IHARF
INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

2011 Annual Report

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Table of Contents

Indian Head Agricultural Research Foundation

The Indian Head Agricultural Research Foundation (IHARF) is a non-profit, producer directed research organization which works closely with various levels of government, commodity groups, private industry and producers.

Founded in 1993, the mission of IHARF is to promote profitable and sustainable agriculture by facilitating research and technology transfer activities for the benefit of its members and the agricultural community at large.

IHARF Mandate

- Identify new research priorities required to meet the needs of agriculture now and in the future.
- Support public good research – research that has value to the public but is not tied to studying or promoting a specific product or service.
- Maintain strategic alliances with the agricultural community in order to strengthen the provincial research base.
- Play an active role in the technology transfer process and be involved in public education and awareness activities.
- Maintain a scientific research base at the Indian Head Research Farm.

IHARF Board of Directors

IHARF is led by a nine member Board of Directors that provide guidance for the organization. Residing all across South-Eastern Saskatchewan, IHARF Directors are dedicated to the betterment of the agricultural community as a whole. The 2011 IHARF Directors are:

Franck Groeneweg – President – Edgeley
Chad Skinner – Vice President – Indian Head
Terry Rein – Secretary / Treasurer – Indian Head
Barry Rapp – Regina
Brian Acton – Lemberg
Scott Bonnor – Sintaluta
Jeff Molder – Weyburn
Keith Stephens – Balcarres
Gus Lagace – Balcarres

Ex-Officio

IHARF receives additional guidance from an experienced team of AAFC personnel at the Indian Head Research Farm. They include:

David Gehl – Officer in Charge
Guy Lafond – Research Scientist
Bill May – Research Scientist
Chris Omoth – Technician

IHARF Staff

The dedicated team of IHARF staff for the 2011 season include:

Danny Petty – Executive Manager
Chris Holzapfel – Research Manager
Karter Kattler – Field and Plot Technician

Extension Events

Indian Head Crop Management Field Day

On July 19th, 2011, IHARF hosted the annual Indian Head Crop Management Field Day, which coincided with the 125th anniversary of the AAFC Indian Head Research Farm. Producers, industry personnel and special guests from AAFC in Ottawa took in tours led by IHARF, AAFC, and industry specialists. Speakers included:

Chris Holzapfel - IHARF,
Dr. Hugh Beckie - AAFC Saskatoon,
Dr. Ron Palmer - IHARF,
Dr. Guy Lafond - AAFC Indian Head,
Bill May - AAFC Indian Head,
Dr. Randy Kutcher - AAFC Melfort,
David Gehl - AAFC Indian Head.

IHARF Winter Seminar

This year's IHARF Winter Seminar which highlighted the 2011 research program was held in Melville, Saskatchewan on February 1, 2012. Over 180 guests came out to take in presentations delivered by:

Dr. Guy Lafond - AAFC Indian Head,
Bill May – AAFC Indian Head,
Dr. Ron Palmer - IHARF,
Dr. Adrian Johnston - International Plant Nutrition Institute,
Chris Holzapfel - IHARF,
Dr. Jeff Schoenau - University of Saskatchewan,
Kevin Hursh.

Interpreting Statistical Results

Statistics are used in experiments to assess whether differences between means are a result of treatment effects or simply due to random variability or experimental error. When interpreting results, lower-case letters are used to denote whether or not treatment differences are statistically significant. If the letters following two values in a table are the same, the results are not statistically significant. If the letters are different, the results are statistically significant (see example).

Treatment	**Yield** ***(Not Significant)***	**Plant Density** ***(Significant)***
Product A	45*a*	70*a*
Product B	47*a*	90*b*

2011 IHARF Partners

Platinum

Agriculture and Agri-Food Canada – Indian Head Research Farm
Agriculture and Agri-Food Canada – Cluster and DIAP Program Funding
Bayer CropScience
Saskatchewan Canola Development Commission
Saskatchewan Ministry of Agriculture

Gold

BASF
Canada / Saskatchewan ADOPT Program
Canola Council of Canada
Manitoba Canola Growers Association
Viterra

