2015 Annual Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Nitrogen Response of Modern Fall Rye Varieties

(Project #20140303)

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Project Identification

1. **Project Title:** Nitrogen Response of Modern Fall Rye Varieties
2. **Project Number:** 20140303
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-2014 to Nov-2015
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 hybrid versus conventional fall rye variety.

8. **Project Rationale:**

Recent breeding efforts have improved the yield potential and other agronomic qualities of fall rye and, with new hybrids varieties becoming available, there is renewed interest in this crop amongst growers. Averaged across the major provincial zones, the yield potential of AAFC's most recent fall rye variety Hazlet, is 113% of the older check variety, Prima (SaskSeed Guide, 2015). Brasseto, a newly available European hybrid, has shown up to 43% higher yields averaged across the province; however, field performance data on the new hybrids for western Canada is still limited (SaskSeed Guide 2015). 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 often tends to be grown on poorer land. In spite of this, farmers may require higher rates of N fertilizer to achieve maximum yield potential of these modern fall rye varieties. This demonstration aimed to show farmers the response to N fertilization and overall yield potential of modern open pollinated versus hybrid fall rye varieties under a high input, no-till system.

Methodology and Results

9. **Methodology:**

A field demonstration was initiated in the fall of 2014 near Indian Head, Saskatchewan (50.5546 N, 103.5769 W) with similar trials conducted by other Agri-ARM sites at Melfort and Scott which 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.

Pertinent agronomic information is provided in Table 1. Treated fall rye seed was direct seeded into canola stubble on September 23 (2014) 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) and, with the exception of N, applied at uniform rates for all treatments. Weeds were controlled using registered pre-emergent and in-crop herbicide applications and fungicides were applied during early heading/anthesis to protect against late occurring leaf disease and fusarium head blight. Pre-harvest glyphosate was applied at maturity (August 14, 2015) to terminate the plots which were straight-combined on August 21 (2015).

Table 1. Agronomic information for the ADOPT Fall Rye N Response Demonstration at Indian Head (2014-15).

Factor / Field Operation	Indian Head 2014-15
Previous Crop	Canola (LL)
Pre-emergent herbicide	880 g glyphosate ha^{-1} + 729 g 2,4-D ha^{-1} (Sep-21-2014)
Soil Nutrient Sampling	May-10-2015
Seed Treatment	Cruiser Vibrance Quattro
Seeding Date	Sep-23-2014
Row spacing	30 cm
kg P_2O_5-K_2O-S ha^{-1}	30-34-16
In-crop herbicide 1	280 g bromoxynil ha^{-1} + 280 g MCPA ester ha^{-1} + 198 g tralkoxydim ha^{-1} (May-25-2015)
In-crop herbicide 2	—
Foliar fungicide 1	89 g metconazole ha^{-1} (June 12) [Z]
Foliar fungicide 2	89 g metconazole ha^{-1} (June 17)[Z]
Pre-harvest herbicide	880 g glyphosate ha^{-1} (Aug-14-2015)
Harvest date	Aug-21-2015

[Z] Caramba was applied twice during heading to account for variation in growth stage across treatments

Soil samples were collected in the early spring (May 10) and submitted to ALS Laboratory Group Agricultural Services (Saskatoon, SK) for residual nutrient analyses. Normalized difference vegetation index (NDVI), an indirect measure of canopy density and above-ground biomass, was measured using a handheld GreenSeeker during stem elongation on May 28. The average plant height was determined by recording the height of four plants per plot after heading was complete on July 9. Lodging was assessed at maturity using the Belgian lodging scale where the area of the plot affected is rated (A=1-9) along with the intensity of lodging in 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. Daily temperature and precipitation data were estimated from the nearest Environment Canada weather station located approximately 5 km west of the field trial site.

