2017

Annual Report

Michael Hall

Research Coordinator

306 621 6032

www.ecrf.ca

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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 2017 ECRF Directors are:

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

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
- Brendan Dzuba - 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/

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 13, 2017 (attendance 73)

Speaking engagements

January 12, 2017- Spoke on Lentil trial and Nozzle use for suppression of Fusarium Head Blight (Crop Production Show, Saskatoon)

March 22, 2017 - Rate payers meeting for RM of Hyas. An overview of past projects (attendance 20)

April 4, 2017 - Rate payers meeting for RM of Churchbridge. An overview of past projects, MLA was present. (attendance 150)

April 18, 2017 - Rate payers meeting for RM of Spy Hill (attendance 100)

2017 Videos- Website

- Demonstrating 4R Nitrogen Principles in Canola - **(81)** (WARC linked to this video from their website)
- Effect of Seeding Date, Seeding Rate and Seed Treatment on Winter Wheat - **(51)**
- Importance of Dual Inoculation and Seeding Soybeans into Warm Soil - **(38)**

2016 Videos- Website

- Lentil Production in the Black Soil Zone - **(150)**
- Effect of Nozzle Selection and Boom Height on Fusarium Head Blight - **(77)**
- Effect of Preceding Legume Crop on Spring Wheat - **(37)**
- Effect of Fall Cultivation on Soybeans Seeded Early, Mid, and Late May - **(51)**
- Effect of Variety, Nitrogen Rate ad Seeding Rate on Forage Corn - **(43)**
- Effect of Variety, and Nitrogen Rate on Oat Yield and Test Weight - **(77)**
- Flax Response to Nitrogen and Phosphorus - **(90)**
- Evaluating Inoculant Options for Faba beans - **(33)**

2015 Videos -Website

- Flax Studies with IHARF and NARF - **(54)**
- Early Defoliation of Cereals for Swath Grazing - **(155)**
- Soybean Stature by Row Spacing - **(92)**
- Manipulator Effects on Lodging in Wheat 2015 - **(302)**
- Forage Termination 2015 - **(88)**

2014 Videos - Website

- Canary Seed Fertility - **(103)**
- Fungicide Timing on Wheat - **(172)**
- Soybean Variety by Seeding Date - **(95)**
- Cereal Forage by Seeding Date - **(37)**

Total website views **1829 (Jan 3, 2018)**

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 Melfort, Indian Head, Scott, and Yorkton during the 2017 season are presented relative to the long-term averages in Table 3. Seed and fertilizer were placed into adequate soil moisture and plant emergence was generally good. Precipitation was below average, but yields were good due to low disease and excellent soil moisture reserves at the beginning of the season.

Table 3. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) normals for the 2017 growing seasons at Indian Head, Scott and Yorkton in Saskatchewan.

Location	Year	May	June	July	August	Avg. / Total
		-----------------------------*Mean Temperature (°C)* -----------------------------				
Melfort	2017	10.8	15.2	18.7	17.2	15.5
	Long-term	***10.7***	***15.9***	***17.5***	***16.8***	***15.2***
Indian Head	2017	11.6	15.5	18.4	16.7	15.6
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Scott	2017	11.5	15.1	18.3	16.6	15.4
	Long-term	***10.8***	***14.8***	***17.3***	***16.3***	***14.8***
Yorkton	2017	11.1	15.5	19.0	17.4	15.8
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
		--------------------------------- *Precipitation (mm)* ------------------------------				
Melfort	2017	46.4	44.1	33.3	3.1	126.9
	Long-term	***42.9***	***54.3***	***76.7***	***52.4***	***226.3***
Indian Head	2017	10.4	65.6	15.4	25.2	116.6
	Long-term	***49***	***77.4***	***63.8***	***51.2***	***241.4***
Scott	2017	69	34.3	22.4	53	178.7
	Long -term	***38.9***	***69.7***	***69.4***	***48.7***	***226.7***
Yorkton	2017	12.5	53.9	59.1	32.5	158
	Long-term	***51***	***80***	***78***	***62***	***272***

Special Thanks to SaskOats and Morris Sebulsky

This year we received a generous grant from the estate of Morris Sebulsky. The grant was administered by SaskOats and went towards the purchase of a new SeedMaster drill. We are quite delighted with the new drill as our old SeedHawk drill is worn out. The gooseneck broke off twice this past season, but it is well and truly welded together now.


SEED HAWK
SEED
SEED HAWK


HAWK
SEED HAWK
Saskatchewan

Hastening Maturity of Oats without Preharvest Glyphosate

Mike Hall[1], Christiane Catellier[2] and Jessica Pratchler[3]

[1]East Central Research Foundation, Yorkton, SK.
[2]Indian Head Agricultural Research Foundation, Indian Head, SK.
[3]Northeast Agricultural Research Foundation, Melfort, SK.

Abstract/Summary:

Trials were established at Yorkton, Indian Head and Melfort to demonstrate the impact of seeding date, seeding rate and nitrogen/phosphorus fertility on oat yield, maturity and milling quality. Seeding early was expected to produce higher yielding oats with better test weights. Higher test weights were associated with early seeding at Yorkton and Melfort but not at Indian Head. Early seeding resulted in yields that were 17 and 5 percent lower yielding at Yorkton and Indian Head, respectively. Early seeded oats suffered substantially floral blasting at Yorkton due to high temperature during flowering and this may have also been the case at Indian Head. Yield did not differ between seeding dates at Melfort. Increasing seeding rate was expected to hasten maturity but this was only observed at Indian Head where maturity was hastened by 3 days. Increasing nitrogen rate was expected to delay maturity and this was observed at Yorkton and Indian Head. Increasing nitrogen delayed maturity more for late seeded oats than early seeded oats at both Yorkton and Indian Head. This means producers may need to curb nitrogen rates

when seeding late. Increasing nitrogen rate increased yields at all sites. Indian Head was the least responsive site with yield maximizing with 65 lbs N/ac. Melfort was the most responsive site with yield continuing to respond strongly to 90 lbs N/ac. Test weights were expected to decline with increasing nitrogen and this occurred at Yorkton and Melfort but not Indian Head. However, test weights were all well above the 245 g/0.5 l minimum requirement for milling quality. Increasing phosphorus rates from 12.5 to 30 lbs P_2O_5/ac was expected to hasten maturity, but was not observed. However, yield increased with increasing phosphorus for all sites and seeding dates, with responses ranging from 2.8 to 9%. Thins were always well below the maximum limit of 10% and beta glucans were well above the desired level of 4%. Fats from the Indian Head site were getting close to exceeding the desired maximum of 7.5%. However, this is now more of a suggestion than a red line. None of the management factors greatly influenced thins, beta glucans or fats.

To hasten maturity and increase the chance of producing milling quality oats, producers should consider the following factors listed in order of importance:

- Seed early
- Manage nitrogen
- Increase seeding rate to 300 seeds/m^2
- Ensure adequate levels of phosphorus

Project objectives:

Major oat buyers in eastern Saskatchewan have made the decision not to purchase oats treated with pre-harvest glyphosate due to reductions in milling quality. The groat of oats treated with pre-harvest glyphosate becomes brittle and falls apart. Producers must now either swath the crop or wait until the crop is ripe before harvesting. However, either option increases the risk of weathering the oats, making it more difficult for oat producers to achieve milling quality. Thus, producers will need to focus on other agronomic practices to hasten the maturity of oats under field conditions. These include seeding date, seeding rates and fertility management.

The objectives of this project are to demonstrate the impact of seeding date, seeding rate and Nitrogen/Phosphorus fertility on oat yield, maturity, and milling quality.

Project Rationale:

Millers are not purchasing oats desiccated with glyphosate. Producers must now either swath the crop or wait until the crop is dead ripe before harvesting. Both scenarios come with an increased risk of "weathering" the grain below milling standards. Producers must focus on other agronomic practices that hasten maturity. Seeding date is an obvious practice. The earlier the crop is seeded, the more likely the crop is harvested under ideal environmental conditions. Increasing nitrogen rates increases yield but also delays maturity. The ideal rate depends on seeding date. Studies have shown, oats are more responsive to increasing rates of applied N when seeded in early May versus early June (May et al.[1]). So high rates of nitrogen with late seeding are not required for yield and will just further delay maturity. Producers need to "weigh" the yield benefit of higher N rates with delayed maturity. Ensuring adequate levels of phosphorus is also key to hastening maturity. Phosphorus is part of the plant's energy system and is key to development. Finally, increasing seeding rates reduces the number of tillers producing immature heads, which hastens maturity. Work by O'donovan et al. suggest plant populations of 200-250 plants/m^2 should be achieved [2].

[1]May, W. E., Mohr, R. M., Lafond, G. P., Johnston, A. M. and Stevenson, F. C. 2004. Effect of nitrogen, seeding date and cultivar on oat quality and yield in the eastern Canadian prairies. Can. J. Plant Sci. 84: 1025–1036.

[2]O'Donovan, J.T., Dosdall, L.M., Maurice, D.C., Turkington, T.K., Moyer, J.R. Blackshaw, R.E.,. Harker K.N, and. Clayton G.W. 2007. Integrated approaches to managing weeds in spring-sown crops in Western Canada. Crop Protection 26:390-398.

Methodology and Results

Methodology:

CS Camden oats were seeded into a trial setup as a factorial with 3 factors. The first factor contrasted seeding in early vs late May. The second factor compared seeding rates of 200 and 300 seeds/m^2. The third factor evaluated 40, 65 and 90 lbs/ac of actual nitrogen (N). All treatments received 30 lbs/ac of P_2O_5 from mono-ammonium phosphate except for treatments 7 and 14, which received only 12.5 lbs/ac of P_2O_5. These two treatments were added to the factorial, but cannot be part of the factorial analysis. They were added to show the impact of proper phosphorus levels on crop maturity and yield. Nitrogen was banded to the side and phosphorus was seed placed. Table 1 lists the treatments.

Table 1. Treatment list

#	Seeding Date	Seeding Rate (Seeds/m^2)	Nitrogen (lbs N/ac)	Phosphorus (lbs P_2O5/ac)
1	Early May	200	40	30
2	Early May	200	65	30
3	Early May	200	90	30
4	Early May	300	40	30
5	Early May	300	65	30
6	Early May	300	90	30
7	Early May	300	90	12.5
8	Late May	200	40	30
9	Late May	200	65	30
10	Late May	200	90	30
11	Late May	300	40	30
12	Late May	300	65	30
13	Late May	300	90	30
14	Late May	300	90	12.5

At Yorkton, plots were seeded with a 10 foot Seedhawk drill on 10 inch row spacing. The middle 5 rows from each plot were harvested by a Wintersteiger plot combine. At Indian Head, plots were seeded with an 8 opener SeedMaster plot drill on 12 inch row spacing. A Fabro seeder on 12 inch row spacing was used at Melfort. Table 2 lists the 2017 dates of operations.

Table 2. Dates of operations in Yorkton, Melfort and Indian Head

Operations for early seeded treatments in 2017	Yorkton	Melfort	Indian Head
Seeded	May 7	May 11	May 3
Emergence counts	May 29	June 8	May 30
In-crop herbicide	June 1 (Frontline)	Hand weeded	June 13 (Curtail M)
In-crop fungicide	June 28 (Twinline)	NA	NA
Harvest	Sept 8	August 29	August 29
Operations for late seeded treatments in 2017	Yorkton	Melfort	Indian Head
Seeded	May 29	May 29	May 23
Emergence counts	June 13	June 26	Not done
In-crop herbicide	June 20 (Frontline)	Hand weeded	June 26 (Curtail M)
In-crop fungicide	July 12 (Twinline)	NA	NA
Harvest	Sept 30	September 7	August 31

Results:

Trial Results

The following list of quality standards must be met before raw oats are accepted for milling.

• Moisture – 13.5% max • Test Weight – 245 g/0.5 l • Wild Oats – 2.0 % max • Barley – 1.0 % max • Wheat - 1.0 % max	• De-hulled – 8.0% max • Thins – 10% max • Green Groats – 0.5% max • Dockage – 5.0% max • Mustard -5.0% max

Other nutritional factors, not monitored at the front pit, include protein, beta glucans and fat. These "nutritionals" are of interest to the end user and are mostly addressed through plant breeding. This is why millers have preferred varieties. Historically, there has not been much focus on protein but this may change as there is greater interest in the market for plant-derived protein. Beta glucan is currently of interest to the end user. To support the "Heart Healthy" claim, the oat groat must have a minimum of 4% beta glucan. Beta glucan levels tend to be lower in north-west Saskatchewan and Alberta and increasing levels remains a priority for breeders. Desired level of fat may be changing. Historically, high levels of fat were undesirable in order to meet the “Heart Healthy” claim. However, the industry is realizing that there are healthy fats and most dieticians are unconcerned about most plant-derived fats. The end user is less concerned with fat. The breeding target remains at 7.5% or below, but it was changed from a red line to a suggestion.

Yorkton

Emergence was significantly affected at Yorkton by seeding date, seeding rate, and nitrogen rate (Table 4). Seeding rates of 200 and 300 seeds/m^2 produced populations of 182 and 256 plants/m^2, respectively. Emergence was a little higher for the later seeded oats and the 90 lbs N/ac significantly reduced emergence by 14% compared to the 40 lbs N/ac. Obviously, some of the side-banded nitrogen is making its way into the seed row and is reducing emergence.

Days to physiological maturity (hard dough) were not affected by seeding rate, but there was a significant interaction between seeding date and nitrogen rate (Table 4). Increasing nitrogen rate from 40 to 90 lbs/ac delayed maturity of early seeded oats by 4.5 days and further delayed late seeded oats by 5.5 days. While oats seeded late matured later in the calendar year, the days to reach physiological maturity fell by almost 10 days. In other words, oats compensated for later seeding.

Yield increased significantly with increasing nitrogen and started to plateau at 65 lbs N/ac. Yield was almost 20% greater for oats seeded late. This is not typical as yield is usually higher for early seeded oats. However, early seeded oats in this trial suffered from floral blasting in response to high temperatures during flowering. While, the degree did not significantly differ (Table 5), floral blasting appeared higher for the high seeding rate and the low nitrogen rate. Perhaps these plants were under more stress due to greater inter-plant competition.

As mentioned in the materials and methods, treatments 7 and 14 were added to determine the response to phosphorus, but could not be included in the statistical analysis. Numerically, there appeared to be a response to added phosphorus at both the early and late seeding dates. At the seeding rate of 300 seeds/m^2 and 90 lbs N/ac, reducing applied phosphorus from 30 to 12.5 lbs P_2O_5/ac reduced yield by 5 and 9 percent for the early and late seeding dates, respectively. While there appears to have been a yield response, added P_2O_5 had no visible effect on maturity despite relatively low levels of soil phosphorus (8 ppm).

Table 6 presents some other quality factors that are of interest to millers. Treatment means are from a sample bulked over the 4 reps and therefore cannot be statistically analyzed. Test weights are of particular importance with discounts starting at test weights below 245 g/0.5 l and out right rejection under 230 g/0.5 l. For the Yorkton site, all treatments were above 245 g/0.5 l. However, test weight appeared to be influenced by seeding date, seeding rate and nitrogen rate. On average, test weights were greater for the early seeding date (260.3 vs 254 g/0.5 l) and the lower seeding rate (259.1 vs 255.7 g/0.5 l). As nitrogen rate was increased from 40 to 90 lbs/ac, test weights declined from 259.6 to 254.9 g/0.5 l. Other quality factors, such as thins, beta glucans and fat all fell within acceptable ranges and did not appear to be greatly influenced by seeding date, seeding rate, or nitrogen rate. Protein, which is not currently a concern to millers, was not affected by seeding date or seeding rate. When average over seeding date and rate, added nitrogen increased protein from 13.4 to 14.3 %.