Silver

Agriculture Council of Saskatchewan
Agrium
Canadian Wheat Board
Cargill
Donaghies
Dow AgroSciences
FMC Agricultural Products
Grain Millers Canada
International Plant Nutrition Institute
Mosaic
Pioneer Hi-Bred
Saskatchewan Pulse Growers
Saskatchewan Sunflower Committee
Syngenta
Town of Indian Head
Western Ag Labs

Bronze

Brett Young Seeds
Ducks Unlimited Canada
Engage Agro
HCI Ventures
Monsanto / Dekalb
Nite Hawk Trucking
Paterson Grain
Saskatchewan Institute of Agrologists – Regina Branch
University of Saskatchewan

IHARF Yield-Busters

Grain farmers across the Prairies now have access to an unprecedented amount of new products and practices that claim to increase profitability through either higher yields or increased efficiencies. That said, relatively slim economic margins limit how much growers have to invest into their crops and still remain profitable. Furthermore, many products currently being marketed are not consistent with what has been traditionally recommended or used on the prairies. While growers are often intrigued by novel products or practices, in many cases third-party data is not available to help them determine which of these products are in fact worth the investment.

The Yield-Busters program was kicked off by the IHARF Board of Directors in February of 2010, primarily as a means to help engage producers in the process of deciding research and demonstrations activities and determine what areas of study are of importance to farmers. In the Yield-Busters program, producers and agronomists are canvassed at IHARF field days and grower meetings that take place throughout the year and are asked to provide ideas for future projects. As a result, the ideas are then compiled and selected based on:

- The level of importance to a large number of producers;
- Straight forward to address and replicate at multiple sites;
- Capacity to produce results quickly (no long-term studies);
- Focus on topics that have not been extensively tested or demonstrated.

In 2011, three Yield-Busters projects were undertaken which included:

1. Micronutrient Seed Dressing Effects on Various Crops
2. Evaluating Fungicide Application on Flax
3. Evaluating Fungicide Application on Canola

YIELD-BUSTERS

IHARF
INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

2011 Yield-Busters – Micronutrient Seed Dressing Effects on Various Crops

C. Holzapfel[1], A. Kirk[2], B. Nybo[3], A. Severson[4]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK
[2]Western Applied Research Corporation, Scott, SK
[3]Wheatland Conservation Area, Swift Current, SK
[4]East Central Research Foundation, Canora, SK

Overview

The objective of this project was to evaluate the effects of micronutrient seed dressings on the establishment and seed yield of spring wheat, canola, lentil and field pea. The trial was carried out at Indian Head, Canora, Swift Current and Scott, Saskatchewan in both 2010 and 2011.

Results

To assess whether the seed dressings had an impact on crop establishment, two separate one meter rows were marked out in each plot after seeding with plant counts completed on the marked rows repeatedly over the emergence period. In Canora, Scott and Swift Current in 2010, the first measurements were completed too late to assess the rate of emergence, and in 2011, plant counts were not completed at Canora. At all other locations in 2011, plant counts were completed correctly. Separate analyses of the emergence data were used to determine the impact of the seed dressings on the rate of emergence at Indian Head, Scott and Swift Current in 2011 and are presented below in Figures 1, 2 and 3. There appeared to be a benefit from the zinc primer on spring wheat and, to a lesser extent, canola in Scott in 2011; however, the observed differences were no longer evident by the end of the emergence period. When all sites were combined, final wheat populations were slightly higher for the untreated check than when a seed dressing was used while no differences were observed for the remaining three crops. Figures 1, 2 and 3 show the plant emergence at Indian Head, Scott and Swift Current in 2011.

