2016

Annual Report

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Table of Contents

Introduction

The East Central Research Foundation (ECRF) is a non-profit, producer directed research organization which works closely with various levels of government, commodity groups, private industry and producers. Founded in 1996, the mission of ECRF is to promote profitable and sustainable agricultural practices through applied research and technology transfer to the agricultural industry.

In 2013, ECRF signed a memorandum of understanding with Parkland College that will allow the partners to jointly conduct applied field crop research in the Yorkton area. The City of Yorkton provided the college with a 5 year lease of land (108 acres) located just a half mile south of town on York lake road and another 60 acre parcel located just west of town. We will be entering the 5th year of that agreement.

Parkland College is the first regional college in Saskatchewan to undertake an applied research program. Parkland College is thrilled to be involved in applied research because it fits with one of their mandates to "serve regional economic development". The Partnership also provides the college with a location and equipment to use for training students. Both partners benefit from each other's expertise and connections. ECRF and Parkland College also have access to different funding sources which is another strength of the partnership.

ECRF Board of Directors

ECRF is led by a 6 member Board of Directors consisting of producers and industry stakeholders who volunteer their time and provide guidance to the organization. Residing all across East-Central Saskatchewan, ECRF Directors are dedicated to the betterment of the agricultural community as a whole. The 2015 ECRF Directors are:

- Glenn Blakely (Chairperson) – Tantallon, SK
- Fred Phillips (Vice Chairperson) – Yorkton, SK
- Blair Cherneski - Goodeve, SK
- Dale Peterson - Norquay, SK
- Wayne Barsby - Sturgis, SK
- Ken Waldherr - Churchbridge, SK
- Gwen Machnee – Yorkton, SK -Co-ordinator for University and Applied Research-Parkland College

Ex-Officio

- Charlotte Ward – Regional Forage Specialist- Saskatchewan Agriculture
- Lyndon Hicks – Regional Crops Specialist – Saskatchewan Agriculture

Staff

- Mike Hall – Research Coordinator
- Kurtis Peterson – Administrator
- Clark Anderson – "On Call" Equipment Technician
- Heather Sorestad –Summer Student

Agri-Arm

The Saskatchewan Agri-ARM (Agriculture Applied Research Management) program connects eight regional, applied research and demonstration sites into a province-wide network. Each site is organized as a non-profit organization, and is led by volunteer Boards of Directors, generally comprised of producers in their respective areas.

Each site receives base-funding from the Saskatchewan Ministry of Agriculture to assist with operating and infrastructure costs, with project-based funding sought after through various government funding programs, producer / commodity groups and industry stakeholders. Agri-ARM provides a forum where government, producers, researchers and industry can partner on provincial and regional projects.

The eight Agri-ARM sites found throughout Saskatchewan include:

- Conservation Learning Centre (**CLC**), Prince Albert
- East Central Research Foundation (**ECRF**), Yorkton
- Indian Head Agricultural Research Foundation (**IHARF**), Indian Head
- Irrigation Crop Diversification Corporation (**ICDC**), Outlook
- Northeast Agriculture Research Foundation (**NARF**), Melfort
- South East Research Farm (**SERF**), Redvers
- Western Applied Research Corporation (**WARC**), Scott
- Wheatland Conservation Area (**WCA**), Swift Current

For more information on Agri-ARM visit http://Agri-ARM.ca/

Farm sites

ECRF and Parkland College currently have three farm site locations. The north and south farm site is located a half mile south of Yorkton down York Lake Road. (SW 26 25 4 w2). The soil at this site is described in the tables below:

Soil description for NW 26 25 4 w2 (North Farm site)

Factor	Comments
Drainage	Well drained
Soil Characteristics	Loam; pH 7.2; Non-saline
Nutrient levels 2016	0-6 inch soil test levels; N-NO3 11 lbs/ac (Deficient); P 24 lbs/ac (deficient); K >600 lbs/ac (Sufficient); S-SO4 >48 lbs/ac (Sufficient) 6-18 inch soil test levels; N-NO3 19 lbs/ac; S-SO4 35 lbs/ac

Soil description for SW 26 25 4 w2 (South Farm site)

Factor	Comments
Drainage	Well drained
Soil Characteristics	Loam; pH 7.5; Non-saline
Nutrient levels 2016	0-6 inch soil test levels; N-NO3 11 lbs/ac (Deficient); P 20 lbs/ac (deficient); K 488 lbs/ac (Sufficient); S-SO4 8 lbs/ac (Deficient) 6-12 inch soil test levels; N-NO3 8 lbs/ac; S-SO4 8 lbs/ac

Soil description for NW 24 25 4 w2 (East Farm site)

Factor	Comments
Drainage	Well drained
Soil Characteristics	Loam; pH 7.8; Non-saline
Nutrient levels 2016	0-6 inch soil test levels; N-NO3 7 lbs/ac (Deficient); P 22 lbs/ac (deficient); K >600 lbs/ac (Sufficient); S-SO4 15 lbs/ac (Marginal) 6-12 inch soil test levels; N-NO3 15 lbs/ac; S-SO4 >48 lbs/ac

Research and Statistical analysis

Unless stated otherwise all trials are small plot research. Plot size is typically either 11 or 22 feet wide and 35 feet long. The trials are seeded with a 10 foot wide Seed Hawk drill and the middle 5 rows of plots are harvested using a small plot Wintersteiger combine. In the case for forage trials, the middle 5 rows of each plot are harvested with a small plot forage harvester.

Treatments are replicated and randomized throughout the field so that data may be analyzed. If a treatment is seeded in multiple plots throughout the field, experience tells us we are unlikely to obtain the same yield for each of these plots. This is the result of experimental variation or variation within the trial location. This variation must be taken into consideration before the difference between two treatment means can be considered "significantly" different. This is accomplished through proper trial design and statistical analysis.

Trials are typically set up as Randomized complete blocks, Factorial or split plot designs and replicated 4 times. This allows for an analysis of variance. If the analysis of variance finds treatments to differ statistically then means are separated by calculating the least squares difference (lsd). For example, if the lsd for a particular treatment comparison is 5 bu/ac then treatment means must differ more than 5 bu/ac from each other to be considered significantly (statically) different. In this example, treatment means that do not differ more than 5 bu/ac are not considered to be significantly different. All data in our trials must meet or exceed the 5% level of significance in order to be considered significantly different. In other words, the chance of concluding there is a significant difference between treatments when in reality there is not, must be less than 1 out of 20. For the sake of simplicity, treatment means which are not significantly different from each other will be followed by the same letter.

Extension Events

ECRF/Parkland College Farm Tour July 21, 2016

Tours

- July 21, 2016 ECRF/Parkland College Annual Farm Tour – 60 attending
- August 10, 2016
  - Alliance Seed Tour -20 attending
- August 26, 2016
  - Era Ag Technology tour-3 attending

Summary

Total number of field days held	3
Total number of producers attending field days	83

2016 Videos- Website

- Lentil production in the black soil zone**-** (**140** website)
- Effect of Nozzle Selection and Boom Height on Fusarium Head Blight**-** (**70** website)
- Effect of Preceding Legume Crop on Spring Wheat (**33** website)
- Effect of Fall Cultivation on Soybeans Seeded Early, Mid, and Late May (**44** website)
- Effect of Variety, Nitrogen Rate ad Seeding Rate on Forage Corn (**34** website)
- Effect of Variety, and Nitrogen Rate on Oat yield and Test Weight (**51** website)
- Flax Response to Nitrogen and Phosphorus (**39** website)

2015 Videos -Website

- Flax Studies with Iharf and Narf**-** (**52** website)
- Early Defoliation of Cereals for Swath Grazing**-** (**117** website)
- Soybean Stature by Row Spacing**-** (**72** website)
- Manipulator Effects on Lodging in Wheat 2015**-** (**175** website)
- Forage Termination 2015**-** (**86** website)

2014 Videos - Website

- Canary Seed Fertility- (**76** website)
- Fungicide Timing on Wheat- (**153** website)
- Soybean variety by seeding date **-** (**61** website)
- Cereal forage by seeding date **-** (**35** website)

Total Website views **1238 (As of March 8, 2017)**

Environmental Data

Data for Yorkton was obtained from Environment Canada from the following internet site: [http://www.climate.weatheroffice.gc.ca/climateData/canada_e.html].

Mean monthly temperatures and precipitation amounts for Yorkton during the 2015 and 2016 seasons are presented relative to the long-term averages in Table 3. Seed and fertilizer were placed into adequate soil moisture and plant emergence was very good in both years. Growing conditions were also excellent in both years however, the spring of 2015 was somewhat dry.

Table 3. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) normals for the 2015 growing seasons at Yorkton in Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
		-----------------------------*Mean Temperature (°C)* ------------------------------				
Yorkton	2016	13.5	17.2	18.5	17.0	16.6
	2015	10.5	16.7	19.3	17.5	16.0
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
		-------------------------------- *Precipitation (mm)* -----------------------------				
Yorkton	2016	74.9	62.8	141.7	59.1	338
	2015	8	28	123	46	205
	Long-term	***51***	***80***	***78***	***62***	***272***

Managing Leaf Disease in Oats

M. Hall[1]

[1]East Central Research Foundation/Parkland College, Yorkton, SK

Abstract/Summary:

Crown rust (CR) of Oats is occasionally an issue in the Yorkton area. Even in the absence of crown rust, producers are claiming yield responses to applied fungicide. However, responses are not consistently observed. Oat varieties with differing levels of resistance to crown rust were sprayed with either propiconazole or pyraclostrobin. The oat varieties compared were Souris (susceptible to CR), Ruffian (intermediate resistance to CR) and Stride (resistant to CR). Crown rust was not present during the study and the response of oats to applied fungicide did not differ between varieties. The application of propiconazole significantly increased the yield of oat over the application of pyraclostrobin. The propiconazole may have suppressed septoria which is not on the pyraclostrobin label. However, the difference in yield response is not clear, particularly since pyraclostrobin also significantly reduced lodging compared to oats treated with propiconazole. The results from this trial confirm that oat yield can be increased with the application of propiconazole even in the absence of crown rust.

Project objectives:

The objective is to demonstrate the impact of fungicide on crown rust and grain yield on oat varieties with differing levels of resistance to crown rust.

Project Rationale:

Crown rust (CR) of oat has been a problem in Manitoba, around Saskatoon and along the south Saskatchewan river where alternative hosts such as buckthorn prevail. Other leaf spot diseases appear to be mostly an issue for Manitoba growers. Studies lead by Randy Kutcher (associate professor at U of S) at Saskatoon and Melfort looked at the disease control and yield benefit from spraying propiconazole (tilt) and pyraclostrobin (Headline) on oat varieties with differing levels of resistance to crown rust (CR). Where crown rust pressure was high, the application of propiconazole and pyraclostrobin reduced the severity of disease on AC Morgan (Oat variety susceptible to CR) and increased yield. The benefit of fungicide application was less for CDC Dancer (intermediate resistance) and no benefit was detected for the resistant variety CDC Morrison. The benefit of spraying fungicide on oats appears to be a bit "hit and miss" and regionally specific. This study evaluated the benefit of spraying propiconazole and pyraclostrobin on the oat varieties Souris (very poor resistance to CR), Ruffian (fair resistance to CR) and Stride (very good resistance to CR) at Yorkton.

Methodology:

The trial was setup as a 2 order factorial with 4 replicates. The first factor was variety. The varieties were chosen to represent a range of susceptibilities to crown rust (CR). The second factor contrasted no fungicide vs propiconazole (tilt) vs pyraclostrobin (headline) sprayed at the flag leaf stage. Thus the treatment list is as follows:

1. Souris Oat (susceptible to CR); No fungicide
2. Souris Oat (susceptible to CR); Propiconazole at flag
3. Souris Oat (susceptible to CR); Pyraclostrobin at flag

4. Ruffian Oat (Intermediate resistance to CR); No fungicide
5. Ruffian Oat (Intermediate resistance to CR); Propiconazole at flag
6. Ruffian Oat (Intermediate resistance to CR); Pyraclostrobin at flag

7. Stride Oat (resistant to CR); No fungicide
8. Stride Oat (resistant to CR); Propiconazole at flag
9. Stride Oat (resistant to CR); Pyraclostrobin at flag

Plots were double wide (22 by 35 feet) to accommodate the passage of the tractor while spraying. Plots were seeded using a 10 foot Seed Hawk drill. Yield was harvested using a Wintersteiger plot combine from the side of the plot not trampled by the tractor.

Results:

Table 2 lists the dates of operations for the trial.

Table 2. Dates of Trial Operations in 2016	
Operation	**Date**
Pre-seed burn-off 0.66 l/ac Roundup Transorb	May 2
Seeded	May 9
Emergence Counts	May 30
Spectrum sprayed in-crop cross all treatments	June 1
Propiconazole at flag trts 2, 5 and 8	June 27
Pyraclostrobin at flag trts 3, 6 and 9	June 27
Leaf disease assessments (no crown rust; mostly bacterial blight)	August 5
Lodging	August 5
Harvest	Sept 1

Emergence between the varieties varied more than desired. Emergence rates were 21.2, 25.8 and 29.1 plants/ft^2 for the oat varieties Souris, Ruffian and Stride, respectively. Leaf disease rating were taken but much of the data was lost due to a computer glitch which was not caught until it was too late to make reassessments. However, there was no presence of crown rust in any treatment. Disease levels on the unsprayed check were relatively low and much of it appeared to be bacterial blight. Fungicide does not control bacterial blight.

No interactions were detected for the lodging and yield data and main effects have been presented in table 3. Souris was somewhat lower yielding but significant differences in yield were not detected. When averaged across variety, the application of propiconazole resulted in significantly more oat yield compared to the application of pyraclostrobin. While application of pyraclostrobin produced the lowest yield, it did result in the least amount of lodging. Ruffian tended to stand better than the other varieties but differences were not quite significant at p =0.05. As mentioned earlier no interactions were detected. So the yield response to applied fungicide did not differ between varieties. Not a surprise as crown rust was not present.

Table 3. Main Effects of Variety and Fungicide on Lodging and Yield of Oat.		
Main effects	Lodging (0-10)[1]	Yield (bu/ac)
Variety (V)[2]		
Souris	4.0 a	101.2 a
Ruffian	2.5 a	105.1 a
Stride	3.8 a	105.7 a
Fungicide (F)[2]		
No fungicide	4.1 b	103.6 ab
Propiconazole	3.8 b	108.4 b
Pyraclostrobin	2.4 a	100.0 a
Significance of Interactions between main effects[3]		
(V) X (F)	NS	NS
[1]Lodging (0-no lodging; 10- flat to ground)		
[2]Means followed by the same letter within a main effect are not significantly different p=0.5		
[3]NS-not significant at p=0.05; S-significant at p=0.05		

Conclusions and Recommendations

The application of pyraclostrobin to oats significantly reduced lodging compared to the application of propiconazole. However, Oats sprayed with propiconazole yielded significantly more than oats treated with pyraclostrobin. The reason for this is not clear. Since crown rust was not present in this study, propiconazole may have performed better because it is also registered for control of septoria leaf blotch and pyraclostrobin is not. All oat varieties responded equally to the application of propiconazole because crown rust was not the cause of yield loss. The results from this trial indicate that the yield of oats can be increased with the application of propiconazole even in the absence of crown rust.

Acknowledgements:

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during the annual tour.

Lentils in the Black Soil Zone

M. Hall[1]

[1]East Central Research Foundation/Parkland College, Yorkton, SK

Abstract/Summary:

The effect of row spacing, seeding rate and application of fungicide on disease of small red lentil and yield was evaluated on a moist black soil near Yorkton, Saskatchewan. The study found less disease and higher yields were associated with a wider row spacing (20 inch vs 10 inch), a lower seeding rate (160 vs 260 seeds/m^2) and dual application of fungicide. The best combination of factors produced 22.6 bu/ac whereas, the poorest combination only produced 12.5 bu/ac. However, the factors which had the greatest influence were seeding rate and fungicide. Yield could still be maximized at 10 inch row spacing provided seeding rates did not exceed 160 seeds/m^2 and a dual application of fungicide was applied. The results of this study are somewhat contrary to past studies involving seeding rates and row spacing. However, the results of this study should be view in light of excellent environmental conditions which were conducive to vegetative growth. The lentils easily filled in the canopy which was conducive to

disease development. More study in moister soil zones is required before adjusting seeding rate and row width recommendations.

Project objectives:

The objectives are to determine how disease severity and yield of lentils are impacted in the black soil zone by:

- expanding row widths
- varying seeding rates
- the use of single or dual applications of fungicide

Project Rationale:

In the winter of 2015/2016, small red #2 lentils were trading at $0.46/lb. This high price certainly created some interest in growing lentils. However, northeast Saskatchewan is not a traditional area for growing lentils. Lentils produced in the moister black soil zones usually grow “rank” and succumb to disease. Publications from the Saskatchewan Ministry of Agriculture suggest wider row spacing may be less conducive to foliar disease development by allowing the canopy to dry out during the day. Work by Dr. Manjula Bandara (Pulse research scientist AAFRD) looked at row widths of 8 10 and 12 inches. He found yields increased with wider row spacing when moisture conditions were satisfactory. But under hot dry conditions, narrow row spacing yielded more.

Seeding rate may also have an impact on disease development and yield. Current recommendations are for establishing 130 plants/m^2. However, this recommendation is being challenged by recent studies conducted in Alberta and Saskatchewan. Initial studies by Steve Shirtliffe with the University of Saskatchewan have observed higher yield and greater economic returns with small and extra small lentils at double the recommended seeding rate. Robyne Bowness (Pulse scientist) lead studies across 5 soil zones in Alberta and determined the ideal seeding rate to be closer to 160 plant/m^2. However, the impact of higher seeding rates have not been extensively studied in the moister black soil zones, particularly in regard to disease development.

Fungicide is another important part of controlling leaf disease in lentils. The main diseases to be controlled in north east Saskatchewan are anthracnose and ascochyta. Sequential applications are recommended when disease pressure is heavy. Producers growing lentils in moister regions need to know how the crop should be managed.

Methodology:

A small red variety of lentil (Maxim) was seeded with a 10 foot Seed Hawk drill and plot size was 22 by 35 ft. Plots were harvested with a Wintersteiger plot combine. The trial was setup as 3 order factorial with 4 replicates. The first factor contrasted 10 inch versus 20 inch row spacing. The 2nd factor compared seeding rates of 160 and 260 seeds/m^2. The 3rd factor evaluated the effect of fungicide applied alone or sequentially against a no fungicide check. Thus the following 12 treatments listed in table 1 were established.

Table 1. Treatment list			
Trt #	Row spacing (inches)	Seeding rate (Seeds/m2)	Fungicide
1	10	130	No Fungicide
2	10	130	Priaxor 180 ml/ac (@beginning of flowering)
3	10	130	Priaxor 180 ml/ac (@beginning of flowering) followed by Headline 160 ml/ac (7 to 10 days later)
4	10	260	No Fungicide
5	10	260	Priaxor 180 ml/ac (@beginning of flowering)
6	10	260	Priaxor 180 ml/ac (@beginning of flowering) followed by Headline 160 ml/ac (7 to 10 days later)
7	20	130	No Fungicide
8	20	130	Priaxor 180 ml/ac (@beginning of flowering)
9	20	130	Priaxor 180 ml/ac (@beginning of flowering) followed by Headline 160 ml/ac (7 to 10 days later)
10	20	260	No Fungicide
11	20	260	Priaxor 180 ml/ac (@beginning of flowering)
12	20	260	Priaxor 180 ml/ac (@beginning of flowering) followed by Headline 160 ml/ac (7 to 10 days later)

Table 2 lists the dates of operations.

Table 2. Dates of Trial Operations in 2016	
Operation	**Date**
Pre-seed burn-off 0.66 l/ac Roundup Transorb	May 3
Seeded	May 17
Emergence Counts	June 1 & 2
Ares sprayed in-crop cross all treatments	June 2
Assure sprayed in-crop cross all treatments	June 9
Priaxor sprayed beginning of flowering on trts 2,3,5,6,8,9,11,12 (light rain after app)	July 10
Headline sprayed on trts 3,6,9,12	July 15
Disease ratings	July 28
Maturity	various
Pre-harvest glyphosate (0.66 l/ac Roundup Transorb)	August 30
Yield (reps 1 and 3)	Sept 14
Yield (reps 2 and 4)	Sept 15

Results:

The target seeding rate of 130 seeds/m^2 produced plant populations/m^2 of 159 and 142 at the 10 and 20 inch row spacing, respectively. Clearly, the seeding rate was closer to 160 seeds/m^2 and treatment listing has been altered to reflect this. The target seeding rate of 260 seeds/m^2 produced plant populations/m^2 of 259 and 237 at the 10 and 20 inch row spacing, respectively. At both seeding rates, the plant establishment was significantly reduced by the wider row spacing due to greater interplant competition.