Table 4. Main Effects on Emergence, Maturity and Yield for Oats at Yorkton[a]			
Main Effects	Emergence (plants/m^2)	Maturity (days)[b]	Yield (kg/ha)
Seeding date (A)			
Early (May 7)	211 a	93.2 a	5331 a
Late (May 29)	227 b	84.3 b	6384 b
$Lsd_{0.05}$	25.4	1.1	553
Seeding Rate (B)			
200 seeds/m^2	182 a	88.9	5822 a
300 seeds/m^2	256 b	88.5	5894 a
$Lsd_{0.05}$	9.2	A by C	NS
Nitrogen Rate (C)			
40 lbs N/ac	230 a	86.4 a	5467 a
65 lbs N/ac	228 a	88.8 b	5929 b
90 lbs N/ac	199 b	90.9 c	6177 b
$Lsd_{0.05}$	21.9	0.64	276
Interactions	none	none	none
[a]Means within a main effect followed by the same letter are not significantly different p=0.05 [b]Days from seeding to hard dough stage			

Table 5. Main Effects on floral blasting in Oats at Yorkton[a]	
Main Effects	Floral Blasting (% visual rating)
Seeding Rate (B)	
200 seeds/m^2	8.3 a
300 seeds/m^2	14.3 a
$Lsd_{0.05}$	NS
Nitrogen Rate (C)	
40 lbs N/ac	15.6 a
65 lbs N/ac	10.4 a
90 lbs N/ac	8.0 a
$Lsd_{0.05}$	NS
Interactions	none
[a]Means within a main effect followed by the same letter are not significantly different p=0.05	

Table 6. Quality Parameters from Yorkton

Trt #	Seeding Date	Seeding Rate (Seeds/m^2)	Nitrogen (lbs /ac)	P_2O_5 (lbs /ac)	Test wt (g/0.5l)	Thins (%)	Protein (%)	Beta Glucan (%)	Fat (%)
1	May 7	200	45	30	263	0.8	13.3	5.1	6.0
2	May 7	200	65	30	265	1.4	14.0	5.1	6.1
3	May 7	200	90	30	258	1.1	14.6	5.1	5.8
4	May 7	300	45	30	261	1.2	13.2	5.1	6.1
5	May 7	300	65	30	262	1.0	13.8	5.2	5.7
6	May 7	300	90	30	252	1.0	14.3	5.1	5.9
7	May 7	300	90	12.5	262	1.4	14.4	5.2	5.9
8	May 29	200	45	30	258	0.3	13.4	5.3	5.7
9	May 29	200	65	30	256	0.6	13.9	5.3	5.4
10	May 29	200	90	30	254	0.7	14.0	5.4	5.4
11	May 29	300	45	30	256	0.4	13.6	5.3	5.2
12	May 29	300	65	30	247	0.4	14.0	5.3	5.3
13	May 29	300	90	30	255	0.4	14.3	5.4	5.2
14	May 29	300	90	12.5	248	0.5	14.7	5.3	5.4

Indian Head

Crop emergence was good at Indian Head but only emergence counts for the early seeded oats were completed. Seeding rates of 200 and 300 seeds/m^2 produced populations of 150 and 206 plants/m^2, respectively (Table 7). Plant populations decreased slightly with increasing nitrogen, but the differences were not significant. To compensate for the missing emergence data, plant tiller counts were taken later in the season (Table 8). Tiller counts were significantly higher for the late seeded oats, however, differences could not be detected between seeding rate and nitrogen rate.

Like the Yorkton results, oats compensated for late seeding by significantly reducing the days to physiological maturity (Table 8). Maturity was also delayed as nitrogen rate increased. Unlike Yorkton, maturity was significantly hastened with increasing seeding rate. While days to maturity were increased by seeding early, decreasing seeding rate or increasing nitrogen, the strength of the response depended on the particular combination of factors as there was an interaction between all factors. Increasing nitrogen rate delayed maturity the most for the low seeding rate and late planting date (Table 9). Increasing nitrogen delayed maturity by 4.3 days (95.8-91.5) days when 200 seeds/m^2 were seeded late and by only 1.8 days (104.8-103) when 300 seeds/m^2 were seeded early. These results are reflective of those from Yorkton where the maturity of late seeded oat was delayed more than early seeded oats by increasing nitrogen rate.

Yield at Indian Head was significantly affected by seeding date, seeding rate and nitrogen rate (Table 8). Like Yorkton results, yield was significantly higher for the late seeded oats. Floral blasting was not noted at Indian Head but conditions were warm and dryer for the early seeded oats. Yield was significantly higher for the low seeding rate, but was only 2.5% more. Yield increased significantly with added nitrogen up to 65 lbs/ac.

Similar to the results from Yorkton, increasing phosphorus from 12.5 to 30 lbs P_2O_5/ac did not hasten maturity, but did increase yield by 5 and 4% for the early and late seeded oats, respectively.

Table 10 presents the individual treatment means for other quality factors of importance to millers. All treatments had test weights well above the minimum requirement of 245 g/0.5 l. While test weights are typically higher for early seeded oats, the opposite was true at Indian Head. When averaged across seeding rate and nitrogen rate, early and late seeded oats had test weights of 263 and 270 g/ 0.5 l. Higher test weights were associated with the higher seeding rate (300 seeds/m^2) and did not decline with increasing nitrogen, which is not typically the case. Thins were well below the maximum limit of 10% and beta glucans were above the desired level of 4%. Fat levels were close to maximum desired level of 7.5 %, but again this is not as concerning to end users as it has been in the past. When averaged across seeding date and seeding rate, protein levels increased 12.8 to 14.3 % with increasing nitrogen.

Table 7. Main Effects on Emergence for Oats at Indian Head[a]	
Main Effects	Emergence (plants/m^2)
Seeding date (A)	
200 seeds/m^2	150 a
300 seeds/m^2	206 b
$Lsd_{0.05}$	23.4
Nitrogen Rate (B)	
40 lbs N/ac	185 a
65 lbs N/ac	175 a
90 lbs N/ac	174 a
$Lsd_{0.05}$	NS
Interactions	none
[a]Means within a main effect followed by the same letter are not significantly different p=0.05	

Table 8. Main Effects on Tiller density, Maturity and Yield for Oats at Indian Head[a]			
Main Effects	Tillers/m^2	Maturity (days)[b]	Yield (kg/ha)
Seeding date (A)			
Early (May 3)	326 a	105.1 a	4818 a
Late (May 23)	285 b	91.5 b	5047 b
$Lsd_{0.05}$	35.6	0.7	172
Seeding Rate (B)			
200 seeds/m^2	294 a	99.9 a	4994 a
300 seeds/m^2	318 a	96.8 b	4870 b
$Lsd_{0.05}$	NS	0.6	106
Nitrogen Rate (C)			
40 lbs N/ac	295 a	97.1 a	4574 a
65 lbs N/ac	318 a	98.4 b	5111 b
90 lbs N/ac	304 a	99.4 c	5112 b
$Lsd_{0.05}$	NS	0.5	163
Interactions	none	A by B by C	none
[a]Means within a main effect followed by the same letter are not significantly different p=0.05 [b]Days from seeding to hard dough stage			

Table 9. Maturity means for the A by B by C interaction at Indian Head[a]			
Seeding date (A)	Seeding Rate (B)	Nitrogen Rate (C)	Maturity (days)[b]
Early (May 3)	200 seeds/m^2	40 lbs N/ac	105.5
		65 lbs N/ac	106.3
		90 lbs N/ac	107.0
	300 seeds/m^2	40 lbs N/ac	103.0
		65 lbs N/ac	104.3
		90 lbs N/ac	104.8
Late (May 29)	200 seeds/m^2	40 lbs N/ac	91.5
		65 lbs N/ac	93.3
		90 lbs N/ac	95.8
	300 seeds/m^2	40 lbs N/ac	88.3
		65 lbs N/ac	90.0
		90 lbs N/ac	90.3
$Lsd_{0.05}$			1.17

[a]Means within a main effect followed by the same letter are not significantly different p=0.05

[b]Days from seeding to hard dough stage

Table 10. Quality Parameters from Indian Head									
Trt #	Seeding Date	Seeding Rate (Seeds/m^2)	Nitrogen (lbs /ac)	P_2O_5 (lbs /ac)	Test wt (g/0.5l)	Thins (%)	Protein (%)	Beta Glucan (%)	Fat (%)
1	May 3	200	45	30	260	2.8	13.0	4.9	7.4
2	May 3	200	65	30	265	3.3	13.8	4.9	7.4
3	May 3	200	90	30	267	2.6	13.9	5.0	7.2
4	May 3	300	45	30	265	2.8	12.4	5.0	7.5
5	May 3	300	65	30	262	2.8	13.7	5.0	7.4
6	May 3	300	90	30	261	2.3	14.4	5.0	7.2
7	May 3	300	90	12.5	256	3.7	14.4	5.0	7.3
8	May 23	200	45	30	270	1.8	13.0	4.8	7.7
9	May 23	200	65	30	261	1.7	13.8	5.0	7.4
10	May 23	200	90	30	269	2.2	14.4	5.0	7.2
11	May 23	300	45	30	271	2.4	12.8	4.8	7.6
12	May 23	300	65	30	271	2.1	13.8	4.9	7.4
13	May 23	300	90	30	275	2.3	14.4	4.9	7.3
14	May 23	300	90	12.5	273	2	14.3	5.1	7.1

Melfort

At Melfort, emergence was not affected by seeding date but did decline with increasing nitrogen (table 11). Seeding rates of 200 and 300 seeds/m^2 produced plant populations of 120 and 156 plants/m^2, respectively. Similar to results from Yorkton and Indian Head, oats compensated for late seeding by reducing the number of days to maturity. There were some issues with the maturity ratings so the rest of the data has been omitted from discussion.

Yield did not significantly differ between seeding dates or seeding rates. However, yield increased significantly with up to 90 lbs/ac of actual nitrogen. Numerically, there was a yield response to added phosphorus. Increasing the rate of P_2O_5 from 12.5 to 30 lbs/ac increased yields by 2.8 and 3.7% for early and late seeded oats, respectively.

Oat test weights were generally higher for early seeded oats and decreased somewhat with increasing nitrogen (Table 12). However, test weights were always well above the minimum requirement of 245 g/0.5 l. Thins, beta glucan and fat were at acceptable levels for the end user. On average, protein increased by 1.3% when nitrogen rates were increased from 40 to 90 kg/ha.

Table 11. Main Effects on Emergence, Maturity and Yield for Oats at Melfort[a]			
Main Effects	Emergence (plants/m^2)	Maturity (days)[b]	Yield (kg/ha)
Seeding date (A)			
Early (May 11)	140 a	109.7 a	5178 a
Late (May 29)	136 a	95.7 b	5013 a
$Lsd_{0.05}$	NS	0.23	NS
Seeding Rate (B)			
200 seeds/m^2	120 a		5075 a
300 seeds/m^2	156 b		5116 a
$Lsd_{0.05}$	9.1		NS
Nitrogen Rate (C)			
40 lbs N/ac	149 a		4714 a
65 lbs N/ac	131 b		5172 b
90 lbs N/ac	134 b		5400 c
$Lsd_{0.05}$	14.2		202
Interactions	none		none

[a]Means within a main effect followed by the same letter are not significantly different p=0.05

[b]Days from seeding to hard dough stage

Table 12. Quality Parameters from Melfort									
Trt #	Seeding Date	Seeding Rate (Seeds/m^2)	Nitrogen (lbs /ac)	P_2O_5 (lbs /ac)	Test wt (g/0.5l)	Thins (%)	Protein (%)	Beta Glucan (%)	Fat (%)
1	May 11	200	45	30	290	1.2	12.2	5.0	6.5
2	May 11	200	65	30	286	1.3	13.0	5.0	6.8
3	May 11	200	90	30	287	1.7	12.9	5.2	6.4
4	May 11	300	45	30	284	1.3	12.2	4.9	6.5
5	May 11	300	65	30	287	1.4	13	5.0	6.5
6	May 11	300	90	30	285	1.6	13.5	5.0	6.5
7	May 11	300	90	12.5	284	1.2	13.6	5.1	6.5
8	May 29	200	45	30	278	1.0	11.5	5.0	7.1
9	May 29	200	65	30	277	1.4	12.5	4.9	7.1
10	May 29	200	90	30	281	1.2	13.2	5.1	6.7
11	May 29	300	45	30	280	1.2	11.8	5.0	6.7
12	May 29	300	65	30	278	1.4	12.1	5.0	6.7
13	May 29	300	90	30	287	1.1	13.0	5.2	6.8
14	May 29	300	90	12.5	277	1.2	12.7	5.1	6.8

Extension and Acknowledgement

This report on the results will be available for download from the ECRF website (www.ecrf.ca). The trial was part of ECRF's annual farm tour.

Conclusions and Recommendations

The objective of this study was to demonstrate the importance of early seeding, higher seeding rates and good fertility management for achieving high yielding milling quality oats without using pre-harvest glyphosate. Virtually all treatments from all locations would have made milling quality. However, yield and some quality parameters were affected by treatment. The benefit of seeding early was not greatly apparent. While seeding allowed for earlier harvest in the calendar year, this did not result in a better quality crop or higher yields. Higher test weights were associated with earlier seeding at Yorkton and Melfort, but not Indian Head. However, all test weights were well above the minimum requirement of 245 g/0.5 l. Early seeded oats yielded 17 and 5 percent lower at Yorkton and Indian Head, respectively. Higher yields are usually associated with early seeding, but early seeded oats suffered severe floral blasting at Yorkton and possibly Indian Head due to environmental conditions. Yield did not differ between seeding dates at Melfort. The benefit of a higher seeding rate was not always apparent. Increasing seeding rate from 200 to 300 seeds/m^2 did significantly hasten maturity at Indian Head by 3 days but it also significantly reduced yield by 2.5%. A maturity or yield difference between seeding rates was not detected at either Yorkton or Melfort. Increasing nitrogen rate increased yields at all sites but also delayed maturity. Indian Head was the least responsive site with yield maximizing with 65 lbs N/ac due to very dry conditions. Melfort was the most responsive site with yield continuing to respond strongly with 90 lbs N/ac. Added nitrogen delayed the maturity of late seeded oats more than early seeded oats at the Yorkton and Indian Head sites. This means producers need to pay special attention to nitrogen rates when seeding oats late to avoid maturity issues. Increasing applied P_2O_5 from 12.5 to 30 lbs/ac increased yield for early and late seed oats at all locations. Responses varied from 2.8 to 9%. However, increasing applied phosphorus was not observed to hasten maturity.

Other quality parameters such as thins and beta glucans were all within acceptable levels. Fat levels were on the high side at Indian Head, but high fat levels are of less concern to the end user as dieticians are now less concerned with fat derived from plants. The maximum desired level of 7.5% is now more of a suggestion than a red line. None of the management factors appeared to influence thins, beta glucans or fat. However, beta glucan and fat differed substantially between locations. Protein consistently increased with added nitrogen at all locations, but end user are not currently selecting oats by this parameter. This may change in the future as the industry focuses more on plant-derived protein.

To hasten maturity and increase the chance of producing milling quality oats, producers should consider the following factors listed in order of importance:

- Seed early
- Manage nitrogen
- Increase seeding rate to 300 seeds/m^2
- Ensure adequate levels of phosphorus

Supporting Information

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 Grain Millers (Yorkton) for quality testing.

Early Weed Removal Improves Herbicide Efficacy and Canola Yield

Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

Abstract

Abstract/Summary:

A trial was established near Yorkton with the objective of demonstrating the yield impact of early and late weed removal on light and heavy stands of Roundup Ready (RR) and Liberty Link (LL) canola. The project intended to demonstrate the value of early or sequential applications of herbicide for maximizing canola yield, particularly when stands are thin. It also intended to demonstrate improved herbicidal efficacy when weeds are small and not sheltered by the crop. This is particularly important for contact herbicides such as Liberty. The plant populations per m^2

established in this study were 74 and 102 for the Roundup Ready canola and 87 and 114 for the Liberty Link canola. Weed control was best when herbicide was applied early at the 1-2 leaf stage or sequentially at the 1-2 and 5-6 leaf stages for both Roundup Ready and Liberty Link canola. A sequential application of herbicide never improved yield over an early application. In fact, yield of Roundup Ready canola did not significantly differ between any of the herbicide timings. For Liberty Link canola, an early application (1-2 leaf stage) significantly increased yield over a late application (5-6 leaf stage), but only for the low plant stand. This supports the notion that an early application of herbicide is particularly important for lower plant stands that are less competitive against weeds. Dual application of herbicide in the Liberty Link canola did not increase yield compared to a single application at the 1-2 leaf stage. In fact, a dual application significantly reduced yield for the lower plant stand. Substantial "bronzing" from the application of Liberty occurred in this study and the dual application may have significantly set the crop back. However, the dual application did not significantly reduce yield at the higher plant population. Perhaps the higher population was better able to compensate for the "bronzing". Overall, there was some evidence to support early weed removal as a best management practice. Sequential application of herbicide should only be considered if the weed pressure is there it warrant it.

Objectives and Rationale

Project objectives:

The objectives of this project were to demonstrate the yield impact of early and late weed removal on light and heavy stands of Roundup Ready and Liberty Link canola.

The project intended to demonstrate:

- the value of early weed removal in maximizing canola yield, particularly if stands are thin.
- the improved herbicidal efficacy when weeds are small and not sheltered by the crop, which is of particular importance for a contact herbicide such as Liberty.
- the value of sequential applications particularly if crop stands are thin.

Project Rationale:

Early weed removal at the 2 leaf stage of canola is required to maximize crop yield. In the late nineties, canola production sites found weed removal at the 1 to 2 leaf stage provided the greatest canola yields in 24 out of 27 sites. Despite these results, some producers still delay spraying so they can "get them all" with one application of herbicide. This strategy may be ill-advised, particularly if weed pressure is high or crop stands are thin. Herbicide efficacy is also compromised by delaying application. Many weed species become more tolerant to herbicides with age and a larger crop canopy at the time of spraying can shelter weeds from the herbicide. This is particularly problematic for the contact herbicide Liberty and is one of the reasons Bayer advocates for early weed removal in Liberty canola systems. It is also well established that thinner stands are less competitive against weeds and are more likely to benefit from dual applications of herbicide.

Methodology and Results

Methodology:

Two separate trials designed as 2 level factorials with 4 replicates were established. One trial used Roundup Ready canola and the other used Liberty Link canola. The first level factor examined the application of herbicide at following leaf stages of canola:

- 1-2 leaf stage
- 5-6 leaf stage
- 1-2 leaf stage and 5-6 leaf stage

In the RR canola study, Roundup Transorb was applied at 0.5 l/ac for the single applications. For the dual applications, 0.33 l/ac was applied at each timing. In LL canola study, the single applications were Liberty at 1.6 l/ac with 77 ml/ac of Centurion. For the dual application treatment, the first application was 1.35 l/ac of Liberty + 77 ml/ac of Centurion and the second application was 1.6 l/ac of Liberty alone.
The 2nd level factor for both studies compared seeding rates of 80 and 150 seeds/m^2. Tables 1 and 2 list the treatments for the Roundup Ready and Liberty Link trials, respectively.