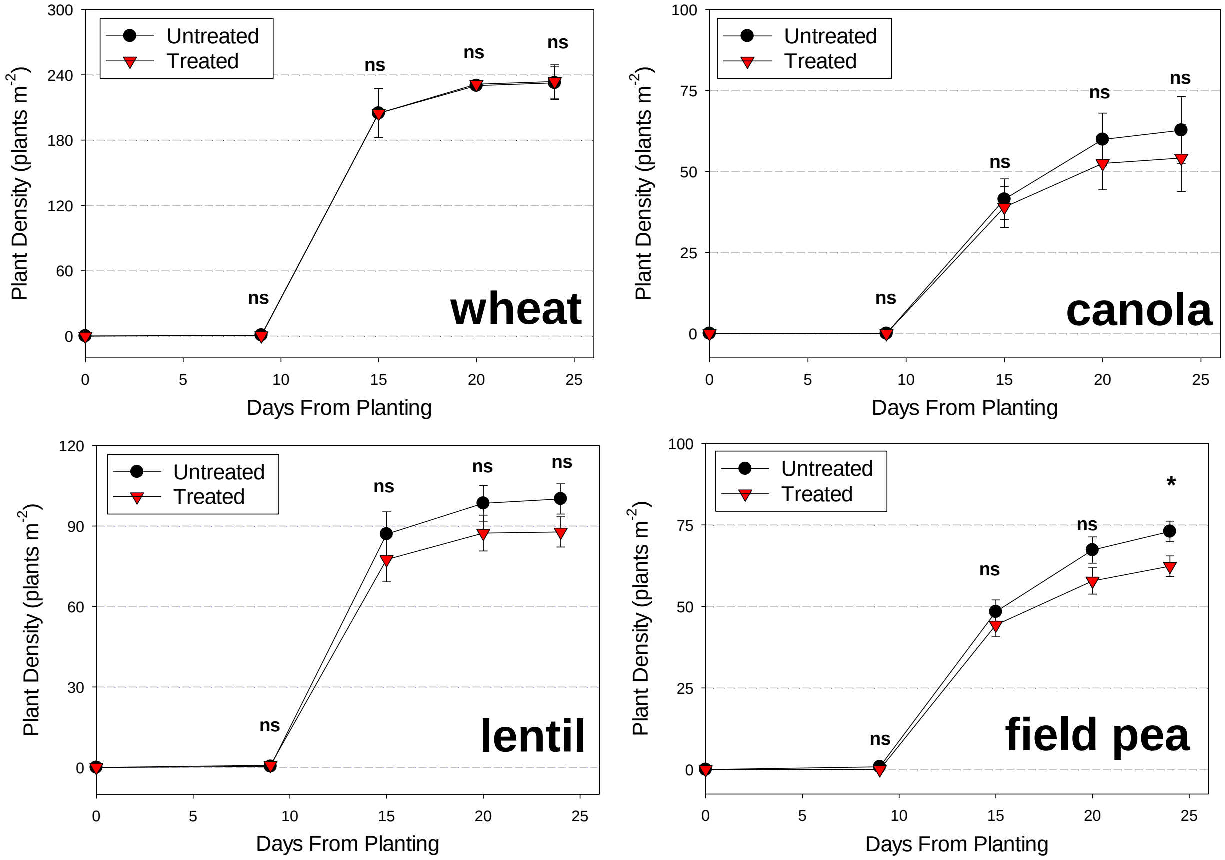

Figure 1: Plant emergence at Indian Head, 2011.