Main effects for row spacing, seeding rate and application of fungicide on maturity, disease severity and yield of lentil are presented in Table 3. Maturity was hastened by disease. The lower seeding rate lowered disease and increased days to physiological maturity. Maturity differences between row spacing and fungicide could not be detected as disease development by that time was high for all treatments. A significant interaction between all factors was detected with the disease severity data but not the yield data. However, all treatment means have been produced in figures 1 and 2 so the impact of compounding factors on disease and yield can be seen.

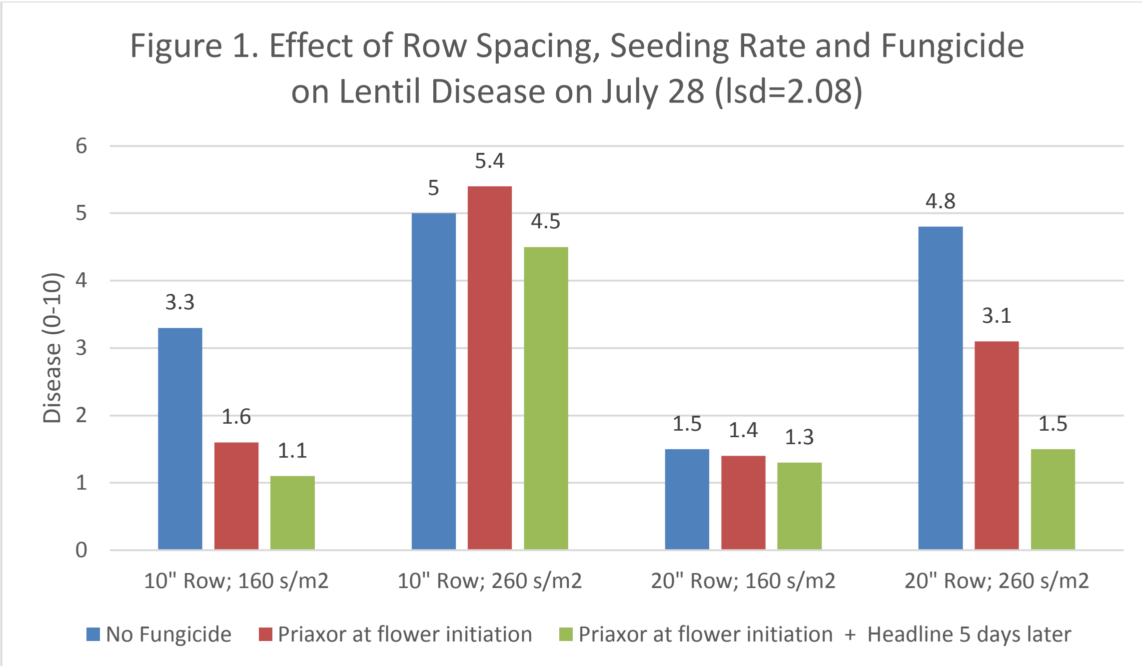
Decreasing seeding rate to 160 seeds/m^2 and dual application of fungicide significantly reduced disease severity and increased yield of lentil (Table 3). Increasing row spacing also significantly reduced disease development but associated yield increases were not statistically significant. The greatest yield and suppression of disease was associated with 20 inch row spacing, 160 seeds/m^2 and dual application of fungicide. In contrast, the lowest yield and greatest disease were associated with 10 inch row spacing, 260 seeds/m^2 and no fungicide. Combining the best of all these factors produced 22.6 bu/ac and a disease severity of 1.3 whereas, combining the worst of all these factor only produced 12.5 bu/ac and a disease severity of 5 (Figures 1 and 2). Seeding rate and fungicide had the biggest effects on yield. Yield could still be maximized on 10 inch row spacing provided seeding rate did not exceed 160 seeds/m^2 and dual application of fungicide was applied.

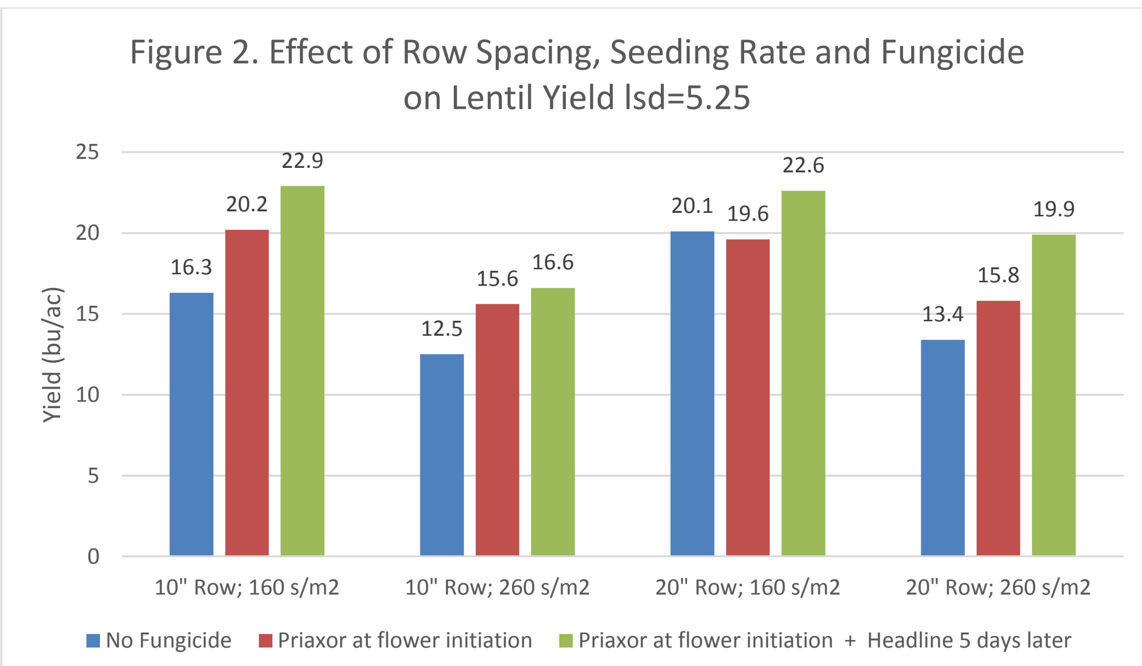
Dual application of fungicide was least effective on 20 inch row spacing with 160 seeds/m2 as disease levels with this thin canopy were already low. The dual application also did not appear to reduce disease levels with the heaviest canopy stand (10 inch row; 260 seeds/m^2) despite a positive yield response. This crop stand already had high levels of disease by the time of the July 28 rating and earlier differences of control may have been missed. Overall, the dual application of fungicide easily paid for itself.

Table 3. Main Effects of Row Spacing, Seeding Rate and Fungicide on Disease Severity and Yield of Lentil.

Main effects	Disease severity[1] (July 28)[2]	Yield (bu/ac)[2]	Days to Physiological Maturity
Row Spacing (R)			
10 inches	3.5 a	17.3 a	97.2 a
20 inches	2.3 b	18.6 a	97.3 a
Seeding Rate (S)			
160 seeds/m^2	1.7 a	20.3 a	98.7 a
260 seeds/m^2	4.0 b	15.6 b	95.8 b

Fungicide (F)			
No fungicide	3.6 a	15.6 a	96.9 a
Priaxor[3]	2.9 a	17.8 b	96.9 a
Priaxor[3] + Headline[4]	2.1 b	20.5 c	97.9 a
Significance of Interactions between main effects[5]			
(R) X (S)	NS	NS	NS
(R) X (F)	NS	NS	NS
(S) X (F)	NS	NS	NS
(R) X (S) X (F)	S	NS	NS
[1]Visual disease rating (0-no disease; 10-heavily diseased and flat to ground)			
[2]Means within a main effect followed by the same letter are not significantly different p=0.05			
[3]Priaxor 180 ml/ac @ beginning of flowering			
[4]Headline 160 ml/ac 5 days after Priaxor application			
[5]NS-not significant at p=0.05; S-significant at p=0.05			





Conclusions and Recommendations

Highest yields and lowest levels of disease were associated with the wider row spacing (20"), lower seeding rate (160 seeds/m2) and the dual application of fungicide. While 20 inch row spacing did reduce disease levels, maximum yields could still be achieved on 10 inch row spacing provided seeding rates did not exceed 160 seeds/m^2 and dual fungicide is applied. The benefit from lower seeding rates and wide row spacing is somewhat contradictory to research previously conducted in areas where lentils are traditionally grown. The results from this study should be considered in light on the excellent growing conditions of 2016. The ideal conditions experienced for vegetative growth meant lentils could easily fill the canopy and create an ideal environment for disease. More study is needed to determine whether row spacing and seeding rate recommendations should be adjusted for moister climes.

Acknowledgements:

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during the annual tour.

The Value of New Legume Crops in Rotation with Wheat

M. Hall[1]

[1]East Central Research Foundation/Parkland College, Yorkton, SK

Abstract/Summary:

This demonstration evaluated the impact canola, faba bean, soybean and peas on the nitrogen response of wheat seeded the following year. Unlike past research, the yield of wheat did not benefit from having a grain legume grown the previous year. In fact, wheat yields were highest on canola stubble. The reason for this is unclear. Like past research, the prior crop did not affect the response of wheat to added nitrogen. In other words, nitrogen rate should not be adjusted when growing wheat on legume versus canola stubble. Though the yield of wheat grown on legume stubble did not increase, it did increase grain protein which is consistent with past research. Increasing nitrogen rate significantly increased fusarium head blight (FHB) levels. Added nitrogen likely delayed and extended the flowering period, resulting in greater levels of fusarium head blight infection. However, lowering nitrogen rate also lowers yield and is not an economic means of controlling FHB. Economically, canola and soybeans provided the greatest economic returns. However, soybeans are a long season crop which makes growing the crop riskier.

Project objectives:

The objective in the first year was to compare the productivity and economic return of canola, soybeans, faba beans and peas.

The objective in the second year was to determine the nitrogen and non-nitrogen benefits from the crop grown in year one on wheat grown the following year. How does the preceding crop type influence the nitrogen response of wheat?

Project Rationale:

Numerous studies have shown the benefit of legumes in rotation. Legumes contribute nitrogen benefits and non-nitrogen benefits to subsequent cereal crops. Non-nitrogen benefits include many factors such as a break in disease cycles, improved soil tilth and enhanced uptake of other nutrients such as phosphorous. Protein levels of cereals following a legume crop are usually higher as decaying legume residue releases some nitrogen late the following season. However, many agronomists still do not make significant changes to nitrogen recommendations for wheat following an annual legume harvested for grain. Producers in the Yorkton area are well experienced with peas but there are other legume crops which have potential such as soybeans and faba beans. Faba beans are considered the king of legume crops, fixing 180 to 300 lbs/ac of nitrogen compared to only 50 to 200 lbs/ac fixed by peas. What isn't well known is the relative effect various legume grain crops have on a succeeding wheat crop in terms of yield and protein.

Methodology:

The trial required two years to complete and was setup as a 2 factor split-plot with 4 replications. The main plot factor was the crop grown in 2015 which was either canola, faba bean, soybean or peas. In 2016, the subplot factor was nitrogen rate applied to a spring wheat crop. Rates applied were 0, 50, 80, 100 and 120 lbs/ac of actual nitrogen. Table 1 lists the treatments.

Table 1. Treatment list for wheat/legume study

Trt #	2015 Crop	2016 Crop	2016 Actual N (lbs/ac) applied
1	Canola	HRS wheat	0
2	Canola	HRS wheat	50
3	Canola	HRS wheat	80
4	Canola	HRS wheat	100
5	Canola	HRS wheat	120
6	Faba Beans	HRS wheat	0
7	Faba Beans	HRS wheat	50
8	Faba Beans	HRS wheat	80
9	Faba Beans	HRS wheat	100
10	Faba Beans	HRS wheat	120
11	Soybeans	HRS wheat	0
12	Soybeans	HRS wheat	50
13	Soybeans	HRS wheat	80
14	Soybeans	HRS wheat	100

15	Soybeans	HRS wheat	120
16	Peas	HRS wheat	0
17	Peas	HRS wheat	50
18	Peas	HRS wheat	80
19	Peas	HRS wheat	100
20	Peas	HRS wheat	120

Plots were 12 by 35 feet and seeded with a 10 foot Seed Hawk drill. Plots were harvested at the appropriate time based on crop type using a Wintersteiger plot combine. The middle 5 rows of each plot were then harvested. Table 2 lists the dates of operations for 2015 and 2016.

Table 2. Dates of operations for 2015 and 2016	
Operations in 2015	Date
Canola seeded with 222 lbs/ac urea, 62.5 lbs/ac ammonium sulphate and 50 lbs/ac of ammonium phosphate	May 2
Faba bean and Peas seeded with granular inoculant and 29 lbs/ac of ammonium phosphate	May 5
Soybeans seeded with granular inoculant and 29 lbs/ac of ammonium phosphate	May 21
Canola reseeded due to late spring frost	June 1
Odyssey + Centurion on Faba beans and Peas	June 8
Roundup Transorb (0.33 l/ac rate) on Canola	June 13
Roundup Transorb (0.66 l/ac rate) on Soybeans	June 13
Centurion on Faba beans and Peas	June 18
Desiccated Peas with Reglone	August 21
Harvested Peas	August 24
Harvested Canola	Sept 19
Harvested Soybeans	Oct 2
Harvested Faba beans	Oct 10
Operations in 2016	Date
Re-staking trial	April 20
Pre-seed glyphosate (0.66 l/ac Transorb)	May 2
Seeding	May 4
Emergence counts	May 26
In-crop herbicide (Simplicity + prestige)	May 26
In-crop herbicide (Axial)	June 8
In-crop fungicide (Prosaro)	July 5
Lodging ratings	July 27
Harvest	August 22

Results:

Final emergence for all crops was fairly good in 2015 (table 3), although the canola had to be reseeded due to frost and flea beetles. Yields were fairly typical with the exception of faba bean which was a little on the low side. Faba beans really thrive in moist conditions and 2015 started out a bit dry and the trial was situated on a somewhat droughty location.

Table 3. Emergence and yield of crops seeded into main-plots in 2015		
Crop Specie	Emergence (plants/ft2)	Yield (bu/ac)
Canola	8.5	46.0
Faba bean	5.1	54.5
Soybean	3.9	45.9
Peas	7.3	42.0

Table 4 presents the economic returns over variable expenses based on assumptions put forth by Saskatchewan Agriculture's Crop Planner. Returns for canola were fairly consistent based on price assumptions from 2014 to 2017. Returns for the other crops were fairly variable. Faba bean price assumptions were $8.4/bu in 2016 and only $3.6/bu for 2017 which resulted in a huge swing in profitability projections. Pea returns were quite variable and were never comparable to canola. Soybeans produced the highest returns from 2015 to 2017.

Table 4. Return over Variable Expenses based on Saskatchewan's Crop Planner					
Crop Specie	Yield (bu/ac)	Return over Variable Expense ($/ac)			
		2014[1]	2015[2]	2016[3]	2017[4]
Canola	46.0	180.88	166.16	195.14	216.76
Faba Bean	54.5	N/A	N/A	147.73	-114.35
Soybean	45.9	N/A	256.66	223.62	364.99
Peas	42.0	62.81	22.49	135.89	87.59
[1]Crop Planner Price Assumptions (2014): Canola-$9.80/bu; Yellow Pea-$7/bu					
[2]Crop Planner Price Assumptions (2015): Canola-$9.48/bu; Yellow Pea-$6.04/bu; Soybean-$10.07/bu					
[3]Crop Planner Price Assumptions (2016): Canola-$10.11/bu; Yellow Pea-$8.74/bu; Soybean-$9.35/bu; Faba bean-$8.4/bu					
[4]Crop Planner Price Assumptions (2017): Canola-$10.58/bu; Yellow Pea-$7.59/bu; Soybean-$12.43/bu; Faba bean-$3.6/bu					

Table 5 lists the main effects of "previous crop" and "rate of applied nitrogen" on spring wheat. No interaction between these factors was detected for any of the parameters measured. This means the effect of increasing nitrogen on wheat emergence, lodging, yield, grain protein and fusarium damaged kernels (FDK) was the same regardless off the preceding crop. Yield was maximized between 80 to 100 lbs/ac of actual N and grain protein was still rising at 120 lbs/ac of actual N (Table 5, Figures 1 and 2). Though not statistically significant, wheat yields were numerically lower and grain protein was numerically higher when wheat was grown on a legume stubble. Grain protein is typically higher for wheat grown on legume stubble. However, yield is not typically lower. The reason for the lower yield unclear. Winter annual weeds were more abundant on the pea stubble prior to the pre-seed burn-off and may have limited wheat yield. Peas are harvested early in the season allowing more time for fall colonization and establishment of winter annual weeds. However, this was not the case for soybeans or faba beans which are harvested late and yet wheat seeded after these crops was also yielding lower.

Lodging of wheat increased significantly with added nitrogen on every stubble type. However, the level of lodging was significantly higher when wheat was grown after pea and soybean. This may indicate these stubbles were releasing more nitrogen. Levels of FDK in the wheat grain did not significantly differ with stubble type from the previous crop. However, the level of FDK did significantly increase with added nitrogen. Increasing nitrogen is known to increase tillering. This is where most of the yield increase due to added nitrogen comes from. Added nitrogen likely delayed and extended the period of flowering in wheat and resulted in higher levels of fusarium head blight infection.

Table 5. Main Effects of Wheat Emergence, Lodging, Yield, Grain Protein and Fusarium Damaged Kernels (FDK).[1]

Main Effects	Emergence (plants/ft^2)	Lodging (0-10)[2]	Yield (bu/ac)	Grain Protein (%)	FDK (%)
Previous Crop (C)					
Canola	24.8 a	1.4 a	49.0 a	13.6 a	0.32 a
Faba Beans	23.0 a	1.4 a	45.0 a	14.1 a	0.41 a
Soybeans	23.8 a	3 b	46.7 a	14.4 a	0.39 a
Peas	24.6 a	2.8 b	45.7 a	14.3 a	0.36 a
Applied Nitrogen (lbs/ac of Actual) (N)					
0	25.4 a	0.3 a	36.2 a	11.9 a	0.22 a
50	24.7 a	1.5 b	46.6 b	13.1 b	0.34 b
80	24.6 a	2.9 c	49.4 bc	14.5 c	0.4 b
100	24.2 a	2.7 c	51 c	15.2 d	0.39 b
120	21.4 b	3.4 c	49.6 bc	15.8 e	0.5 c
Significance of Interactions between main effects					
C X N	NS	NS	NS	NS	NS
[1]Means within a main effect followed by the same letter are not significantly different p=0.05					
[2]Lodging 0-erect; 10-flat to the ground					

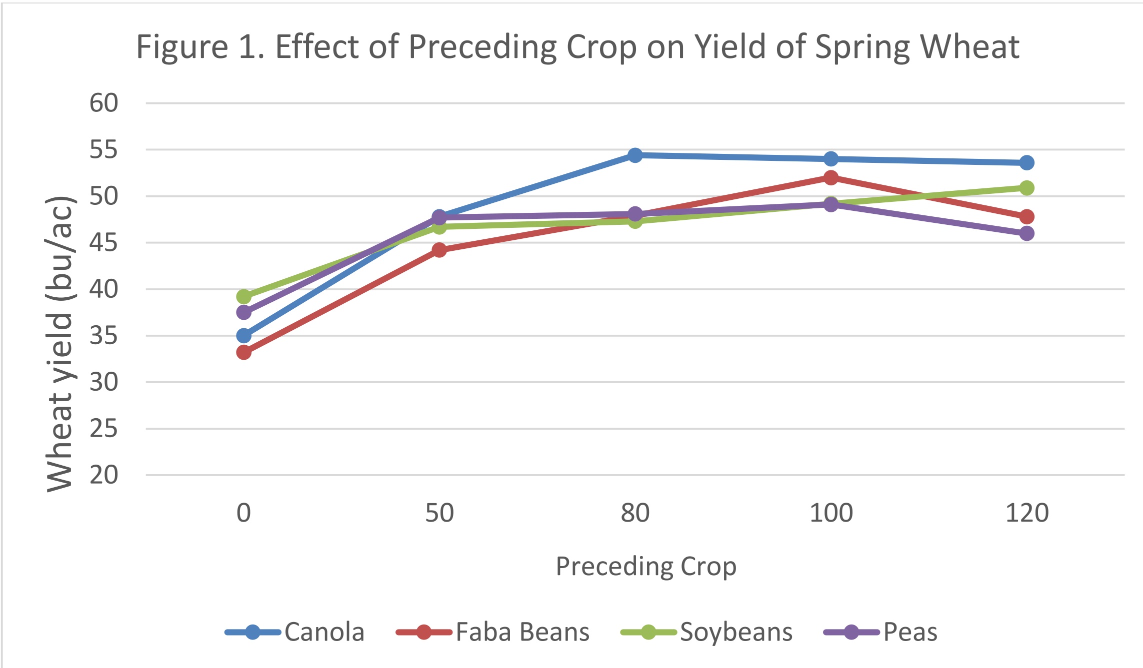


Figure 1. Effect of Preceding Crop on Yield of Spring Wheat
Wheat yield (bu/ac)
60
55
50
45
40
35
30
25
20
0
50
80
100
120
Preceding Crop
Canola
Faba Beans
Soybeans
Peas