Table 1. Treatment list for Roundup Ready Canola Trial

#	Herbicide and timing(s)	Seeding rate (seeds/m^2)
1	Roundup Transorb (0.5 l/ac) @ 1-2 lf stage	80
2	Roundup Transorb (0.5 l/ac) @ 1-2 lf stage	150
3	Roundup Transorb (0.5 l/ac) @ 5-6 lf stage	80
4	Roundup Transorb (0.5 l/ac) @ 5-6 lf stage	150
5	Roundup Transorb (0.33 l/ac) @ 1-2 lf and 5-6 lf stages	80
6	Roundup Transorb (0.33 l/ac) @ 1-2 lf and 5-6 lf stages	150

Table 2. Treatment list for Liberty Link Canola Trial

#	Herbicide and timing(s)	Seeding rate (seeds/m^2)
1	Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 1-2 lf stage	80
2	Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 1-2 lf stage	150
3	Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 5-6 lf stage	80
4	Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 5-6 lf stage	150
5	• Liberty (1.35 l/ac) + Centurion (77 ml/ac) + amigo @1-2 lf stage • Liberty (1.6 l/ac) @ 5-6 lf stage	80
6	• Liberty (1.35 l/ac) + Centurion (77 ml/ac) + amigo @1-2 lf stage • Liberty (1.6 l/ac) @ 5-6 lf stage	150

Fertility was applied at rates to be non-limiting. Plots were 22 by 30 feet wide and seeded with a 10 foot Seedhawk drill on 10 inch row spacing. The middle 5 rows from each plot were harvested using a Wintersteiger plot combine.

Table 3 lists the 2017 dates of operations.

Table 3. Dates of operations in 2017 for the Roundup Ready Canola Trial	
Operations in 2017	Yorkton
Trial seeded	May 19
Emergence counts	June 5
In-crop Roundup Transorb (0.5 l/ac) @ 1-2 lf stage for trts 1 and 2	June 7
In-crop Roundup Transorb (0.33 l/ac) @ 1-2 lf stage for trts 5 and 6	June 7
In-crop Roundup Transorb (0.5 l/ac) @ 5-6 lf stage for trts 3 and 4	June 18 (light rain after)
In-crop Roundup Transorb (0.33 l/ac) @ 5-6 lf stage for trts 5 and 6	June 18 (light rain after)
Acapela fungicide	July 4
Reglone	Sept 5
Harvest	Sept 11

Results:

Roundup Ready Canola Trial Results

Emergence was good in the Roundup Ready canola trial. The target seeding rates of 80 and 150 seeds/m^2 generated plant populations of 74 and 102 plants/m^2, respectively (Table 4). The seeding rate of 80 seeds/m^2 was not achieved due to seeder limitations, so the low plant population is higher than desired. However, the difference in plant population did affect yield, with the higher seeding rate yielding significantly more than the lower seeding rate (Table 4). Based on visual ratings, weed control was significantly better when Roundup Transorb was applied early at the 1-2 leaf stage (data not shown). Delaying application to the 5-6 leaf stage reduced herbicide efficacy. Despite this, yield did not significantly differ between herbicide timings. Yield was not increased by the early application of Roundup or the dual application. In fact, yield was highest for the latter application at the 5-6 leaf stage. There is not a good explanation for this. It is possible that the early application of Roundup Transorb affected canola growth but this is not typically a concern.

Table 4. Main Effects of Emergence, Weed Control and Yield in Roundup Ready Canola[a]		
Main Effects	Emergence (plants/m^2)	Yield (kg/ha)
Herbicide timing (A)		
Roundup Transorb (0.5 l/ac) @ 1-2 lf stage	87 a	3052 a
Roundup Transorb (0.5 l/ac) @ 5-6 lf stage	79 a	3286 a
Roundup Transorb (0.33 l/ac) @ 1-2 lf and 5-6 lf stages	98 a	3109 a
$Lsd_{0.05}$	NS	NS
Seeding Rate (B)		
80 seeds/m^2	74 a	3050 a
150 seeds/m^2	102 b	3248 b
$Lsd_{0.05}$	17	187
Interactions	NS	NS
[a]Means within a main effect followed by the same letter are not significantly different p=0.05		

Liberty Link Canola Trial Results

Again, the seeder was not capable of delivering the low seeding rate. Thus target seeding rates of 80 and 150 seeds/m^2, resulted in plant populations of 87 and 114 per m^2, respectively (Table 5). Like the Roundup Ready study, herbicide efficacy was best with the treatments receiving early application at the 1-2 leaf stage (data not shown). A significant interaction between herbicide timing and seeding rate for the yield data was detected (Table 5) and treatment means for the interaction are presented in Table 6. Spraying early at the 1-2 leaf stage did produce significantly higher yields than spraying latter at the 5-6 leaf stage but only for the lower plant population. This supports the notion that an early application of herbicide is particularly important for thin canola stands, which are less competitive against weeds. A dual application of herbicide on the lowest plant population produced the least yield but a dual application on the highest plant population produced a yield comparable to the highest yield. This interaction is statistically significant but the reason for it is not clear. Liberty “bronzing” was very pronounced under the conditions of this study. Perhaps the higher plant population was better able to compensate for the stress of a dual application of Liberty.

Table 5. Main Effects of Emergence, Weed Control and Yield in Liberty Link Canola[a]		
Main Effects	Emergence (plants/m^2)	Yield (kg/ha)
Herbicide timing (A)		
Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 1-2 lf stage	98 a	3103 a
Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 5-6 lf stage	113 a	3001 a
• Liberty (1.35 l/ac) + Centurion (77 ml/ac) + amigo @1-2 lf stage • Liberty (1.6 l/ac) @ 5-6 lf stage	90 a	2906 a
$Lsd_{0.05}$	NS	NS
Seeding Rate (B)		
80 seeds/m^2	87 a	2957 a
150 seeds/m^2	114 b	3050 a
$Lsd_{0.05}$	26.5	NS
Interactions	NS	A by B
[a]Means within a main effect followed by the same letter are not significantly different p=0.05		

Table 6. Yield Means for the interaction between Herbicide Timing and Seeding Rate for Liberty Link Canola[a]		
Herbicide timing (A)	Seeding rate (B)	Yield (kg/ha)
Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 1-2 lf stage	80 seeds/m^2	3287 c
Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 1-2 lf stage	150 seeds/m^2	2920 ab
Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 5-6 lf stage	80 seeds/m^2	2917 ab
Liberty (1.6 l/ac) + Centurion (77 ml/ac) + amigo @ 5-6 lf stage	150 seeds/m^2	3084 bc
• Liberty (1.35 l/ac) + Centurion (77 ml/ac) + amigo @1-2 lf stage • Liberty (1.6 l/ac) @ 5-6 lf stage	80 seeds/m^2	2667 a
• Liberty (1.35 l/ac) + Centurion (77 ml/ac) + amigo @1-2 lf stage • Liberty (1.6 l/ac) @ 5-6 lf stage	150 seeds/m^2	3145 bc
$Lsd_{0.05}$		291
[a]Means within a main effect followed by the same letter are not significantly different p=0.05		

Extension and Acknowledgement

This report on the results will be available for download from the ECRF website (www.ecrf.ca). The trial was part of ECRF's annual farm tour.

Conclusions and Recommendations

Weed control was better when herbicide was applied early at the 1-2 leaf stage for both the Roundup Ready and Liberty Link canola systems. Delaying application to the 5-6 leaf stage reduced herbicide efficacy. However, yield was not consistently improved by applying herbicide early. Yield was not significantly affected by herbicide timing for the Roundup Ready canola. In fact, yield was numerically the highest when Roundup Transorb was applied at the latter stage of 5-6 leaves. For the Liberty Link canola, yield was highest when herbicide was applied early, but only for the lowest plant population. There were no yield differences between applying herbicide early versus late at the higher plant population. This supports the notion that an early application of herbicide is particularly important for lower plant stands that are less competitive against weeds. Results for the dual application of Liberty herbicide were somewhat odd. At the lowest plant population, the dual application yielded significantly lower than a single application applied early. There was significant "bronzing" in this trial from the liberty and perhaps the dual application suppressed the crop. However, dual application on the high plant population did not produce yields significantly different from the other timings. Perhaps, the higher plant population was better able to compensate for "bronzing". Overall, there was some evidence to support early weed removal as a best management practice to control weeds and increase crop yield. However, this study would suggest sequential application of herbicide should only be considered if the weed pressure is sufficient to warrant it.

Supporting Information

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.

Controlling Sclerotinia in Canola with Varietal Tolerance and Fungicide

Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

Abstract

Abstract/Summary:

A trial was established near Yorkton with the objective of demonstrating the relative effectiveness of genetic tolerance and foliar fungicide to reduce Sclerotinia stem rot infection in canola. The trial was designed to determine if it is economically worthwhile to spray fungicide on varieties resistant to Sclerotinia. Unfortunately, the results from this study are inconclusive as there was a lack of infection by Sclerotinia and no statistically significant response to fungicide. Though not significant, yield of the susceptible variety 75-45 RR and the tolerant variety 45cs40 did increase numerically in response to fungicide. While the tolerant variety 74-44 BL did not respond to fungicide, it was the highest yielding variety albeit insignificantly.

Objectives and Rationale

Project objectives:

The objectives of this study were:

- to demonstrate the relative effectiveness of genetic tolerance and foliar fungicide to reduce Sclerotinia stem rot infection in canola.
- to determine if spraying fungicide on Sclerotinia tolerant varieties can provide an economic yield increase.

Project Rationale:

Industry has developed a number of varieties which show tolerance to Sclerotinia. The varieties which have been secured for this demonstration include 45cs40, 75-45 RR and 74-44 BL. 75-45 RR (Dekalb) is intended to act as a susceptible check whereas 74-44 BL (Dekalb) and 45cs40 (Pioneer) are considered to have better tolerance to Sclerotinia. Dekalb does not advertise the Sclerotinia tolerance of 74-44 BL, but considers it to be on par with Pioneers

Sclerotinia tolerant variety 45S52. Dekalb's internal studies have shown levels of stem infections from Sclerotinia to be equivalent between the varieties.

A number of fungicides are registered for the control of Sclerotinia in canola. Proper timing is considered to be between 20 to 50% bloom and two applications may be required if environmental conditions are conducive for the disease. A rather large study conducted at Indian Head, Melfort, Brandon, Melita, Outlook and Saskatoon compared the impact of various fungicide timings for the control of Sclerotinia on a susceptible variety (45H29) and a tolerant variety (45S53). Fungicide applied at 20% bloom, 50% bloom and a dual application at 20% and 50% bloom were compared to a fungicide free check. Field trials were carried out between 2013 and 2015. Despite conducive environmental conditions, infection levels were still low and little difference between fungicide treatments were detected. However, infection levels did tend to be lower with the Sclerotinia tolerant canola variety.

This trial was initiated in hope of demonstrating the value of fungicide and tolerant varieties under heavier Sclerotinia disease pressure.

Methodology and Results

Methodology:

Trial was setup as 2 level factorial with 4 replicates. The first level compared Sclerotinia tolerant varieties (74-44 BL and 45cs40) with a more susceptible variety (75-45 RR). The second level compared fungicide applied at 20% bloom, 50% bloom and a dual application at those two stages against a fungicide free check. The early fungicide was Acapela (group 11) and late fungicide was Proline (group 3) to promote the rotation of groups when applying fungicide sequentially. The complete treatment list is in Table 1 below.

Table 1. Treatment list for trials

#	Variety	Fungicide
1	Susceptible (75-45 RR)	none
2	Susceptible (75-45 RR)	Acapela at 20% bloom
3	Susceptible (75-45 RR)	Proline at 50% bloom
4	Susceptible (75-45 RR)	Acapela at 20% bloom and Proline at 50% bloom
5	Tolerant (74-44 BL)	none
6	Tolerant (74-44 BL)	Acapela at 20% bloom
7	Tolerant (74-44 BL)	Proline at 50% bloom
8	Tolerant (74-44 BL)	Acapela at 20% bloom and Proline at 50% bloom
9	Tolerant (45cs40)	none
10	Tolerant (45cs40)	Acapela at 20% bloom
11	Tolerant (45cs40)	Proline at 50% bloom
12	Tolerant (45cs40)	Acapela at 20% bloom and Proline at 50% bloom

Fertility was applied at rates so as to be non limiting. Plots were 22 by 30 feet wide and seeded with a 10 foot Seedhawk drill on 10 inch row spacing. The middle 5 rows from each plot were harvested with a Wintersteiger plot combine.

Table 2 lists the 2017 dates of operations.

Table 2. Dates of operations in 2017 for Yorkton, Scott and Melfort	
Operations in 2017	Yorkton
Trial seeded	May 20 & 21
Emergence counts	June 5
In-crop Roundup Transorb 0.5 l/ac	June 7
In-crop Roundup Transorb 0.33 l/ac	June 18
In-crop Roundup Transorb 0.33 l/ac	June 28
Acapela (485 ml/ac @ 20% bloom on trts 2, 4, 6, 8)	July 6
Acapela (485 ml/ac @ 20% bloom on trts 10, 12)	July 10
Proline (150 ml/ac @ 50% bloom on trts 3,4,7,8, 12)	July 12
Proline (150 ml/ac @ 50% bloom on trts 11, 12)	July 19
Harvest	September 6

Results:

Trial Results

Emergence was significantly lower for 45cs40 but plant populations were more than adequate to maximize crop yield for all varieties (Table 3).

Precipitation was much below normal levels in 2017 and disease pressure was very low. Disease ratings found no obvious stem infection by Sclerotinia (data not shown). No lodging was observed either (data not shown). As a result, yield did not statistically increase with an application of fungicide. However, fungicide did increase yields numerically by up to 9% (Table 3). Varieties yielded within 6% of each other and did not statistically differ.

Though there were no significant interactions, individual treatment means have been listed in Table 4. Numerically, the application of fungicide increased yields for the susceptible variety 75-45 RR and the tolerant variety 45cs40. Yield was not increased by fungicide for the tolerant variety 74-44 BL.

Table 3. Main Effects of Emergence and Yield[a]		
Main Effects	Emergence (plants/m^2)	Yield (kg/ha)
Variety (A)		
Susceptible (75-45 RR)	106 a	2540
Tolerant (74-44 BL)	109 a	2638
Tolerant (45cs40)	87 b	2477
$Lsd_{0.05}$	17.7	NS
Fungicide (B)		
none	108	2423
Acapela at 20% bloom	99	2527
Proline at 50% bloom	89	2649
Acapela at 20% bloom and Proline at 50% bloom	106	2608
$Lsd_{0.05}$	NS	NS
Interactions	NS	NS
[a]Means within a main effect followed by the same letter are not significantly different p=0.05		

Table 4. Treatment means for Yield[a]		
Variety	Fungicide	Yield kg/ha (bu/ac)
Susceptible (75-45 RR)	none	2304
Susceptible (75-45 RR)	Acapela at 20% bloom	2687
Susceptible (75-45 RR)	Proline at 50% bloom	2593
Susceptible (75-45 RR)	Acapela at 20% bloom and Proline at 50% bloom	2575
Tolerant (74-44 BL)	none	2730
Tolerant (74-44 BL)	Acapela at 20% bloom	2509
Tolerant (74-44 BL)	Proline at 50% bloom	2761
Tolerant (74-44 BL)	Acapela at 20% bloom and Proline at 50% bloom	2551
Tolerant (45cs40)	none	2236
Tolerant (45cs40)	Acapela at 20% bloom	2386
Tolerant (45cs40)	Proline at 50% bloom	2591
Tolerant (45cs40)	Acapela at 20% bloom and Proline at 50% bloom	2697

Extension and Acknowledgement

This report on the results will be available for download from the ECRF website (www.ecrf.ca). The trial was shown and discussed during ECRF's annual crop tour.

Conclusions and Recommendations

Unfortunately, strong conclusions regarding the level of resistance to Sclerotinia between varieties cannot be made because infection levels were low and there was a lack of statistically significant responses to fungicide. No obviously infected stems or lodging was observed just prior to harvest. Yield of the susceptible variety 75-45 RR and the tolerant variety 45cs40 did increase in response to fungicide but the differences were not statistically significant. The tolerant variety 74-44 BL did not respond to fungicide but it was the highest yielding variety. Overall, varieties yielded within 6% of each other and did not significantly differ.

Supporting Information

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.

Managing Fusarium Head Blight in CWRS Wheat

Mike Hall[1], Jessica Weber[2] and Jessica Pratchler[3]

[1]East Central Research Foundation, Yorkton, SK.
[2]Western Applied Research Corporation, Scott, SK.
[3]Northeast Agriculture Research Foundation, Melfort, SK.

Abstract

Abstract/Summary:

Trials were established at Yorkton, Scott and Melfort with the objective of demonstrating the level of fusarium head blight suppression possible through increasing seeding rate, proper varietal selection and proper timing of fungicide. Varieties differ in their susceptibility to Fusarium head blight (FHB) and higher seeding rates improve crop staging for fungicide application by reducing the number of immature tillers. Unfortunately, levels of Fusarium head blight were extremely low in these studies, making it impossible to demonstrate the principles above. At Scott and Melfort, Fusarium damaged kernels (FDK) were numerically higher for the moderately susceptible variety "CDC Utmost VB" compared to the moderately resistant variety "CDC Plentiful", but levels for both were still quite low. While increasing seeding rate and applying Prosaro tended to increase yield it did not affect levels of FDK. Prosaro likely increased yield by suppressing leaf disease but not Fusarium head blight.