All data were statistically 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 and the effects of replicate considered random. Treatment means were separated using Fisher's protected LSD test and orthogonal contrasts were used to determine whether the observed N responses were linear, quadratic or cubic in shape. For grain yield and protein, the orthogonal contrasts were used to guide regression analyses of the treatment means using SigmaPlot 12. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

10. Results:

Growing season weather conditions

In 2014-15 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 extremely dry with no significant precipitation events until late June. At this point the fall rye was already flowering and yields had likely been negatively impacted by the lack of spring moisture. Moisture conditions remained adequate for the remainder of the growing season. Temperatures throughout the growing season were generally close to the long-term (1981-2010) average.

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

Year	May	June	July	August	Avg. / Total
	---------- Mean Temperature (°C) ----------				
2015	10.3	16.2	18.1	17.0	15.4
Long-term	10.8	15.8	18.2	17.4	15.6
	---------- Precipitation (mm) ----------				
2015	15.6	38.3	94.6	58.8	192
Long-term	51.8	77.4	63.8	51.2	244

Field Trial Results

Residual soil test nutrient levels are presented for the Indian Head 2014-15 site in Table 3. With 34 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 (2014-15).

Nutrient	0-15 cm	15-30 cm	30-60 cm	Total
	---------- kg ha^{-1} ----------			
NO3-N	18	7	9	34
P	12	—	—	12
K	> 605	—	—	> 605
SO_4-S	12	12	7	31

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 a factor affected the applicable response variable while values greater than 0.05 indicate no significant effect. Fall rye variety (VAR) did not affect NDVI (P = 0.260) but had a highly significant effect on height, lodging, 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 = 0.024) and grain protein (P < 0.001) but not for any of the remaining variables (P = 0.159-0.295). Non-significant VAR × NR interactions indicate that the effect of N rate was consistent for both varieties.

Table 4. Variety and nitrogen fertilizer rate effects on selected response variables for fall rye at Indian Head (2014-15).

	NDVI	**Height**	**Lodging**	**Yield**	**Protein**
Effect	---------- p-values ----------				
Variety (VAR)	0.260	< 0.001	< 0.001	< 0.001	< 0.001
N Rate (NR)	< 0.001	< 0.001	0.024	< 0.001	< 0.001
VAR × NR	0.257	0.159	0.024	0.295	< 0.001

Main effect means for NDVI and results of the orthogonal contrasts are presented in Table 5. Averaged across N rates, NDVI was similar for both varieties (0.320-0.314). Focussing on N rate effects, NDVI was lowest at the 250 kg N ha^{-1} rate (0.264), followed by the check (0.305) and 200 kg N ha^{-1} rates (0.311) with the highest values observed at the 50-100 kg N ha^{-1} rates (0.337-0.354). These measurements indicated that the strongest growth was occurring at relatively low N rates (50-100 kg N ha^{-1}) and that the highest rates of side-banded N were potentially having a negative impact. Plant density was not measured so it is uncertain whether the observed results were caused by reduced emergence at the highest N rates. While plant emergence on the site was somewhat variable to due to heavy residues, no visual establishment differences amongst treatments were noted in either the fall or early spring. Even though the VAR × NR interaction was not significant, individual treatment means for NDVI are presented in Table 6. The quadratic orthogonal contrasts for N rate effects on NDVI were significant in all cases (P < 0.001). These results were a reflection of the increasing values to 50-100 kg N ha^{-1} followed by a decline in NDVI as N rates were increased beyond these levels.

Table 5. Main effect means for variety and nitrogen fertilizer rate effects on fall rye NDVI at Indian Head in 2015.

Main effect	NDVI
Variety	
Hazlet	0.320 a
Brasetto	0.314 a
S.E.M.	0.0048
Nitrogen Rate	
6 kg N ha^{-1}	0.305 c
50 kg N ha^{-1}	0.354 a
100 kg N ha^{-1}	0.337 ab
150 kg N ha^{-1}	0.330 b
200 kg N ha^{-1}	0.311 c
250 kg N ha^{-1}	0.264 d
S.E.M	0.0072
Orthogonal Contrasts	---------- Pr > *F* ----------
N Rate – linear	< 0.001
N Rate – quadratic	< 0.001
N Rate – cubic	0.165

Table 6. Individual treatment (VAR × NR) means for variety and nitrogen fertilizer rate effects on fall rye NDVI at Indian Head in 2015.