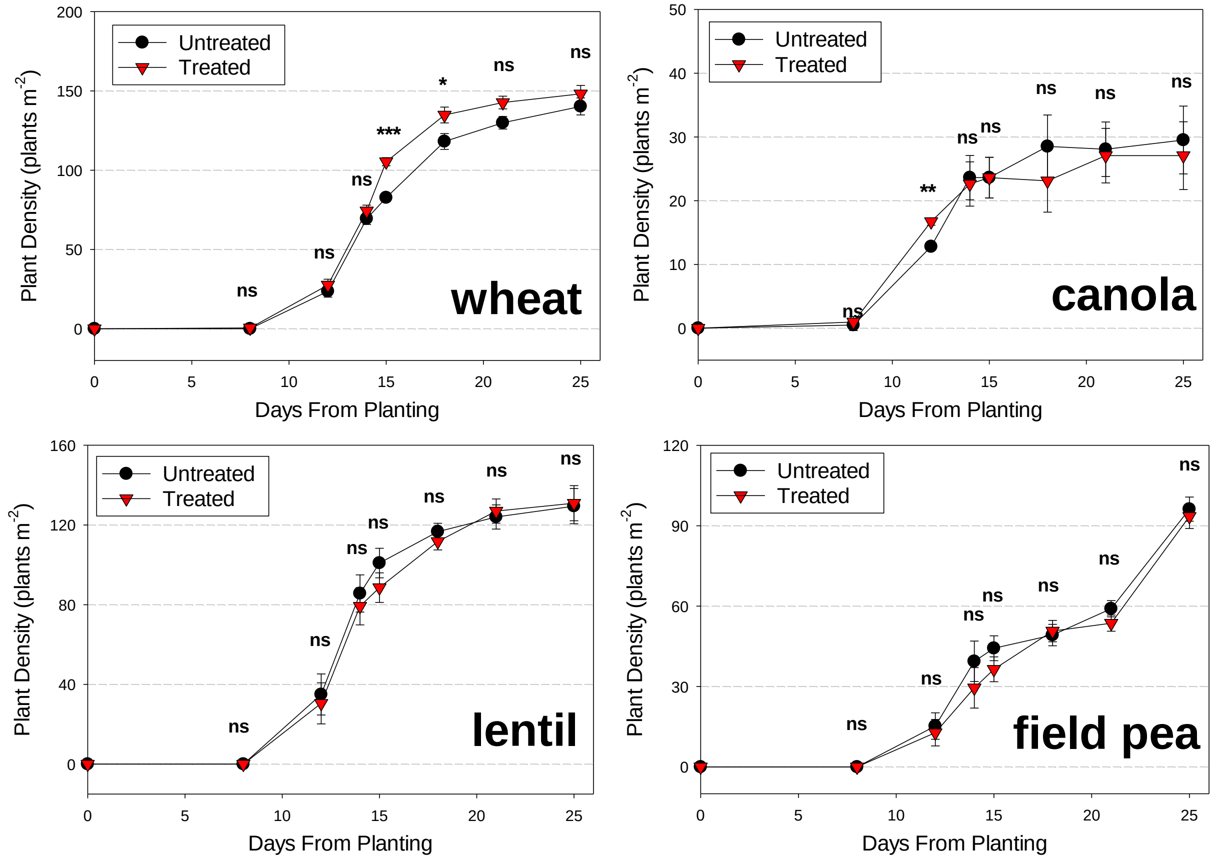

Figure 2: Plant emergence at Scott, 2011.