Objectives and Rationale

Project objectives:

The objective is to demonstrate the level of Fusarium head blight suppression possible through increasing seeding rate, proper varietal selection and proper timing of fungicide. Varieties differ in susceptibility to Fusarium head blight and timing of fungicide to suppress FHB can be improved with higher seeding rates.

Project Rationale:

The two main fungicide products used for the suppression of Fusarium head blight in Saskatchewan are Caramba and Prosaro. The optimum timing of these products is at early anthesis and applications past this stage are ineffective. Proper timing to protect all heads is impossible if the timing of head emergence within the crop is highly variable. Increasing seeding rates of wheat is commonly recommended to increase the uniformity of heading and facilitate proper fungicide timing. Increasing seeding rate, improves the uniformity of heading by reducing the number of tillers which produce heads less mature than main stem heads. Varietal selection can also have an impact on FHB. While no CWRS wheat varieties are truly resistant to FHB there are differences in susceptibility between varieties. The level of susceptibility between varieties is published annually in the Saskatchewan's seed guide. High seeding rates, varietal selection and proper timing of fungicide can reduce the occurrence of FHB.

Methodology and Results

Methodology:

The trials were setup at Yorkton, Scott and Melfort as a split-split plot with 4 replications. The first factor compared Prosaro at 50% anthesis vs no applied fungicide. The subplot factor compared the awnless CWRS varieties CDC Utmost VB with CDC Plentiful. CDC Utmost VB is rated moderately susceptible (MS) to Fusarium head blight whereas, CDC Plentiful is rated moderately resistant (MR). The sub-subplot factor contrasted seeding rates of 150, 300 and 450 seeds/m^2. This produces 12 treatments for this analysis. An additional 2 treatments which are not part of the statistical analysis were added to determine if there is reduced fungicidal efficacy on awned varieties (treatments 7 and 14). Saskatchewan Agriculture has stated "Awns on durum and some hexaploid wheat varieties can further disrupt spray droplets before they reach their destination." This may result in reduced efficacy of fungicide on bearded varieties. The complete treatment list is in Table 1 below.

Table 1. Treatment list for trials					
#	Fungicide	Variety	Beard type	Fusarium resistance	Seeds/m^2
1	none	CDC Utmost VB	awnless	MS	150
2	none	CDC Utmost VB	awnless	MS	300
3	none	CDC Utmost VB	awnless	MS	450
4	none	CDC Plentiful	awnless	MR	150
5	none	CDC Plentiful	awnless	MR	300
6	none	CDC Plentiful	awnless	MR	450
7	none	AAC Brandon	awned	MR	300
8	Prosaro	CDC Utmost VB	awnless	MS	150
9	Prosaro	CDC Utmost VB	awnless	MS	300
10	Prosaro	CDC Utmost VB	awnless	MS	450
11	Prosaro	CDC Plentiful	awnless	MR	150
12	Prosaro	CDC Plentiful	awnless	MR	300
13	Prosaro	CDC Plentiful	awnless	MR	450
14	Prosaro	AAC Brandon	awned	MR	300

At Yorkton, fungicide was applied using dual nozzles designed to provide better coverage on vertical targets such as wheat heads. Plots were 11 by 30 feet wide and seeded with a 10 foot Seedhawk drill with 10 inch row spacing. The middle 5 rows from each plot were harvested by a Wintersteiger plot combine. A Fabro seeder on 12 inch row spacing and an R-tech seeder on 10 inch row spacing were used to seed the trials at Melfort and Scott, respectively. Fertility was applied at rates so as to be non limiting at all sites.

Table 2 lists the 2017 dates of operations for Yorkton, Scott and Melfort.

Table 2. Dates of operations in 2017 for Yorkton, Scott and Melfort			
Operations in 2017	Yorkton	Scott	Melfort
Pre-plant herbicide	NA	May 6	NA
Trial seeded	May 10	May 11	May 19
Emergence counts	May 30	June 7th	June 12
In-crop Herbicide	June 1 (Frontline + Simplicity)	June 6th (Axial iPak)	June 30 (Prestige XC)
In-crop fungicide (Caramba trt 8-14)	July 7	July 18	July 20
Lodging	August 24	August 18	Aug 30
Preharvest Roundup	August 25	September 1	NA
Harvest	??	September 12	September 1

Results:

Trial Results

Crop emergence was good at Yorkton and Scott. Emergence was highly variable within treatments at Melfort as there were seeder issues, a number of the plots were missing rows and an unidentified soil problem with the last 4 plots. This created variability in the yield data making it difficult to separate means statistically. Emergence did not significantly differ between variety at any of the sites (Tables 3, 4 and 5). Seeding rates of 150, 300 and 450 seeds/m^2 produced plant populations per m^2 of 136, 229 and 372 at Yorkton, 121, 203 and 282 at Scott and 89, 169 and 234 at Melfort.

Unfortunately for this study, infection by FHB was very low at all locations as a result of low precipitation. Fusarium damaged kernels were usually well below the level of 0.25% which must not be exceeded to maintain a number 1 CWRS grade. As a result, no substantial differences were observed between treatments. Levels of FDK were very low at Yorkton and Melfort even without the application of fungicide. Numerically, FDK was a little higher where Prosaro had been applied at Scott. However, the FDK data is just coming from a single rep and no statistics are supporting this difference. At Scott and Melfort, levels of FDK were numerically higher for the moderately susceptible variety "CDC Utmost VB" compared to the moderately resistant variety "CDC Plentiful", but levels for both were still low. No consistent affect of seeding rate on FDK was observed.

Though not statistically significant, yield was consistently higher across locations where Prosaro had been sprayed. On average, yield increase from spraying fungicide was 17, 2.3 and 11 percent at Yorkton, Scott and Melfort, respectively. The yield increase is likely the result of suppressing leaf disease and not FHB. Increasing seeding rate also consistently increased yield with the effect being statistically significant at Scott. In turn, increasing seeding rate decreased protein levels at Yorkton and Scott due to dilution from increasing yield. The effect was found to be statistically significant at Scott. Protein was not measured at Melfort. Lodging was not an issue at any site (data not shown).

Treatments 7 and 14 were added to the study for comparison, but could not be part of the factorial analysis. They were added to assess whether the awns on an awned variety would interfere with the efficacy of Prosaro. This really could not be determined, as levels of FDK were very low at all sites whether sprayed with fungicide or not.

Table 3. Main Effects of Emergence, Yield, FDK and Protein of Wheat at Yorkton[a]				
Main Effects	Emergence (plants/m^2)	Yield (kg/ha)	FDK (%)	Protein (%)
Fungicide (A)				
None	244 a	3548 a	0.043	15.3
Prosaro @ 50% anthesis	248 a	4138 a	0.035	15.4
$Lsd_{0.05}$	NS	NS	NA	NA
Variety (B)				
CDC Utmost VB (awnless; MS to FHB)	243 a	3873 a	0.023	15.0
CDC Plentiful (awnless MR to FHB)	249 a	3812 a	0.055	15.7
$Lsd_{0.05}$	NS	NS	NA	NA
Seeding rate (C)				
150 seeds/m^2	136 a	3690 a	0.035	15.9
300 seeds/m^2	229 b	3838 a	0.022	15.1
450 seeds/m^2	372 c	3999 a	0.06	15.0
$Lsd_{0.05}$	28.6	NS	NA	NA
Significant Interactions between main effects				
	NS	NS	NA	NA
7. No fungicide; AC AAC Brandon (awned MR to FHB); 300 seeds/m^2	183	3979	0.04	14.7
14. Prosaro; AC AAC Brandon (awned MR to FHB); 300 seeds/m^2	188	4792	0.07	15.1
[a]Means within a main effect followed by the same letter are not significantly different p=0.05				

Table 4. Main Effects of Emergence, Yield, FDK and Protein of Wheat at Scott[a]				
Main Effects	Emergence (plants/m^2)	Yield (kg/ha)	FDK (%)	Protein (%)
Fungicide (A)				
None	204 a	5503 a	0.04	11.4 a
Prosaro @ 50% anthesis	201 a	5631 a	0.21	11.4 a
$Lsd_{0.05}$	NS	NS	NA	NS
Variety (B)				
CDC Utmost VB (awnless; MS to FHB)	195 a	5477 a	0.21	11.7 a
CDC Plentiful (awnless MR to FHB)	209 a	5658 a	0.05	11.1 a
$Lsd_{0.05}$	NS	NS	NA	NS
Seeding rate (C)				
150 seeds/m^2	121 a	5320 a	0.08	11.7 a
300 seeds/m^2	203 b	5693 b	0.26	11.4 b
450 seeds/m^2	282 c	5689 b	0.05	11.1 b
$Lsd_{0.05}$	14.5	283	NA	0.31
Significant Interactions between main effects				
	NS	NS	NA	NA
7. No fungicide; AC AAC Brandon (awned MR to FHB); 300 seeds/m^2	196	5799	0	11.1
14. Prosaro; AC AAC Brandon (awned MR to FHB); 300 seeds/m^2	180	6063	0	11.8
[a]Means within a main effect followed by the same letter are not significantly different p=0.05				

Table 5. Main Effects of Emergence, Yield, FDK and Protein of Wheat at Melfort[a]				
Main Effects	Emergence (plants/m^2)	Yield (kg/ha)	FDK (%)	Protein (%)
Fungicide (A)				
None	172 a	3706 a	0.09	
Prosaro @ 50% anthesis	156 a	4108 a	0.04	
$Lsd_{0.05}$	NS	NS	NA	
Variety (B)				
CDC Utmost VB (awnless; MS to FHB)	177 a	4188 a	0.11	
CDC Plentiful (awnless MR to FHB)	151 a	3626 a	0.03	
$Lsd_{0.05}$	NS	NS	NA	
Seeding rate (C)				
150 seeds/m^2	89 a	3782 a	0.07	
300 seeds/m^2	169 b	3744 a	0.07	
450 seeds/m^2	234 c	4195 a	0.06	
$Lsd_{0.05}$	36.6	NS	NA	
Significant Interactions between main effects				
7. No fungicide; AC AAC Brandon (awned MR to FHB); 300 seeds/m^2	152	3067	0.03	
14. Prosaro; AC AAC Brandon (awned MR to FHB); 300 seeds/m^2	160	2949	0	
[a]Means within a main effect followed by the same letter are not significantly different p=0.05				

Extension and Acknowledgement

This report as well as a short video on the results will be available for download from the ECRF website (www.ecrf.ca).

Seeding Winter Wheat into Barley Greenfeed Stubble

Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

Abstract

Abstract/Summary:

Historically, the optimum seeding date for seeding winter wheat has been considered to be August 30th with yields starting to decline sharply with seeding dates beyond September 15th. It is difficult to find available stubble during this time frame to seed winter wheat. Barley removed as greenfeed can provide excellent stubble for seeding winter wheat early. Winter wheat survival and yield can also be improved by increasing seeding rates and using seed treatment. This project sought to demonstrate these best practices by evaluating three seeding dates (August 29, September 12 and Sept 29) by 2 seeding rates (250 and 450 seeds/m^2) by 2 seed treatments (Raxil WW and no seed treatment). These comparisons where established on greenfeed barley stubble. Crop emergence was not affect by seeding date and on average seeding rates of 250 and 450 seeds/m^2 resulted in stands of 181 and 292 plants/m^2. Though not statistically significant, the seeding rate of 250 seeds/m^2 produced a little more yield than the seeding rate of 450 seeds/m^2. This may have been the result of greater inter-plant competition for limited moisture with the higher seeding rate. Yield from winter wheat treated with Raxil WW was also

somewhat higher, but the difference was not statistically significant. Early seeding hastened crop maturity. In terms of yield, the optimum seeding date was September 12. Seeding earlier on August 29, 2016 reduced yield significantly by 16%. Seeding later on September 29, 2016 reduced yield by only 4% and the difference was not significant. These results would support recent research from across the prairies (Lawley et al.) that suggest the optimum seeding date has shifted about a 1 week into the fall.

Objectives and Rationale

Project objectives:

The objectives of this study were:

- to demonstrate the establishment of a winter wheat crop after barley was taken for greenfeed.
- 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 has historically been considered to be August 30th. Winter survival is considered to decline rapidly after September 15th. However, there is growing evidence that the optimum time to seed winter wheat may now be a week later into the fall. 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 labor is typically busy with harvest. The lack of opportunity to seed winter wheat in a timely manner is an impediment to expanding acres of winter wheat. If alternative stubble types from early harvested crops could be used this might overcome the challenge.

Irvine, R.B. et al. 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 greenfeed should also make a suitable stubble type for seeding winter wheat early.

Being able to seed early on barley greenfeed stubble provides an opportunity to look at the interactions between seeding date, seeding rate and seed treatment. In Ontario, the provincial recommendation is to increase winter wheat seeding rates by 100000 seeds/ac for every 5 days seeding is delayed past October 1. The author has not been able to find a similar recommendation for winter wheat grown in Saskatchewan. However, studies suggest the traditional seeding rates should be increased from 250 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 were evaluated in this study.

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 and Results

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 then removed for greenfeed and the winter wheat was seeded into plots with a 10 foot SeedHawk drill. Plots were 12 by 35 feet in size and the middle 5 rows of each plot were harvested with a Wintersteiger plot combine. The first factor contrasted the following 3 seeding dates of August 29, September 12 and September 29 of 2016. The second factor contrasted two seeding rates of 250 and 450 seeds/m^2. Finally, the 3rd factor evaluated RaxilWW seed treatment relative to no seed treatment. Table 1 lists the treatments.

Table 1. Treatment list for winter wheat study

Trt #	Seeding date	Seeding rate (seeds/m^2)	Seed Treatment
1	August 29	250	No seed treatment
2	August 29	250	Raxil WW
3	August 29	450	No seed treatment
4	August 29	450	Raxil WW
5	September 12	250	No seed treatment
6	September 12	250	Raxil WW
7	September 12	450	No seed treatment
8	September 12	450	Raxil WW
9	September 29	250	No seed treatment
10	September 29	250	Raxil WW
11	September 29	450	No seed treatment
12	September 29	450	Raxil WW

Table 2 lists the dates of operations for 2016 and 2017.

Table 2. Dates of operations for 2016 and 2017	
Operations in 2016	Date
Pre-seed burn-off with glyphosate (0.66 l/ac transorb)	May 2
Seeded Maverick barley to trial area	May 4
Emergence counts on barley	May 26
Barley in-crop herbicide – Prestige	May 27
Barley removed as greenfeed.	July 25 and 26
Restaked trial	July 27
Seeded winter wheat treatments 1 to 4 (Early seeding date- 30 lbs/ac N)	August 29
Sprayed Pardner for control of volunteer canola	August 30
Seeded winter wheat treatments 5 to 8 (Mid seeding date- 30 lbs/ac N)	September 12
Plant counts on Early seeding	September 23
Plant counts on Mid seeding	September 29
Seeded winter wheat treatments 9 to 12 (Late seeding date- 30 lbs/ac N)	September 29
Plant counts on Late seeding	November 9
Operations in 2017	Date
Winter survival –visual assessment	April 28
Broadcast N on all treatments – 30 lbs/ac	May 3
Winter wheat in-crop herbicide - Frontline	May 23
Winter wheat in-crop fungicide - Twinline	June 13
Lodging ratings	August 14
Harvest Yields	August 14

Results:

Trial Results

Seeding rates of 250 and 450 seeds/m^2 resulted in emergence of 181 and 292 plants/m^2 when averaged over seeding date and seed treatment (Table 4). Emergence was not statistically different between seeding dates. However, seed treated with Raxil WW resulted in significantly fewer plants emerging. This is an unexpected result and the reason for it is unclear. It does not necessarily mean the seed treatment reduced emergence as there may have been other confounding factors. For example, the treated and untreated seed was obtained from a seed producer and was supposed to be from the same seed lot. This may not have been the case. Also the treated seed may have metered differently to deliver fewer seeds/m^2 than the untreated seed. Having said that, there was also a significant seeding rate by seed treatment interaction for the emergence data. In other words, the magnitude of lower emergence associated with treated seed was greater for the higher seeding rate. At 250 seeds/m^2, using treated seed resulted in a 16% reduction in emergence (166 versus 196 plants/m^2). In contrast, using treated seed at 450 seeds/m^2 resulted in a 44% reduction in emergence (233 vs 351 plants/m^2). The author can not think of a good reason for this interaction but it was statistically significant. Differences in stand establishment between treated and untreated seed were still visibly apparent in early spring the following year (Table 4). The establishment of winter wheat significantly declined as seeding date was extended into the fall. However, a good crop stand was obtained from each seeding date. Maturity measurements were not included in the proposal and nor were they taken. However, the earlier winter wheat was seeded, the earlier it matured the following year. Figure 1 provides a visual indication of the extreme differences in maturity between seeding dates.