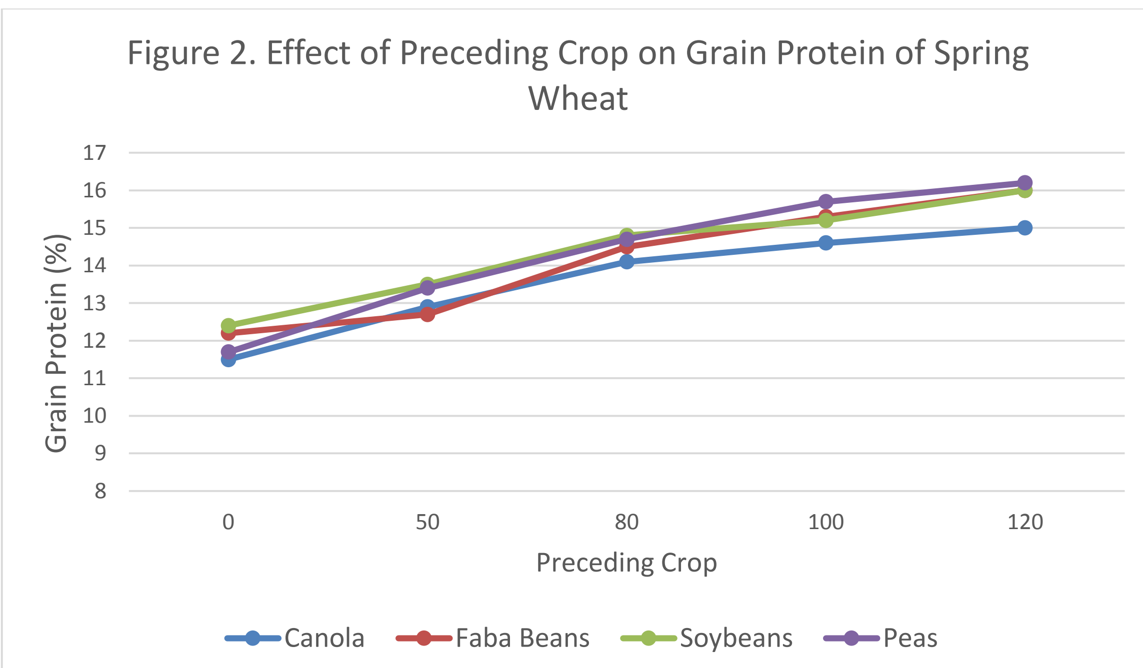


Figure 2. Effect of Preceding Crop on Grain Protein of Spring Wheat
Grain Protein (%)
17
16
15
14
13
12
11
10
9
8
0
50
80
100
120
Preceding Crop
Canola
Faba Beans
Soybeans
Peas

Conclusions and Recommendations

While annual grain legumes may fix a lot of nitrogen, most of that nitrogen is removed with the seed at harvest. Grain legumes typically contribute only 10 to 15 lbs/ac of available nitrogen to the succeeding crop. The release of this nitrogen tends to be late in the year and mostly goes towards increasing protein rather than yield. As a result nitrogen recommendations are not typically reduced for wheat when following an annual legume grown for grain. However, grain legumes can increase cereal yield beyond what can be attributed to an additional 15 lbs/ac of N. This is the rotational benefit of legumes which includes improved physical, chemical and biological characteristics of the soil. The results from this demonstration support the above consensus in part. In this demonstration, growing a legume prior to wheat tended to increase grain protein as expected but did not increase yield. The reason for a lack of yield benefit from growing a legume prior to wheat is unclear. As expected, the yield response of wheat to added nitrogen did not differ whether the previous crop was either canola, faba bean, soybean or peas. In all cases there was a strong response to added nitrogen which supports the notion that fertilizer recommendations should not be reduced following an annual legume grown for grain. Increasing rates of applied nitrogen increased levels of fusarium damaged kernels (FDK) in the grain. Increasing nitrogen likely delayed and extended the flowering period, resulting in greater levels of fusarium head blight infection. Reducing nitrogen rates, significantly lowers yield and protein of wheat and is not likely to become a recommended practice for the reduction of fusarium head blight

Based on price and cost assumptions used in Saskatchewan Agriculture's crop planner, soybeans and canola provided higher and more consistent revenue over the 2014 to 2017 projections. While soybeans provided a greater return than canola they are later maturing which adds risk. In this study there was no yield or economic benefit from growing wheat on any legume stubble versus canola stubble.

Acknowledgements:

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during the annual tour. Thanks to Pioneer out of Yorkton for the protein analysis and grading on the grain.

The Influence of Cultivation and Seeding Date on Soybean Production

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[1]East Central Research Foundation/Parkland College, Yorkton, SK

Abstract/Summary:

Soybeans are a long season crop that should not be seeded early into soils below 8 to 10^{o}C. If soybeans are seeded too early they can be "cold shocked" and this can significantly affect emergence, vigor and yield. Some have recommended fall cultivation as a means to warm up the seed bed so soybeans can be seeded earlier. This demonstration looked at seeding soybeans on May 5th, 16th and 24th into standing stubble or soil that was cultivated the previous fall. Numerically, yields were best with the earliest seeding date and maturity was significantly earlier. However, the spring in this study was much warmer than the historical average. Soil temperatures were well above the minimum requirement of 8 to 10^{o}C, even at the earliest seeding date. Despite the results of this study, producers are still advised to wait until mid-May before seeding even if soil temperatures are warm in order to avoid a late spring frost such as experienced in 2015. The benefit of cultivation was not significant in this study and likely depends on the level of residue present.

Project objectives:

The objective was to determine if blackening the soil with fall cultivation can hasten the maturity and increase the yield of soybean seeded at various dates the following spring.

Project Rationale:

Cultivating the fall prior to seeding soybeans has been recommended to improve the chances of maturing soybeans in more northern climes. Cultivated soils are blacker and thus warm up faster in spring than soils with standing stubble. This potentially allows producers to seed soybeans into the targeted soil temperature of 10 degree Celsius earlier in the season and increase the likelihood of maturity and early harvest. Other potential benefits could include increased internode length (less pods left behind) and yield. However, cultivating the soil has its costs and environmental consequences. It won't be embraced by minimum tillage producers unless there is strong evidence for its benefit to soybean production. The impact of fall cultivation may also depend on the seeding date of the soybeans the following year. Early seeded soybean should benefit from fall cultivation more than later seeded soybeans.

Methodology:

The trial was setup as a split-plot with three factors. The main-plot factor contrasted cultivation versus direct seeding. Cultivated treatment were established into wheat stubble in the fall of 2015. The subplot factor was seeding date of soybean in the spring of 2016. Three seeding dates were early May (May 5), mid-May (May 16) and late May (May 25). Thus the treatment list is as follows:

1. Fall cultivated; Soybeans seeded early May
2. Fall cultivated; Soybeans seeded mid-May
3. Fall cultivated; Soybeans seeded late May
4. Direct Seeded; Soybeans seeded early May
5. Direct Seeded; Soybeans seeded mid-May
6. Direct Seeded; Soybeans seeded late May

Plot size was 12 by 35 feet long and seeded with a 10 foot wide seed hawk. The middle 5 rows of each plot were harvested with a small Wintersteiger plot combine. Seed was treated with inoculant and granular inoculant was side banded.

Table 1 lists the dates of operations for 2015 and 2016.

Table 1. Dates of Trial Operations in 2015 and 2016	
Operation	2015
Trial area staked and seeded to wheat	May 16
In-crop Frontline + Simplicity	June 11
Area harvested (no yield data required)	Mid-September
Treatments 1-3 were cultivated	September 24
Operation	2016
Re-staked Trial	April 20
Pre-seed burn-off (0.66 l/ac Transorb)	May 2
Seeded early May soybeans (trts 1 and 4)	May 5
Seeded mid-May soybeans (trts 2 and 5)	May 16

Seeded late-May soybeans (trts 3 and 6)	May 25
Emergence	June 5
In-crop Odyssey	June 7
Maturity rating	Sept 19
Harvest	Sept 30

Results:

It was discovered that soil temperatures in the top 2 inches can vary significantly with the time of day the reading is taken (Table 2). On May 5, soil temperature was taken first thing in the morning as the sun was rising to determine the minimum temperature. At that time cultivated soil was slightly warmer. Unfortunately, minimum soil temperatures for both treatments were already above the 8°C target despite the early date. At the May 16th seeding date, little difference in soil temperature between treatments was observed first thing in the morning but by late afternoon the cultivated treatment was warmer. At the May 24th seeding date, temperature of the cultivated treatment was warmer than standing stubble when measured in the afternoon. So soil temperatures were well above the minimum 8°C target for seeding soybeans at every date of seeding.

Table 2. Soil temperature reading at 2 inch depth for cultivated and standing stubble treatments

Seeding date (2016)	Cultivated	Stubble
May 5	12.1°C (AM)	11.5°C (AM)
May 16	11.7°C (AM) 18.6°C (PM)	11.5°C (AM) 15.5°C (PM)
May 24	16.2°C (PM)	14.4°C (PM)

Main effects of fall cultivation and seeding date on emergence, maturity and yield of soybean are found in Table 3. No significant interactions were detected so only main effects have been presented. Emergence was good and relatively consistent and no significant differences were detected between any of the treatments. Nodulation was excellent for all treatments. Numerically maturity was somewhat more advanced for soybeans seeded into cultivated soil however, the difference was not statistically significant. Of course delaying seeding, significantly delayed maturity. Numerically yield of soybean seeded into cultivated soil was a little higher but the difference was not statistically significant. Seeding May 5th produced a couple of more bushels/ac but differences were not statistically significant.

Table 3. Main Effects of Fall Cultivation and Seeding Date on Emergence, Maturity and Yield of Soybean[1].			
Main effects	Emergence (plants/ft^2)	Maturity[2]	Yield (bu/ac)
Fall Cultivation (F)			
Cultivated	4.8 a	55.0 a	42.4 a
Standing stubble (No cultivation)	4.8 a	52.5 a	40.1 a
Seeding Date (S)			
May 5	4.9 a	78.1 a	42.8 a
May 16	5.3 a	53.1 b	40.0 a
May 24	4.2 a	30.0 c	40.9 a
Significance of Interactions between main effects[3]			
(F) X (S)	NS	NS	NS
[1]Means within a main effect followed by the same letter are not significantly different p=0.05			
[2]Percent pod color change by Sept 19			
[3]NS-not significant at p=0.05; S-significant at p=0.05			

Conclusions and Recommendations

Fall cultivation prior to seeding soybeans hastened maturity and increased yield somewhat but the differences were not statistically significant. Differences in soil temperature between the cultivated soil and the standing stubble were quite small even at the early seeding date of May 5. Soil temperatures at every seeding date were well above the minimum requirement of 8-10ºC for seeding soybeans so "cold shock" was never an issue. Soybeans seeded on May 5th yielded numerically higher than soybeans seeded at later dates and matured significantly earlier. In this trial, seeding early on May 5th was the best scenario. However, the spring of 2016 was much warmer than the historical average and there wasn't a late spring frost such as that experienced in 2015. Producers are still advised to wait until mid-May before seeding. The benefit of cultivation to warm the soil likely depends of the level of residue covering the soil. Residues were not heavy in this study.

Acknowledgements:
This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during the annual tour.

Nozzle Selection and Use on Fusarium Headblight Control in Wheat

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Abstract/Summary:

Fusarium head blight is a significant disease of wheat in Manitoba and eastern Saskatchewan. This disease may be suppressed with the application of fungicide but coverage of the front and back of wheat heads is required to maximize efficacy. Dual nozzles are addressing this problem by using forward and rearward facing streams to coats both sides of the head. The optimum height for these nozzles is in the range of 12 to 15 inches which is considerably lower than the optimum height of conventional nozzles. This study compared a conventional Bubble Jet nozzle with a TurboDrop Dual Fan (TADF) nozzle at optimum and excessive boom heights and at operating pressures of 40 and 70 psi. The operating pressure of 40 psi provided a very coarse to coarse spray at a water volume of 10 ga/ac; increasing the operating pressure to 70 psi provided a coarse spray at 13.2 ga/ac. At 6 mph, the conventional Bubble Jet nozzle provided excellent coverage of the front of the wheat head and fair coverage on the back. In contrast, the TADF nozzle provided excellent coverage of the back of the head and only fair coverage on the front of

the head. When both nozzles were operated at excessive boom heights, coverage of the wheat head declined, level of fusarium infection increased and yield declined. Proper boom height was required to maximize the efficacy of the fungicide. No effects of operating pressure (spray quality) could be detected. The experiment was run at 6 mph but future comparisons need to be made at travel speeds of 12 to 18 mph to represent those travelled by producers.

Project objectives:

The main objective was to compare the relative performance of a dual nozzle (Green leaf TurboDrop Dual Fan) with a conventional flat fan (Bubble Jet nozzle) in terms of spray coverage and fusarium head blight control. These nozzles were compared at optimum and excessive heights. Spray qualities classified as medium/coarse at 10 ga/ac and medium at 13.2 ga/ac were also evaluated.

Project Rationale:

Fusarium head blight (FHB) in wheat can be suppressed with fungicide. However, complete coverage on both sides of the wheat head is required for the best result. It is difficult to obtain complete coverage of a vertical target such as a wheat head with conventional nozzles. Dual nozzles spraying forward and backwards were created to help alleviate the problem. The full benefit of this nozzle may not be realized if the dual nozzle is being operated above the recommended height. Farmers may spray at excessive heights to protect their booms but intended spray angles will be lost as air resistance and gravity redirects spray droplets. "When you have a high boom, the angle the spray leaves the nozzle at very quickly becomes irrelevant. Air resistance and gravity redirect the spray just to fall vertically, or move with prevailing winds. But when you spray very close to the target, the spray is still moving forward and backward as intended" (Tom Wolf in March 2013 addition of Top Crop Manager). The recommended boom height for asymmetric nozzles is in the range of 12 to 15 inches which is fairly low. Producers need to consider nozzle type, operating height, spray coarseness and water volume to maximize fungicidal efficacy on FHB.

Methodology:

The spring wheat variety "Harvest" was established in a trial setup as a randomized complete block with 4 replicates. Harvest wheat is rated as "susceptible" to FHB. The trial was seeded with a 10 foot Seed Hawk drill. Plot size was double wide (22 ft by 35 ft long) to accommodate in plot sprays with the sprayer. The tractor drove over one side of the plot and yield was be taken from the other side of the plot using a small plot Wintersteiger combine.

The trial evaluated a Bubble Jet 02 nozzle and a Turbodrop Asymmetric DualFan (TADF02) nozzle at optimum and excessive heights above the canopy and at operating pressures of 40 and 70 psi. The boom heights for the Bubble Jet were 25" (optimum) and 36" (excessive). The boom heights compared for the TADF nozzle were 15" (optimum) and 25 and 36 inches which were both excessive. The operating pressure of 40 psi delivered a very coarse to coarse spray at 10 gpa. Increasing the pressure to 70 psi was intended to provide a better spray coverage by increasing the number of fine droplets and water volume. At 70 psi a coarse spray was delivered at 13.2 ga/ac. An unsprayed check was also included in the treatment list which can be found in table 1.

Table 1. Treatment list			
Trt #	Nozzle type	Height	Spray Quality
1	Bubble Jet 02	Optimum (25”)	40 psi (10 ga/ac-very coarse to coarse)
2	Bubble Jet 02	Optimum (25”)	70 psi (13.2 ga/ac – coarse)
3	Bubble Jet 02	Too high (36”)	40 psi (10 ga/ac-very coarse to coarse)
4	Bubble Jet 02	Too high (36”)	70 psi (13.2 ga/ac – coarse)
5	TADF[1] 02	Optimum (15”)	40 psi (10 ga/ac-very coarse to coarse)
6	TADF[1] 02	Optimum (15”)	70 psi (13.2 ga/ac – coarse)
7	TADF[1] 02	Too high (25”)	40 psi (10 ga/ac-very coarse to coarse)
8	TADF[1] 02	Too high (25”)	70 psi (13.2 ga/ac – coarse)
9	TADF[1] 02	Too high (36”)	40 psi (10 ga/ac-very coarse to coarse)
10	TADF[1] 02	Too high (36”)	70 psi (13.2 ga/ac – coarse)
11	Unsprayed check	n/a	n/a
[1]Turbodrop Asymmetric Dual Fan with 10° forward spray and 50° rearward spray			

Before spraying, wooden dowels were staked in front of each treatment and wrapped with water sensitive paper at wheat head height. These targets were then used to assess the spray coverage attained by the various treatments. Various operations and assessments were performed during the season and the dates when they occurred are found in table 2. Grain samples from harvested treatments were assessed for fusarium damaged kernels and protein by the local pioneer elevator.

Table 2. Dates of Trial Assessments and Operations in 2016	
Operation	Date
Pre-seed burn-off 0.66 l/ac Roundup Transorb	May 3
Seeded	May 5
Emergence Counts	May 30
In-crop Simplicity + Prestige	May 27
In-crop Axial	June 8
Fungicide treatments sprayed with Prosaro	June 30
Fusarium assessments	July 27
Lodging assessment	July 27
Lodging assessment	August 5
Harvest	August 23

Results:

When analyzed as a Randomized Complete Block no statistically significant difference could be detected between treatments for any of the parameters measured (Table 3). However, when treatments 1-6, 9 and 10 were analyzed together as a 3 order factorial, significant differences between some main effects could be detected (Table 5). It is easier to detect significant differences between main effects due to extra internal replication associated with a factorial design.

Table 3. Effect of Nozzle Type, Boom Height and Operating Pressure on Wheat Parameters.					
Treatment	Yield (bu/ac)	Fus damaged heads/ 35 ft of row	FDK (%)	Protein (%)	Lodging (0-10)
1. Bubble Jet; optimum (25"); 40 psi[1]	65.4	8.8	0.23	14.1	3.6
2. Bubble Jet; Optimum (25"); 70 psi[2]	65.0	12.8	0.13	13.8	2.9
3. Bubble Jet; Excessive (36"); 40 psi	63.6	14.5	0.38	14.1	3.0
4. Bubble Jet; Excessive (36"); 70 psi	62.7	9.3	0.33	14.4	2.8
5. TADF; Optimum (15"); 40 psi	66.9	9	0.29	14.0	3.4
6. TADF; Optimum (15"); 70 psi	68.6	9.8	0.38	14.0	3.8
7. TADF; Excessive (25"); 40 psi	63.8	12.8	0.34	14.2	3.3
8. TADF; Excessive (25"); 70 psi	60.9	11.5	0.33	14.0	3.1
9. TADF; Excessive (36"); 40 psi	60.0	12.3	0.36	14.7	2.9
10. TADF; Excessive (36"); 70 psi	66.2	12.5	0.34	14.3	4.0
11. Unsprayed check	61.3	14.5	0.38	14.6	2.5
$LSD_{0.05}$	NS	NS	NS	NS	NS
[1]40 psi with a 02 nozzle delivered a "very coarse to coarse" spray at 10 ga/ac					
[2]70 psi with an 02 nozzle delivered a "coarse" spray at 13.2 ga/ac					

Significant differences between nozzle types and operating pressures could not be detected for any parameter measured (Table 4). However, yield was significantly reduced and levels of FDK were increased when the operating height of the boom was increased beyond optimum to 36 inches. Although not statistically significant, visual observations of fusarium damaged heads were also higher at the excessive boom height. Protein level tended to be higher with the excessive height which is likely the result of reduced yield potential.

Table 4. Main Effects of Nozzle Type, Boom Height and Operating Pressure on Wheat Parameters.					
Main Effect	Yield (bu/ac)[3]	Fus damaged heads/ 35 ft of row[3]	FDK (%)[3]	Protein (%)[3]	Lodging (0-10)[3]
Nozzle type					
Bubblejet02	64.2 a	11.5 a	0.26 a	14.1 a	3.1 a
TADF02	65.0 a	10.8 a	0.34 a	14.3 a	3.4 a
Boom height					
Optimum	66.5 a	10.1 a	0.25 a	14 a	3.4 a
Excessive (36”)	62.7 b	12.2 a	0.35 b	14.4 a	3.0 a
Operating pressure					
40 psi[1]	64.9 a	11.4 a	0.31 a	14.2 a	3.3 a
70 psi[2]	64.3 a	10.8 a	0.29 a	14.1 a	3.1 a
Unsprayed[4]	61.3	14.5	0.38	14.6	3.3
[1]40 psi with a 02 nozzle delivered a “very coarse to coarse” spray at 10 ga/ac					
[2]70 psi with an 02 nozzle delivered a “coarse” spray at 13.2 ga/ac					
[3]Mean within main effects followed by the same letter are not significantly different p=0.05					
[4]Unsprayed check for reference, not included in analysis.					

