2016 Annual Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Nitrogen Response of Modern Fall Rye Varieties

(Project #20150322)

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Project Identification

1. **Project Title:** Nitrogen Response of Modern Fall Rye Varieties
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3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156 (NW27-18-12 W2)
5. **Project start and end dates (month & year):** Sep-2015 to Dec-2016
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

The objective of this field trial was to demonstrate the nitrogen (N) fertilizer requirements of a high yielding fall rye hybrid versus conventional open pollinated varieties.

8. **Project Rationale:**

While fall rye acres have dramatically declined since peaking in the 1980s (due to herbicides, other profitable crop options and limited markets), commercial availability of new hybrid varieties has renewed interest in this crop. Averaged across the major provincial zones, the three currently available European hybrids (Brasetto, Guttino and Bono) reportedly yield 120-126% of the current check (and highest yielding open pollinated variety) Hazlet (SaskSeed 2016 Guide). Traditionally, fall rye has been grown as a low-input crop, likely because it has relatively high nitrogen (N) use efficiency compared to winter wheat and tends to be grown on poorer land. In spite of this, it is possible that farmers may require higher rates of N fertilizer to achieve the maximum yield potential of these modern fall rye varieties. The objective of this demonstration was to show farmers the relative response of fall rye to N fertilization and overall yield potential of modern open pollinated versus high yielding hybrids.

Methodology and Results

9. **Methodology:**

A field trial was initiated in the fall of 2014 and repeated in fall of 2015 near Indian Head, Saskatchewan (50.556 N, 103.603 W). Site years conducted at Indian Head in 2014-15 and Melfort in 2015-16 are reported on separately. Indian Head is located in the thin-Black soil zone of southeast Saskatchewan and the soil is classified as an Indian Head heavy clay with typical organic matter concentrations of 4-5%. The treatments were a factorial combination of two varieties and six N fertilizer rates. The variety was either Hazlet (OP) or Brasetto (hybrid) and the N rates were 6, 50, 100, 150, 200 or 250 kg N ha^{-1} (12 treatments in total). The treatments were arranged in a Randomized Complete Block Design (RBCD) with four replicates.

All available and pertinent agronomic information is provided in Table 1. Treated fall rye seed was direct seeded into canola stubble on September 20 (2015) at a rate of 200 seeds m^{-2} and with all fertilizer

applied during planting. The fertilizer sources were side-banded urea (46-0-0, applied as per protocol), monoammonium phosphate (side-banded), and potassium sulphate (seed-placed). With the exception of N, all fertilizer was applied at uniform rates for all treatments, meaning 6 kg N ha^{-1} was supplied by the monoammonium phosphate. Weeds were controlled using registered pre-emergent and in-crop herbicide applications. Fungicides were applied during early heading to protect against late occurring leaf disease and fusarium head blight. Pre-harvest glyphosate was applied at maturity (July 28, 2016) to terminate the plots which were straight-combined on August 13th and 14th (2016).

Table 1. Agronomic information for the ADOPT Fall Rye N Response Demonstration at Indian Head (2015-2016).

Factor / Field Operation	Indian Head 2014-15	Indian Head 2015-16	Melfort 2015-2016
Previous Crop	Canola (LL)	Canola (LL)	Canola
Pre-emergent herbicide	880 g glyphosate ha-1 + 729 g 2,4-D ha-1 (Sep-21-2014)	880 g glyphosate ha^{-1} + 729 g 2,4-D ha^{-1} (Sep-24-2015)	—
Soil Nutrient Sampling	May-10-2015	Oct-23-2015	—
Seed Treatment	Cruiser Vibrance Quattro	Cruiser Vibrance Quattro	—
Seeding Date	Sep-23-2014	Sep-20-2015	Sep-22-2015
Row spacing	30 cm	30 cm	23 cm
kg P_2O_5-K_2O-S ha^{-1}	30-34-16	30-34-16	26-0-20
In-crop herbicide 1	280 g bromoxynil ha-1 + 280 g MCPA ester ha-1 + 198 g tralkoxydim ha-1 (May-25-2015)	280 g bromoxynil ha^{-1} + 280 g MCPA ester ha^{-1} + 198 g tralkoxydim ha^{-1} (May-17-2016)	140 g fluroxypyr ha^{-1} + 99 g clopyralid ha^{-1} + 554 g MCPA ester ha^{-1} (May-16-2016)
In-crop herbicide 2	—	—	—
Foliar fungicide	89 g metconazole ha^{-1} (June 12) 89 g metconazole ha-1 (June 17)[Z]	89 g metconazole ha^{-1} (June 5)	89 g metconazole ha^{-1} (June 18)
Pre-harvest herbicide	880 g glyphosate ha^{-1} (Aug-14-2015)	880 g glyphosate ha^{-1} (Jul-28-2016)	415 g diquat ha^{-1} (Aug-02-2016)
Harvest date	Aug-21-2015	Aug-13/14-2016	Aug-16-2016

Composite soil samples were collected either in the fall or early spring and submitted to ALS Laboratory Group Agricultural Services (Saskatoon, SK) for residual nutrient analyses. The mean plant height of each was determined by recording the height of four plants per plot after heading was complete. Lodging was assessed at maturity using the Belgian lodging scale where the area of the plot affected was rated (A=1-9) along with the intensity of lodging in the affected areas (I=1-5). The lodging index (LI) for each plot was calculated using the formula $LI = A \times I \times 0.2$. Yields were determined from the harvested grain samples which were cleaned and corrected to a constant seed moisture content of 14%. Dockage was determined from a 1000 g sub-sample using CGC methodology for the purpose of correcting grain yields. Grain protein content was determined by the Western Applied Research Corporation (WARC) using an NIR instrument. For Indian Head, daily temperature and precipitation data were estimated from the nearest Environment Canada weather station located approximately 5 km

west of the field trial site in 2015 and from a mobile weather station approximately 2.5 km southeast of the site in 2016. Weather data from Melfort in 2016 was also estimated from the nearest Environment Canada weather station. See ADOPT project 20150320 for further details on the Melfort site.