As previously mentioned, stands of early seeded wheat looked the best when viewed in early May. However, winter wheat seeded on August 29th produced significantly lower yields than winter wheat seeded on either September 12th or 29th (Table 3). Numerically, the highest yields were produced when winter wheat was seeded on September 12th. It would appear that seeding on August 29th was too early despite that date being cited as the optimum time. More recent research from across the prairies and lead by Yvonne Lawley (University of Manitoba) has found the optimum window for seeding winter wheat has shifted about a week into the fall. The results from this trial would certainly support those findings. No significant effects of seeding rate or seed treatment on yield could be detected. However, higher yields were associated with the lower seeding rate and with seed treatment. Precipitation in 2017 was less than average and higher plant populations may have yielded less due to greater inter-plant competition for moisture. The greater performance of the treated seed may have also in part been the result of lower plant population as well. Work by Lawley et al. found winter wheat yields were often higher with seed treatment but most of the responses were from sites conducted in Manitoba.

Table 3. Main Effects of Seeding date, Seeding Rate and Seed Treatment on Emergence, Lodging, Winter Survival and Yield of Winter Wheat.[a]				
Main Effects	Emergence (plants/m^2)	Lodging (0-10)[b]	Winter Survival (% stand establishment)	Yield (bu/ac)
Seeding Date (A)				
August 29, 2016	232 a	1	85.2 c	56.4 a
September 12, 2016	232 a	1	68.8 b	67.1 b
September 29, 2016	247 a	1	38.6 a	64.7 b
$Lsd_{0.05}$	ns		9.1	4.3
Seeding Rate-seeds/m2 (B)				
250	181 a	1	56.7 a	63.8 a
450	292 b	1	71.7 b	61.7 a
$Lsd_{0.05}$	25		7.2	3.4
Seed Treatment (C)				
No seed treat	274 b	1	68.2 b	61.9 a
Raxil WW	200 a	1	60.1 a	63.5 a
$Lsd_{0.05}$	25		7.2	3.4
Significant Interactions between main effects				
	B x C	NS	NS	NS
cv	23.2		23.6	10
[a]Means within a main effect followed by the same letter are not significantly different p=0.05				
[b]Lodging 0-erect; 10-flat to the ground				

Figure 1. Maturity difference between winter wheat seeded August 29, 2016 (left) versus September 29, 2016 (Right). Photo taken July 19, 2017.

Extension and Acknowledgement
This report as well as a short video on the results will be available for download from the ECRF website (www.ecrf.ca).

Conclusions and Recommendations

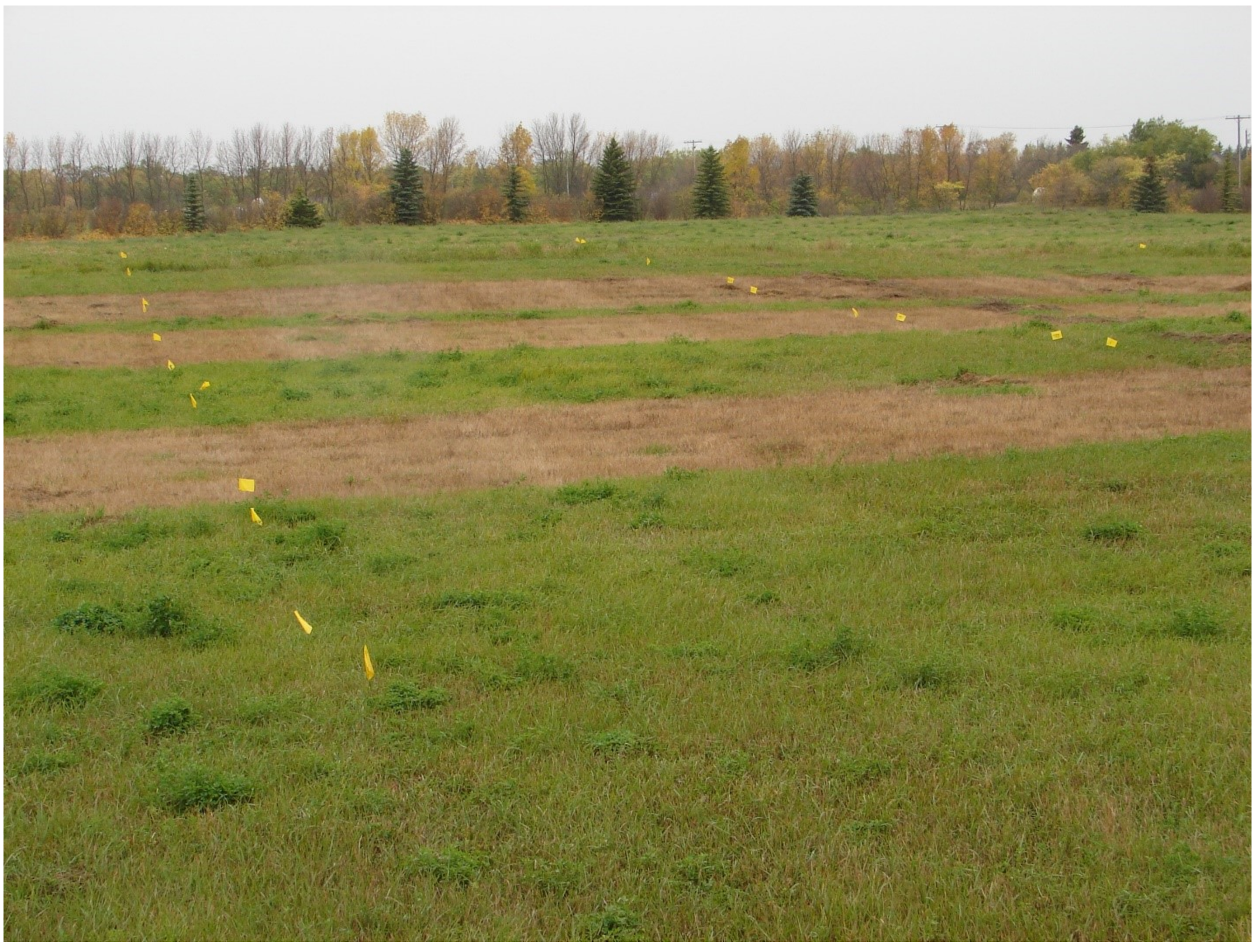
Barley taken off for greenfeed allowed for early seeding of winter wheat and provided adequate stubble. In this study, the optimum seeding date was Sept 12, 2016. Seeding earlier on August 29, 2016 reduced yield significantly by 16%. Seeding later on September 29, 2016 reduced yield by only 4% and the difference was not significant. These results would support recent research from across the prairies (Lawley et al.) that suggest the optimum seeding date has shifted about a 1 week into the fall. This is not surprising as the environment has been getting warmer and the falls more open. Producers could probably seed later into September than what has historically been recommended, as long as soil moisture conditions are adequate for seedling establishment. Though not part of the study, it was quite apparent that maturity was substantially hastened with earlier seeding date. Seed treatment was not found to improve emergence or stand establishment, but was associated with higher yield, though not statistically significant. Higher yields were also associated with lower plant population which was contrary to expectations. In this study, lower plant populations may have benefitted from less inter-plant competition for limited moisture.

Supporting Information

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.

Effect of Fall vs Spring Termination of Hayland on winter wheat, spring wheat and Roundup Ready canola



Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

Abstract

Abstract/Summary:

A trial near Yorkton demonstrated the benefits of terminating a hayland in fall as opposed to spring. Successful termination of hayland in spring requires adequate regrowth before glyphosate will translocate to roots and kill the stand. Unfortunately, the regrowth dried out the seedbed and germination of seeded canola and wheat did not occur for over a month. As a result, maturity was delayed far into the fall and both crops where harvested at high moisture levels on Oct 12, 2017. In contrast, canola and wheat which were seeded into fall terminated hayland emerged in a timely manner because of higher levels of soil moisture. Winter wheat also emerged well in hayland which was terminated in fall and suppressed hayland regrowth more than spring wheat. Regrowth of hayland was not an issue in Roundup Ready (RR) canola because it was easily controlled in-crop with glyphosate. This was not the case for wheat as there are no in-crop herbicides for the control of smooth brome. Conclusions regarding final yields could not be made as the trial suffered damage from feeding deer. Overall, yields for every crop were quite low due to deer and dry conditions. While most cropland in the area had sufficient moisture reserves to produce good yields, the hayland did not.

Objectives and Rationale

Project objectives:

The objectives of this study were:

- to compare the effect of a preharvest termination (mid-late August 2016) of an alfalfa/brome stand with glyphosate (Transorb @ 1 l/ac) on the establishment and yield of winter wheat, spring wheat and Roundup Ready canola
- to compare the effect of a spring termination (mid-late May 2017) of an alfalfa/brome hayland with glyphosate (Transorb @ 1 l/ac) on the establishment and yield of spring wheat and rr canola.

The trial intended to demonstrate that fall termination of hayland is the best approach as soil moisture is conserved and the crop can be seeded earlier in spring. The intent was also to show winter wheat as a better option to spring wheat as it is more competitive against forage regrowth.

Project Rationale:

Fall applied glyphosate is considered the most effective timing for terminating a forage stand. In fall, glyphosate is translocated along with photosynthate to the roots, improving its efficacy. Spring application of glyphosate is often less effective, as food reserves are moving up through the plant and glyphosate is not making it down to kill the roots. To improve control of spring applied glyphosate the application must wait for adequate regrowth of the hayland. This uses up precious moisture reserves and delays seeding which typically leads to reduced yield potential of the annual crop. Even with proper timing of glyphosate, regrowth of the hayland in-crop may occur. This typically is not an issue in RR canola as glyphosate can be applied in-crop for control of grassy forages. However, grassy forages such as smooth bromegrass cannot be controlled in wheat with herbicide. While RR canola obviously has the better herbicide package, wheat is likely to emerge better than canola where seedbed quality is poor because of wheat's larger seed size. In situations where regrowth of the grassy forage occurs in-crop, winter wheat has the advantage over spring wheat as it will be more competitive due to early season growth.

Methodology and Results

Methodology:

The trial was setup as a Randomized Complete Block with four replicates on an alfalfa/brome stand. Plot size was double wide (22 by 35 ft) to accommodate the tractor sprayer and a 5 foot gap between plots was left to guard against drift. The forage stand had 1 cut of hay taken before mid-July prior to the preharvest application of glyphosate. Table 1 lists the treatments established. The first 3 treatments compare sod seeding winter wheat, spring wheat and RR canola into hayland terminated with pre-harvest glyphosate in fall. The forage was removed prior to seeding the winter wheat. Treatments 4 and 5 compare sod seeded spring wheat and canola where the hayland has been terminated with glyphosate in spring.

Table 1. Treatment list for winter wheat study

Trt #	Hay termination (1 l/ac transorb)	Crop	Seeding date
1	August 15, 2016	Winter wheat	Aug 29, 2016
2	August 15, 2016	Spring wheat	May 8, 2017
3	August 15, 2016	RR canola	May 8, 2017
4	May 23, 2017	Spring wheat	May 29, 2017
5	May 23, 2017	RR canola	May 29, 2017

Table 2 lists the dates of operations for 2016 and 2017.

Table 2. Dates of operations for 2016 and 2017

Operations in 2016	Date
Trts 1-3 sprayed with 1 L/ac transorb.	August 15
Hay Harvested off whole trial.	August 22
Winter wheat seeded into trt 1.	August 29
Emergence counts on winter wheat.	Sept 23
Operations in 2017	Date
Broadcasted 145 lbs/ac urea and 25 lbs/ac AS on winter wheat.	April 11
Seeded spring wheat and canola trts 2 & 3.	May 8
Trts 4 & 5 sprayed with 1 l/ac transorb	May 23
Seeded trts 4 & 5	May 29
Sprayed rr canola trt 2 with 0.5 l/ac transorb	May 31
Sprayed wheat trt 3 with curtail M	May 31
Emergence counts trts 2 and 3	May 31
Sprayed canola trt 3 with 0.33 l/ac transorb	June 12
Sprayed canola trt 4 with 0.5 l/ac transorb	July 5
Sprayed wheat trt 5 with curtail M	July 5
Assessment of hayland regrowth	August ?
Preharvest roundup on w. wheat trt 1 and spring wheat trt 2 (0.66 l/ac transorb)	August 16
Harvest trt 1 and 2	August 29
Harvest trt 3 and 4	Sept 30
Harvest trt 5	Oct 12

Results:

Trial Results

Fall termination of hayland was accomplished by spraying 1.0 l/ac of Transorb on August 15, 2016. By September 8, 2016, it was quite apparent that the glyphosate had killed the above ground growth (Figure 1). Winter wheat was seeded into treatment 1 on August 29, 2016 and established well before snowfall (Figure 2, Table 3). As expected, winter wheat established early (Figure 3, trt 1). Spring wheat and canola that were seeded May 8 on hayland that was terminated the previous fall also established well (Figure 3, trt 2 & 3, Table 3). However, seeding canola and wheat on May 29, 2017 into hayland which was not terminated until May 23, 2017 did not emerge in a timely manner (Figure 3, trt 5 for canola only). When terminating in spring, hayland must be allowed to regrow before it can be effectively sprayed out. This regrowth created a dry seedbed where canola and wheat did not emerge for over a month until significant rain fell. By July 19, 2017, the canola and wheat had become well established, but maturity was severely delayed and these treatments were harvested at a high moisture content on Oct 12, 2017. The large difference in crop development between canola seeded on hayland terminated in fall vs the spring is quite apparent in Figure 4.

The early emergence of winter wheat made it more competitive against regrowth from the hayland. For treatments where termination occurred in fall, regrowth of hayland was lowest under the winter wheat and highest under the spring wheat (Table 3). There was less regrowth in the canola than the wheat because regrowth could be controlled in the canola with glyphosate. Regrowth was also very low where the hayland had been terminated in spring.

The yield result from this trial is highly questionable as plots were heavily fed upon by deer. Only results from the 1st rep have been presented in Table 3 as that rep was the least affected. Yield for all treatments were very low as a result of drought and damage from deer. Little precipitation fell in 2017 and unlike cropland, soil moisture reserves in the hayland were low. The lower winter wheat yield relative to spring wheat may be related to rainfall patterns. The spring was particularly dry and this may have had a greater affect on the yield potential of the more advanced winter wheat.

Figure 1. Strips of hayland terminated by 1.0 l/ac of Roundup Transorb on August 15, 2016

Table 3. Treatment means from the first rep only.				
Treatment	Emergence (plant/m^2)	Hayland regrowth (g/m^2) wet by mid August	Lodging (0-10)	Yield (bu/ac)
1. Fall termination; w. wheat	189	7.5	0	10.8
2. Fall termination; s. wheat	195	80.5	0	17.4
3. Fall termination; canola	85	13.8	0	16.0
4. Spring termination; s. wheat	114	14.7	0	9.0
5. Spring termination; canola	173	0	0	12.2

Figure 2. Winter wheat establishment by Oct 25, 2016

Figure 3. Establishment on treatments 1-3 & 5 on June 19, 2017

Figure 4. Establishment on treatments 1-3 & 5 on July 19, 2017

Conclusions and Recommendations

For hayland which was terminated in the fall, winter wheat was more competitive against regrowth than spring wheat. Regrowth was not a problem for canola as it was controlled in-crop with glyphosate. Delaying forage termination into spring created a dry seedbed and delayed crop emergence to late June. Yields were very low due to drought like conditions and damage from deer. Deer damage makes any observed differences between treatments highly questionable.

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.

Soybeans-Importance of Dual Inoculation and Seeding into Warm Soil

Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

Abstract

Abstract/Summary:

The objective of this trial was to demonstrate the risk of seeding soybeans "too early" into cold soil and the benefit of dual inoculation. Soybeans seeded into soils below 8°C may become "cold shocked". Cold shocked soybeans do not emerge or yield well. In this study, soils were already well above 8°C at the "too early" seeding date of May 5. Moreover, the spring continued to warm from that date forward without a cold spell. As a result, the crop emerged and yielded well with the "too early" seeding date. However, it is still considered prudent to wait until mid to late May before seeding to reduce the risk of losing the crop to a late spring frost. Also, there was no yield penalty in this study from delaying seeding until May 24th. In this study, soybean yield was substantially increased by 56% when granular

inoculant was side banded. There was no yield response to seed applied inoculant suggesting it may have been mishandled before it was received.

Objectives and Rationale

Project objectives:

The overall objectives of this project were to demonstrate the importance of seeding soybeans into warm soils (>8ºC) and dual inoculation (inoculant on seed and in furrow). Specifically, the impact of seeding date and inoculant placement on soybean emergence and yield was demonstrated.

Project Rationale:

According to Kristen Podolsky (MPSG production specialist) double inoculation, on the seed and in the furrow, is still the standard recommendation for Manitoba's soybean industry where soybeans have not been in the rotation. Double inoculation is of less importance on fields with a history of growing soybeans. On fields with a history of two previously well-nodulated soybean crops, an economic response to additional in-furrow inoculant only occurred 3 times in 26 farm fields. Building up soil levels of rhizobia is reducing the need to inoculate. In the U.S. soybean belt, many growers are not inoculating at all! However, soybeans are not commonly grown in the Yorkton area and soybeans which are not inoculated will not produce any nodules (personal observation). Dual inoculation should be considered "cheap insurance" in fields with no history of soybean production.

The "chilling effect" in soybeans has been documented by researchers such as Ramona Mohr with AAFC's Brandon Research Centre. The "chilling effect" occurs when soybean seed imbibes water colder than 8ºC at the time of seeding. The result is reduced emergence and poorer seedling vigor. Producers should ensure soil temperatures are above 8ºC for at least 8 hours after seeding. This can be accomplished by seeding in the warm afternoons and delaying seeding to Mid-May in northeast Saskatchewan. This project set out to demonstrate the importance of dual inoculating soybeans and seeding into warm soil.