Nitrogen Rate	Hazlet (OP)	Brasetto (HYB)
	---------- NDVI ----------	
6 kg N ha^{-1}	0.316 cd	0.294 de
50 kg N ha^{-1}	0.361 a	0.347 ab
100 kg N ha^{-1}	0.347 ab	0.327 bc
150 kg N ha^{-1}	0.325 bc	0.334 bc
200 kg N ha^{-1}	0.313 cd	0.308 cd
250 kg N ha^{-1}	0.256 f	0.271 ef
S.E.M	0.0097	0.0097
Orthogonal Contrasts	---------- Pr > *F* ----------	
N Rate – linear	< 0.001	0.007
N Rate – quadratic	< 0.001	< 0.001
N Rate – cubic	0.344	0.302

Main effect means and orthogonal contrast results for plant height are presented in Table 7. Hazlet was nearly 20% taller than the hybrid Brasetto, with a 15 cm difference observed between the two varieties. The effects of N rate on plant height were somewhat unexpected, 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. Averaged across the two varieties, both the linear (P < 0.001) and cubic (P = 0.012) responses were significant while the quadratic response was not (P = 0.091). The cubic response appeared to be due to heights leveling off at fertilizer rates between 100-200 kg N ha^{-1} then declining further when the rate was increased to 250 kg N ha^{-1}.

Table 7. Main effect means for variety and nitrogen fertilizer rate effects on fall rye plant height at Indian Head in 2015.

Main effect	Plant Height
Variety	---------- cm ----------
Hazlet	93 a
Brasetto	78 b
S.E.M.	0.7
Nitrogen Rate	
6 kg N ha^{-1}	90 a
50 kg N ha^{-1}	88 b
100 kg N ha^{-1}	85 c
150 kg N ha^{-1}	86 c
200 kg N ha^{-1}	84 c
250 kg N ha^{-1}	82 d
S.E.M	0.7
Orthogonal Contrasts	---------- Pr > F ----------
N Rate – linear	< 0.001
N Rate – quadratic	0.091
N Rate – cubic	0.012

Again, while the VAR × NR interaction was not significant (P = 0.159; Table 4), individual treatment means for height and orthogonal contrast results for each variety individually are presented in Table 8. 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 possible that these unusual results were partly due to minor lodging that occurred with N fertilization not being adequately accounted for when the measurements were completed. In most cases, plant heights will increase with N fertilization; however, heights do tend to level off at considerably lower rates than for yield and, if lodging is.

Table 8. Individual treatment (VAR × NR) means for variety and nitrogen fertilizer rate effects on fall rye height at Indian Head in 2015.

Nitrogen Rate	Hazlet (OP)	Brasetto (HYB)
	---------- Height (cm) ----------	
6 kg N ha^{-1}	99 a	82 e
50 kg N ha^{-1}	95 b	80 ef
100 kg N ha^{-1}	92 c	78 fg
150 kg N ha^{-1}	93 bc	78 fg
200 kg N ha^{-1}	92 c	76 g
250 kg N ha^{-1}	88 d	76 g
S.E.M	0.9	0.9
Orthogonal Contrasts	---------- Pr > *F* ----------	
N Rate – linear	< 0.001	< 0.001
N Rate – quadratic	0.344	0.143
N Rate – cubic	0.005	0.470

Main effect means for lodging are presented in Table 9 while individual treatment means are in Table 10. In general, lodging was considered minor for all treatments in that it did not result in any difficulties with harvest and was unlikely to have impacted yield. Any lodging that was observed was subtle and mostly occurred at base of the plants with the upper stems remaining fully upright. With a mean ranking of 3.9, lodging was significantly worse for the open pollinated variety Hazlet than for Brasetto, which received an average rating of 2.0. While the main effect means for N rate showed a very slight increase in lodging when N fertilizer was applied, the VAR × NR effect was significant for this variable (P = 0.024) and the interaction appeared to be due to the increased lodging with N rate occurring with Hazlet but not Brasetto.