All response data were analysed using the Mixed procedure of SAS 9.3 with the effects of variety (VAR), N rate (NR) and their interaction (VAR × NR) considered fixed while replicate effects were considered random. Treatment means were separated using Fisher's protected LSD test and orthogonal contrasts were used to determine whether the observed responses to N were linear or quadratic. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

10. Results:

Growing season weather

In 2014-15 at Indian Head, establishment was excellent and the crop overwintered well; however, the spring was extremely dry and, consequently, yield potential was limited in the winter cereals to a greater extent than any of the spring crops. In 2015-16 at Indian Head, moisture conditions were considered excellent in the fall and the rye got off to a strong start. While there was adequate snow cover through the winter and good initial soil moisture reserves, most of the snow had melted by the second week in April and the rest of the spring was relatively normal for precipitation. Moisture conditions remained adequate for the remainder of the growing season. Precipitation during April and May in Melfort were lower than normal and likely has some effect on early crop growth and tillering. Normal precipitation levels occurred throughout the remaining growing season, which would have helped recover some of the potential yield loss from a dry spring. Temperatures throughout the growing season were generally close to the long-term (1981-2010) average, with spring temperatures being slightly warmer than normal at both sites (Table 2).

Table 2. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) averages for the 2015 and 2016 growing season at Indian Head and 2016 at Melfort, SK.

Year	April	May	June	July	August	Avg. / Total
	---------- Mean Temperature (°C) ----------					
IH-2015	4.8	10.2	16.2	18.1	17.0	13.3
IH-2016	3.8	13.9	17.5	18.5	17.1	14.2
IH-LT	4.2	10.8	15.8	18.2	17.4	13.3
ME-2016	2.9	13.6	17.1	18.1	16.3	13.6
ME-LT	2.8	10.7	15.9	17.5	16.8	12.7
	---------- Precipitation (mm) ----------					
IH-2015	9.5	15.6	38.3	94.6	58.8	217
IH-2016	13.9	72.6	63.0	112.8	29.8	292
IH-LT	17.1	51.8	77.4	63.8	51.2	261
ME-2016	13.5	16.8	53.2	128.7	80.8	293

ME-LT	26.7	42.9	54.3	76.7	52.4	253

Field Trial Results

Residual soil test nutrient levels are presented for the Indian Head is in Table 3. With 28 kg NO_3-N ha^{-1} available in the top 60 cm soil profile, residual N levels were considered limiting and also to be representative of typical fields in this region. Residual phosphorus levels were also low while potassium was sufficient and sulphur availability was considered marginal.

Table 3. Residual soil nutrient levels in Fall Rye N Demonstration at Indian Head, Saskatchewan (2015-16).

Nutrient	IH-2015	IH-2016
	---------- kg ha^{-1} ----------	
NO_3-N (0-60 cm)	34	28
P (0-15 cm)	12	19
K (0-15 cm)	>605	> 605
SO_4-S (0-60 cm)	31	64

Results of the overall tests of fixed effects are presented for all response variables in Table 4. In this test, p-values that are less than or equal to 0.05 indicate that we are at least 95% confident that an observed effect was due to the treatment and not naturally occurring or random variability. Fall rye variety (VAR) did not have an affect on lodging in Melfort but had a highly significant effect on height, yield, protein and ergot ($P < 0.001$-0.028), as well as lodging at the Indian Head site in both years ($P < 0.001$). At Melfort, variety did affect height, yield, and protein ($P < 0.001$). Nitrogen fertilizer rate (NR) had a significant impact on all response variables ($P < 0.001$-0.024). The interaction (VAR × NR) was significant for lodging ($P < 0.001$- 0.024) at Indian Head in both years, grain protein ($P < 0.001$-0.041) at Indian Head in 2015 and Melfort 2016, and yield ($P < 0.001$) and ergot ($P = 0.009$) at Indian Head in 2016. No interaction was detected for the remaining variables ($P = 0.159$-0.295). Non-significant VAR × NR interactions indicate that the response to N was consistent for both varieties.

Table 4. Overall effects of variety (VAR) and nitrogen rate (NR) effects on selected response variables for fall rye.