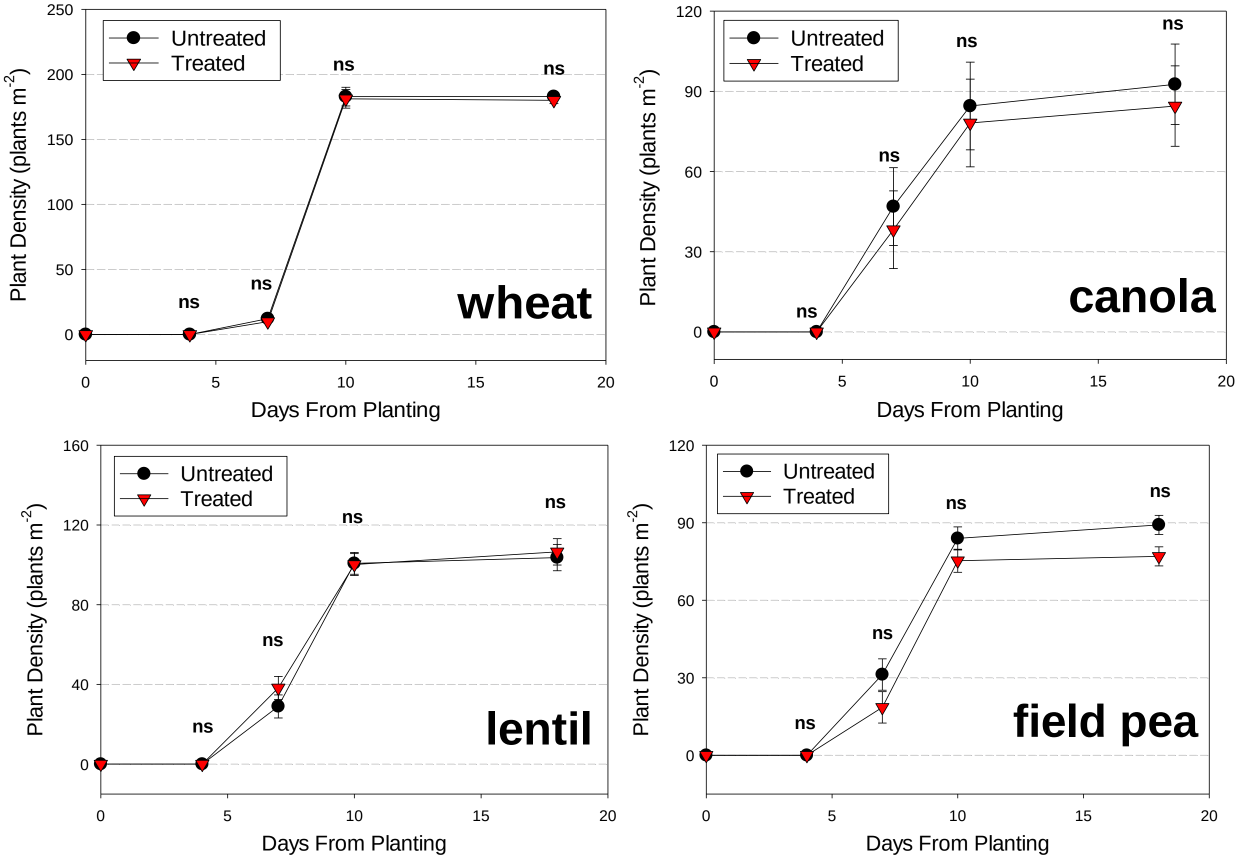

Figure 3: Plant emergence at Swift Current, 2011.

The effects of seed dressing on the total number of plants established are presented in Table 1, where the plant establishment results have been averaged over the two years and four locations where the trials were conducted. The site by treatment interaction was not significant for any crop, indicating that the effects of seed dressing on plant density were similar for all sites. Untreated seed went through the same physical processes as the treated seed; however, the untreated seed had distilled water applied instead of the seed dressings. All seed was treated a minimum of one week before planting and the drills were calibrated separately for treated and untreated seed.

Table 1: Effects of micronutrient seed dressing on crop establishment; Indian Head, Scott, Swift Current, 2011.

	Plants / m^2			
Treatment	***Wheat***	***Canola***	***Lentil***	***Field Pea***
Untreated Check	220.2*a*	67.4*a*	113.0*a*	66.7*a*
Seed Dressing Applied	206.1*b*	65.5*a*	114.8*a*	62.4*a*
LSD ($P \le 0.05$)	13.8	10.4	11.3	5.3

Yields were determined by mechanically harvesting, cleaning and weighing the grain for each plot and the data were analyzed in the same manner as for the final plant densities. Grain yields were affected by site for all crops but not by seed treatment or site by seed treatment interaction. This indicates that the same yields were achieved with or without the seed dressings and that the effects of the products on seed yield were similar for all sites. Overall, yields for each crop varied widely across sites. Because neither the treatment nor site by treatment effect was significant, separate yields for the seed dressing treatments are not presented for individual sites or years. Table 2 shows the average yields between all sites and years.

Table 2: Effects of micronutrient seed dressing on seed yield, 2010 and 2011.

	Yield – bu / ac			
Treatment	***Wheat***	***Canola***	***Lentil***	***Field Pea***
Untreated Check	44.04*a*	31.60*a*	20.33*a*	42.17*a*
Seed Dressing Applied	43.75*a*	32.08*a*	21.59*a*	41.41*a*
LSD (P≤0.05)	1.66	2.42	1.80	3.04

Conclusion

Micronutrient seed dressings are often marketed as having the greatest benefit when crops are emerging under stressful conditions (i.e. cold and wet soils). With this in mind, early seeding was targeted but not always achieved due to the wet springs in 2010 and 2011. However, while growers typically strive to start as early as possible, the seeding dates achieved at each location were representative of farmer practices for the years this trial was conducted. Furthermore, cool and wet conditions after planting were frequently encountered with 75% of the sites in this study experiencing below normal temperatures and the majority of sites experiencing at least 125% of normal precipitation in May and June over the two year period.