Table 9. Main effect means for variety and nitrogen fertilizer rate effects on fall rye lodging at Indian Head in 2015.

Main effect	Lodging
Variety	---------- 0-10 ----------
Hazlet	3.9 a
Brasetto	2.0 b
S.E.M.	0.03
Nitrogen Rate	
6 kg N ha^{-1}	2.75 b
50 kg N ha^{-1}	3.0 a
100 kg N ha^{-1}	3.0 a
150 kg N ha^{-1}	3.0 a
200 kg N ha^{-1}	3.0 a
250 kg N ha^{-1}	3.0 a
S.E.M	0.06
Orthogonal Contrasts	---------- Pr > *F* ----------
N Rate – linear	0.016
N Rate – quadratic	0.027
N Rate – cubic	0.123

Table 10. Individual treatment (VAR × NR) means for variety and nitrogen fertilizer rate effects on fall rye lodging at Indian Head in 2015.

Nitrogen Rate	Hazlet (OP)	Brasetto (HYB)
	---------- Lodging (0-10) ----------	
6 kg N ha^{-1}	3.5 b	2.0 c
50 kg N ha^{-1}	4.0 a	2.0 c
100 kg N ha^{-1}	4.0 a	2.0 c
150 kg N ha^{-1}	4.0 a	2.0 c
200 kg N ha^{-1}	4.0 a	2.0 c
250 kg N ha^{-1}	4.0 a	2.0 c
S.E.M	0.08	0.08
Orthogonal Contrasts	---------- Pr > *F* ----------	
N Rate – linear	0.001	1.000
N Rate – quadratic	0.003	1.000
N Rate – cubic	0.032	1.000

Mean grain yields for the main effects of variety and N fertilizer rate are presented in Table 11 along with results from the orthogonal contrasts. Averaged across N rates, the hybrid Brasetto yielded 772 kg ha^{-1}, or 25% higher than Hazlet (open pollinated) at Indian Head in 2015. Across varieties, yields in the control were significantly lower than for any fertilized treatments with an increase of 915 kg ha^{-1} or 32% observed at the 150 kg N ha^{-1} level. Fall rye yields leveled off at relatively low N rates with similar yields across N rates despite the the highest absolute yield at a rate of 150 kg N ha^{-1}. There was a slight decline in grain yield with further increases in N whereby, at 250 kg N ha^{-1}, yields were significantly lower than at the 150 kg N ha^{-1} rate. While the linear and quadratic orthogonal contrasts were significant ($P < 0.001$), the cubic response was also significant ($P = 0.002$) and appeared to describe the data best with a relatively sharp increase in yield with 50 kg N ha^{-1} followed a relatively flat response at intermediate N rates and a slight decline in yield at the highest rates (Fig. 1). Averaged across varieties, yields were maximized at 3814 kg N ha^{-1} with a rate of 120 kg N ha^{-1}.

Table 11. Main effect means for variety and nitrogen fertilizer rate effects on fall rye grain yield at Indian Head in 2015.

Main effect	Grain Yield
Variety	---------- kg ha^{-1} ----------
Hazlet	3147 b
Brasetto	3919 a
S.E.M.	65.0
Nitrogen Rate	
6 kg N ha^{-1}	2861 c
50 kg N ha^{-1}	3643 ab
100 kg N ha^{-1}	3681 ab
150 kg N ha^{-1}	3776 a
200 kg N ha^{-1}	3707 ab
250 kg N ha^{-1}	3548 b
S.E.M	80.9
Orthogonal Contrasts	---------- Pr > *F* ----------
N Rate – linear	< 0.001
N Rate – quadratic	< 0.001
N Rate – cubic	0.002