Site-Year	Effect	Height	Lodging	Yield	Protein	Ergot
		p-values				
Indian Head (2015)	VAR	<0.001	<0.001	<0.001	<0.001	0.028
	NR	<0.001	0.024	<0.001	<0.001	<0.001
	VAR x NR	0.159	0.024	0.295	<0.001	0.687
Indian Head (2016)	VAR	<0.001	<0.001	<0.001	<0.001	<0.001
	NR	<0.001	<0.001	<0.001	<0.001	<0.001
	VAR x NR	0.553	<0.001	<0.001	0.089	0.009
Melfort (2016)	VAR	<0.001	0.151	<0.001	<0.001	–
	NR	0.010	0.002	<0.001	<0.001	–
	VAR x NR	0.661	0.489	0.795	0.041	–

Treatment means and results of the orthogonal contrasts for plant height are presented in Table 5. When averaged across all three site-years Hazlet was nearly 13% taller than the hybrid Brasetto, with an average 11 cm difference observed between the two varieties. The effects of N rate on plant height were somewhat unexpected at Indian Head in 2015, with the tallest plants (90 cm) observed in the check and small but significant reductions in height as the N rate was increased to 250 kg N ha^{-1} where the mean height was only 82 cm. Maximum heights were achieved at the 100 kg N ha^{-1} rate at Indian Head (103 cm) and Melfort (99 cm) in 2016. Plant heights at both Indian Head and Melfort in 2016 started to decrease after the 150 kg N ha^{-1}. Averaged across the two varieties, the linear response was significant at Indian Head in 2015 while the response was quadratic at both locations in 2016. While the effects of N rate on height were similar for both varieties, with Hazlet it appeared that heights were more strongly reduced at lower N rates relative to Brasetto. It is probable that the observed height reduction with N fertilizer was due to lodging not being adequately accounted for when the measurements were completed. Under normal circumstances, plant heights will increase with N fertilization; however, heights do tend to level off at considerably lower rates than for yield.

Means for variety and N rate effects on lodging are presented with the contrast results in Table 6. Any lodging that did occur was minor for all treatments at Indian Head in both 2015 and, to a lesser extent, 2016 as it did not result in harvest difficulties and was unlikely to have impacted yield. While still relatively minor, lodging was more prevalent at both sites in 2016. Higher N rates, specifically 200-250 kg N ha^{-1}, had a tendency to increase lodging in both varieties. With a mean ranking of 1.7 across all site-years, lodging was significantly worse for the open pollinated variety Hazlet than for Brasetto, which received an average rating of 1.3. While the main effect means for N rate showed increased lodging when N fertilizer was applied, the VAR × NR effect was also significant at Indian Head in 2015

and 2016. The interaction was due to the increased lodging with N rate occurring with Hazlet but not Brasetto, thereby indicating superior standability with the hybrid.

Mean fall rye grain yields for the effects of variety and N fertilizer rate are presented in Table 7 with the orthogonal contrasts results. Averaged across N rates, the hybrid Brasetto yielded 772-1320 kg ha^{-1}, or 17-27% higher than Hazlet (open pollinated), depending on the site-year. Across varieties, yields in the control were always significantly lower than for any of fertilized treatments. In 2015 at Indian Head, fall rye yields leveled off at relatively low N rates with similar yields across N rates despite the highest absolute yield at a rate of 150 kg N ha^{-1} in 2015. The response to N rate was stronger at Indian Head in 2016 with the highest yield at 250 kg N ha^{-1}. The VAR × NR interaction was also significant at Indian Head in 2016; however, from a practical perspective the response curves for the two varieties were similar despite the higher yields with the hybrid. Rye yields at Melfort peaked at approximately 150 kg N ha^{-1} and there was no interaction between hybrids. The linear and quadratic orthogonal contrasts were significant ($P < 0.001$). The significant quadratic responses in all cases were indicative of typical yield responses to N whereby the yield increases tend to diminish and eventually cease as N becomes less limiting. Based on the estimated quadratic response curves, yields for Hazlet reached a maximum yield of 3385 kg ha^{-1} at 152 kg N ha^{-1}, 6233 kg ha^{-1} with 242 kg N ha^{-1} and 6967 kg ha^{-1} with 189 kg N ha^{-1} at Indian Head 2015, 2016 and Melfort 2016, respectively. For Brasetto, the observed maximum yields were 4268 kg ha^{-1} with 156 kg N ha^{-1}, 7745 kg ha^{-1} with 220 kg N ha^{-1}, and 7882 kg ha^{-1} with 208 kg N ha^{-1} at Indian Head 2015, 2016 and Melfort in 2016.

While protein is not considered an important grading factor in rye, it is commonly affected by N fertilizer application and treatment effects on this parameter are presented in Table 8. Percent grain protein was affected by both variety and N rate in all site-years. A significant VAR x NR interaction occurred at Indian Head in 2015 and Melfort in 2016. Across N rates, the mean protein concentration of the lower yielding variety Hazlet was 0.6-0.9 g 100 g^{-1} higher (6-9%) than Brasetto. At any given N level, protein concentrations are generally inversely related to grain yield, thus this response was expected. Averaged across varieties, the linear and quadratic responses for N rate effects on grain protein were all significant. Under the lower yielding conditions in 2015, the protein response curve was shaped similarly to an N response curve with diminishing increases as the N rate was increased beyond approximately 150 kg N ha^{-1}. With the higher yields in 2016, the shape of the curve differed with smaller increases at the lower N levels (where the yield curve was steepest) but sharper increases as the N rates reached the highest levels of 150-250 kg N ha^{-1}. The significant interactions appeared to be due to been due to the two varieties having similar protein levels at the 0 N level at Indian Head 2015 and at the 200-250 kg N ha^{-1} levels at Melfort 2016.