The impact of excessive boom height on head coverage was determined with water sensitive paper wrapped around wooded dowels at the time of spraying (Figures 1 and 2). The conventional Bubble Jet 02 nozzle provided excellent coverage of the front of the head and partial coverage of the back when operated at the optimum height of 25 inches (Figure 1). Increasing to the excessive height of 36 inches resulted in virtually no coverage on the back of the head. In contrast, the dual nozzle (TADF) provided excellent coverage of the back of the head and partial coverage of the front when operated at the optimum height (Figure 2). When the boom height was raised excessively, coverage of the front of the head was completely lost. When averaged over nozzle type, the yield loss resulting from an excessive boom height was 4 bu/ac. It should be noted that the speed at which these plots were sprayed was 6 mph which is well below speeds of 12 to 18 mph typically travelled by applicators. The impact of higher travel speeds on head coverage is uncertain. However, this project nicely demonstrated the importance of proper nozzle height.

Figure 1. Spray Coverage on front and back of head at the Time of Spraying with a Bubblejet 02 Nozzle sprayed at 40 psi to deliver 10 ga/ac

Optimum Height (25")
65.2 bu/ac

Excessive Height (36 ")
63.2 bu/ac

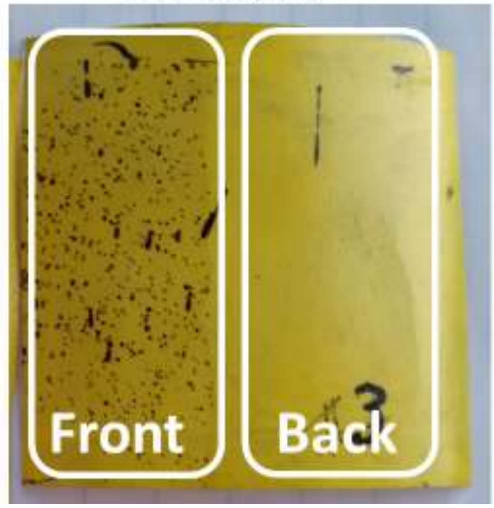
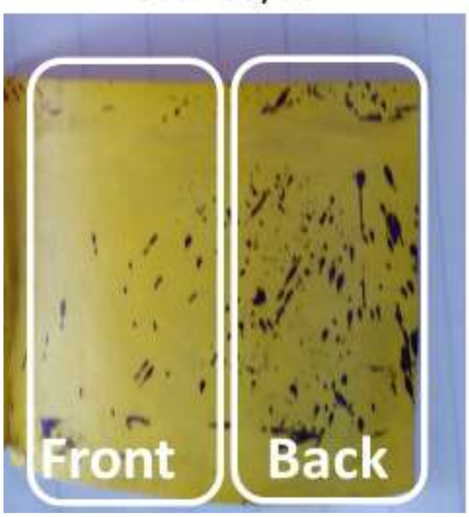
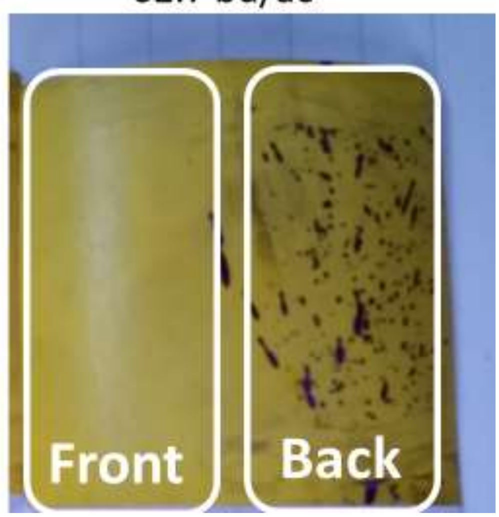


Figure 2. Spray Coverage on front and back of head at the Time of Spraying with a TADF 02 Nozzle sprayed at 40 psi to deliver 10 ga/ac

Optimum Height (15")
67.7 bu/ac



Excessive Height (36")
62.7 bu/ac



Conclusions and Recommendations

At 6 mph, the conventional Bubble Jet nozzle provided excellent coverage of the front of the wheat head and fair coverage on the back. In contrast, the TADF nozzle provided excellent coverage of the back of the head and only fair coverage on the front of the head. When both nozzles were operated at excessive boom heights, coverage of the wheat head declined, level of fusarium infection increased and yield declined. Proper boom height was required to maximize to efficacy of the fungicide. Producers typically apply fungicide at travel speeds between 12 to 18 mph. The travel speed in this study was only 6 mph and these nozzles should be re-evaluated at travel speeds more typical of producers.

Acknowledgements:

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during the annual tour. Thanks to Pioneer out of Yorkton for the protein analysis and grading on the grain.

Seeding Winter Wheat into Barley Green Feed Stubble (Interim report)

M. Hall[1]

[1]East Central Research Foundation/Parkland College, Yorkton, SK

Abstract/Summary:

Final results for this study will not be available until the end of 2017 growing season. The objective of the study is to assess the effect of seeding date, seeding rate and seed treatment on the yield of winter wheat seeded in barley that was taken off for green feed. Winter wheat has been established and was seeded on August 29, September 12 and September 29. The emergence of winter wheat which was seed treated was significantly poorer than untreated seed. The reason for this is unclear. There are two possibilities. Either the treated and untreated seed are not from the same seed lot as promised or the seed was over treated.

Project objectives:

The objectives of this study are:

- to demonstrate the establishment of a winter wheat crop after barley taken for green feed.
- to determine if increasing seeding rate and/or the use of seed treatment can compensate for increased winter injury at late seeding dates.

Project Rationale:

The optimum time for seeding winter wheat in the Yorkton area is August 30th. After September 15th winter survival starts to decline rapidly. Winter wheat should be seeded into stubble in order to capture snow and improve winter survival. Canola stubble is best, however with late maturing canola varieties it can be difficult to plant winter wheat within the ideal time frame. Moreover, it is difficult to seed at this time as man power is stretched with harvest. The lack of opportunity to seed winter wheat in a timely manner is an impediment to expanding acres of winter wheat. Using alternative stubble types from earlier harvested crops might overcome this challenge.

Irvine, R.B. et al.[1] determined barley silage stubble made a very suitable stubble type for seeding winter wheat. The silage comes off in good time to seed winter wheat and does a good job of snow capture. In fact, their study found winter wheat yields to be less variable on barley silage stubble than other stubble types. They attributed this to the good crop residue management associated with having taken the crop for silage. Intuitively, barley taken for green feed should also make a suitable stubble type for seeding winter wheat early.

Being able to seed early on barley green feed stubble gives us an opportunity to look at the interactions between seeding date and seeding rate of winter wheat. In Ontario, the provincial recommendations are to increase winter wheat seeding rates by 100000 seeds/ac for every 5 days seeding is delayed past October 1st. The author has not been able to find similar recommendation for winter wheat grown in Saskatchewan. However, studies suggest the traditional seeding rates should be increased from 250 seeds/m^2 to 450 seeds/m^2 in western Canada.

Studies in western Canada have also determined that seed treatments can improve winter survival of winter wheat. Work by Brian Beres (not published yet) observed yield increases from the application of Raxil WW particularly at low plant populations. The interactions between seeding date, rate and seed treatment will be evaluated in this demonstration.

[1] Irvine, R.B., Lafond, G.P., May, W.E., Kutcher, H.R., Clayton, G.W., Harker, K.N., Turkington, T.K, and Beres, B.L. (2013). "Stubble options for winter wheat in the Black soil zone of western Canada." Canadian Journal of Plant Science, 93(2), pp. 261-270.

Methodology:

The trial was setup as a 3 order factorial with 4 replicates. Plots were staked in spring of 2016 and seeded to barley. The barley was taken off for green feed and the winter wheat was seeded into plots at the appropriate time. The first factor contrasts the following 3 seeding dates:

- August 29 (optimal seeding date)
- September 12 (winter hardiness expected to decrease by 12%)
- September 29 (winter hardiness expected to decrease by 38%)

The second factor contrasted two seeding rates:

- 250 seeds/m^2
- 450 seeds/m^2

The third factor contrasted no seed treatment with the seed treatment Raxil WW.
Thus winter wheat was established with the following 12 treatments listed in Table 1.

Table 1 lists the treatments.

Table 1. Treatment list for winter wheat study			
Trt #	Seeding date 2015	Seeding rate (seeds/m^2)	Seed treatment
1	August 29	250	none
2	August 29	250	Raxil WW
3	August 29	450	none
4	August 29	450	Raxil WW
5	September 12	250	none
6	September 12	250	Raxil WW
7	September 12	450	none
8	September 12	450	Raxil WW
9	September 29	250	none
10	September 29	250	Raxil WW
11	September 29	450	none
12	September 29	450	Raxil WW

Only dates of operation for 2016 are available at this time and are found in Table 2.

Table 2. Dates of operations for 2016 and 2017	
Operations in 2016	Date
Pre-seed burn-off (0.67 l/ac Transorb)	May 2
Trial area seeded to Maverick barley	May 4
Emergence of Barley	May 26
Barley in-crop herbicide (Prestige)	May 27
Barley harvested off as green feed	July 25 and 26
Re-staked trial	July 27
First winter wheat seeding- 30lbs/ac of N, rest to be broadcasted in spring	August 29
Pardner sprayed to take out RR volunteer canola	August 30
Second winter wheat seeding- 30lbs/ac of N, rest to be broadcasted in spring	September 12
Winter wheat plant counts on first seeding	September 23
Winter wheat plant counts on second seeding	September 29
Third winter wheat seeding-30lbs/ac of N, rest to be broadcasted in spring	September 29
Winter wheat emergence on third seeding	November 9
Operations in 2017	Date
Have not been done yet.	

Results:

Maverick barley was seeded on May 4th and emergence was 20 plants/ft^2. The barley was taken off as green feed and winter wheat was seeded on August 29th, September 12th and September 29th. Main effects for the winter wheat emergence are presented in table 3. Emergence of winter wheat did not significantly differ between seeding dates. A significant interaction was detected between seeding rate and seed treatments. In other words, the effect of seed treatment depended on the seeding rate. The treatment means for this interaction are presented in table 4.

Table 3. Main Effects of Seeding Date, Seeding Rate and Seed Treatment on Emergence of Winter Wheat.[1]

Main Effect	Emergence (plants/m^2)
Seeding date of winter wheat (2016) (D)	
August 29	232 a
September 12	232 a
September 29	247 a
Seeding rate (seeds/m^2) (R)	
250	181 a
450	292 b
Seed treatment (T)	
none	274 a
Raxil WW	200 b
Interactions	
D x R	NS
D x T	NS
R x T	S
D x R x C	NS

[1]Mean within main effects followed by the same letter are not significantly different p=0.05

The application of Raxil WW significantly reduced the emergence of winter wheat. The reduction in emergence was proportionately more when seeding rate was increased to 450 seeds/m^2. The reason for the reduction in emergence is not clear. There are two possibilities. Either the treated and untreated seed are not from the same seed lot as promised or the seed was over treated.

Table 4. Means for the interaction between Seeding Rate and Seed Treatment, averaged over seeding dates.		
Seeding rate (seeds/m^2)	Seed treatment	Emergence (plants/m^2)
250	none	197
250	Raxil WW	166
450	none	350
450	Raxil WW	233
Lsd		
Seed treatment means for the same seeding date and rate.		59.2
Seeding rate means for the same seeding date and same or different seed treatment		54.6

Conclusions and Recommendations

The trial will not be concluded until the end of the 2017 growing season. No conclusions are available at this time.

Acknowledgements:

This project was funded through the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Adopt signs were posted during the annual tour.

Fungicide Use in Cereal Forages

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Abstract/Summary:

Propiconazole (Tilt) is registered for use on cereal forages as it only has a 3 day grazing restriction. Despite this, it is rarely used on cereals harvested for forage. The objective of this study was to determine whether the application of tilt could increase yield and quality of oat, barley and triticale sown early for green feed and late for fall grazing. While the application of Tilt did reduce leaf disease and tended to reduce lodging, it did not increase cereal forage yield or quality for either seeding date. In other words the application of Tilt provided no economic value in this study.

Oat and triticale yield did not differ significantly between seeding dates. However, barley was the lowest yielding cereal when seeded early (May 27) and the highest when seeded late (July 4). This is contrary to past research which shows barley tends to yield comparatively less as seeding date is delayed due to its sensitivity to photo period. In this study the late seeding date was quite late so all forage were harvested

on the same day as the season was coming to an end. Thus the barley was more developmentally mature which may explain its relatively higher yield with the later seeding date.

Project objectives:

The objective was to demonstrate impact of fungicide (propiconazole) on yield and quality of oat, barley and triticale sown early for green feed and late for swath grazing.

Project Rationale:

Cereals are commonly grown across the province for green feed or swath grazing. Propiconazole is registered for use on cereal forages as it only has a 3 day grazing restriction. Barley and Oats are most commonly grown for cereal forage. Within the past few years a new variety for both oats (CDC Haymaker) and barley (CDC Maverick) have been released by the Crop Development Centre in Saskatoon. CDC Haymaker is intended to replace CDC Baler and CDC Maverick is expected to replace CDC Cowboy. CDC Maverick was bred from CDC Cowboy but has smooth awns to reduce the occurrence of mouth sores especially where cattle are using snow as a source of water. There is also some interest in the triticale variety "Bunker" as it has reduced awns (awnlets). These cereals can be seeded either early (late May) for green feed or seeded late (late June) for swath grazing. Producers generally consider cereal forage a low input crop. High rates of nitrogen or foliar fungicide are not typically applied. However, the author has observed barley taken for green feed having high levels of leaf disease. This is likely having an impact on yield and possibly forage quality. Crops seeded late for swath grazing may also be impacted by leaf disease. The use of fungicide in cereal forage production might be warranted.

Methodology:

The project was setup as a split split-plot design with 4 replicates. The main-plot factor contrasted early seeding for green feed (May 27) with late seeding for swath grazing (July 4). The subplot factor was crop specie and the sub-subplot factor contrasted a full rate of propiconazole (Tilt) versus no foliar fungicide. Treatments are listed in table 1.

Table 1. Treatment list

Trt #	Seeding date 2016	Crop Variety	Fungicide
1	May 27	Maverick Barley	No fungicide
2	May 27	Maverick Barley	Full rate Tilt at Flag
3	May 27	Haymaker Oats	No fungicide
4	May 27	Haymaker Oats	Full rate Tilt at Flag
5	May 27	Bunker Triticale	No fungicide
6	May 27	Bunker Triticale	Full rate Tilt at Flag
7	July 4	Maverick Barley	No fungicide
8	July 4	Maverick Barley	Full rate Tilt at Flag
9	July 4	Haymaker Oats	No fungicide
10	July 4	Haymaker Oats	Full rate Tilt at Flag
11	July 4	Bunker Triticale	No fungicide
12	July 4	Bunker Triticale	Full rate Tilt at Flag

Plots were 11 by 35 feet and seeded with a 10 foot Seed Hawk drill except for those plots receiving fungicide which were double wide to accommodate the passage of the tractor. The tractor drove on one side of the plot and yield was taken from the other side that had not been trampled. The harvest area for each plot was 5 rows by 35ft. Plot yields were taken with a mechanical forage harvester at early soft dough for the early seeded treatments. All cereals were harvested on the same day for the late seeded treatments because the season was coming to an end. Thus, barley was harvested at soft dough but the oats and triticale were only at the milk stage. Approximately, 20 plants from each treatment of the first rep were bagged separately after each harvest and air dried. The bagged samples were then sent away for feed analysis (protein, energy and minerals). Dates of trial assessments and operations are found in table 2.

Table 2. Dates of Trial Assessments and Operations in 2016

Operation	Date
Pre-seed burn-off 0.66 l/ac Roundup Transorb	May 15
Seeded treatments 1 to 6	May 27
In-crop herbicide treatments 1 to 6 (Prestige)	June 13
Pre-seed burn-off 0.66 l/ac Roundup Transorb for treatments 7-12	June 13
Emergence counts on early seeded treatments	June 14
Seeded treatment 7-12	July 4
In-crop herbicide treatments 7 to 12 (Prestige)	July 15
Sprayed Tilt on treatments 2, 4 and 6	July 14
Emergence counts on later seeding date	July 22 and 25
Sprayed Tilt on treatments 8, 10 and 12	August 15
Lodging ratings	August 5
Harvested early seeded barley (treatments 1 and 2)	August 5
Harvested early seeded oats and triticale (Treatments 3-6)	August 16
Leaf disease assessment and lodging on 2nd seeding	September 19
Harvested late seeded treatments (7 to 12)	September 20

Results:

Emergence of the crops seeded on May 27th were 23.8, 26.2 and 30.2 plants/ft^2 for Maverick barley, Haymaker oats and Bunker triticale, respectively. For the July 4th seeding date, emergence was 23.2, 28.2 and 37.7 plants/ft^2 for Maverick barley, Haymaker oats and Bunker triticale, respectively.

Table 3 presents the main effects for cereal forage yield, lodging and leaf disease development on the flag. No interactions were detected with fungicide. When averaged across crop type and seeding date, the application of Tilt significantly reduced the development of leaf disease. It also reduced lodging but the difference was not quite significant at p=0.05. Despite these benefits, the application of Tilt did not increase in yield. Significant interactions were detected between seeding date and crop type for each parameters listed in Table 3. Thus the treatment means for these interactions are listed in Table 4.

Table 3. Main Effects of Seeding Date, Crop Type and Fungicide on Cereal Forage Parameters			
Main Effect	Yield (Dry tonnes/ac)	Lodging (0-erect; 10-flat)	Leaf Disease (% coverage of flag leaf)
Seeding Date (S)			
May 27, 2016	3.1 a	3.9 a	21.9 a
July 4, 2016	3.4 a	2.1 b	13.0 b
Crop type (C)			
Maverick barley	3.2 a	4.35 a	13.3 b
Haymaker oats	3.3 a	3.65 b	6.9 a
Bunker triticale	3.2 a	1.05 c	32.1 c
Fungicide (F)			
No Fungicide	3.2 a	3.3 a	22.0 a
Tilt	3.2 a	2.7 a	12.9 b
Interactions			
S x C	S	S	S
S x F	NS	NS	NS
C x F	NS	NS	NS
S x C x F	NS	NS	NS

For the early seeding date (May 27), Bunker triticale had significantly more leaf disease development and less lodging compared to Maverick barley and Haymaker oats at the time of harvest. For the second seeding date (July 40, Bunker triticale and Maverick barley had significantly more leaf disease then Haymaker oats. Again, triticale lodged less than the other cereals and Haymaker oats lodged less than Maverick barley. When seeded early, Maverick barley yielded significantly less than the other cereals. However, it was the highest yielding variety when seeded late.   Oat and triticale yields did not significantly differ between seeding dates.

Table 4. Mean effects for Seeding Date by Crop Type Interaction			
Effect	Yield (Dry tonnes/ac)	Lodging (0-erect; 10-flat)	Leaf Disease (% coverage of flag leaf)
Seeding Date (S) by Crop Type (C) interaction			
Maverick barley seeded May 27, 2016	2.7	5.3	9.5
Haymaker oats seeded May 27, 2016	3.3	5.3	8.6
Bunker triticale seeded May 27, 2016	3.2	1.1	47.5
Maverick barley seeded July 4, 2016	3.7	3.4	17.2
Haymaker oats seeded July 4, 2016	3.2	2.0	5.2
Bunker triticale seeded July 4, 2016	3.3	1.0	16.6
Lsd			
Between different crop types within a seeding date (C1S1-C2S1)	0.45	0.98	4.8
All other comparisons (C1S1-C1S2; C1S1-C2S2)	0.51	1.67	6.0

Table 5 gives some basic guidelines for nutrient requirements of Beef cattle. This table is used as a reference for interpreting the forage quality results.

Table 5. Nutrient Requirements of Beef Cattle				
Stock Class	TDN (%)	CP (%)	Ca (%)	P (%)
600 lb heifer @ 1.5 lb ADG	69	10.5	0.36	0.21
1300 lbs cow mid trimester	48	6.8	0.24	0.19
1300 lb cow lactating 20 lb milk	55	9.7	0.39	0.28

Table 6 and 7 are the feed analysis results taken from a single rep. Thus there are no statistics associated with these values. Numerically, protein values were somewhat lower for Haymaker oats for both seeding dates. The application of Tilt appeared to reduce protein levels of barley and oats whereas it increased the protein of triticale. If this is a true effect the reason for it is unclear. The application of Tilt did not appear to have a consistent effect on calcium levels and had no substantial effect of phosphorus levels. Many of the calcium levels would be considered inadequate for young heifers or lactating cows. Some of phosphorus levels were inadequate for lactating cows but most levels were fine for young heifers or cows in mid trimester.

