 a	389.9 d	12.2 a
CWRW – 200 kg N/ha	3079 a	389.8 d	12.4 a
CWRW – 250 kg N/ha	2603 bc	389.9 d	12.4 a
NR – linear	0.136	0.506	<0.001
NR – quadratic	<0.001	0.483	<0.001
CWSP – 7 kg N/ha	2530 c	396.8 a	9.1 d
CWSP – 50 kg N/ha	3190 a	392.3 bcd	11.3 bc
CWSP – 100 kg N/ha	3465 a	394.7 abc	12.0 ab
CWSP – 150 kg N/ha	3154 a	395.0 ab	12.2 a
CWSP – 200 kg N/ha	3394 a	395.7 ab	12.2 a
CWSP – 250 kg N/ha	3344 a	395.9 a	12.3 a
NR – linear	0.003	0.526	<0.001
NR – quadratic	0.019	0.180	<0.001
S.E.M.	268.9	1.41	0.33

Table 10. Basic economic analyses showing estimated revenues based on actual yields, the estimated cost of N fertilizer, and marginal profits for each winter wheat class by N rate treatment. Actual grain revenues and N costs will vary and the profit values presented do not take into account all expenses.

Individual Treatment	Gross Revenue [Z]	Cost of Nitrogen [Y]	Marginal Profits
Class – N Rate	---------------------------- $/ha ----------------------------		
CWRW – 7 kg N/ha	$366.72	$7.16	$359.56
CWRW – 50 kg N/ha	$507.17	$51.13	$456.03
CWRW – 100 kg N/ha	$543.08	$102.27	$440.81
CWRW – 150 kg N/ha	$517.79	$153.40	$364.39
CWRW – 200 kg N/ha	$519.14	$204.53	$314.61
CWRW – 250 kg N/ha	$438.88	$255.66	$183.22
CWSP – 7 kg N/ha	$419.14	$7.16	$411.98
CWSP – 50 kg N/ha	$528.48	$51.13	$477.35
CWSP – 100 kg N/ha	$574.04	$102.27	$471.77
CWSP – 150 kg N/ha	$522.51	$153.40	$369.12
CWSP – 200 kg N/ha	$562.27	$204.53	$357.74
CWSP – 250 kg N/ha	$553.99	$255.66	$298.33

[Z] Assumes grain prices of $169/Mt ($4.59/bu) for CWRW and $166/tonne ($4.51/bu) for CWSP

[Y] Assumes an N price of $1.02/kg N ($0.46/lb N), or $470/Mt urea

Figure 8. Severe over-winter mortality observed in winter wheat plots on June 15, 2018.

Abstract

13. Abstract/Summary:

A field trial was established near Indian Head to demonstrate the response of contrasting winter wheat classes to a wide range of N fertilizer rates. The classes were CWRW (Moats), a milling type where high protein is desirable, and CWSP (Accipiter), a utility type that is usually grown as ethanol feedstock. The N rates evaluated were 7, 50, 100, 150, 200, and 250 kg N/ha with 7 kg/ha provided by the monoammonium phosphate and the remainder as side-banded urea. Despite dry conditions at seeding, timely precipitation events allowed for excellent initial emergence with an estimated 93% of the planted seeds emerging in the fall. There was a slight but significant decline in fall plant populations with increasing N rates; however, even at 250 kg N/ha approximately 90% of the planted seeds emerged with mean populations of 358 seeds/m^2. Despite the initially high populations, dry conditions, lack of snow cover and cold temperatures resulted in substantial winter-kill and spring plant populations were only 52% of those recorded in the fall, averaging 195 plants/m^2. Over-winter mortality was similar regardless of variety or N rate and, combined with the dry spring, was a major yield limiting factor. Despite challenging conditions, there was still a strong yield response to N with the fertilized plots yielding 34% higher than the control. For both classes, yields peaked at 100 kg N/ha and levelled off or declined slightly with further increases in N rate. The was a slight difference between the two classes but test weight was not affected by N rate. Protein was affected by N rate but not variety/class and there was no interaction between the two factors. Averaged across varieties, grain protein concentrations ranged from 9.2% in the control where no urea was applied to 12.0-12.4% for the N rates ranging from 100-250 kg N/ha. The maximum economic N rate is typically lower than the rate required to maximize yield; however, profits are usually reasonably well-buffered within this range 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 winter cereal insurance options and spring assessment/reseeding considerations.