The percentage of ergot in the cleaned grain samples was affected by both variety and N rate both years at Indian Head. The Melfort site did not measure presence of ergot. A significant VAR × NR interaction occurred in 2016 but not in 2015. Across N rates, ergot was higher in Hazlet than Brasetto in 2015, but then lower in 2016 (Table 9). Higher rates of nitrogen saw more ergot across varieties in both years; however, the response differed between years in that higher ergot was also detected in the control plots in 2016. There difference in response between years was evident in the contrast results where the responses were primarily linear in 2015 but quadratic in 2016. The significant VAR × NR interaction at

Indian Head in 2016 and Melfort in 2016 suggests the effect of N on ergot could differ between the two varieties. The VAR × NR interaction in 2016 was due to ergot levels being similar between varieties at low or modest N rates, but higher with the hybrid when N rates were increased to 150 kg N ha^{-1} or higher.

Table 5. Treatment means for variety (hybrid vs. open pollinated) and nitrogen fertilizer rate effects on fall rye plant height at Indian Head in 2014-15, 2015-16 and Melfort 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Nitrogen Rate	All Varieties			Hazlet (OP)			Brasetto (HYB)		
	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16
	---------- cm ----------								
All N Rates	–	–	–	93.2 a	106.0 a	100.4 a	78.3 b	97.1 b	90.3 b
S.E.M.	–	–	–	0.570	0.87	1.26	0.570	0.87	1.26
6 kg N/ha	90.3 a	98.4 c	94.2 bc	98.7 a	103.4 b	98.9 bcde	82.0 e	93.5 d	89.6 fgh
50 kg N/ha	87.5 b	102.2 ab	95.6 abc	95.2 b	106.7 a	99.5 abcd	79.8 ef	97.7 c	91.7 fgh
100 kg N/ha	84.8 c	103.3 a	99.2 a	92.2 c	108.3 a	105.7 a	77.5 fg	98.2 c	92.6 efgh
150 kg N/ha	85.6 c	102.4 ab	98.4 ab	93.0 bc	106.0 ab	103.3 ab	78.2 fg	98.9 c	93.5 defg
200 kg N/ha	84.1 c	102.2 ab	93.7 c	92.0 c	106.0 ab	100.3 abc	76.3 g	98.5 c	87.0 h
250 kg N/ha	82.1 d	101.0 b	91.2 c	88.3 d	105.9 ab	94.9 cdef	76.0 g	96.1 cd	87.5 gh
S.E.M	0.73	1.05	1.80	0.93	1.27	2.40	0.93	1.27	2.40
Orthogonal Contrasts	---------- Pr > *F* ----------								
NR – lin	<.0001	0.066	0.096	<.0001	0.379	0.279	<.0001	0.081	0.196
NR – quad	0.0756	<0.001	0.001	0.3162	0.020	0.002	0.1243	<0.001	0.079

Table 5. Treatment means for variety (hybrid vs. open pollinated) and nitrogen fertilizer rate effects on fall rye lodging at Indian Head in 2014-15, 2015-16 and Melfort 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Nitrogen Rate	All Varieties			Hazlet (OP)			Brasetto (HYB)		
	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16
	---------- 1-10 ----------								
All N Rates	–	–	–	0.39 a	2.03 a	2.65 a	0.20 b	0.32 b	3.38 a
S.E.M.	–	–	–	0.003	0.060	0.389	0.003	0.060	0.389
6 kg N/ha	0.28 b	0.35 e	1.48 c	0.35 b	0.50 e	1.55 d	0.20 c	0.20 e	1.40 d
50 kg N/ha	0.30 a	0.41 e	1.70 c	0.40 a	0.60 e	2.00 cd	0.20 c	0.23 e	1.40 d
100 kg N/ha	0.30 a	0.75 d	2.28 bc	0.40 a	1.20 d	2.00 cd	0.20 c	0.30 e	2.55 bcd
150 kg N/ha	0.30 a	1.29 c	3.88 ab	0.40 a	2.18 c	2.95 bcd	0.20 c	0.40 e	4.80 ab
200 kg N/ha	0.30 a	1.89 b	4.23 a	0.40 a	3.38 b	4.05 abc	0.20 c	0.40 e	4.40 abc
250 kg N/ha	0.30 a	2.35 a	4.55 a	0.40 a	4.30 a	3.35 abcd	0.20 c	0.40 e	5.75 a
S.E.M	0.006	0.105	0.633	0.008	0.148	0.880	0.008	0.148	0.880
Orthogonal Contrasts	---------- Pr > *F* ----------								
NR – lin	0.019	<0.001	<0.001	0.001	<0.001	0.033	1.000	0.198	<0.001
NR – quad	0.030	0.009	0.840	0.003	<0.001	0.821	1.000	0.726	0.952