In regards to soil fertility, zinc supplies were less than half of the requirements for maximum crop potential in Canora and Swift Current in 2010 and at Indian Head in 2010 and 2011. Zinc requirements were also less than ideal in Scott and Swift Current in 2011. The likelihood of a crop response to nutrient based seed dressings would be higher when soil test levels or when seed concentrations of the relevant nutrients are low; however, the actual quantities of nutrients that can be supplied with a seed applied product are very low and may not be sufficient to fully correct a micronutrient deficiency.

While relatively inexpensive when compared to other crop inputs, the results of this study were not able to show a benefit to using micronutrient seed dressings, even in cases where soil test results show a marginal availability of micronutrients. Nonetheless, many different products are available and the formulations are always changing. The eight site years of data collected in this study cannot be representative of every potential field or situation; thus, it is possible that benefits might exist under certain circumstances.

2011 Yield-Busters – Evaluating Fungicide Application on Flax

C. Holzapfel[1], B. Nybo[2], A. Severson[3]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK
[2]Wheatland Conservation Area, Swift Current, SK
[3]East Central Research Foundation, Canora, SK

Overview

The purpose of this project was to evaluate the effects of fungicide applications on flax yield. The trial took place at Indian Head, Canora and Swift Current in 2010 and 2011. The treatments for this project were:

1. No fungicide
2. Headline® applied mid-flower (161 mL/ac)

The data were analyzed individually for each site as well as combined over all six site-years, examining the effects of site, treatment and site by treatment.

Results

For the combined analysis where all six site-years were included, flax yield was significantly affected by site, treatment and site by treatment. The significant site by treatment interaction justified looking at the results from each site individually, which revealed a significant response to fungicide at Indian Head in 2010 and 2011 and a notable response in Canora in 2010. The 2010 and 2011 results from Swift Current and 2011 results from Canora did show a slight increase in yield; however, the increase was not significant and could not be proved to be from the fungicide application.

Table 3: Effects of fungicide application on flax yield.

	Clean Seed Yield (bu/ac)						
	Canora		***Indian Head***		***Swift Current***		***All Sites***
Treatment	***2010***	***2011***	***2010***	***2011***	***2010***	***2011***	**-**
Untreated	13.27 *a*	18.27 *a*	24.90 *a*	32.56 *a*	10.05 *a*	25.47 *a*	20.76 *a*
Headline®	17.25 *a*	18.72 *a*	31.72 *b*	34.29 *b*	10.32 *a*	26.86 *a*	23.10 *b*
Std. Error	1.20	2.48	0.41	0.30	0.19	1.58	0.55

Conclusion

Overall, flax responded well to the application of Headline® with a significant yield increase of 2.34 bu/ac (11%) over the untreated check when data were averaged across all sites and years. However, the fact that the site by location interaction is significant indicates that this response would not be expected at every location or in every year. A significant response was observed at one-third of the individual sites. With drier overall climatic conditions and presumably lower levels of disease inoculum at Swift Current, flax yields were never increased with the application of fungicide. The fact that flax yields were not statistically affected by the fungicide application in Swift Current in either year and Canora in 2011 suggests that the positive yield responses observed in this study were likely a result of disease suppression as opposed to any more general plant benefits that might be associated with the Headline® application.

While flax does appear to respond well to fungicide applications, this data suggests that growers should still inspect their crop for Pasmo at the early flowering stage and base the decision to spray on whether or not the disease is present. Leaving check strips and looking at the yield response will allow producers who spray Headline® on their flax, or fungicides on any crop, to confirm that the practice is in fact cost effective.

Figure 4: Effects of fungicide application of flax maturity.