Table 6. Effect of seeding date, crop type and fungicide on forage cereal protein and minerals.								
Seeding date 2016	Crop type	Fungicide	Protein (%)	Ca (%)	P (%)	Mg (%)	K (%)	Na (%)
May 27	Maverick barley	No Fungicide	9.85	0.34	0.36	0.17	1.45	0.02
May 27	Maverick barley	Tilt	8.01	0.19	0.30	0.15	1.46	0.01
May 27	Haymaker oats	No Fungicide	7.35	0.37	0.21	0.17	2.56	0.03
May 27	Haymaker oats	Tilt	5.96	0.30	0.22	0.14	2.08	0.02
May 27	Bunker triticale	No Fungicide	8.70	0.17	0.28	0.12	1.11	0.00
May 27	Bunker triticale	Tilt	8.71	0.29	0.28	0.14	1.62	0.01

July 4	Maverick barley	No Fungicide	11.68	0.22	0.32	0.12	0.95	0.01
July 4	Maverick barley	Tilt	10.43	0.15	0.33	0.15	0.88	0.01
July 4	Haymaker oats	No Fungicide	8.37	0.30	0.20	0.20	2.82	0.03
July 4	Haymaker oats	Tilt	7.65	0.32	0.20	0.19	2.59	0.01
July 4	Bunker triticale	No Fungicide	9.48	0.25	0.28	0.12	1.94	0.00
July 4	Bunker triticale	Tilt	10.38	0.22	0.30	0.13	1.57	0.00

Good forage has total digestible nutrients (TDN) in the range of 53-64 percent and an acid detergent fibre (ADF) in the low 20s. ADF is a measure of how much your cows will eat. Values in the 30's and above means poorer quality forage and lower intake. ADF values were mostly on the high side but TDN levels were good. The forage quality in terms of ADF, TDN and metabolizable energy (ME) was better for barley, particularly for the later seeding date. The application of Tilt didn't improve forage quality.

Table 7. Effect of seeding date, crop type and fungicide on forage cereal protein and minerals.

Seeding date 2016	Crop type	Fungicide	ADF[1] (%)	TDN[2] (%)	ME[3]	NEL[4]	DE[5]	NEM[6])	NEG[7]
May 27	Maverick barley	No Fungicide	28.31	68.39	2.50	1.56	3.02	1.61	1.01
May 27	Maverick barley	Tilt	30.38	66.18	2.42	1.50	2.92	1.54	0.94
May 27	Haymaker oats	No Fungicide	40.70	55.15	2.02	1.23	2.43	1.17	0.61
May 27	Haymaker oats	Tilt	39.25	56.70	2.08	1.27	2.50	1.22	0.66
May 27	Bunker triticale	No Fungicide	32.50	63.92	2.34	1.45	2.82	1.46	0.88
May 27	Bunker triticale	Tilt	38.01	58.03	2.12	1.30	2.56	1.27	0.70

July 4	Maverick barley	No Fungicide	19.42	77.89	2.85	1.79	3.43	1.91	1.27
July 4	Maverick barley	Tilt	18.31	79.08	2.89	1.82	3.49	1.94	1.30
July 4	Haymaker oats	No Fungicide	38.05	57.99	2.12	1.30	2.56	1.27	0.70
July 4	Haymaker oats	Tilt	38.49	57.52	2.10	1.29	2.54	1.25	0.68
July 4	Bunker triticale	No Fungicide	36.40	59.75	2.19	1.35	2.63	1.33	0.75
July 4	Bunker triticale	Tilt	36.83	59.29	2.17	1.34	2.61	1.31	0.74

[1]Acid Detergent Fibre; [2]Total Digestible Nutrients; [3]Metabolizable Energy (Mcal/kg); [4]Digestible Energy (Mcal/kg); [5]Net Energy (Mcal/kg) ; [6]Net Energy for Gain (Mcal/kg)

Conclusions and Recommendations

The application of Tilt to cereal forages significantly reduced leaf disease albeit modestly and tended to reduce lodging. However, lodging for Triticale was low with or without the application of Tilt. Despite the benefits of applying Tilt, cereal yield and forage quality was unaffected. Thus the application of Tilt to cereal forages grown for green feed or swath grazing provided no economic value.

Oat and triticale yield did not differ significantly between seeding dates. However, barley was the lowest yielding cereal when seeded early (May 27) and the highest when seeded late (July 4). This is contrary to past research where barley tends to yield comparatively poorer when seeded late due to its photo period sensitivity. For the first seeding date, barley was first to reach milk-dough and was harvested first. With the late seeding date, all forages were harvested on the same day because the season was coming to a close and the oats and triticale were not going to reach the appropriate stage. Thus for the late seeding, barley was harvested at a more advanced stage. This may explain the higher yields and better forage quality for barley with the later seeding date.

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Effect of Variety, Nitrogen Rate and Seeding Rate on Forage Corn

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- **Abstract and Summary**

Forage corn trials were establish at Lanigan, Yorkton, Redvers, Outlook, Scott and Melfort in 2016. The trials looked at the impact of variety, nitrogen rate and seeding rate on yield. Growing conditions were excellent at Yorkton and yields were much higher than the average of all other sites combined. Forage corn at the Yorkton site was also more responsive to increasing N level and increasing seeding rate compared to the average of all sites. In the economic analysis, the cost of nitrogen was considered to be

$0.4/lb of actual and the cost of seed was considered to be $3.13/1000 seeds. The conclusions drawn from the results of this study depend on the assumed value of forage corn which can varied widely. Thus results have been presented in terms of breakeven values so producers can draw their own conclusions. However, the author believes corn silage can be valued at roughly $100/dry tonne and grazing corn standing in the field might be valued at $50/dry tonne.

At the Yorkton site, increasing actual nitrogen levels (soil + fertilizer) from 100 to 150 lbs/ac would likely be considered economical as the breakeven price was only $24/dry tonne. Increasing nitrogen further from 150 to 200 lbs/ac would likely not be considered economical as the value of corn forage would need to be $250/ dry tonne to breakeven. When considering all sites together, the break even prices were 95 and 125 dollars per dry tonne for increasing actual N rates from 100 to 150 and 150 to 200 lbs/ac, respectively. In other words, Yorkton by itself was more responsive to nitrogen and it would have likely been economical to increase actual n levels to 150 lbs/ac. For all sites as a whole, the value of corn forage would have to be quite high to justify increasing actual nitrogen levels beyond 100 lbs/ac which is the level at which many producers are fertilizing.

As with nitrogen, the Yorkton site was more responsive to increasing seeding rate than all sites considered together. The breakeven values of corn forage when increasing seeding rates from 75,000 to 125,000 seeds/ha were $86.79 and $141/dry tonne for Yorkton and all sites together, respectively. In other words, the value of corn forage would have to be very high to justify increasing seeding rates beyond 75,000 seeds/ha which is currently recommended.

This is just a glance at the results from the 1st year of a 3 year project. A more in-depth economic analysis which includes feed quality results will be written up by PAMI at the conclusion of the project.

- **Project objectives:**

The objectives of this project are

- To develop and refine seeding and fertility recommendations for corn silage production, and
- To evaluate the cost of production and feed quality of corn silage grown in Western Canada

- **Project rationale:**

Forage corn may prove to be a high yielding, high-quality alternative for winter feeding in Saskatchewan. The input costs for this crop are high and appropriate fertility and seeding rates need to be determined. Current recommendations are based on grain corn production with older varieties and the information is not regionally specific. This project was developed by PAMI to better develop seeding and fertility recommendations for corn silage production in Western Canada. Trials were conducted at 3 short season sites (Lanigan, Melfort and Scott) and in 3 longer-season sites (Yorkton, Redvers and Outlook). Trials were conducted in 2016 and will be repeated in 2017 and 2018. Results from the Yorkton site conducted by the East Central Research Foundation are presented in this report and compared to the combined results for all locations.

Methodology and Results

- **Methodology:**

Trials were setup as a 3 order factorial with 3 replicates. The first factor contrasted two brands of silage corn (Brand A and Brand B). The hybrids within each brand were selected by representatives from the seed companies and were based on the CHU rating at each location. The second factor compared available nitrogen levels (soil + fertilizer) of 100, 150 and 200 lbs N/ac. The third factor looked at target seeding rates of 75,000, 100,000 and 125,000 seeds/ha. Phosphorus, K and S levels were maintained at adequate levels based on soil test. Fertilizer was banded in the ground prior to seeding and then harrowed. All trials were precision seeded with a Vaderstad planter that had been calibrated for each brand of seed to deliver the required seeding rate. This insured plants were evenly spaced. Each plot contained 4 rows at 30 inch row spacing but only the middle two rows were harvested by hand. A wood chipper was used to obtain a ground sample from 4 randomly select plants from each plot and was sent away for forage quality analysis. The complete treatment list is presented in table 1.

Table 1. Treatment List for Forage Corn Study

Trt#	Variety Brand	Available N (lbs/ac soil + fertilizer)	Seeding rate (seeds/ha)
1	A	100	75,000
2	A	100	100,000
3	A	100	125,000
4	A	150	75,000
5	A	150	100,000
6	A	150	125,000
7	A	200	75,000
8	A	200	100,000
9	A	200	125,000
10	B	100	75,000
11	B	100	100,000
12	B	100	125,000
13	B	150	75,000
14	B	150	100,000
15	B	150	125,000
16	B	200	75,000
17	B	200	100,000
18	B	200	125,000

Dates of assessments and operation are found in Table 2.

Table 2. Dates of Trial Assessments and Operations in Yorkton (2016)

Operation	Date
Trial area cultivated	April 30
Fertilizer banded	May 5
Corn seeded	May 17

In-crop herbicide (0.67 L/ac Roundup Transorb)	June 1
Emergence Counts	June 7
In-crop herbicide (0.67 L/ac Roundup Transorb)	June 13
Corn harvest	Sept 21
Corn heights and milk line	Sept 22
Sampled corn and sent away for forage analysis	Sept 27

- **Results:**

Trial Results

Table 3 shows the number of seeds/ha seeded and the resulting plant populations for brand A and B varieties. At the Yorkton site emergence counts for the brand B variety were on average 7% higher. Nitrogen rate did not have a significant effect on emergence as it was banded ahead of seeding. The emergence was similar at the other sites. Averaged across all sites and the seeding rates of 75,000, 100,000 and 125,000 seeds/ha resulted in populations of 66,755, 89,953 and 111,107 plants/ha, respectively.

Table 3. Seeds/ha versus Emergence Achieved for Varieties A and B at Yorkton and all site combined[1]

Seeds/ha	Brand A emergence (plants/ha)	Brand B emergence (plants/ha)
75,000	70,102	74,024
100,000	89,326	96,020
125,000	106,636	115,626

[1]All sites includes Yorkton,

Corn silage yields varied significantly by location ranging from 7.7 to 4.4 dry tonnes/ac (Table 4). The overall average was 6.3 dry tonnes/ha.

Table 4. Yield averaged over all treatments by location[1]

Site	Dry yield (tonnes/ac)
Lanigan	7.73 a
Yorkton	7.41 ab
Redvers	7.04 b
Outlook	6.48 c
Scott	4.98 d
Melfort	4.41 e

[1]Means followed by the same letter are not significantly different p=0.05

A complete economic analysis will be completed for this study by PAMI at the end of the 3rd year. However, a rough economic analysis is attempted in this paper for the Yorkton site alone and all sites combined. The economic analysis assumes a cost of $0.4/lb of actual nitrogen. Seed costs for the varieties used in this study average about $250/bag which is about $3.13 for every 1000 seeds. These are high end varieties and cheaper varieties around $210/bag could be found however, the actual cost of the seed used in these trials will be used in the economic analysis. Calculating the value of the corn forage is difficult. Is it being used for grazing or silage? Manitoba has a guide entitled "Guidelines for

Estimating Silage Production Costs 2016 in Manitoba". The guide estimates the costs of production to be $20.87/wet ton based on variable costs and to be $31.40/wet ton when total costs are considered. The guide placed a market value of $32/wet ton on corn silage which is equivalent to $100/dry tonne. However, the value of grazing corn in the field might only be considered to be only half at $50/dry tonne. The interpretation of the results from this study will depend on the value assigned to the forage corn. Because these values may vary substantially, the results have been presented in terms of "breakeven" values for corn forage. This enables producers to interpret the results for their own operation.

Table 5 shows the main effects of variety, nitrogen level and seeding rate for the Yorkton site and then for all sites combined together. At Yorkton, yield was significantly increased by 0.81 dry tonnes/ac as actual nitrogen levels were increased from 100 to 150 lbs/ac (table 5, figure 1). Assuming $0.40/lb for nitrogen, increasing n levels from 100 to 150 lbs/ac would likely be economical as the breakeven price for corn forage would only be $25/dry tonne. Increasing N levels further from 150 to 200 lbs/ac provided an insignificant yield improvement of only 0.08 tonnes/ac. Even if this increase is real, corn silage would have to be $250/ dry tonne to break even. For the Yorkton site, increasing actual N up to 150 lbs/ac would likely be considered economical. When averaged across all sites, increasing nitrogen levels from 100 to 200 lbs/ac provided a significant yield gain of 0.37 dry tonnes/ac in a fairly linear fashion. The economics here for increasing nitrogen rates are harder to justify. Increasing N rates from 100 to 150 lbs/ac would require the value of forage corn to be $95/dry tonne to break even. Increasing N rates from 150 to 200 lbs/ac increased corn forage yield by 0.16 dry tonnes/ac and in this instance the value of corn silage would need to be valued at $125/dry tonne to breakeven. The optimum nitrogen level depends on the value you place on the corn forage. Overall fertilizing beyond 100 lbs/ac of actual N would not likely be considered economic.

At Yorkton the yield response to increasing seeding rate was fairly linear and when all sites were considered together the response was somewhat curvilinear (Table 5, figure 2). So the economics of increasing seeding rate from 75,000 to 125,000 seeds per ha will be discussed as economics would either be the same or worse when considering a seed rate change from 75,000 to 100,000 seeds per ha. Corn seed is expensive and the cost of increasing seeding rate from 75,000 to 125,000 seeds per ha is 63.36/ac. Increasing the seeding rate increased corn dry matter yield by 0.8 and 0.49 dry tonnes/ac at the Yorkton site and with all sites combined, respectively (table 6, figure 2). Thus the breakeven corn silage price for increasing seeding rate would have to be $86.79 and $141 per dry tonne for Yorkton and all sites combined, respectively. In other words, a case could be made to increase seeding rates based on Yorkton data but the case is a lot harder to make when considering all the trials together.

Table 5. Main Effects of Variety Brand, Nitrogen Level and Seeding Rate on Corn Yield (dry tonnes/ac) at Yorkton and All Sites Combined.[1]		
Main Effects	Yorkton	All Sites Combined[2]
Variety Brand (V)		
A-Brand	7.36 a	6.48 a
B-Brand	7.68 a	6.23 b
Nitrogen Level (lbs/ac of Actual) (N)		
100	6.96 b	6.15 b
150	7.76 a	6.36 ab
200	7.84 a	6.52 a
Seeding Rate (Seeds/ha) (S)		
75,000 (30,364 seeds/ac)	7.14 b	6.15 b
100,000 (40,485 seeds/ac)	7.47 ab	6.23 b
125,000 (50,607 seeds/ac)	7.94 a	6.64 a
[1]Means within a main effect followed by the same letter are not significantly different p=0.05		
[2]All sites includes Redvers, Yorkton, Outlook, Melfort, Scott and Lanigan		

Figure 1. Effect of Nitrogen Level on Forage Corn Yield, Averaged over variety and seeding rate for Yorkton and All sites

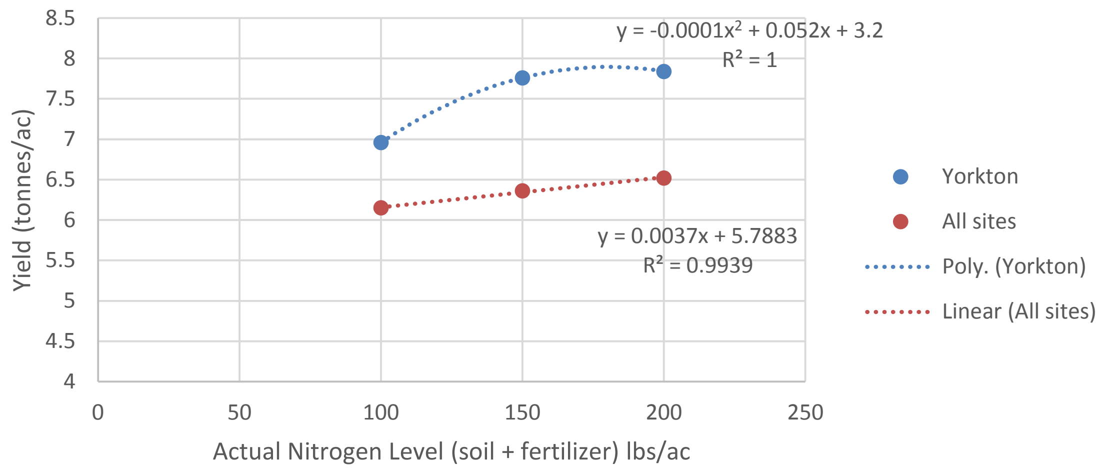
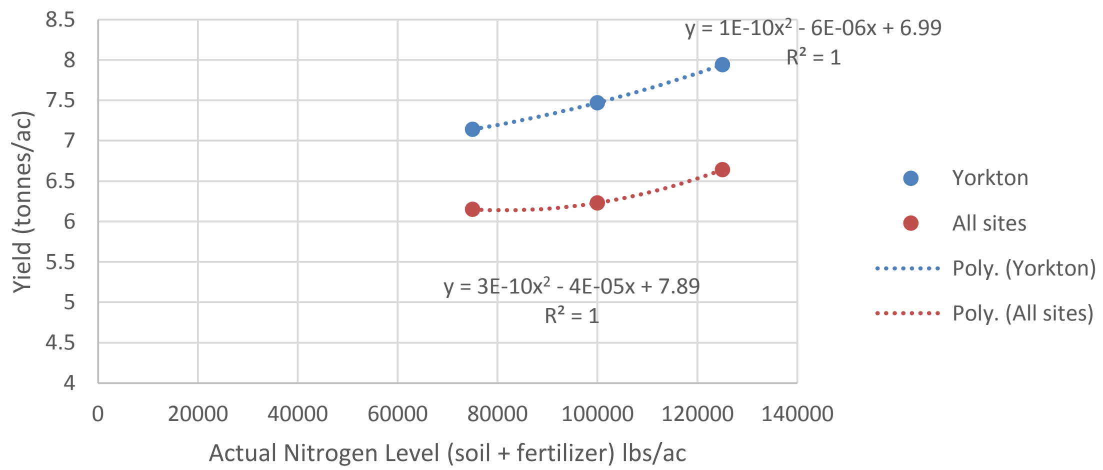


Figure 2. Effect of Seeding Rate on Forage Corn Yield, Averaged over variety and Nitrogen Level for Yorkton and All sites



Forage quality results are not available at this time.

- **Conclusions and Recommendations**

Overall, sites were responsive to increasing seeding rates and increasing levels of nitrogen. However, not all responses would likely be considered economical.

Yorkton by itself was more responsive to nitrogen and it would have likely been considered economical to increase actual n levels to 150 lbs/ac. For all sites as a whole, the value of corn forage would have to be quite high (>$95/ dry tonne) to justify increasing actual nitrogen levels beyond 100 lbs/ac which is the level at which many producers are fertilizing.

The Yorkton site was more responsive to increasing seeding rate compared to all sites considered together. The breakeven values of corn forage when increasing seeding rates from 75,000 to 125,000 seeds/ha were $86.79 and $141/dry tonne for Yorkton and all sites combined, respectively. In other words, the value of corn forage would have to be fairly high to justify increasing seeding rates beyond 75,000 seeds/ha which is currently recommended.

This is just a glance at the results from the 1st year of a 3 year project. A more in-depth economic analysis which includes feed quality results will be written up by PAMI at the conclusion of the project.