Table 7. Treatment means for variety (hybrid vs. open pollinated) and nitrogen fertilizer rate effects on fall rye grain yield at Indian Head in 2014-15, 2015-16 and Melfort 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Nitrogen Rate	All Varieties			Hazlet (OP)			Brasetto (HYB)		
	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16
	---------- kg/ha ----------								
All N Rates	–	–	–	3147 b	4938 b	6050 b	3919 a	6258 a	7090 a
S.E.M.	–	–	–	65.0	65.6	108.0	65.0	65.6	108.8
6 kg N/ha	2861 c	2950 f	5005 c	2579 d	2621 i	4249 g	3143 c	3278 h	5762 ef
50 kg N/ha	3643 ab	4549 e	5432 c	3315 c	3953 g	5030 f	3971 ab	5144 f	5833 e
100 kg N/ha	3681 ab	5798 d	6945 b	3239 c	5019 f	6484 de	4124 ab	6577 c	7406 abc
150 kg N/ha	3756 a	6482 c	7634 a	3306 c	5667 e	7106 bcd	4205 a	7298 b	8162 a
200 kg N/ha	3707 ab	6797 b	7138 a	3296 c	6144 d	6710 cd	4118 ab	7449 b	7567 ab
250 kg N/ha	3548 b	7014 a	7267 a	3146 c	6225 d	6722 cd	3951 b	7803 a	7813 ab
S.E.M	80.9	79.6	187.1	100.1	96.8	264.7	100.1	96.8	264.7
Orthogonal Contrasts	---------- Pr > *F* ----------								
NR – lin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
NR – quad	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 8. Treatment means for variety (hybrid vs. open pollinated) and nitrogen fertilizer rate effects on fall rye grain protein at Indian Head in 2014-15, 2015-16 and Melfort 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Nitrogen Rate	All Varieties			Hazlet (OP)			Brasetto (HYB)		
	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16
	% protein								
All N Rates	–	–	–	12.1 a	10.6 a	9.9 a	11.3 b	9.7 b	9.3 b
S.E.M.	–	–	–	0.05	0.06	0.11	0.05	0.06	0.11
6 kg N/ha	9.8 e	9.4 d	8.0 e	9.9 g	9.7 e	8.3 e	9.7 g	9.1 f	7.6 f
50 kg N/ha	11.0 d	8.7 e	8.2 de	11.4 e	9.3 f	8.8 e	10.6 f	8.1 g	7.5 f
100 kg N/ha	12.1 c	9.4 d	8.6 d	12.6 c	9.8 e	8.8 e	11.6 e	9.0 f	8.4 e
150 kg N/ha	12.4 b	10.4 c	10.1 c	12.9 b	10.8 d	10.6 c	11.9 d	9.9 e	9.5 d
200 kg N/ha	12.5 ab	11.3 b	11.2 b	13.0 ab	11.6 b	11.3 b	12.0 d	11.1 cd	11.2 bc
250 kg N/ha	12.6 a	11.9 a	11.7 a	13.1 a	12.6 a	11.9 a	12.1 d	11.3 bc	11.6 ab
S.E.M	0.07	0.10	0.17	0.09	0.14	0.22	0.09	0.14	0.22
Orthogonal Contrasts	Pr > *F*								
NR – lin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
NR – quad	<0.001	<0.001	0.013	<0.001	<0.001	0.213	<0.001	<0.001	0.019

Table 9. Treatment means for variety (hybrid vs. open pollinated) and nitrogen fertilizer rate effects on ergot in fall rye at Indian Head in 2014-15, 2015-16 and Melfort 2015-16. Means were separated using Fisher's protected LSD test and site-years were analysed individually.

Nitrogen Rate	All Varieties			Hazlet (OP)			Brasetto (HYB)		
	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16	IH-15	IH-16	ME-16
	% ergot								
All N Rates	–	–	–	0.77	0.31 b	–	0.63	0.53 a	–
S.E.M.	–	–	–	0.041	0.029	–	0.041	0.029	–
6 kg N/ha	0.17 d	0.54 a	–	0.19 f	0.47 cd	–	0.15 f	0.62 bc	–
50 kg N/ha	0.36 d	0.14 c	–	0.34 ef	0.15 f	–	0.38 ef	0.14 f	–
100 kg N/ha	0.71 c	0.27 bc	–	0.80 bcd	0.25 ef	–	0.61 de	0.30 def	–
150 kg N/ha	0.93 b	0.31 b	–	1.03 abc	0.17 f	–	0.83 bcd	0.46 cd	–
200 kg N/ha	0.90 bc	0.61 a	–	1.02 abc	0.46 cd	–	0.77 cd	0.75 ab	–
250 kg N/ha	1.15 a	0.65 a	–	1.22 a	0.39 de	–	1.07 ab	0.90 a	–
S.E.M	0.071	0.050	–	0.100	0.071	–	0.100	0.071	–
Orthogonal Contrasts	Pr > *F*								
NR – lin	<0.001	<0.001	–	<0.001	0.410	–	<0.001	<0.001	–
NR – quad	0.047	<0.001	–	0.055	0.005	–	0.362	<0.001	–

Extension Activities and Dissemination of Results

This demonstration was highlighted during the IHARF Crop Management Field Day (July 19, 219 registered guests) where Chris Holzapfel (IHARF) and Dr. Brian Beres (AAFC-Lethbridge) led a discussion on winter cereal agronomy and opportunities. The trial was also shown and discussed by Chris Holzapfel on a tour co-hosted with Arysta Lifesciences (July 26, 45 guests). In addition to these more formal tours, the site was visited by numerous growers, agronomists and researchers over the season. Final data from these presentations will be presented at the Agri-ARM Research Update on January 12, 2017 as part of Crop Production Week. Results from the project will also be made available in the 2016 IHARF Annual Report (available online) and through a variety of other media (i.e. oral presentations, popular agriculture press, fact sheets, etc.) as opportunities arise. This demonstration is being continued at Indian Head in 2016-17 and data from all suitable locations will be combined in a cumulative report upon conclusion of the project.