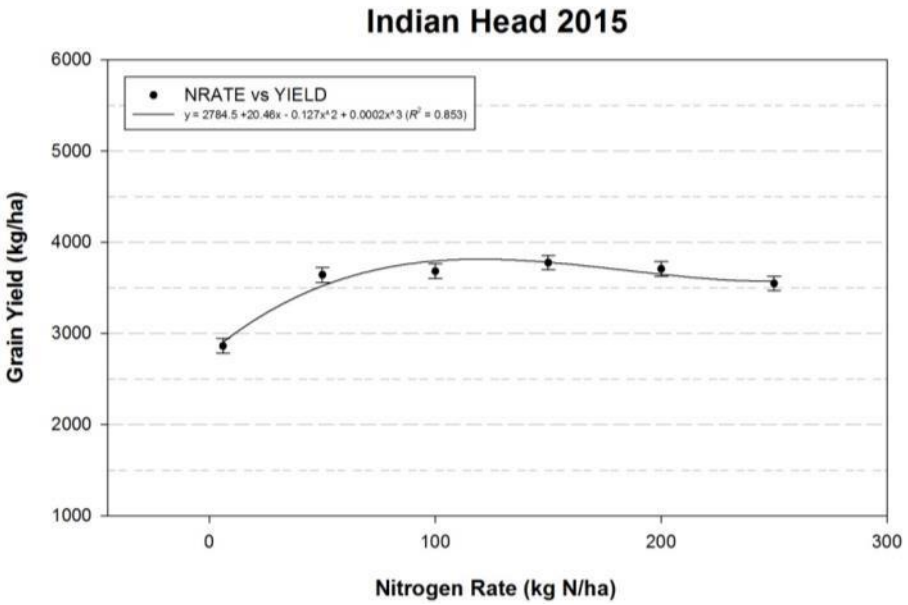

Figure 1. Average fall rye yield response to N fertilizer rates at Indian Head, Saskatchewan (2015).

While the VAR × NR interaction was not significant for yield (P = 0.295), these means are presented with the orthogonal contrast results for individual varieties in Table 12 and a graphical representation in Figure 2. For both varieties, the cubic response described the responses most accurately, again with a sharp yield increase at low N fertilizer rates followed by a relatively flat response and a slight decline at the highest rate (Figure 2). Based on the estimated cubic response curves, yields for Hazlet reached a maximum yield of 3378 kg ha^{-1} at 112 kg N ha^{-1} while Brasetto reached a maximum yield of 4239 kg ha^{-1} with 124 kg N ha^{-1}.

Table 12. Individual treatment (VAR × NR) means for variety and nitrogen fertilizer rate effects on fall rye grain yield at Indian Head in 2015.

Nitrogen Rate	Hazlet (OP)	Brasetto (HYB)
	---------- Yield (kg ha^{-1}) ----------	
6 kg N ha^{-1}	2579 d	3143 c
50 kg N ha^{-1}	3315 c	3971 ab
100 kg N ha^{-1}	3239 c	4124 ab
150 kg N ha^{-1}	3306 c	4205 a
200 kg N ha^{-1}	3296 c	4118 ab
250 kg N ha^{-1}	3146 c	3951 b
S.E.M	100.1	100.1
Orthogonal Contrasts	---------- Pr > F ----------	
N Rate – linear	< 0.001	< 0.001
N Rate – quadratic	< 0.001	< 0.001
N Rate – cubic	0.022	0.023