Acknowledgements:

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Yield Response and Test Weight Stability of Oat to Increasing Nitrogen

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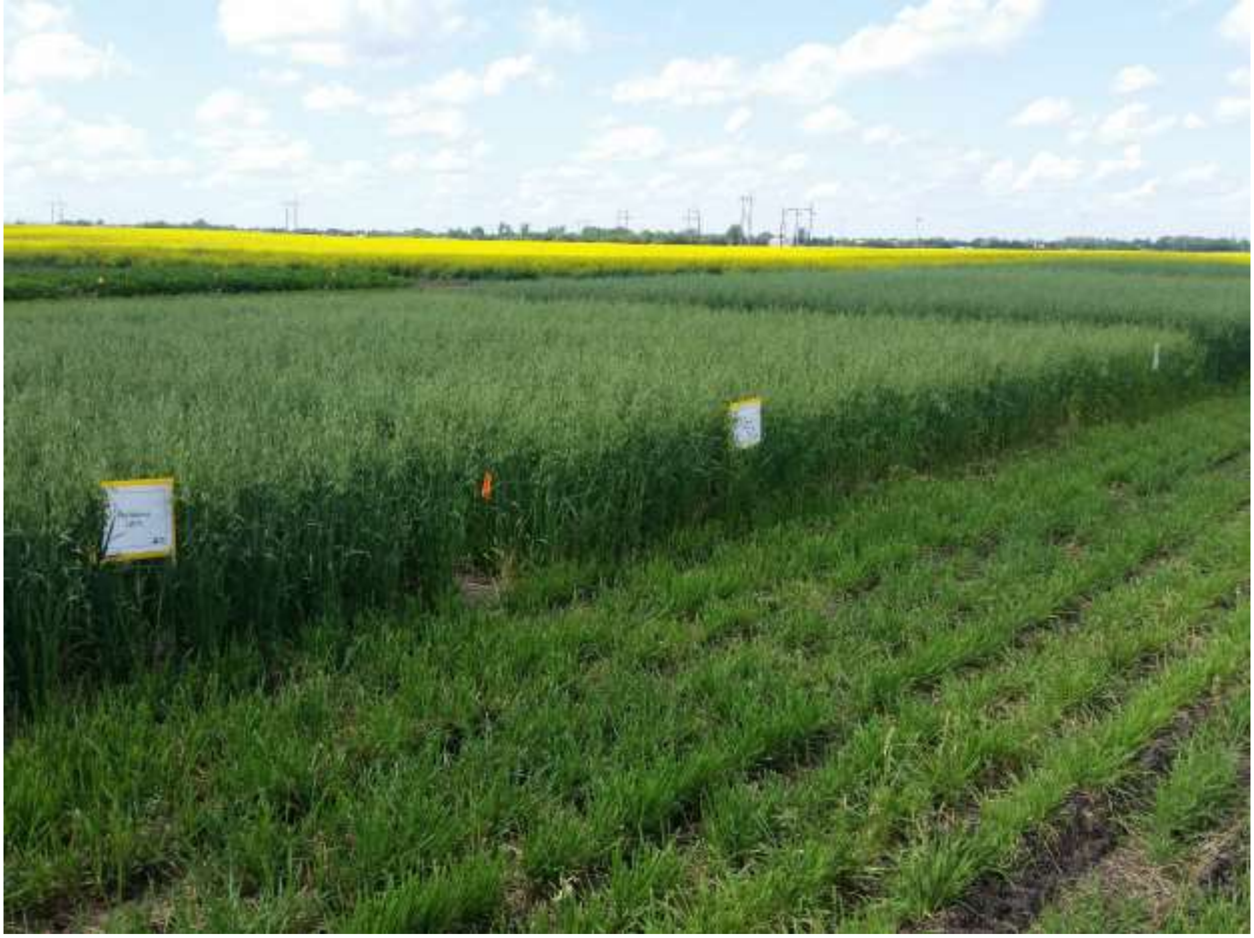
[2]East Central Research Foundation/Parkland College, Yorkton, SK
[3]Northeast Agriculture Research Foundation, Melfort, SK
[4]South East Research Farm, Redvers, SK



- **Abstract and Summary**

Growers can increase oat yields by increasing nitrogen rates. However, increasing nitrogen rates can also reduce oat test weights below the milling standard of 235 g/0.5L. Earlier studies have indicated that the test weights for some oat varieties may be more resilient to increasing nitrogen. The yield and test weight response of various oat varieties to increasing nitrogen was evaluated at Yorkton, Indian Head and Melfort in 2014 to 2016 and at Redvers in 2015 and 2016. Stride was used as a check variety at every location and had relatively good test weight stability but it was often the lowest yielding variety. Stride's

test weight averaged 258.3 g/0.5L, whereas, the average test weight for the remaining varieties was 250g/0.5L. Test weights over the course of this study were higher than anticipated. This was likely the result of adequate moisture levels throughout the summers. Unfortunately, Stride was lower yielding than the other varieties by 6% on average. Current recommendation for fertilizing oats are around 60 kg/ha of N. However, there were quite a few instances where oats responded to nitrogen well beyond this level which may also be related to the wetter cycle we have been experiencing. In this study there were 22 instances where oats responded up to 120 kg/ha of N, 6 instances up to 80 kg/ha of N and 16 instances up to only 60 kg/ha of N. Overall, increasing nitrogen rates decreased test weights of oats. But good environmental conditions conducive to high yields don't seem to be reducing test weights. Lodging was associated with reduced test weights. From the Yorkton site, Summit appeared to be a decent yielding variety that resisted lodging and had good test weights. From the Melfort site, AC Morgan looked like a variety worth considering based on yield and test weight. However, it doesn't come with the best disease package and is only on the acceptable list for Grain Millers. From the Indian Head site, Big Brown was decent yielding and maintained a good test weight. It doesn't appear on the Grain Millers list but is on the Richardson list. It is a tan hulled oat. From Redvers, it was hard to pick a potential variety other than stride which numerically had higher test weights. Justice also maintained good test weight but there is only just one site year of data to support this. It is difficult to find an oat variety which is high yielding, responsive to N and able to sustain test weight

- **Project objectives:**

  Objectives:

  - 1) to validate under local conditions, recent research results showing that oat requires moderate amounts of N and that test weight declines as N rate is increased.
  - 2) to expose growers to new oat cultivars that may be better than cultivars currently grown in the area of the trial.
  - 3) to determine if the test weight of current oat cultivars vary as the nitrogen rate is increased.

- **Project rationale:**

Growers can increase oat yields by increasing nitrogen rates. However, increasing nitrogen rates can also reduce oat test weights below the milling standard of 250 g/0.5L. Earlier studies have indicated that the test weights for some oat varieties may be more resilient to increasing nitrogen. This demonstration was developed to help producers choose the appropriate nitrogen rate and cultivar when growing oats.

<u>Methodology and Results</u>

- **Methodology:**

The trials were established as a 2 order factorials with 4 replicates. First factor was Oat cultivar. Cultivars varied between locations. Cultivars picked for each location were based on two popular and two new cultivars with potential. Each oat cultivar was then evaluated at 40, 60, 80 and 120 Kg N ha-1 of actual nitrogen. Varieties tested at each locations are summarized in table 1.

Table 1. Oat Varieties Tested at Each Location			
Redvers	Yorkton	Indian Head	Melfort
Stride	Stride	Stride	Stride
Leggett[3]	CDC Dancer	Pinnacle[1]	CDC Minstrel
Souris	Summit	CDC Orrin[1]	AC Morgan
CDC Morrison	Triactor	CDC Big Brown	CDC Seabiscuit
Justice[4]		CDC Ruffian[2]	
		CS Camden[2]	
[1]2014 only			
[2]2015 and 2016 only			
[3]2015 only			
[4]2016 only			

- **Results:**

The experiment was successfully carried out at Indian Head, Yorkton and Melfort from 2014 to 2016 and at Redvers in 2015 and 2016.

Yorkton

At Yorkton the check variety Stride was compared to CDC Dancer, Summit and Triactor. Statistically, Triactor was the highest yielding variety in 2014 and 2015 (figure 1). Numerically, it was also the highest yielding variety in 2016 but statistically it didn’t yield more than summit. The ranking of CDC Dancer was inconsistent between years. It was the second highest yielding variety in 2014 but was the lowest yielding variety in 2015 and 2016. There were no interactions between variety and nitrogen rate for yield or test weights in 2014 and 2015. In other words, the varieties responded the same to increasing nitrogen rates

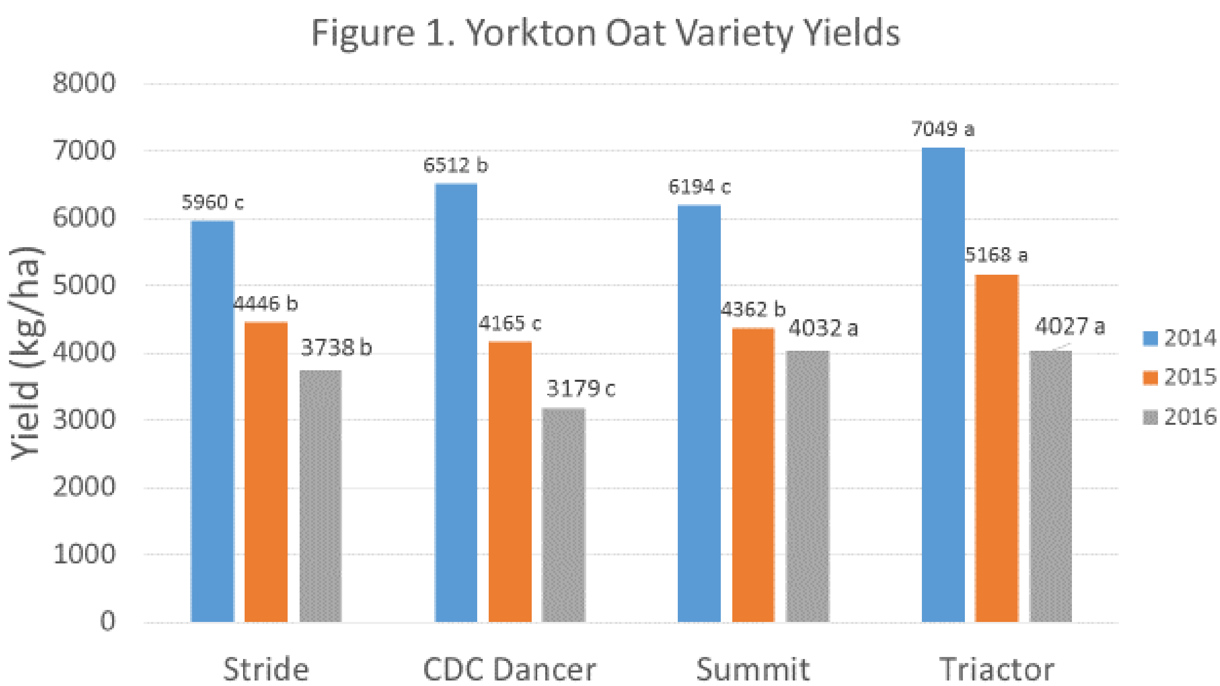
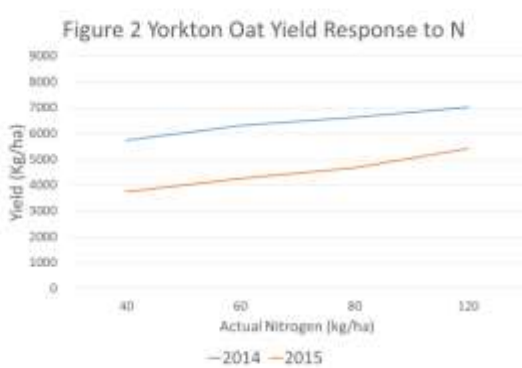
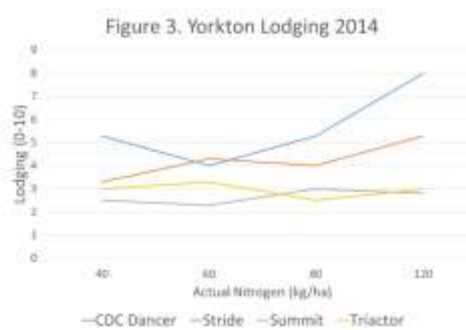


Figure 2 shows the nitrogen response for those years when averaged over variety. The varieties kept responding to added nitrogen all the way to 120 kg/ha which is substantially more than the 60 kg/ha currently recommended. High rates of nitrogen come with added risk of lodging. Figure 3 shows CDC Dancer and Stride substantially lodged at 120 kg/ha. In contrast, Summit and Triactor are holding up pretty good in 2014 which likely contributed to their higher yields.





In 2016, Yield of Summit and Triactor responded again to N all the way to 120 kg/ha (figure 4). However, the yield of CDC Dancer and Stride were maxed out more around 80 kg/ha. Lodging with CDC Dancer and Stride was more pronounced as n rates were increased (figure 5). Likely the reason their yield maxed out at 80 kg/ha of N. Again Summit and Triactor were fairly resistant to lodging. So at this point I am really cheering for Triactor to have good test weights because it was the highest yielding variety 3 years running and had excellent resistance to lodging.

Figure 4. Yorkton Yield 2016

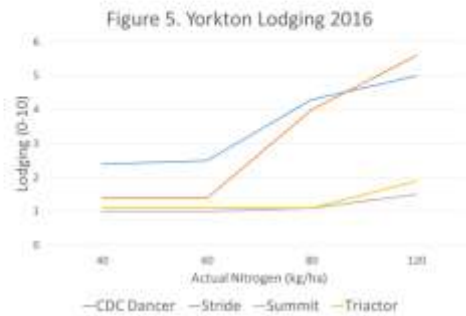


Figure 5. Yorkton Lodging 2016

But it would appear you can't have it all. The red line is in figure 6 is at a test weight of 250 g which is a good place to aim for. Technically anything over 235 g can be acceptable for milling quality but it should be noted that test weights over the course of this study were higher than normal. This is likely because ideal growing conditions were always experienced. Late summer never really got dry which can markedly reduce test weights. Figure 6 shows Triactor had considerably lower test weights than the rest in 2014. Triactor again had substantially poorer test weights in 2015 (Figure 7) and in 2016 (figure 8). So Stride had the best test weight in 2 years and Triactor and the worst for three years in a row. Again, this is very disappointing as Triactor was the highest yielding variety and resisted lodging quite well but its lower test weights make it a risker variety to grow. I guess all things considered Summit would be a good variety to try as it had decent yields, good test weights and resisted lodging. It is also on the preferred list of Grain Millers and Richardson Milling

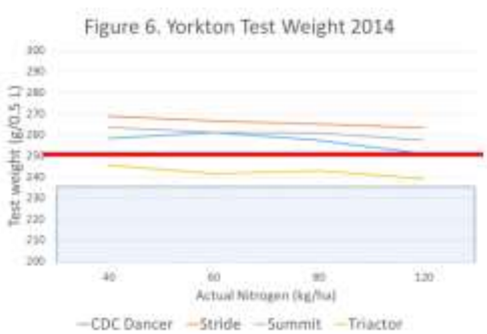


Figure 6. Yorkton Test Weight 2014

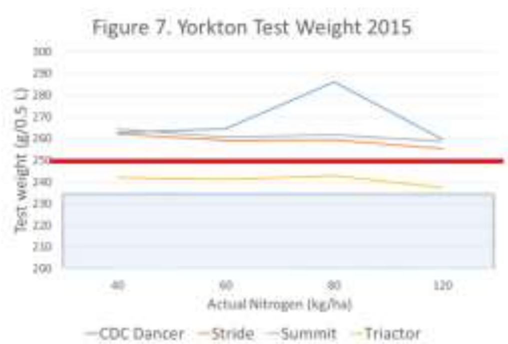
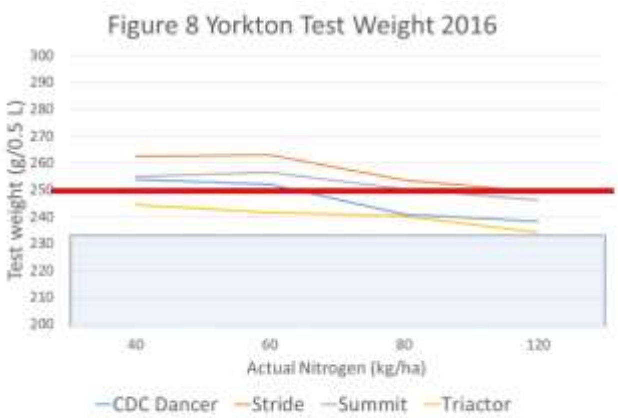
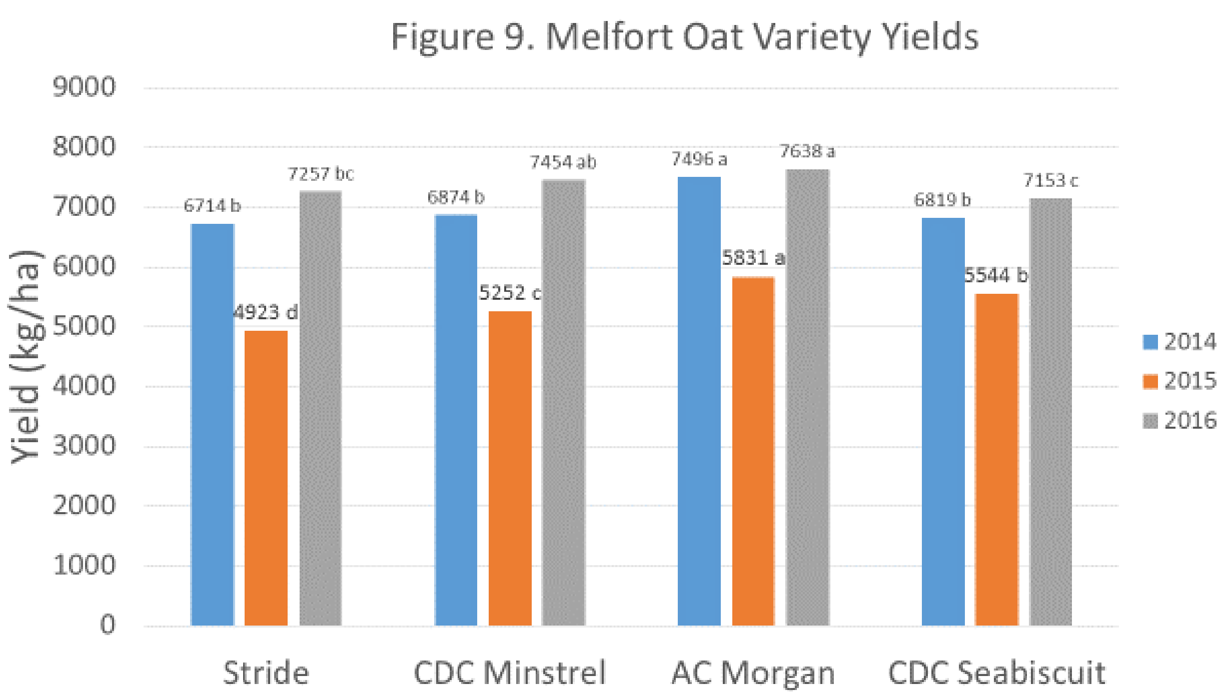


Figure 7. Yorkton Test Weight 2015



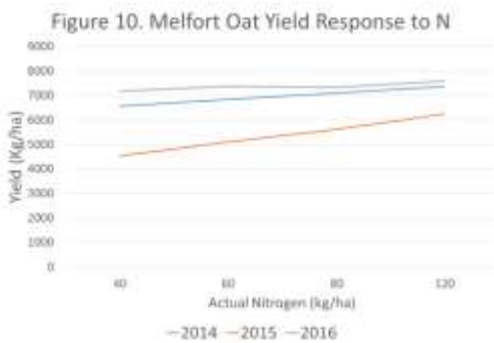
Melfort

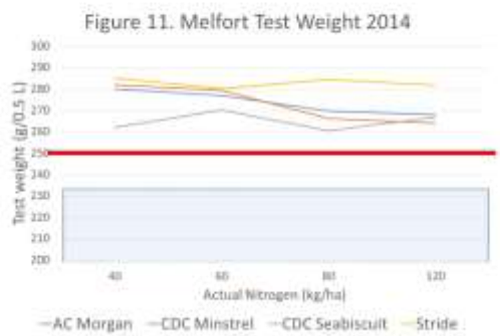
At Melfort the check variety Stride was compared to CDC Minstrel, AC Morgan and CDC Seabiscuit. AC Morgan was the highest yielding variety three years running (figure 9).



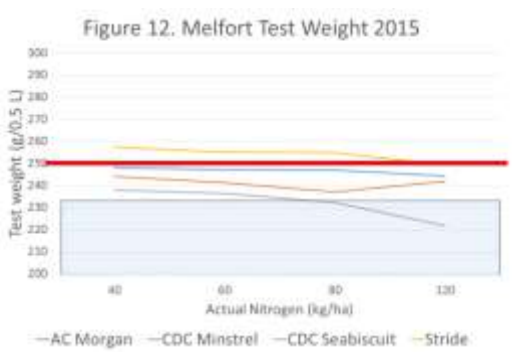
Like Yorkton, varieties responded to increasing N rates all the way to 120 kg/ha in 2014 and 2015 (figure 10). In 2016, Yields were very high but the yield response was fairly modest maxing out at 60 kg/ha.

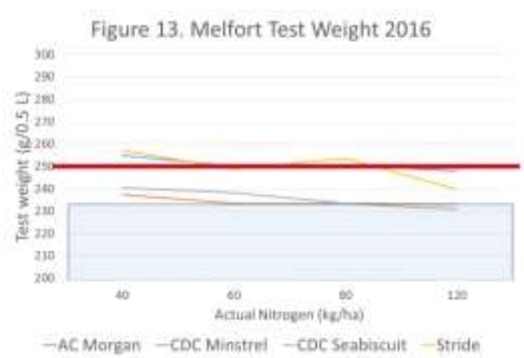
Lodging was fairly modest in 2014 and 2015 and only increased slightly at the highest rate of 120 kg/ha. For 2016, lodging increased substantially with increasing N and this may have limited the yield response. In 2014, the test weight for all varieties stayed above the target red line of 250 g regardless of nitrogen rate (figure 11).