11. Conclusions and Recommendations

This project has demonstrated the relative yield potential and N fertilizer response of modern open pollinated (Hazlet) versus hybrid (Brasetto) fall rye varieties at Indian Head and Melfort, Saskatchewan. Overall, Hazlet was 13% taller than Brasetto and the hybrid also appeared less susceptible to lodging. Nitrogen effects on plant height were somewhat unexpected in that it was uncommon for heights to decline with increasing N rates; however, it is probable that this was primarily a result of lodging and human error. Grain yields for Brasetto were 17-27% higher than Hazlet (across N rates) and there was no significant VAR × NR interaction at 2/3 site-years. Even where the interaction was significant (Indian Head 2016), the calculated optimal N rates and overall response curves were still similar. The results to date suggest that the response to N fertilizer is similar between OP and hybrid rye, despite the higher yield potential of the hybrid and strong overall responses in 2016. Protein concentrations were higher on average for Hazlet than for Brasetto which was not unexpected considering Hazlet's lower yield. The effect of N rate on grain protein concentrations varied with variety. Both varieties had similar grain protein concentrations in the control treatment, but protein was always higher for Hazlet when N was applied. Protein levels normally level off at higher N fertility levels than grain yield; however, for fall rye, producers are not paid for high protein so there is no economic incentive to apply rates beyond those required to optimize yield. Ergot is arguably the most important grading factor in fall rye and, where measured, was affected by both variety and N rate (Indian Head only). The variety effects were inconsistent in that higher ergot was detected with the OP variety in 2015 but the opposite occurred in 2016. In addition to the higher input costs, above optimal N rates consistently resulted in higher ergot levels. This is important because the observed ergot levels observed in both years at Indian Head were sufficiently high to be major grading factors, particularly in 2015 and when combined with excessive N rates. Based on the results to date, both varieties evaluated appeared to respond similarly to N fertilizer rates. While the hybrid yielded significantly and consistently higher, producers must be weigh this advantage against the increased initial seed costs and inability to save seed for future crops. This project is continuing at Indian Head in 2016-17.

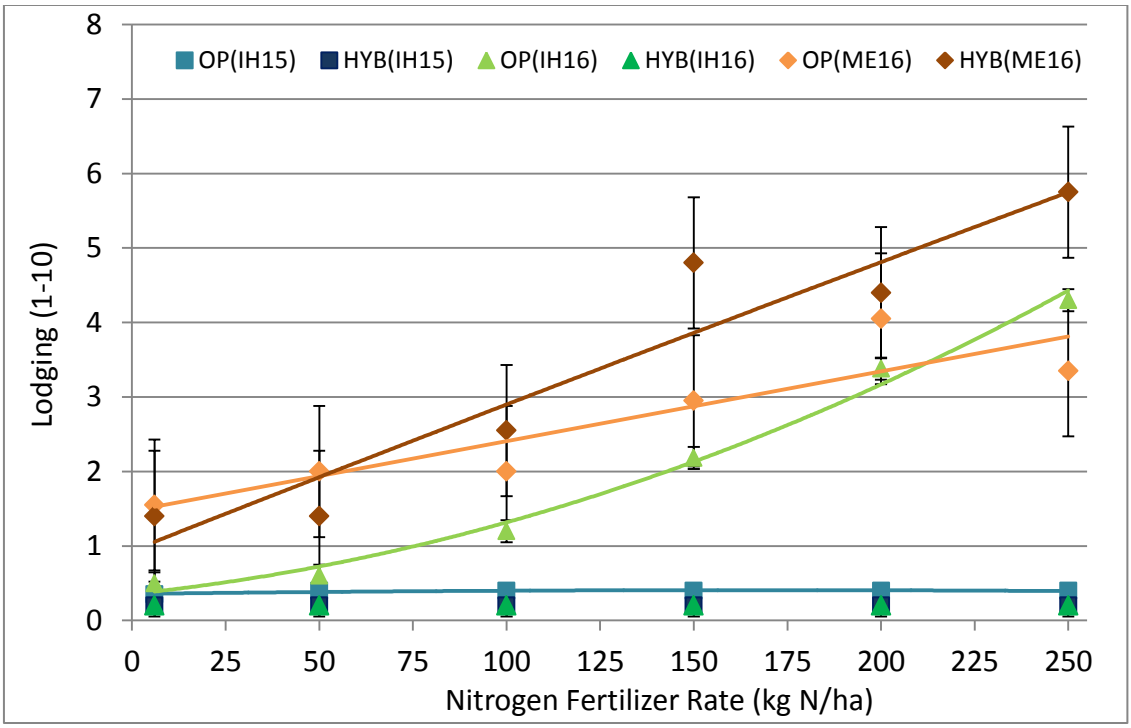

Figure 1. Fall rye (hybrid versus open pollinated) lodging at varying N fertilizer rates at Indian Head (2014-15 and 2015-16) and Melfort (2016).