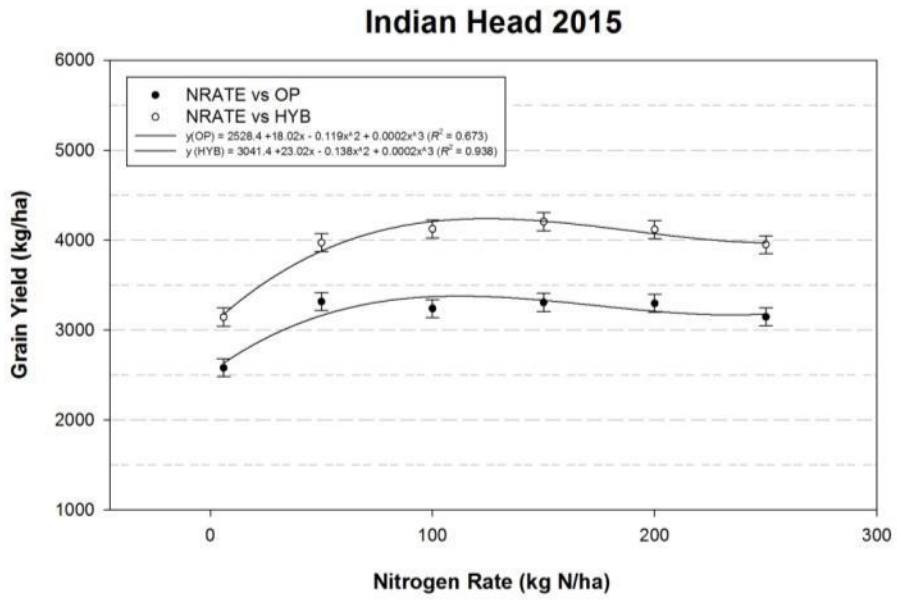

Figure 2. Fall rye yield response to N rate for individual varieties Hazlet (OP) and Brasetto (HYB) at Indian Head, Saskatchewan (2015)

Grain protein concentrations (g protein 100 g seed^{-1}) were affected by both variety ($P < 0.001$) and N rate ($P < 0.001$) with a significant VAR x NR interaction ($P < 0.001$; Table 4). Across N rates, the mean protein concentration of the lower yielding variety Hazlet was 0.8 g 100 g^{-1} higher (7%) than Brasetto (Table 13). At any given N level, protein concentrations are generally inversely related to grain yield, thus this response was not unexpected. Averaged across varieties, the linear, quadratic and cubic responses for protein response to N rate were all significant; however, the cubic response again appeared to describe the data most accurately (Fig. 3). Protein concentrations increased rather sharply from 6-150 kg N ha^{-1} at which point protein continued to increase but more slowly. While the overall mean protein concentrations still had not been maximized at 250 kg N ha^{-1}, the significant VAR × NR interaction indicated that the effect of N on protein differed between the two varieties.

Table 13. Main effect means for variety and nitrogen fertilizer rate effects on fall rye grain protein at Indian Head in 2015.

Main effect	Grain Protein
Variety	---------- g 100 g^{-1} ----------
Hazlet	12.1 a
Brasetto	11.3 b
S.E.M.	0.05
Nitrogen Rate	
6 kg N ha^{-1}	9.8 e
50 kg N ha^{-1}	11.0 d
100 kg N ha^{-1}	12.1 c
150 kg N ha^{-1}	12.4 b
200 kg N ha^{-1}	12.5 ab
250 kg N ha^{-1}	12.6 a
S.E.M	0.07
Orthogonal Contrasts	---------- Pr > *F* ----------
N Rate – linear	<0.001
N Rate – quadratic	<0.001
N Rate – cubic	0.003