In 2015, Stride was the only variety that could stay above the target red line (figure 12). Unfortunately, it was also the lowest yielding variety in 2015. Ac Morgan was close to the line. In 2016, Stride and AC Morgan again had better test weights and managed to stay close to the red line (figure 13). Morgan might be a variety to consider as it was highest yielding 3 years in a row and maintained better test weights compared to CDC Minstrel and CDC Seabiscuit.

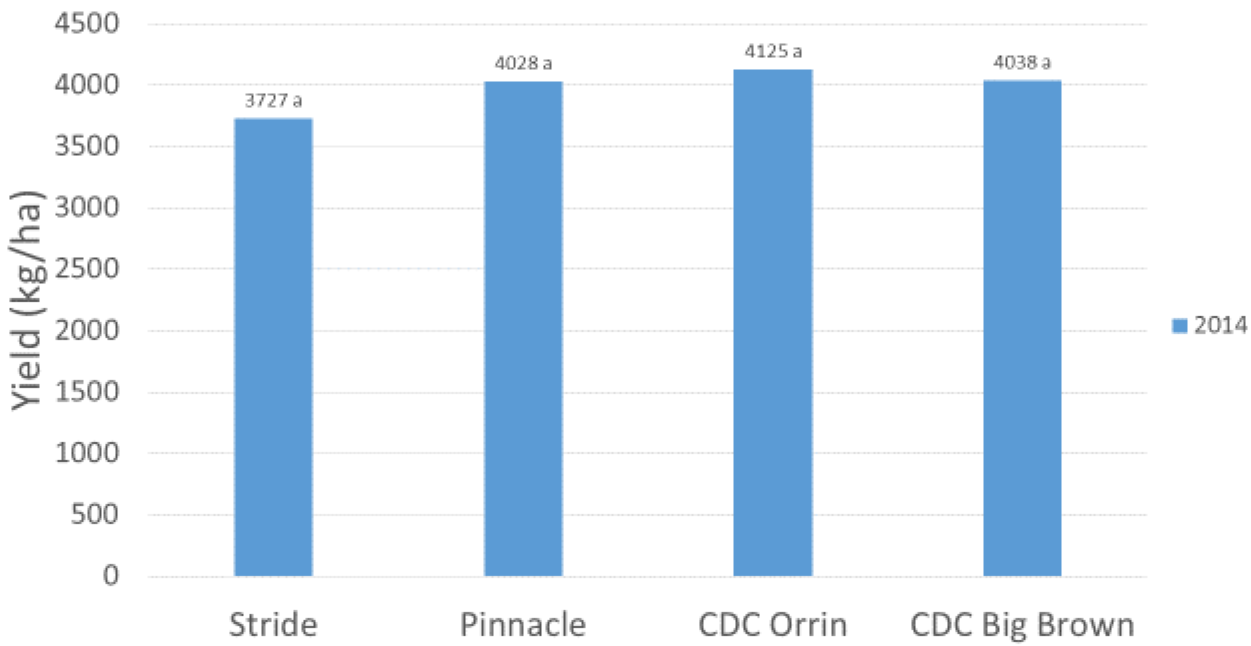




Indian Head

In 2014, the check variety Stride was tested against Pinnacle, CDC Orrin and CDC Big Brown. While no significant differences could be detected between varieties, numerically Stride ended up being the lowest yielding variety again (figure 14).

Figure 14. Indian Head Oat Variety Yields 2014



Oat varieties were fairly unresponsive to increasing N and yield peaked at 60 kg/ha in 2014 (figure 15). This is quite different from Yorkton and Melfort which responded all the way to 120 kg/ha of N. Lodging was pretty bad and increased significantly with increasing nitrogen rates which must have limited yield (figure 16). Now I can hear everyone saying “see I told you. This is why I don’t apply a lot of N to my oats. It is going to go flat. The test weights were all clearly declining with increasing n rate (figure 17). Increasing lodging is associated with decreasing test weights. Stride was the best at maintaining a high test weight but CDC Big Brown and CDC Orrin were in the running too. Pinnacle was definitely poorer.

Figure 15. Indian Head Oat Yield Response to N

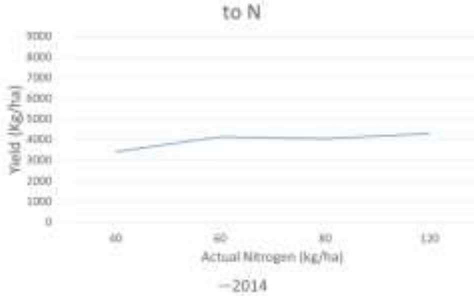
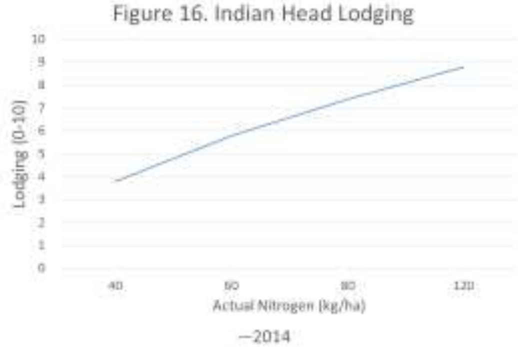
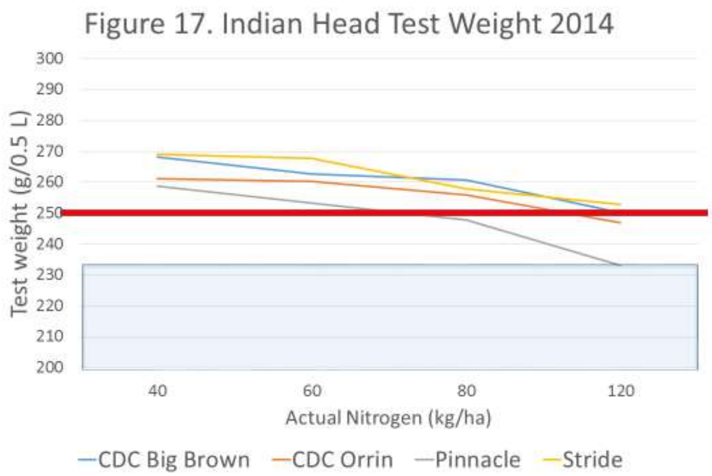
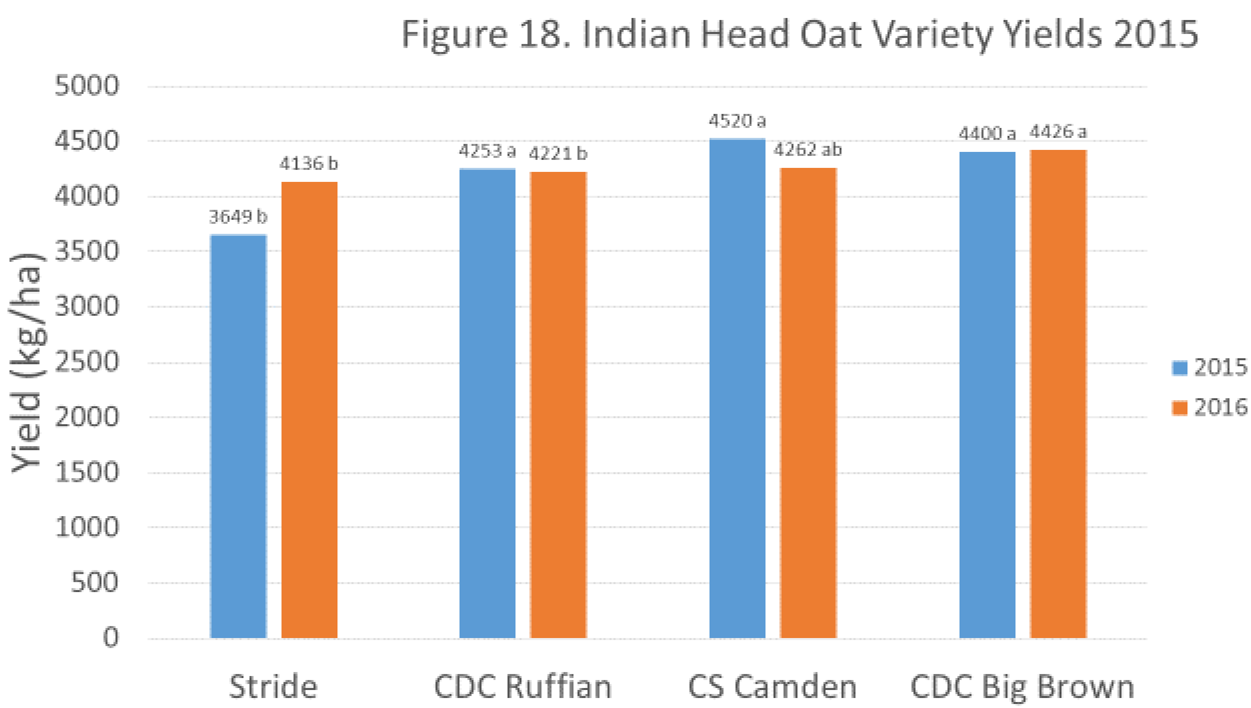


Figure 16. Indian Head Lodging

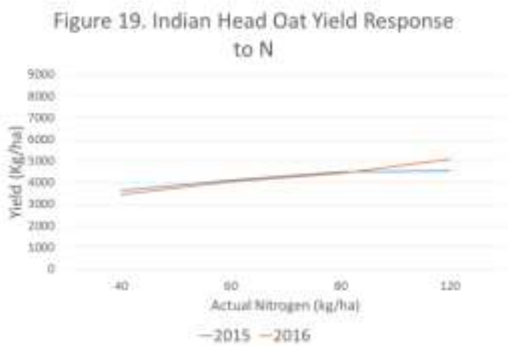


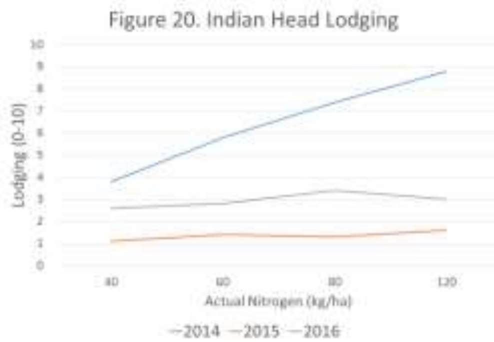


In 2015 and 2016, the varieties tested were changed. Stride was tested against CDC Ruffian, CS Camden and CDC Big Brown. Stride yielded significantly less than the other varieties 2015 (figure 18). It was also numerically the lowest in 2016.

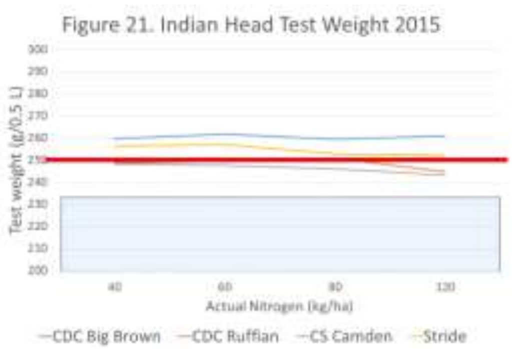


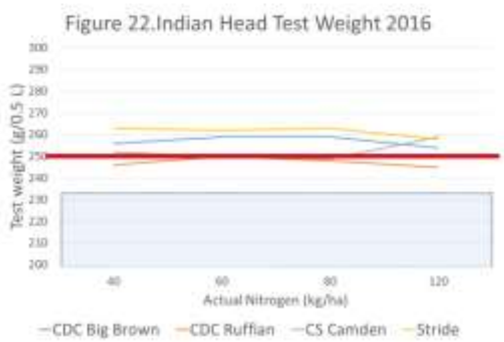
Overall, the yield of Oats was maximized at 80 kg/ha in 2015 whereas it was maximize at 120 kg/ha in 2016 (figure 19). In 2015 and 2016, lodging wasn't an issue like it was in 2014 which may explain why the latter two years were more responsive to nitrogen (figure 20).





In 2015, Stride and CDC Big Brown had significantly higher test weights than the rest and managed to stay above the red line even at high nitrogen rates (figure 21). In 2016, Stride and CDC Big Brown again had significantly higher test weights. So Stride seems to maintain good test weights but is a low yielding variety. CDC Big Brown seems to be a higher yielding variety that is better at maintaining its test weight. Stride is on Grain Millers preferred list and CDC Big Brown is on Richardson's preferred list (figure 22).

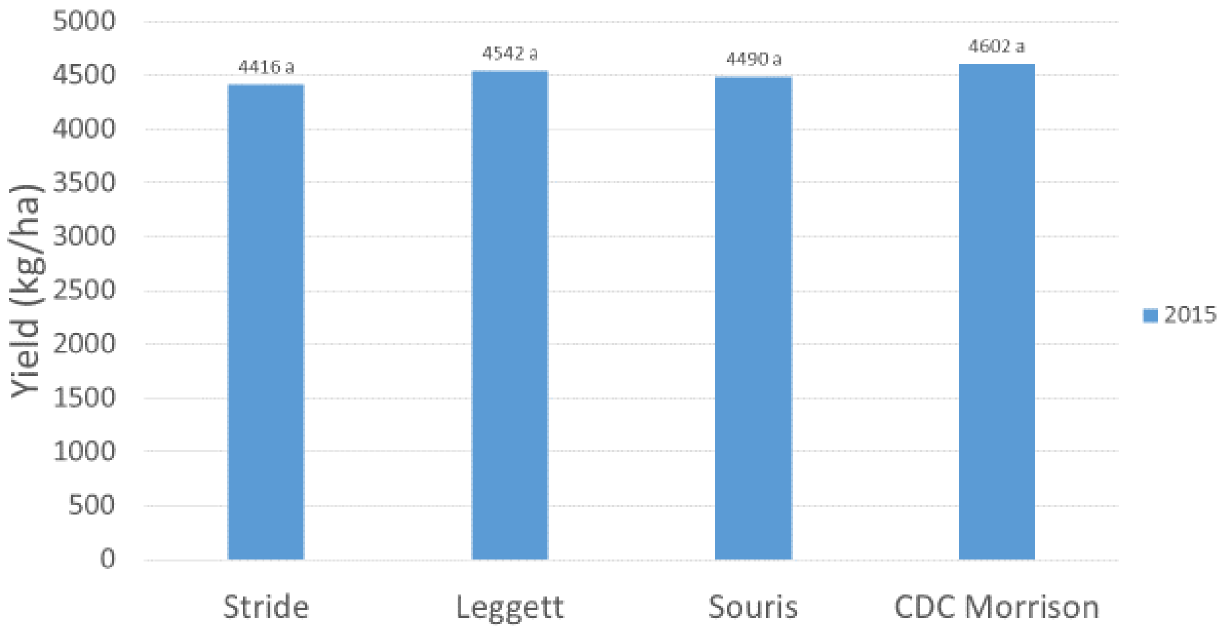




Redvers

In 2015, Stride was numerically the lowest yielding variety however, there technically wasn't a statistical difference between varieties (figure 23).

Figure 23. Redvers Oat Variety Yields 2015



Overall, Oat yields were maximized between 60 and 80 kg/ha of N (figure 24). However Oat yield was not very responsive to added N. There was an interaction with the lodging data. The lodging was quite bad with the Souris whereas the CDC Morrison kept standing well all the way to 120 kg/ha (figure 25). CDC Morrison is rated to have very good resistance to lodging.

Figure 24. Redvers Oat Yield Response to N

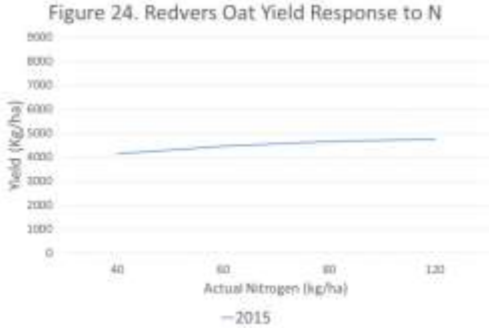
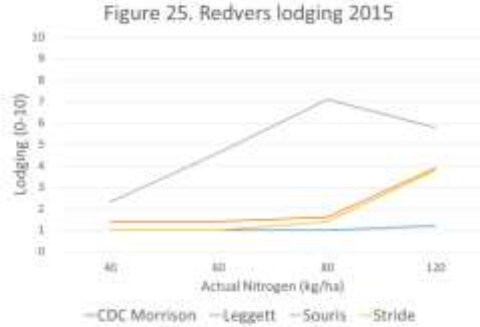
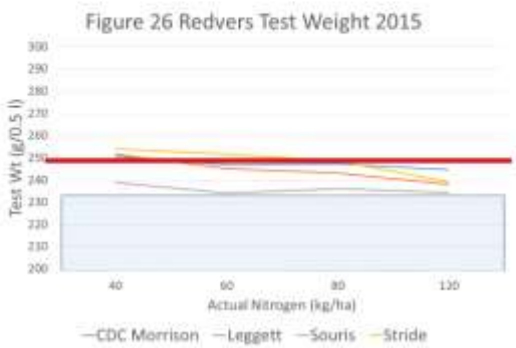


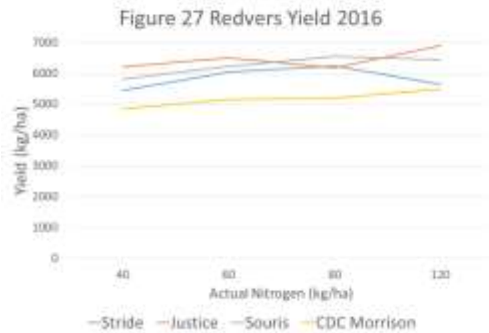
Figure 25. Redvers lodging 2015



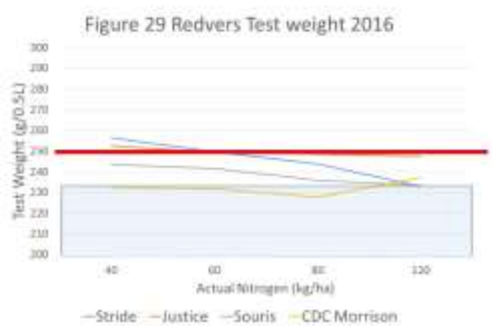
Test weights at Redvers didn't do a good job of staying above the target red line. Souris was particularly bad and was never above the line even at 40 kg/ha of N (figure 26). This likely because it incurred significant lodging. Surprisingly Souris is rated to have very good lodging resistance and a relatively high test weight according to the seed guide. Stride and CDC Morrison had the best test weights. Unfortunately, for some reason Morrison doesn't appear on a preferred list from either grain millers or

Richardson. In 2016 Justice replaced Leggett. There was a significant interaction with the yield data with Justice being less responsive to added fertilizer (figure 27).





Again CDC Morrison resisted lodging quite well as n rates were increased just as it did in 2015 (figure 28). However, Lodging was a significant factor for the remaining varieties. Despite CDC Morrison resisting lodging, its test weights were still poor (figure 29). Overall, it is hard to pick a favorite from the Redvers data.



- **Conclusions**

  - Stride had relatively good test weight stability but it was often the lowest yield variety. Stride's test weight averaged 258.3 g/0.5L, whereas, the average test weight for the remaining varieties was 250g/0.5L. Test weights over the course of this study were higher than anticipated. This was likely the result of adequate moisture levels throughout the summers. Though Stride had high test weights it unfortunately was lower yielding than the other varieties by 6% on average. The current recommendation for fertilizing oats is around 60 kg/ha of N. However, there were quite a few instances where oats responded to nitrogen well beyond this level which may also be related to the wetter cycle we have been experiencing. In this study there were 22 instances where oats responded up to 120 kg/ha of N, 6 instances up to 80 kg/ha of N and 16 instances up to only 60 kg/ha of N. Overall, increasing nitrogen rates which increase yields also decreased test weights of oats. But good environmental conditions conducive to high yields don't seem to be reducing test weights. Lodging was associated with reduced test weights. From the Yorkton site, Summit appeared to be a decent yielding variety that resisted lodging and had good test weights. From the Melfort site, AC Morgan looked like a variety worth considering based on yield and test weight. However, it doesn't come with the best disease package and is only on the acceptable list for Grain Millers. From the Indian Head site, Big Brown was decent yielding and maintained a good test weight. It doesn't appear on the Grain Millers list but is on the Richardson list. It is a tan hulled oat. From Redvers, it was hard to pick a potential variety other than stride which numerically had higher test weights. Justice also maintained good test weight but just one site year of data to support this. It is difficult to find an oat variety which is high yielding, responsive to N and able to sustain test weight.

Acknowledgements

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Flax Response to a Wide Range of Nitrogen and Phosphorus Fertilizer Rates in Western Canada

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- **Abstract and Summary**

The first year of a three year project examining the response of flax to added Nitrogen and Phosphorus fertilizer has been completed. Trials were conducted at Indian Head, Melfort, Redvers, Scott, Swift Current, Yorkton, Vegreville and Brandon. With the exception of Melfort which suffered severe weather before harvest, responses to N were consistent and in some cases highly responsive to relatively high rates of N fertilizer (>100 kg N/ha) than are currently recommended. Responses to P fertilizer were much less frequent and, when they did occur, smaller. This doesn't mean phosphorus should be omitted when fertilizing flax. Soil reserves of phosphorus need to be maintained for long term crop productivity. Plant populations were frequently reduced by high rates of applied N despite all fertilizer being side banded. Populations were not affected by increasing rates of P. Flax is sensitive to the toxic effects of urea and

producers targeting higher rates of N should increase seeding rates to compensate for the loss. Added N delayed maturity by 2-5 days but this delay coincided with higher yields and was unlikely to create any significant agronomic challenges. Phosphorus rate did not affect maturity.