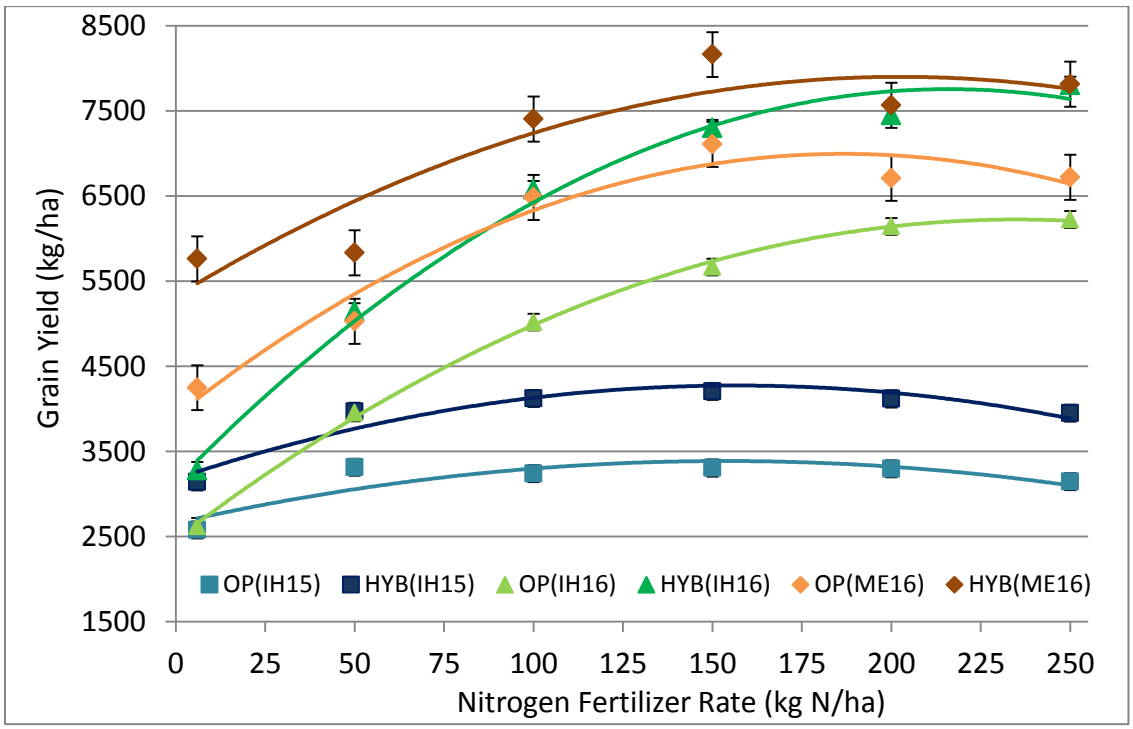

Figure 2. Fall rye (hybrid versus open pollinated) grain yields at varying N fertilizer rates at Indian Head (2014-15 and 2015-16) and Melfort (2016).

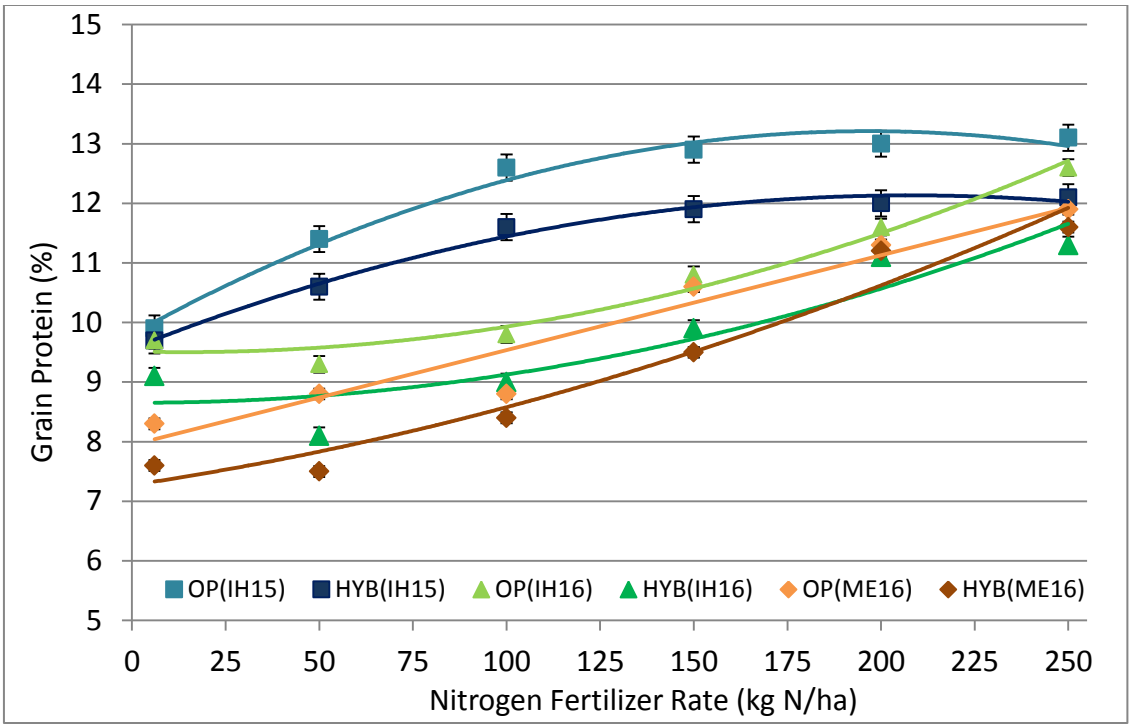

Figure 3. Fall rye (hybrid versus open pollinated) grain protein at varying N fertilizer rates at Indian Head (2014-15 and 2015-16) and Melfort (2016).