Methodology and Results

Methodology:

- The demonstration was set up as split plot with 4 replicates. The main-plot factor was time of seeding (too early versus optimum). The split-plot factor was 4 different inoculant placements. All seed was treated with CruiserMaxx Vibrance. Seed treatment inoculant was Nodulator PRO and the side banded granular inoculant was Cell-Tech granular for soybeans. Thus the following 8 treatments were established:

Table 1. Treatment list for winter wheat study		
Trt #	Seeding date	Inoculant
1	Too Early (May 5)	No inoculant
2	Too Early (May 5)	Inoculant on seed only
3	Too Early (May 5)	Granular inoculant banded to the side only
4	Too Early (May 5)	Inoculant on seed and granular banded to the side
5	Optimum (May 24)	No inoculant
6	Optimum (May 24)	Inoculant on seed only
7	Optimum (May 24)	Granular inoculant banded to the side only
8	Optimum (May 24)	Inoculant on seed and granular banded to the side

Plot size was 11 by 30 ft and seeded with a 10 foot SeedHawk drill with 10 inch row spacing. The middle 5 rows of each plot were harvested with a Wintersteiger plot combine. Table 2 lists the dates of operations for 2017.

Table 2. Dates of operations for 2017	
Operations in 2017	Date
Pre-seed burn-off (0.67 l/ac Roundup Transorb)	May 5
Early seeding (treatments 1-4)- Soil temperature 11.4ºC	May 5
Post Seed Burn-off (0.67 l/ac Roundup Transorb)	May 12
Optimum seeding (trts 5-8)- Soil temperature 14.7ºC	May 24
Emergence Counts (trts 1-4)	June 6
In-crop Roundup Transorb (0.67 l/ac) for trts 1-4	June 7
2nd In-crop Roundup Transorb (0.67 l/ac) for trts 1-4 1st for trts 5-8	June 18
Emergence Counts (trts 5-8)	June 19
2nd In-crop Roundup Transorb (0.33 l/ac) for trts 5-8	June 28
Yield (all treatments)	Sept 30

Results:

Trial Results

Neither seeding date nor inoculant had an effect on crop emergence (Table 3). While inoculant was not expected to impact emergence, early seeding was anticipated to reduce emergence and stand establishment. Soybeans which were seeded "too early" on May 5th still emerged well because the soil temperature at seeding was 11.4ºC, well above the minimum requirement of 8ºC.

Soybeans which were seeded "too early" reached "95% pod color change" earlier in the calendar year. On average, soybeans seeded on May 5th and 24th were physiologically mature by September 3rd and September 8th, respectively. While seeding earlier resulted in earlier maturity by the calendar year, it did take more days to mature than soybeans seeded later (Table 3). Regardless of seeding date, soybeans which did not receive inoculation were extremely nitrogen deficient and matured significantly earlier than soybeans receiving inoculant. Soybeans receiving inoculant only on seed did not nodulate well, were nitrogen deficient and were somewhat earlier maturing.

Yield wise, there was no difference between soybeans seeded May 5th versus May 24th (Table 3). Again, early seeded soybeans were anticipated to emerge and yield poorer than soybeans seeded on the optimum seeding date of May 24th. However, this was not the case because soil temperature was well above 8°C and conditions beyond May 5th were warm with no frost.

Table 3 shows side banded granular inoculant significantly increased soybean yield by 56% (ie: from 20 to 31.3 bu/ac). Seed applied inoculant did not increase yield. Figure 1 shows a representative root system for each treatment. No nodules formed on the root system of the “No Inoculant” check. Very minimal nodulation occurred when inoculant was placed on the seed only. Nodulation was best for treatments receiving side-banded granular inoculant. The differences in nodulation could also be seen above ground (Figure 2). Treatments receiving granular inoculant were noticeably darker green, indicating less nitrogen deficiency. This trial set out to demonstrate the importance of dual inoculation but the extremely poor performance of the seed applied inoculant was not expected. The inoculated seed may have been mishandled at some point in the chain before we received the seed.

Table 3. Main Effects of Seeding date and Inoculation on Emergence, Maturity and Yield of Soybean.[a]			
Main Effects	Emergence (plants/m^2)	Maturity (days)	Yield (bu/ac)
Seeding Date (A)			
Early – May 5	51.9 a	121.0 a	25.4 a
Optimum- May 24	52.2 a	107.6 b	25.8 a
$Lsd_{0.05}$	NS	2.5	NS
Inoculation (B)			
No Inoculant	56.1 a	112.3 a	20.0 a
Inoculant on seed only	47.0 a	114.1 b	20.7 a
Granular inoculant banded to the side only	54.9 a	115.5 b	31.3 b
Inoculant on seed and granular banded to the side	50.2 a	115.4 b	30.4 b
$Lsd_{0.05}$	NS	1.6	3.2
Significant Interactions between main effects			
	NS	NS	NS
cv	21	6.2	26.8
[a]Means within a main effect followed by the same letter are not significantly different p=0.05			
[b]Lodging 0-erect; 10-flat to the ground			

Figure 1.
Effect of Inoculant on Root Nodules of Soybean

No Inoculant | Inoculant on Seed Only | Side-banded Granular Inoculant | Inoculant on Seed and Side-banded Granular

Figure 2.
Effect of Inoculant on of Soybean

No Inoculant | Inoculant on Seed Only | Side-banded Granular Inoculant | Inoculant on Seed and Side-banded Granular

Extension and Acknowledgement

This report as well as a short video on the results will be available for download from the ECRF website (www.ecrf.ca).

Conclusions and Recommendations

This trial set out to demonstrate the risk of seeding too early into cold soil (<8°C) and the importance of dual inoculating soybeans where there has been no history of growing soybeans. Despite seeding early on May 5th, soil temperature was well above the minimum 8°C required and the weather continued to warm without frost. As a result, soybeans seeded on this date emerged and yielded as well as the optimum seeding date on May 24th. The earlier seeded soybeans matured about 5 days earlier in the calendar which could be considered an advantage. However, it is still prudent to seed in mid to late May as this reduces the risk of crop loss to spring frost. Besides, no yield loss occurred in this study by waiting until May 24th to seed the soybeans. This trial also set out to demonstrate the importance of dual inoculation. Dual inoculation did not produce higher yielding soybeans than single inoculation with side-banded granular inoculant. The seed applied granular inoculant performed very poorly, suggesting the treated seed may have been mistreated before we received it.

Supporting Information

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.

Demonstrating 4R Nitrogen Principles in Canola

Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

<u>Abstract</u>

Abstract/Summary:

This project demonstrated some best practices for nitrogen management. Banding the full nitrogen (N) requirement of the crop at seeding is typically the most economical approach. However, in the interest of time or logistics, producers may broadcast apply fertilizer. Broadcast applications of straight urea are prone to N loss through volatilization if significant rainfall is not received shortly after application. Products such as Agrotain and Super Urea can resist volatilization for a couple weeks, but still require a significant rainfall to move into the soil. In this demonstration, urea, Agrotain and Super Urea were broadcast on to wet soil prior to seeding and experienced no rainfall for 8 days. Under these ideal conditions for N volatilization loss, Agrotain and Super Urea provided 18% higher yields compared to straight urea when broadcasted. In fact, broadcasting Agrotain or Super Urea just prior to seeding provided the same yield as banded urea at seeding. In this study, split applications with Agrotain or Super Urea provided somewhat higher yield than a banded application of urea at seeding. Split applications can occasionally improve nitrogen use efficiency, but it more likely to happen during a year with high precipitation. Banding the whole nitrogen requirement upfront at seeding is usually most economical.

Objectives and Rationale

Project objectives:

The main objective of this study was to demonstrate some best management practices for the application of nitrogen to a canola crop. Best management must take into consideration the 4R's which are:

1. The right source
2. The right rate
3. The right time
4. The right place

This study evaluated impact of product formulation, application timing and placement on canola's response to nitrogen.

Project Rationale:

Nitrogen is the most limiting nutrient in annual crop production and is often one of the most expensive crop nutrients, particularly for crops with high N requirements like canola. Most inorganic N fertilizers contain NH_4-N which is prone to volatilization when surface broadcasted. The nitrogen in UAN is one-fourth ammonic, one-fourth nitrate and one-half urea. The NO_3-N is not prone to volatilization, but can be lost to denitrification and leaching. Single pass seeding and fertilization is fairly standard and is the best management practice for applying nitrogen. Banding nitrogen at the time of seeding minimizes loses to volatilization and maximizes nitrogen use efficiency. However, producers may apply nitrogen in the fall or post seeding to increase operational efficiencies. These timings increase the risk of nitrogen loss, particularly if it is surface applied. While the timing and/or placement associated with two pass systems are usually not ideal, enhanced efficiency formulations (EEF) such as polymer coats (ESN), volatilization inhibitors (i.e. Agrotain) and volatilization / nitrification inhibitors (Super Urea) can reduce the potential risks associated with applying N well ahead of peak crop uptake (i.e. fall applications) or sub-optimal placement methods (i.e. surface broadcast). Enhanced efficiency N products are more expensive, but may be justified by improvements in efficacy and logistics. While it is not necessarily prudent to encourage growers to revert to two pass seeding and fertilization system, it is important for them to have a certain amount of flexibility with respect to how they manage N on their farms. This project demonstrates how to mitigate the risks associated with broadcast applications of nitrogen.

Methodology and Results

Methodology:

The trial was setup as a Randomized Complete Block Design with 4 replicates. The plots were direct seeded into stubble using a SeedHawk plot drill and other factors (i.e. weeds, disease and insects) were kept non-limiting throughout the season. Plot size was 11 by 30 feet. Soil residual N was 34 lbs/ac in the top 24 inches. The 12 established treatments were as follows:

1. No Fertilizer
2. 0.5x[Z] N (100 lb/ac 21-0-0-24 + 58 lb/ac 11-52-0 in treatments 2-12)
3. 1.0x side-band urea
4. 1.5x side-band urea
5. 1.0x pre-seed broadcast urea
6. 1.0x pre-seed dribble band UAN
7. 1.0x pre-seed broadcast Agrotain
8. 1.0x pre-seed broadcast Super U
9. 1.0x split[Y] broadcast urea
10. 1.0x split dribble band UAN
11. 1.0x split broadcast Agrotain
12. 1.0x split broadcast Super U

[Z]1x = Total N (residual NO_3-N plus fertilizer) = 107 lbs N/ha
[Y] Split application with 50% of total N side-banded during seeding and remainder applied as per protocol approximately 4 weeks after planting (4-6 leaf stage)

Table 1 lists the dates of operations for 2017.

Table 1. Dates of operations for 2017

Operations in 2017	Date
Pre-seed fertilizer applications trts 5-8	May 16
Seeded all treatments	May 23
Crop Emergence	June 5
Treat 10 UAN	June 6
In-crop Herbicide 0.5 l/ac Transorb	June 7
Broadcast fertilizer trts 9,11 and 12	June 7
In-crop Herbicide 0.33 l/ac Transorb	June 18
In-crop Herbicide 0.33 l/ac Transorb	June 28
Acapela fungicide	July 9
Harvest	Sept 15

Results:

Trial Results

The “no fertilizer check” (Trt 1- Table 2) had the highest emergence because there was no fertilizer applied to interfere with germination. The germination rate was significantly reduced by approximately 38% with the 1 X and 1.5 X rate of side banded urea plus P and S (trts 3 and 4). However, plant emergence rates for all treatments were more than adequate to maximize canola yield potential.

The cv is very high for the yield data (Table 2). However, the relative values for the treatment means makes sense. Application of side banded urea to bring soil N levels from 34 to 107 lbs/ac plus the application of phosphorus and sulphur increased canola yield significantly from 24.7 to 42 bu/ac (trt 1 vs 3). A further increase in soil N level to 160.5 lbs/ac (trt 4) resulted in 45.8 bu/ac of canola. Surface broadcasting urea (trt 5), just prior to seeding, resulted in less yield (36.6 bu/ac) compared to a banded application of urea (42 bu/ac) at seeding. The broadcast application of urea likely lost a significant amount of N to volatilization. The urea was broadcast on May 16th. On May 14th and 15th, a total of 3.4 mm of precipitation had been received (Table 3). Therefore, the urea was broadcast on to wet soil and sat for 8 days before any further rainfall was received. Even then, the amounts were not sufficient to adequately move nitrogen into the ground. Thus, conditions were ideal for volatilization of N. Broadcast applications of Agrotain (trt 7) and Super Urea (trt 8) did not appear to lose N to volatilization and produced yields similar to banded urea (trt 3). Both of these products are designed to provide a couple weeks of protection from volatilization loss, but still require rainfall to move into the soil. Dribble banded UAN (trt 6) did not perform as well as expected. UAN is urea-ammonium nitrate. Only one-fourth of it is nitrate N, so much of it is still prone to volatilization, but losses are typically low because it is applied in a concentrated band. There may have been an issue with the sprayer not holding its rate and this may be the reason for the poorer than anticipated performance of this treatment.

Split applications of N (trts 9-12) performed the same or better than the entire N requirement banded at seeding (trt 3). Again, Agrotain and Super Urea numerically out performed urea and UAN when broadcast applied. While split applications of nitrogen can improve nitrogen use efficiency, this result would typically be more likely with a wetter season.

Table 2. Treatment Effects on Emergence and Yield of RR Canola.[a]

Treatment	Emergence (plants/m^2)	Yield (bu/ac)
1. No Fertilizer	197 e	24.7 a
2. 0.5x[Z] N (100 lb/ac 21-0-0-24 + 58 lb/ac 11-52-0 in treatments 2-12)	178 bcde	26.5 a
3. 1.0x side-band urea	121 a	42.0 cde
4. 1.5x side-band urea	123 a	45.8 de
5. 1.0x pre-seed broadcast urea	146 abc	36.6 bc
6. 1.0x pre-seed dribble band UAN	150 abcd	35.2 b
7. 1.0x pre-seed broadcast Agrotain	186 cde	43.2 cde
8. 1.0x pre-seed broadcast Super U	190 de	43.7 de
9. 1.0x split[Y] broadcast urea	175 bcde	41.7 bcde
10. 1.0x split dribble band UAN	156 abcde	40.2 bcd
11. 1.0x split broadcast Agrotain	140 ab	45.1 de
12. 1.0x split broadcast Super U	169 bcde	47.3 e
Lsd	43.8	6.9
cv	24.3	66.7

[a]Means within a main effect followed by the same letter are not significantly different p=0.05

[Z]1x = Total N (residual NO_3-N plus fertilizer) = 107 lbs N/ha

[Y] Split application with 50% of total N side-banded during seeding and remainder applied as per protocol approximately 4 weeks after planting (4-6 leaf stage)

Table 3. Yorkton Rainfall Amounts for May and June 2017			
May	Precipitation (mm)	June	Precipitation (mm)
14	2.8	09	1.4
15	0.6	10	0.4
24	2.0	11	0.2
25	1.4	13	0.3
28	3.7	14	36.7
		15	4.1
		18	5.1
		19	0.2
		21	0.6
		22	3.3
		24	0.3
		30	1.3

Extension and Acknowledgement

This report as well as a short video on the results will be available for download from the ECRF website (www.ecrf.ca).

Conclusions and Recommendations

Under ideal conditions for N volatilization loss, Agrotain and Super Urea provided 18% higher yields compared to straight urea when broadcasted. In fact, broadcasting Agrotain or Super Urea just prior to seeding provided the same yield as banded urea at seeding. These products are designed to provide a couple weeks of protection from volatilization losses, but still need rain to move into the soil. Numerically, split applications with Agrotain or Super Urea provided somewhat higher yield than a banded application of urea at seeding. Split applications can occasionally improve nitrogen use efficiency particularly during wet seasons. However, banding the whole nitrogen requirement upfront at seeding is usually most economical.

Supporting Information

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.

Demonstrating 4R Phosphorus Principles in Canola

Mike Hall[1]

[1]East Central Research Foundation, Yorkton, SK.

Abstract

Abstract/Summary:

This study evaluated the effect of phosphorus (P) rate and placement on canola. Proper placement is one of the 4R's of nutrient management. The response to phosphorus was not statistically significant in this study as background levels of phosphorus were in the medium range (11 ppm). However, there were some numerical trends which are supported by past research. Broadcast applications of phosphorus did not yield any better than the 0 phosphorus control. When broadcast, phosphorus is tied up by the soil and is less available for uptake by plants. Increasing the rate of phosphorus did not provide any further yield benefit. When phosphorus was side-banded or seed-placed, yields were 2 to 4 bushels higher than the no phosphorus check. Placing the phosphorus with the seed did not provide a yield benefit over side-banding as soil conditions at the time of seeding were ideal for rapid seedling growth. Seedlings easily accessed the phosphorus in the side band and there was no need to place the phosphorus closer to the seed. Placing phosphorus with the seed did reduce emergence, but plant populations where still adequate to maximize yield. Applied phosphorus is most effective when either seed-placed or side-banded. It should not be broadcasted.

Objectives and Rationale

Project objectives:

The main objective of this study was to demonstrate some best management practices for the application of phosphorus to a canola crop. Best management must take into consideration the 4R's which are:

5. The right source
6. The right rate
7. The right time
8. The right place

This study focuses on placement. The yield response of canola to 25 and 55 kg/ha of P_2O_5 was compared between spring broadcasted, seed-placed and side-banded applications. The project intended to illustrate the potential risks and benefits of seed-placement relative to side-banding while also demonstrating that either of these methods is preferable to broadcast applications.