- **Project objectives:**

  The objective of the study is to evaluate the yield response of flax to various rates and combinations of nitrogen and phosphorus fertilizer.

- **Project rationale:**

  Producers have been frustrated by inconsistent flax yields. This study takes another look at the response of flax to nitrogen and phosphorus rates beyond what is currently recommended.

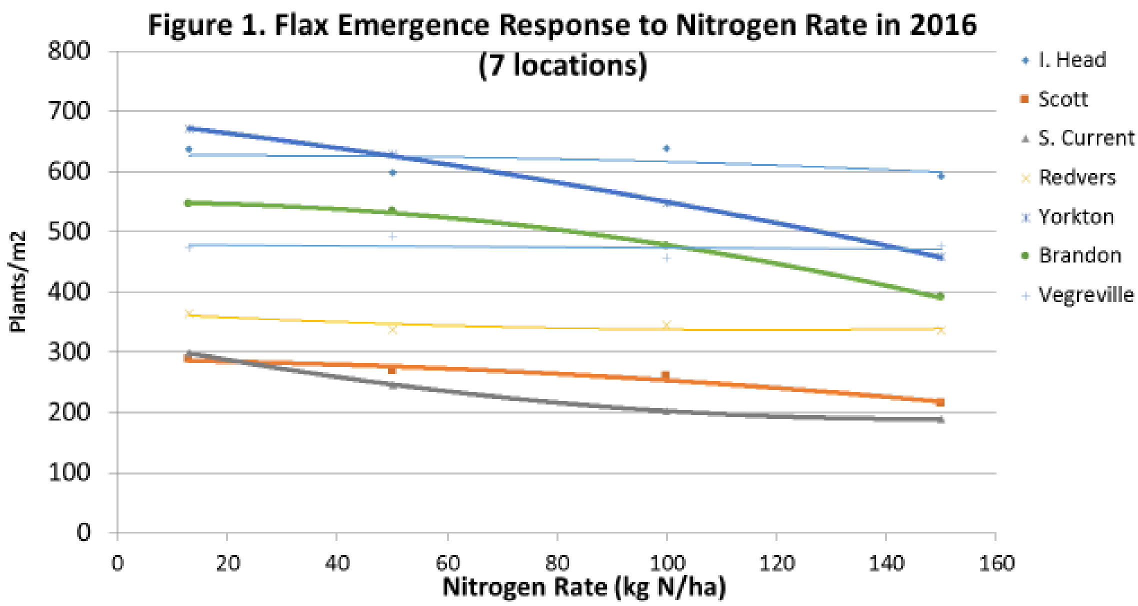
Methodology and Results

- **Methodology:**

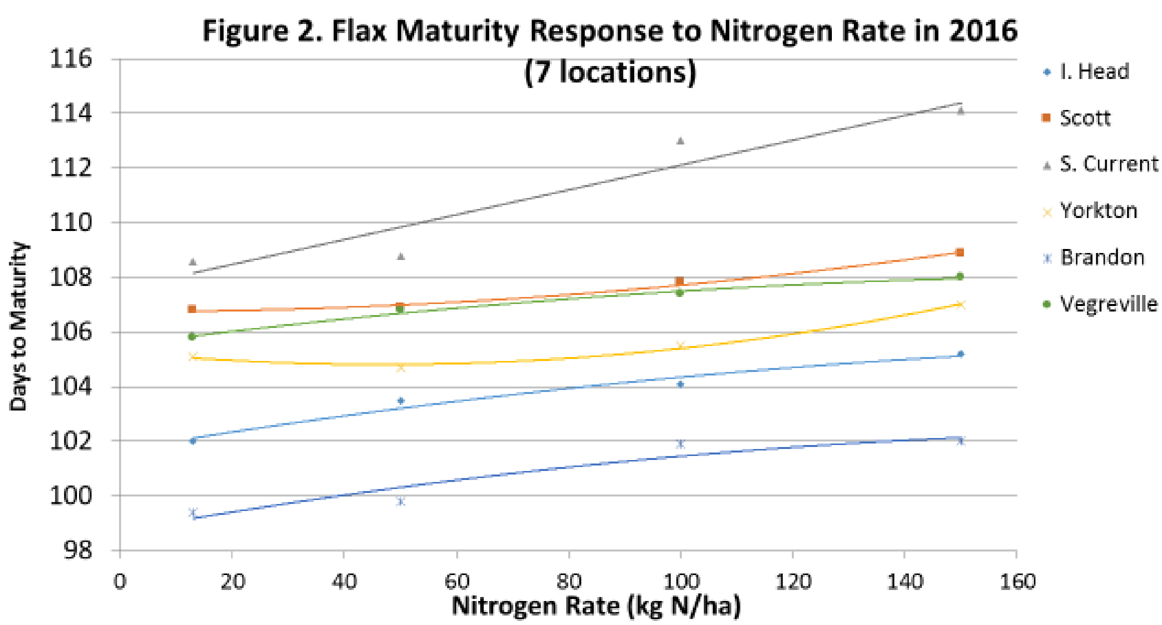
  The three-year project was initiated in 2016 with eight locations including six in Saskatchewan (Indian Head, Melfort, Redvers, Scott, Swift Current and Yorkton), one in Alberta (Vegreville) and one in Manitoba (Brandon). The treatments were a factorial combination of four N rates (13, 50, 100 and 150 kg N/ha) and four P rates (0, 20, 40 and 60 kg P_2O_5/ha) arranged in Randomized Complete Block Design (RCBD) with four replicates. While certain aspects of the specific seeding equipment varied (i.e. row spacing, opener type) across locations, all plots were direct-seeded into cereal stubble and all fertilizer was side-banded during seeding. The fertilizer products utilized in the treatments were commercial grade urea (46-0-0) and monoammonium phosphate (11-52-0).

- **Results:**

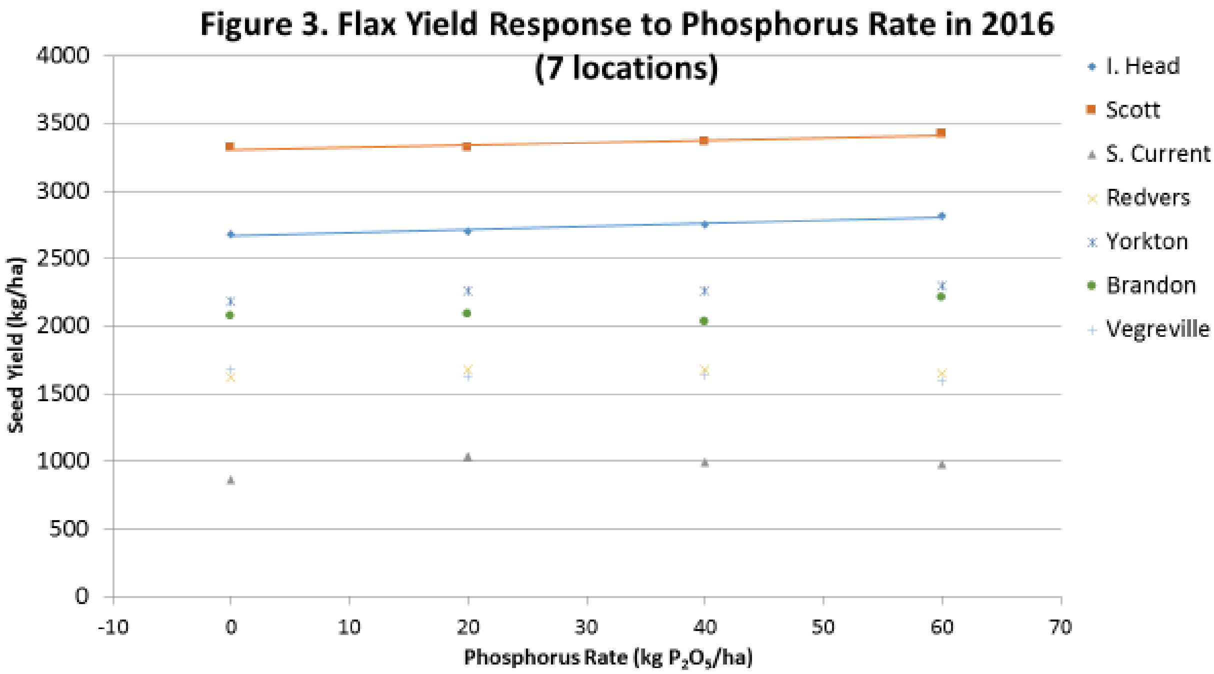
Increasing rates of phosphorus did not significantly affect flax emergence at any of the locations (data not shown). However, increasing rates of n did reduce emergence at Scott, Swift Current, Yorkton and Brandon which have been bolded in figure 1. Even though the fertilizer was side banded, inadequate separation of seed and fertilizer caused a significant stand reduction. This demonstrates the sensitivity of flax to the toxic effects of urea. However, with the exception of Scott and Swift Current, plant populations still remained above the minimum recommendation of 300 plants/m^2.



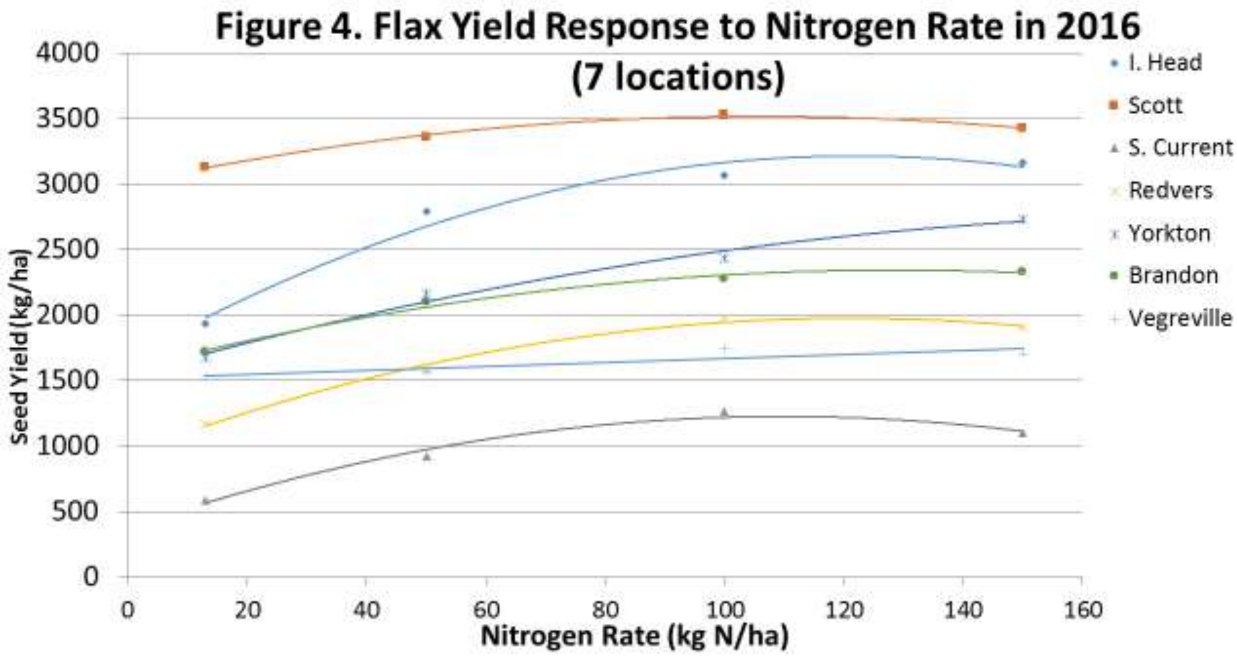
Added Phosphorus didn't significantly affect maturity of flax (data not shown). In contrast, increasing nitrogen rates significantly delayed maturity by approximately 2-5 days depending on location (Figure 2).



Yield response to added phosphorus was significant at Indian head with a yield gain of almost 5% (Figure 3). Conditions were best for observing a P response at Indian Head as the site was high yielding and low in residual P. Yield did not respond significantly to added phosphorus at any of the remaining locations. This supports past research and grower experience. While flax may be a good scavenger for phosphorus, this does not mean phosphorus should be routinely omitted when growing flax. On the contrary phosphorus should still be applied to maintain adequate levels of soil phosphorus for long term crop productivity. Soils with depleted reserves of P cannot be compensated for in one season by applying high rates of p fertilizer.



All sites, with the exclusion of Melfort, significantly responded to increasing rates of nitrogen (figure 4). Generally yields were maximized between 100 and 150 kg/ha of N which is somewhat higher than past research would indicate. The magnitude of the response was quite variable and ranged from 13-115% or expressed another way 3.5 to 19.5 bu/ac. Overall yields at Swift Current and Vegreville were lower where severe weather hampered harvest. The average yields of the remaining sites varied between 2100 to 3360 kg/ha or 33 -53 bu/ac.



- **Conclusions and Recommendations**

Responses to N were consistent and in some cases highly responsive to relatively high rates of N fertilizer (>100 kg N/ha) than are currently recommended. Responses to P fertilizer were much less frequent and, when they did occur, smaller. Again, this doesn't mean we shouldn't be fertilizing flax with phosphorus. Soil reserves of phosphorus need to be maintained for long term crop productivity. Plant populations were frequently reduced by high rates of applied N despite all fertilizer being side banded. Populations were not affected by increasing rates of P. Flax is sensitive to the toxic effects of urea and producers targeting higher rates of N should increase seeding rates to compensate for the loss. Added N delayed maturity by 2-5 days but this delay coincided with higher yields and was unlikely to create any significant agronomic challenges. Phosphorus rate did not affect maturity.

Acknowledgements:

Project lead by Chris Holzapfel (Iharf). Funding provided by Saskatchewan's Agricultural Development Fund, the Saskatchewan Flax Development Commission and the Western Grains Development Commission.

Evaluating Inoculant Options for Faba beans

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- **Abstract and Summary**

Trials were conducted at 7 locations across Saskatchewan to evaluate the impact of various inoculant options on a low tannin faba bean variety (Snowbird) and a normal tannin variety (CDC SSNS-1). The trials evaluated various combinations of Nodulator peat (seed applied) and TagTeam Granular for faba beans. No significant differences between the un-inoculated check and any of the inoculation treatments could be detected at any of the sites. Numerically, the yield of inoculated

treatments yielded 3.6 % higher than the un-inoculated check. The reason for the lack of response is unclear. Perhaps faba beans are good at forming associations with native rhizobia. Despite the results, it is still recommended to inoculate faba beans. Rhizobia levels vary between fields and inoculant should be considered cheap insurance. The trials will continue for one more year.

- **Project objectives:**

To determine the effects of two inoculants at different rates and in combination on Faba bean grown in various soil/climatic zones of Saskatchewan.

- **Project rationale:**

Interest in growing faba beans has increased among farmers, especially as a way to maintain pulses in the crop rotation without the disease issues of alternative pulse options, i.e. field pea or lentil. Although faba beans are not resistant to *Aphanomyces*, which currently infests many pea and lentil fields, they do have a higher tolerance to the level of infection from the disease as well as other root rot pathogens (Lamari and Bernier, 1985 and van Leur et al., 2008). Along with increased disease tolerance, faba beans are very efficient in fixing nitrogen (N) through *Rhizobium* symbiosis compared to other cultivated legumes and derives most of the N requirement through atmospheric N fixation (Bremer et al., 1988). Farmers struggling to grow field peas or lentils because of disease issues could substitute faba beans in the rotation if faba beans perform well agronomically and economically.

Although there are well adapted varieties available for producers in Saskatchewan, research on best suited inoculant options for faba beans is limited. Successful nodulation of the crop is extremely important to ensure the crop reaches maximum yield potential; therefore farmers need to inoculate faba bean seed. The objective of this experiment is to develop recommendations for commercially available inoculants registered for faba beans, allowing farmers to select the best option to maximize yield.

Methodology and Results

- **Methodology:**

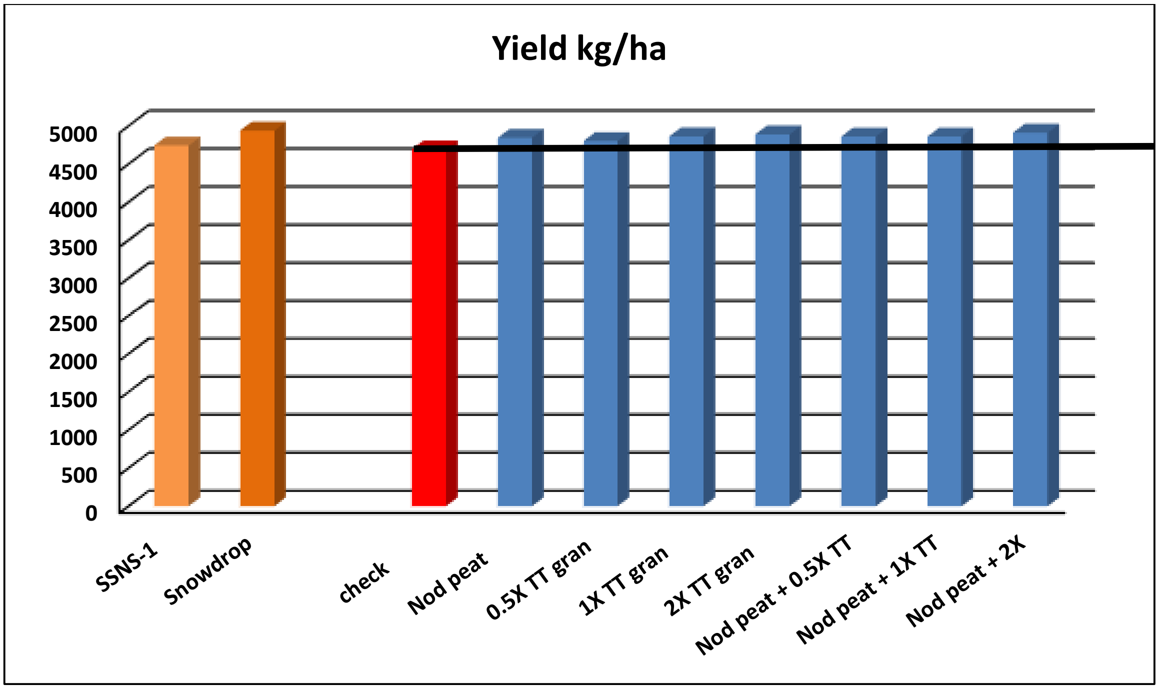
Trials were established as a 2 level factorial with 4 replicates. The first factor compared the low tannin variety "Snowdrop" against a normal tannin variety "CDC SSNS-1". The second factor examined various combinations of Nodulator peat (seed applied) with TagTeam Granular. Thus the following inoculant treatments were tested on both varieties at Redvers, Indian Head, Yorkton, Melfort, Scott, Outlook and Swift Current.

1. Un-inoculated
2. Nodulator peat for faba beans
3. 0.5x rate TagTeam Granular for faba beans
4. 1x rate TagTeam Granular for faba beans
5. 2x rate TagTeam Granular for faba beans
6. Nodulator peat + 0.5x rate TagTeam Granular for faba beans
7. Nodulator peat + 1x rate TagTeam Granular for faba beans
8. Nodulator peat + 2x rate TagTeam Granular for faba beans

Trials were small to medium sized plot.

- **Results:**

With the exception of Iharf, there were no significant differences between the inoculant treatments. At Iharf, Nodular peat yielded significantly more than the half rate of TagTeam granular but no differences could be detected between the remaining treatments. Figure 1 shows the average for all sites combined. Again, there are no significant differences between the un-inoculated check and any of the inoculated treatments. However, all inoculated treatments are slightly higher yielding than the un-inoculated check. On average the inoculated treatments were 3.6 percent higher yielding. There were no interactions between variety and inoculant. In other words, the effect of inoculant was the same between varieties. Overall, snowdrop significantly out-yielded SSNS-1 by about 4%.



- **Conclusions and Recommendations**

Neither SSNS-1 or Snowdrop significantly responded to inoculant. The reason for this is unclear. Faba beans may just be very good at forming associations with native rhizobia. At the Yorkton site the un-inoculated checks started out slower but seemed to catch up. In the end, even the un-inoculated checks had healthy nodules. This trial will be repeated again at all locations next year and we'll just have to wait and see if these results are repeated. Despite the results of this study, it is not recommended to seed faba beans without inoculant as rhizobia levels are going to vary between fields. Inoculation should be considered cheap insurance.

Acknowledgements:

Project lead by Garry Hnatowich (ICDC). Funding provided by the Saskatchewan Pulse Growers.