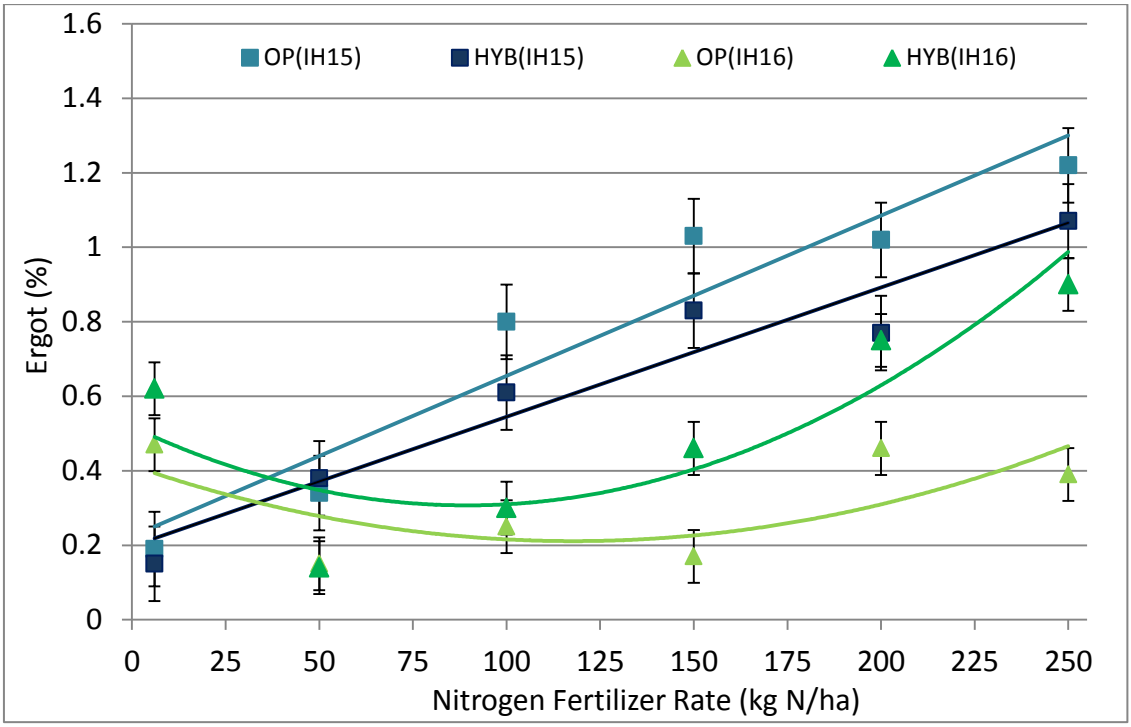

Figure 4. Fall rye (hybrid versus open pollinated) percent ergot at varying N fertilizer rates at Indian Head (2014-15 and 2015-16) and Melfort (2016).

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. The hybrid rye seed was provided in-kind by FP genetics and some of the in-crop herbicides used were provided in-kind by Bayer CropScience. The technical, administrative and professional support of Christiane Catellier, Danny Petty, Dan Walker, Karter Kattler, Carly Miller and Andrea De Roo is greatly appreciated.

13. Appendices

Figure A-1. Hazlet (OP) fall rye fertilized with 6 kg N ha^{-1} (from 11-52-0) at Indian Head 2015 (July 29).

Figure A-2. Brasetto (HYB) fall rye fertilized with 6 kg N ha^{-1} (from 11-52-0) at Indian Head 2015 (July 29).

Figure A-3. Hazlet (OP) fall rye fertilized with 250 kg N ha^{-1} at Indian Head 2015 (July 29).

Figure A-4. Brasetto (HYB) fall rye fertilized with 250 kg N ha^{-1} at Indian Head 2015 (July 29).

Abstract

14. Abstract/Summary:

Field trials were conducted near Indian Head and Melfort to demonstrate the yield potential and nitrogen response of open-pollinated versus hybrid fall rye. The open-pollinated variety (Hazlet) was nearly 13% taller than the hybrid (Brasetto). While Brasetto yielded 17-27% higher than Hazlet, the yield response to N was generally similar for the two varieties. Under lower yielding conditions in 2015, the protein response curve showed diminishing increases as the N rate was increased beyond approximately 150 kg N ha^{-1}. With the higher yields in 2016, the shape of the curve differed with

smaller increases at the lower levels but sharper increases as N rates approached 150-250 kg N ha^{-1}. The difference in the shape of the protein response is attributable to the much stronger response to N and higher overall yields in 2016. While protein is not an important grading factor for rye, ergot is a major cause of downgrading and generally increased when N rates were increased to or beyond the optimal rates for maximizing yield. Variety effects on ergot were significant but not consistent. Overall results to date suggest that N can be managed similarly for hybrid versus OP fall rye; however, this work is continuing at Indian Head in 2016-17.