Project Rationale:

Phosphorus is the second most commonly limiting nutrient throughout most of Saskatchewan and, in many cases, residual P levels are declining over the long-term as a result of continuous cropping, recent high yields and inadequate application rates. Phosphorus is not highly mobile in the soil, so seed-placed applications can be ideal when soils are cool and roots are not growing quickly. Unfortunately, there is a limit to the amount of P_2O_5 that can be safely placed with the seed. If it is not possible to safely apply the full requirement with the seed, some of the phosphorus may need to be side banded. Side banding all the phosphorus is also an option and research finds this practice to be sufficient in the majority of cases. Broadcasting phosphorus is not efficient as this placement is not close to the seed and broadcast applications quickly become insoluble and unavailable in our high pH, calcareous soils. This project intended to demonstrate to potential risks and benefits of seed-placing phosphorus relative to side banding and to show that either placement is superior to broadcast applications.

Methodology and Results

Methodology:

A field trial with canola as a test crop was established on spring wheat stubble. The plots were direct seeded into stubble using a SeedHawk plot drill and other factors (i.e. weeds, disease and insects) were kept non-limiting throughout the season. The trial was an RCBD with 4 replicates and plot size was 11 by 30 feet. The middle 5 rows of each plot were harvested with a Wintersteiger plot combine. The site had 11 ppm of phosphorus in the soil which considered a medium level. The soil test recommended 28 lbs/ac of P_2O_5 for a 40 bu/ac canola crop. The 7 established treatments were:

1. 0 P control[Z]
2. Early spring[Y] broadcast – 25 kg P_2O_5/ha (starter)
3. Early spring broadcast – 55 kg P_2O_5/ha (replacement[X])
4. Seed-placed – 25 kg P_2O_5/ha (starter)
5. Seed-placed – 55 kg P_2O_5/ha (replacement)
6. Side-banded – 25 kg P_2O_5/ha (starter)
7. Side-banded – 55 kg P_2O_5/ha (replacement)

[Z]All treatments will receive a full rate of N, K and S fertilizer (based on soil test)
[Y]Applied as early as possible, no incorporation other than seeding operation
[X]Based on estimated yield of 50-55 bu/ac

Table 1 lists the dates of operations for 2017.

Table 1. Dates of operations for 2017

Operations in 2017	Date
Broadcast monoammonium phosphate on treatments 2 and 3	May 4
Seeded Trial	May 17
Emergence Counts	June 5
In-crop glyphosate (transorb 0.5 l/ac)	June 7
In-crop glyphosate (transorb 0.33 l/ac)	June 18
In-crop glyphosate (transorb 0.33 l/ac)	June 28
In-crop fungicide (Acapela)	July 9
Desiccation (Reglone)	Sept 5
Harvest	Sept 11

Results:

Trial Results

No statistical differences could be separated between means for either the emergence or yield data (table 2). However, there were some numerical trends that support past research. Emergence was reduced where phosphorus was applied with the seed. The highest rate of seed-placed phosphorus resulted in a 40% decline in emergence relative to the control. However, the resulting plant population was still adequate to maximize yield. Despite low precipitation, soil moisture reserves were good at seeding, providing protection against the salt effects of monoammonium phosphate (MAP). If conditions had been dry at seeding, seed placed fertilizer would have reduced emergence even more.

There was not a strong response to added phosphorus at this site, as background phosphorus was at medium levels (11 ppm). Side banding 55 kg P_2O_5/ha resulted in the highest yield of 52.2 bu/ac which was only 4 bu/ac higher than the 0 phosphorus control. Broadcast applications did not yield anymore than the no phosphorus treatment. This is in keeping with past research, as broadcast applications are not considered readily available to plants. The best yields were associated with seed-placed and side-banded applications of phosphorus.

Table 2. Treatment Effects on Emergence and Yield of RR Canola.[a]		
Treatment	Emergence (plants/m^2)	Yield (bu/ac)
13. 0 P control[Z]	111.2	48.3
14. Early spring[Y] broadcast – 25 kg P_2O_5/ha (starter)	77.3	48.0
15. Early spring[Y] broadcast – 55 kg P_2O_5/ha (replacement[X])	106.8	48.8
16. Seed-placed – 25 kg P_2O_5/ha (starter)	77.8	51.2
17. Seed-placed – 55 kg P_2O_5/ha (replacement)	67.4	50.9
18. Side-banded – 25 kg P_2O_5/ha (starter)	90.6	50.8
19. Side-banded – 55 kg P_2O_5/ha (replacement)	101.4	52.2
Lsd	NS	NS
cv	29.2	7.7
[Z]All treatments will receive a full rate of N, K and S fertilizer (based on soil test)		
[Y]Applied as early as possible, no incorporation other than seeding operation		
[X]Based on estimated yield of 50-55 bu/ac		

Extension and Acknowledgement

This report as well as a short video on the results will be available for download from the ECRF website (www.ecrf.ca).

Conclusions and Recommendations

The phosphorus response at this site was not strong as background levels were in the medium range (11 ppm). As a result, no statistical differences could be detected between treatment means. There were some numeric trends which were parallel to past research. Emergence was generally lower where P_2O_5 was seed placed. Increasing the rate of phosphorus further reduced plant population but not by much. Good soil moisture at seeding likely diluted the harmful salt effects of MAP. Placing phosphorus away from the seed by either broadcasting or side-banding the fertilizer increased seed safety and emergence. However, yields were poorer where phosphorus had been broadcasted and increasing the rate of application did not compensate for this loss. Broadcasting is not an effective means of application for phosphorus. When broadcasted, phosphorus is more readily "tied up" by the soil and is less available for plant growth. In this study, seed-placed P_2O_5 did not improve yields compared to side-banded applications. Soil temperature was quite warm (>15oC) at the time of seeding and seedlings grew rapidly. Seedlings easily accessed the side banded phosphorous and placing the phosphorus closer to the seed was not necessary. Phosphorus is most readily taken up by crops when seed-placed or side-banded. It should not be broadcasted.

Supporting Information

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.

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

C. Holzapfel[1], J. Schoenau[2], S. Brandt[3], L. Shaw[4], M. Hall[5], G. Issah[6], R. Mohr[7], B. Nybo[8], J. Slaski[9] and J. Weber[6]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK
[2]University of Saskatchewan, Saskatoon, SK
[3]Northeast Agriculture Research Foundation, Melfort, SK
[4]South East Research Farm, Redvers, SK
[5]East Central Research Foundation, Yorkton, SK
[6]Western Applied Research Corporation, Scott, SK
[7]Agriculture & Agri-Food Canada, Brandon, MB
[8]Wheatland Conservation Area Inc., Swift Current, SK
[9]Inno Tech, Alberta, Vegreville, AB

Adapted from ADF20150105 Interim Report written by Chris Holzapfel

Abstract

Abstract/Summary:

Sixteen site years of trials have been conducted across western Canada to re-evaluate the yield response of flax to various rates and combinations of nitrogen (N) and phosphorus (P) fertilizer. Results of this project have shown consistent, and in some cases strong yield responses to relatively high rates of N fertilizer (i.e. > 100 kg N/ha). Averaged across all 13 site-years where data will tentatively be combined, the observed increased was 683 kg/ha, or 46%. Responses to P fertilizer were less frequent (occurring <50% of the time) and, when they did occur, the yield increase ranged from 3-19%.

Objectives and Rationale

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 second year of a 3 year project initiated in 2016 has now been completed. Locations include 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:

Trial Results

Nitrogen rate affected yield at 13/16 site-years and 12/13 of those which will tentatively be included in the final combined analysis. At Melfort in 2017, the lack of a significant N response can be attributed to high residual N levels (56 kg NO3-N/ha at 0-30 cm depth), organic matter (9%) and subsequent mineralization, and overall variability. The observed yield increases at N responsive site-years ranged from 192-1229 kg/ha or 13-115% over the lowest, 13 kg N/ha, rate (Fig. 2). In the vast majority of individual cases the responses were quadratic with yields levelling off at 80-125 kg N/ha.

Averaged across all 13 site-years where data will tentatively be combined, the observed increased was 683 kg/ha, or 46% with no further yield increases past 100 kg N/ha (Fig. 3). Yield responses to P were less frequent and smaller in magnitude with evidence of a P response detected (through either overall F-tests or orthogonal contrasts) at 6/13 site-years. Amongst the responsive sites, the yield increase with P fertilization ranged from 3-19% and, in most (not all) cases where the response was not statistically significant, the highest yields still tended to be observed where P fertilizer was applied. Averaged across all thirteen site-years, regardless of significance, yields were approximately 10% higher with P fertilization. For individual sites, the responses were generally linear (Fig. 4); however, when data from all sites were averaged the preliminary combined response appeared to be more quadratic with much of the yield increase being realized with the first 20 kg P2O5/ha and diminishing returns associated with further increases. Interactions between N and P were rare, significant only at Indian Head and Scott in 2016. At Indian Head in 2016 the interaction was such that the yield response to P became larger at the higher N rates with little or no P effect detected at 13-50 kg N/ha. At Scott the interaction was less consistent with no patterns identified aside from P responses occurring at 13 and 100 kg N/ha but not at 50 or 150 kg N/ha.

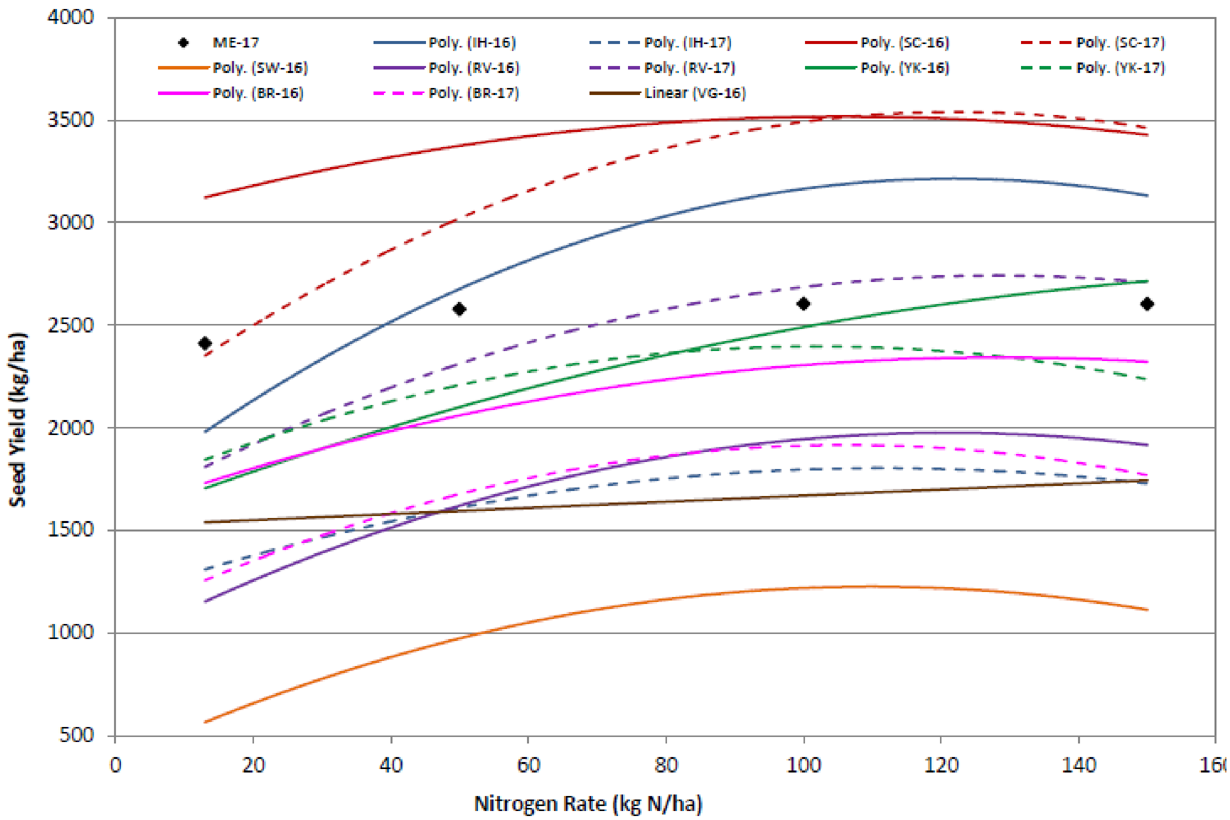


Figure 2. Flax seed yield response to nitrogen (N) fertilizer rate at thirteen site-years in western Canada (2016-17). BR – Brandon, MB; IH – Indian Head, SK; ME – Melfort, SK; RV – Redvers, SK; SC – Scott, SK; SW – Swift Current, SK; VG – Vegreville, AB; YK – Yorkton, SK

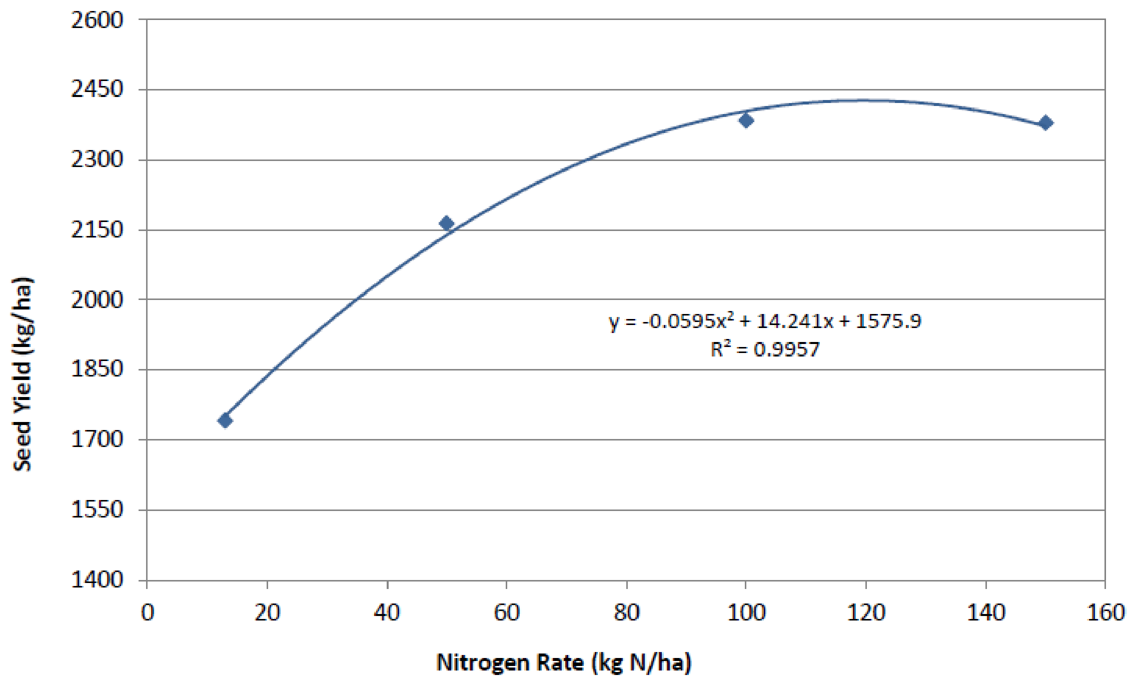


Figure 3. Overall flax seed yield response to nitrogen (N) fertilizer rate averaged across thirteen site-years in western Canada (2016-17).

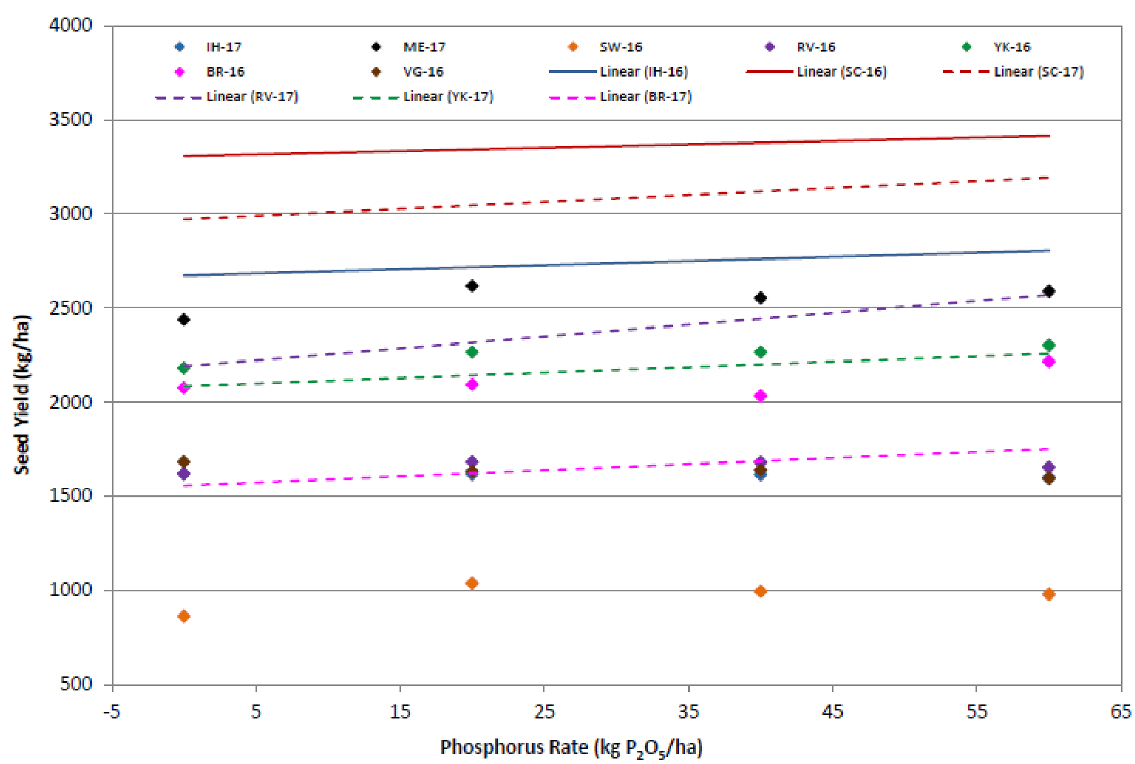


Figure 4. Flax seed yield response to phosphorus fertilizer rate at thirteen site-years in western Canada (2016-17). BR – Brandon, MB; IH – Indian Head, SK; ME – Melfort, SK; RV – Redvers, SK; SC – Scott, SK; SW – Swift Current, SK; VG – Vegreville, AB; YK – Yorkton, SK

Extension and Acknowledgement
This report as well as a short video on the results will be available for download from the ECRF website (www.ecrf.ca).