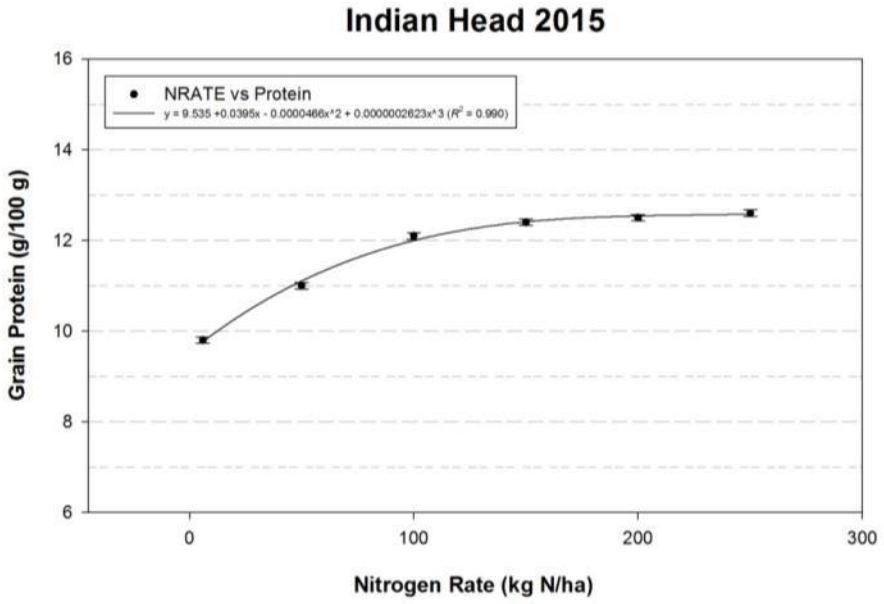

Figure 3. Average fall rye protein response to N fertilizer rates at Indian Head, Saskatchewan (2015).

Mean protein concentrations for individual treatments along with the orthogonal contrast results are presented in Table 14. For the open pollinated variety Hazlet, the response was cubic and followed a pattern similar to the combined results where protein concentrations increased most sharply from 6-150 kg N ha^{-1} and then climbed at a slower rate when N levels were increased beyond 150 kg N ha^{-1}. For the hybrid Brasetto, the cubic response was not significant (P = 0.479) but the quadratic response was with the effect on protein concentrations tapering off as N rates were increased beyond 150 kg N ha^{-1} (Table 12, Fig. 4). According the calculated response curves, protein concentrations for Brasetto reached a maximum of 12.13% with 207 kg N ha^{-1} while, for Hazlet, protein concentrations were still climbing at the 250 kg N ha^{-1} rate. Furthermore, protein levels for both varieties were similar in the control but they were always higher for Hazlet in the fertilized treatments.

Table 14. Individual treatment (VAR × NR) means for variety and nitrogen fertilizer rate effects on fall rye grain protein at Indian Head in 2015.

Nitrogen Rate	Hazlet (OP)	Brasetto (HYB)
	Protein (g 100 g^{-1})	
6 kg N ha^{-1}	9.9 g	9.7 g
50 kg N ha^{-1}	11.4 e	10.6 f
100 kg N ha^{-1}	12.6 c	11.6 e
150 kg N ha^{-1}	12.9 b	11.9 d
200 kg N ha^{-1}	13.0 ab	12.0 d
250 kg N ha^{-1}	13.1 a	12.1 d
S.E.M	0.09	0.09
Orthogonal Contrasts	Pr > F	
N Rate – linear	< 0.001	< 0.001
N Rate – quadratic	< 0.001	< 0.001
N Rate – cubic	< 0.001	0.479