Conclusions and Recommendations

Results of this project to date have shown consistent, and in some cases strong yield responses to relatively high rates of N fertilizer (i.e. > 100 kg N/ha) while responses to P fertilizer were less frequent (occurring <50% of the time) and, when they did occur, smaller. All factors considered, the results are largely consistent with previous research and it should be noted that the optimum economic N rate will generally be slightly lower than that where maximum yield is achieved. The lack of a P yield response at many sites does not suggest that P fertilizer should not be applied to flax, but rather that, in any given year, current P fertilization practices are not likely major limiting factors to yields of this crop in western Canada. The lack of response to P fertilization at many sites may be explained by contributions of residual inorganic P and organic P mineralization in addition to the strong AM fungi relationships that flax can develop to assist with P uptake.

Supporting Information

Acknowledgements:
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Strategies for Management of Feed and Malt Barley

Mike Hall[1], Christiane Catellier[2], Jessica Weber[3]

[1]East Central Research Foundation, Yorkton, SK.
[2]Indian Head Agricultural Research Foundation, Indian Head, SK.
[3]Western Applied Research Corporation, Scott, SK.

Abstract

Abstract/Summary:

Trials were established at Yorkton, Scott and Indian Head with the objective of demonstrating the importance of early seeding and nitrogen management when producing malt versus feed barley. The second object was to provide an economic analysis for feed and malt barley scenarios, including the scenario where a malt barley variety is sold as feed. The feed variety CDC Austenson was 16% higher yielding than the malt variety AC Metcalfe at Yorkton and Scott. It was only 6% higher yielding at Indian Head. Despite the higher yield potential of CDC Austenson, growing AC Metcalfe would be more economical if acceptance for malt was more than once in 2.5, 4.3 and 6.7 years based on the results from Yorkton, Scott and Indian Head, respectively. There may be little reason to grow feed varieties in the future as higher yielding malt varieties are selected by the market place. Seeding barley early provided the highest yields and best probability of making malt at Yorkton. At Indian Head seeding early and late produced malt barley with similar economic results. At Scott, only late seeded barley made malt as early seeded barley was adversely affected by rain prior to harvest. Nitrogen management appears to be key to producing malt barley. Excessive amounts of nitrogen often increased protein and decreased kernel plumpness beyond acceptable levels.

Objectives and Rationale

Project objectives:

The main objective of this project was to demonstrate how nitrogen management for malt and feed grade barley differ when seeded in early or late May. A secondary objective was to provide an economic analysis for feed and malt barley scenarios, including the scenario where a malt barley variety is sold as feed.

Project Rationale:

The decision to grow either malt or feed barley varieties requires a realistic expectation for achieving malt, and a clear understanding of the potential yield differences between the varieties. Across western Canada, approximately 40% of the barley grown are malting varieties. Yet according to the Canadian Grain Commission, only 20% of malting barley production is actually selected for malting each year. Metcalfe is a popular malting variety, but yields considerably less than a number of feed varieties. The implication is that 80% of malt barley acres should have been grown for feed. Work by AgriProfits would suggest that feed varieties should be grown if the chance of making malt is less than 50%. This may change in the future if newer malt varieties, yielding as well as feed varieties, are accepted by the market. However, this is not currently the case.

When growing for malt, barley should be seeded early and nitrogen (N) needs to be managed to limit the protein content of the grain. Research has shown that seeding malting barley relatively early in the growing season should result in less protein, greater plumpness, and reduced lodging, thus improving the likelihood of obtaining malting grade [1]. Moreover, early seeding increases the likelihood of harvesting during dry conditions, reducing the likelihood of weathering and pre-harvest sprouting. If barley cannot be seeded early or the chance of achieving malt is not sufficient, then the producer may be better off to manage a feed variety.

[1] O'Donovan, J. et al. (2012). Effect of seeding date and seeding rate on malting barley production in western Canada. Can J Plant Sci. 92:321-330.

Methodology and Results

Methodology:

Trials were established at Yorkton, Indian Head and Scott as a split-split plot design with 4 replicates. The main plot factor compared seeding dates of early and late May. The 2nd factor contrasted the malt variety "AC Metcalfe" against the feed variety "CDC Austenson". The 3rd factor evaluated nitrogen rates. The nitrogen rates tested by Yorkton differed by accidentally using an earlier protocol. The nitrogen rates tested by Indian Head and Scott were 40, 80 and 120 lbs/ac of actual nitrogen as proposed. Yorkton tested nitrogen rates of 60, 80, 100 and 120 lbs/ac of actual nitrogen. Thus, 12 treatments were tested by Indian Head and Scott and 16 treatments were tested by Yorkton (Table 1).

Table 1. Treatment list conducted by IHARF, WARC and ECRF

Trt #	Seeding Date	Variety	N rate (lbs N/ac) for IHARF and WARC	N rate (lbs N/ac) for ECRF
1	Early May	AC Metcalfe (Malt)	40	60
2	Early May	AC Metcalfe (Malt)	80	80
3	Early May	AC Metcalfe (Malt)	120	100
4	Early May	AC Metcalfe (Malt)	Na	120
5	Early May	CDC Austenson (Feed)	40	60
6	Early May	CDC Austenson (Feed)	80	80
7	Early May	CDC Austenson (Feed)	120	100
8	Early May	CDC Austenson (Feed)	Na	120
9	Late May	AC Metcalfe (Malt)	40	60
10	Late May	AC Metcalfe (Malt)	80	80
11	Late May	AC Metcalfe (Malt)	120	100
12	Late May	AC Metcalfe (Malt)	Na	120
13	Late May	CDC Austenson (Feed)	40	60
14	Late May	CDC Austenson (Feed)	80	80
15	Late May	CDC Austenson (Feed)	120	100
16	Late May	CDC Austenson (Feed)	Na	120

Results:

Trial Results

Barley emergence was good at all sites, ranging between 200 to 250 plants/m^2. At Yorkton, emergence of AC Metcalfe was significantly lower than CDC Austenson (200 vs 246 plant/m^2) and emergence steadily declined from 242 to 202 plants/m^2 as nitrogen rate was increased from 60 to 120 lbs/ac (Table 2). Although the nitrogen was side banded, obviously some of the nitrogen was making its way into the seed row and affecting germination. Scott and Indian Head's emergence was unaffected by increasing nitrogen rates. At Scott, there was a significant interaction between seeding date and variety with the emergence data (Table 3). When seeded early, the emergence of AC Metcalfe was significantly higher than CDC Austenson (Table 4). The opposite was true for the later seeding date. At Indian Head, emergence counts for AC Metcalfe and CDC Austenson was 210 and 228 plants/m^2, respectively. To compensate for the some missed emergence data at Indian Head, tiller counts were done later in the summer (Table 5). The number of tillers was significantly greater for CDC Austenson and tiller number increased numerically with increasing nitrogen rate. Cereals typically tiller more with added nitrogen, which accounts for most of the yield response.

Lodging was not an issue in Indian Head or Scott. However, in Yorkton lodging was increased with added nitrogen (Table 2). The increased lodging with higher application of N may have limited the yield response.

At Yorkton and Scott yields did not significantly differ between early and late May seeding dates and CDC Austenson yielded 16% more than AC Metcalfe (Table 2 and 3). Indian Head's CDC Austenson only yielded 6% more than AC Metcalfe. In Yorkton, yield did not respond to added nitrogen beyond 60 lbs/ac, yet in Scott yields increased up to 80lbs/ac of N (Table 3). Unlike Yorkton and Scott, there was a significant seeding date by nitrogen rate interaction with the yield data at Indian Head. Both barley varieties were more responsive to added nitrogen when seeded in early May at Indian Head (Table 8).

In Yorkton, as nitrogen rate was increased from 60 to 120 lbs/ac, percent protein for AC Metcalfe and CDC Austenson increased from 12.2 to 14.3 and from 13.8 to 15.4, respectively (Table 6). The lack of a yield response, lodging and high protein levels suggest high levels of residual soil nitrogen. This was unexpected, as soil testing found only 39 lbs/ac of nitrogen in the top 12 inches and soil test recommendation for an 85 bu/ac malt barley crop was 93 lbs/ac of N. Clearly, these recommendations were not appropriate in light of actual field results where 60 lbs/ac of N produced at 96 bu/ac crop.

At Scott, barley protein content significantly increased with added nitrogen (Table 3 and 7). Protein levels did not quite differ significantly between varieties at the 5% level (Table 3), but were significantly higher for the earlier seeding date, which is not typically the case. There was no interaction between seeding date and nitrogen rate for the protein data. When seeded in late May, protein levels for AC Metcalfe did not exceed the maximum allowable limit of 12.5% protein until 120 lbs/ac N had been applied (Table 7). In contrast, the protein limit was exceeded with the application of only 40 lbs/ac of N when seeding was early. Usually protein levels are lower for barley when seeded early. It is difficult to explain these results particularly since yield did not differ between seeding dates, but the results are likely a response to environmental factors that were atypical for Scott.

As with all sites, Indian Head's protein increased with increasing nitrogen. The response did not differ substantially between seeding dates and the allowable limit of 12.5% protein was not exceeded until 120 lbs/ac of N had been applied.

At Yorkton, seeding AC Metcalfe early with no more than 60 lbs/ac of N produced 96 bu/ac and was the only treatment to meet malt barley grade based on levels below 12.5% protein. At Scott, the early seeded barley did not make malt quality due to low plump kernels, chitting and low germination.

However, late seeded barley did make malt quality up to 80 lbs/ac of N, which is also where yields were maximized for both the feed and malt varieties. At Indian Head, achieving malt barley was possible with early and late seeding.

Table 2. Main effects of Seeding Date, Variety and Nitrogen Rate on Emergence, Lodging and Yield of Barley at Yorkton.			
Seeding Date (A)	Emergence (plants/m^2)	Lodging (0-10)	Yield (kg/ha)
Early May	220.2 a	2.8 a	5773 a
Late May	226.7 a	3.8 a	5737 a
$Lsd_{0.05}$	NS	NS	NS
Barley Variety (B)			
AC Metcalfe (Malt)	200.6 a	3.7 a	5322 a
CDC Austenson (Feed)	246.3 b	2.9 a	6188 b
$Lsd_{0.05}$	17	NS	445
Nitrogen Rate (lbs/ac of Actual) (C)			
60	241.8 c	2 a	5784 a
80	230.3 bc	3.6 b	5813 a
100	219.8 ab	3.4 b	5705 a
120	201.9 a	4.1 b	5717 a
$Lsd_{0.05}$	19	0.84	NS
Significant interactions	None	None	None

Table 3. Main effects of Seeding Date, Variety and Nitrogen Rate on Emergence, Test Weight, Protein and Yield of Barley at Scott.				
Seeding Date (A)	Emergence (plants/m^2)	Test wt (kg/hl)	Protein (%)	Yield (kg/ha)
Early May	248.0 a	63.6 a	12.4 a	5941.3 a
Late May	225.2 b	66.9 b	11.3 b	5994.7 a
$Lsd_{0.05}$	7.2	0.41	0.47	NS
Barley Variety (B)				
AC Metcalfe (Malt)	236.9 a	64.5 a	12.2 a	5529.5 a
CDC Austenson (Feed)	236.3 a	65.9 b	11.5 a	6406.5 b
$Lsd_{0.05}$	NS	0.87	NS	389
Nitrogen Rate (lbs/ac of Actual) (C)				
40	245.9 a	65.6 b	10.5 a	5682.8 a
80	228.3 a	65.2 ab	11.8 b	6121.8 b
120	235.6 a	64.9 a	13.3 c	6099.4 b
$Lsd_{0.05}$	NS	0.49	0.47	278
Significant interactions	A by B	None	None	None

Table 4. Seeding Date by Variety Interaction for Barley Emergence at Scott.		
Seeding Date (A)	Barley Variety (B)	Emergence (plants/m^2)
Early May	AC Metcalfe (Malt)	259.7
Early May	CDC Austenson (Feed)	236.3
Late May	AC Metcalfe (Malt)	214.2
Late May	CDC Austenson (Feed)	236.3
Lsd for B1A1-B2A1		7.3
Lsd for B1A1-B1A2 or B1A1-B2A2		12.8

Table 5. Main effects of Seeding Date, Variety and Nitrogen Rate on Tiller # and Yield of Barley at Indian Head.		
Seeding Date (A)	Tillers/m^2	Yield (kg/ha)
Early May	587.6 a	5463.5 a
Late May	637.4 a	5547.9 a
$Lsd_{0.05}$	NS (p=0.13)	NS
Barley Variety (B)		
AC Metcalfe (Malt)	597.0 a	5333.5 a
CDC Austenson (Feed)	628.0 b	5677.9 b
$Lsd_{0.05}$	20.7	109
Nitrogen Rate (lbs/ac of Actual) (C)		
40	570.4 a	4952.2 a
80	602.6 a	5713.1 b
120	664.6 a	5851.8 b
$Lsd_{0.05}$	NS (p=0.054)	177
Significant interactions	None	A by C

Table 6. Malt Barley Quality Measurements from the Yorkton Site (treatments bulked over 4 reps).									
May Seeding	Nitrogen	Protein (%)	Moisture (%)	Plump (%)	Thin (%)	Peeled & Broken (%)	Chitted (%)	Test Weight (kg/hl)	Germination (%)
Early	60	12.2	12.7	94.6	0.4	1.4	0.6	68.4	98
Early	80	13.6	12.8	92.1	0.5	2.8	1.2	67.0	100
Early	100	14.1	12.4	93.2	0.5	2.2	1.4	68.0	100
Early	120	14.3	13.0	92.4	0.6	2.4	0.6	67.4	99
Late	60	13.8	13.3	93.4	0.6	5.2	0.0	69.9	98
Late	80	14.5	13.5	93.6	0.8	5.0	0.2	69.9	99
Late	100	14.9	13.7	90.0	1.3	1.8	0.4	69.0	96
Late	120	15.4	13.7	90.0	0.7	3.0	0.6	68.4	100

Table 7. Malt Barley Quality Measurements from the Scott Site (treatments bulked over 4 reps).									
May Seeding	Nitrogen	Protein (%)	Moisture (%)	Plump (%)	Thin (%)	Peeled & Broken (%)	Chitted (%)	Test Weight (kg/hl)	Germination (%)
Early	40	12.7	13.6	90.4	0.9	1.7	24.0	64.2	48
Early	80	13.4	13.6	89.6	1.0	1.2	22.9	63.6	56
Early	120	14.5	13.9	86.8	1.3	1.1	19.7	64.0	54
Late	40	10.9	11.4	95.8	0.3	0.6	0.6	67.9	97
Late	80	12.1	11.7	94.2	0.4	1.9	0.0	67.5	98
Late	120	13.9	11.6	94.6	0.4	1.1	0.0	67.2	98

Table 10 Seeding Date by Nitrogen Rate Interaction for Barley Yield at Indian Head.		
Seeding Date (A)	Nitrogen Rate (lbs/ac of Actual) (C)	Yield (kg/ha)
Early May	40	4781.3
Early May	80	5680.4
Early May	120	5928.9
Late May	40	5123.1
Late May	80	5745.9
Late May	120	5774.6
Lsd for C means for same A		251
Lsd for A means for same or difference C		250

Conclusions and Recommendations:

Despite the higher yield potential of the feed variety CDC Austenson, it would likely be more economical to grow the malt variety AC Metcalfe. Growing CDC Austenson would only prove to be more economical if the chance of achieving malt with AC Metcalfe was less than once in 2.5, 4.3 and 6.7 years based on the results from Yorkton, Scott and Indian Head, respectively. There may be little reason in the future to grow feed varieties as malt varieties with yields comparable to the best feed varieties are accepted by maltsters. Seeding barley early provided the highest yields and best chance of making malt at Yorkton. At Indian Head seeding early and late produced malt barley with similar economic results. At Scott, only later seeded barley made malt as early seeded barley was adversely affected by rain prior to harvest. Nitrogen management is key to producing malt barley. Excessive amounts of nitrogen often increased protein and decreased kernel plumpness past acceptable levels.

Extension and Acknowledgement

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<u>Supporting Information</u>

Acknowledgements:

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