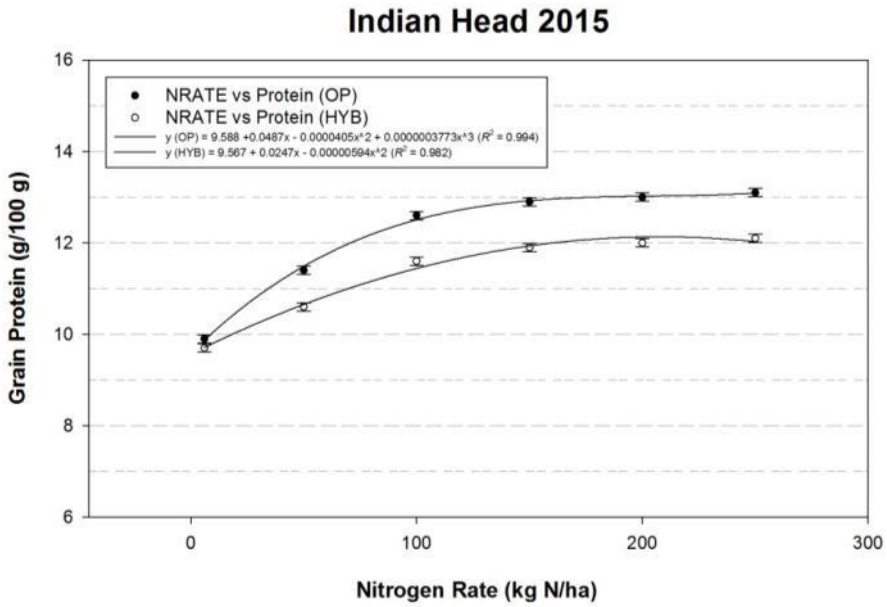

Figure 4. Fall rye protein response to N rate for individual varieties Hazlet (OP) and Brasetto (HYB) at Indian Head, Saskatchewan (2015)

Extension and Acknowledgement

While this demonstration could not be shown at the 2015 Indian Head Crop Management Field Day for logistic reasons, the site was visited by numerous agronomists (i.e. Ducks Unlimited, Bayer CropScience), farmers and seed growers on several occasions throughout the growing season. Results from the project will be made available in the 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. In addition, these results were combined with those from Melfort and Scott, Saskatchewan in a combined report prepared by the Western Applied Research Corporation.

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 in the thin-Black soil zone of southeast Saskatchewan. Overall, Hazlet was 19% taller than Brasetto and, while minor in all cases, the hybrid also appeared less susceptible to lodging. Unexpectedly, heights were reduced with increasing N rates; however, it is possible that these results were confounded by lodging to some extent. Grain yields for Brasetto were nearly 25% higher than Hazlet on average and there was no significant interaction between the varieties and N rate for this variable. The lack of an interaction here suggested that the response to N fertilizer was similar for both varieties, despite the higher yield potential of Brasetto. Averaged across varieties and based on the estimated response curve, the maximum yield (3814 kg ha^{-1}) was achieved with 120 kg N ha^{-1}; however, with relatively small yield differences amongst fertilized treatments, profits were likely maximized at a lower rate depending on relative grain and fertilizer prices. 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. For Hazlet, protein concentrations still had not peaked at 250 kg N ha^{-1} while, for Brasetto, protein reached a maximum of 12.1 g 100 g^{-1} at an N rate of 207 kg ha^{-1}. 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 little economic incentive to apply rates

beyond those required to optimize yield. Based on the results from this single site-year demonstration, both varieties evaluated appeared to respond similarly to N fertilizer rates and, while the hybrid yielded significantly higher, the higher yield potential must be weighed against the increased seed costs. This project is continuing at both Indian Head and Melfort in 2015-16.

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 and many of the crop inputs utilized in this demonstration were provided in-kind by industry partners. The original field protocols were developed by Laryssa Grenkow (Western Applied Research Corporation) who also sourced the seed for the project. The technical and administrative support of Christiane Catellier, Danny Petty, Dan Walker and Carly Miller was greatly appreciated.

13. Appendices

Abstract

14. Abstract/Summary:

A field trial was conducted near Indian Head to demonstrate yield potential and nitrogen response of open-pollinated versus hybrid fall rye. Overall, the open-pollinated variety (Hazlet) was nearly 20% taller than the hybrid (Brasetto). While Brasetto yielded 25% higher than Hazlet (3919 versus 3147 kg ha^{-1}), the varieties responded similarly to N with yields maximized at 112-124 kg N ha^{-1} and a maximum yield increase of 33% (953 kg ha^{-1}) over the control. Mean protein concentrations were lower for Brasetto but N effects on protein varied with variety. While protein concentrations were similar in the control they were always higher with Hazlet when fertilized and peaked at a lower rates for Brasetto (207 kg N ha^{-1}) than for Hazlet (>250 kg N ha^{-1}). While it appears that N can be managed similarly for these varieties this is only a single site-year and yields were limited by dry spring conditions.