IHARF Yield-Busters – Evaluating Fungicide Application on Canola

C. Holzapfel[1], B. Nybo[2], A. Severson[3]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK
[2]Wheatland Conservation Area, Swift Current, SK
[3]East Central Research Foundation, Canora, SK

Overview

The purpose of this project was to evaluate the effects of fungicide applications on canola yield. This trial was initiated in 2011 and took place at Indian Head, Swift Current and Canora. Treatments for the trial consisted of:

1. Untreated check
2. Headline® (161 mL/ac)
3. Lance® (142 g/ac)
4. Lance® plus Headline® (142 g/ac and 121 mL/ac - respectively)
5. Proline® (151 mL/ac)
6. Astound® (390 g/ac)

Results

When averaged across all three sites, seed yield was affected by site but not by fungicide treatment and the site by treatment interaction was also not significant. Statistically, the combined analysis of the fungicide effects did not indicate any significant difference amongst the various products applied; however, there was a trend showing the treated canola yielding higher than the untreated check. There was no significant yield increase observed at Swift Current or Canora, but when the data from Indian Head was analyzed independently, there was an average yield increase of 13% in the fungicide treated plots.

Table 4: Effects of fungicide application on canola yield, 2011.

	Clean Seed Yield (bu/ac)			
Treatment	***Canora***	***Indian Head***	***Swift Current***	***All Sites***
Untreated	32.12 *a*	42.93 *c*	47.05 *a*	40.70 *a*
Headline	31.01 *a*	49.62 *ab*	47.34 *a*	42.65 *a*
Lance	31.80 *a*	50.23 *a*	46.79 *a*	42.93 *a*
Headline + Lance	37.53 *a*	50.10 *ab*	48.28 *a*	45.32 *a*
Proline	33.15 *a*	45.57 *bc*	45.22 *a*	41.47 *a*
Astound	36.97 *a*	47.79 *ab*	47.04 *a*	43.93 *a*
Std. Error	2.72	1.53	1.89	1.80

Conclusion

As this was the first year of the project, this study needs to be continued in order to draw conclusions on the response of canola to fungicide applications. The response at Indian Head was of interest and somewhat unexpected as traditionally, fungicides have not been regularly applied to canola in the area. However, many growers are re-evaluating the viability of this practice as a result of tightening rotations, recent wet growing conditions and high canola prices. It should be noted that the Headline® application at Indian Head was targeted for application at herbicide timing but was delayed by weather until the bolting stage. While disease levels were not formally measured, sclerotinia symptoms were not observed at Indian Head either at the time of application or prior to swathing. There were symptoms of alternaria evident late in the season, with a few black spots occurring on the stems and pods, but they did not appear to be severe enough to have a significant impact on yield. Growers in the thin black and black soil zones who are not using foliar fungicides on their canola may consider applying a few test passes on their fields and monitoring the response, specifically if rotations are tight or the weather is conducive to the disease. Growers who are routinely applying fungicides to canola will benefit from leaving untreated checks to confirm the cost-effectiveness of their investment.

Exploring the Merits of Field Pea-Canola Intercrops for Improved Yield and Profit

C. Holzapfel[1], S. Chalmers[2]

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[2]Westman Agricultural Diversification Organization, Melita, MB

Overview

When it comes to intercropping, large gains in grain yields and land equivalent ratios have been reported on the prairies by both growers and researchers alike. Despite the logistic challenges of intercropping, particularly at harvest, growers in Saskatchewan are interested in this practice as a means of increasing net profits and potentially reducing fertilizer use in canola production. Research is required to advance our understanding of the potential advantages and disadvantages of pea-canola intercropping and to develop agronomic recommendations for growers who are interested in this practice.

The primary objectives of this project were to: 1) gain experience with intercropping field pea with canola and demonstrate its potential agronomic and economic merits, 2) compare alternating versus mixed-row configurations for field pea-canola intercrops, and 3) demonstrate the effects of nitrogen fertility on the performance of field pea-canola intercrops.

Materials and Methods

At Indian Head, canola and field pea were seeded alone (monocropped) and pea-canola were mixed within the same seed row and in alternating rows. Thirteen different treatments were included in the trial which is detailed in Table 5. The 100% nitrogen rate is equal to 111.56 lbs/ac of actual nitrogen. The 100% seeding rate was equal to 206 lbs/ac for pea and 5 lbs/acre for canola.

Phosphorus and sulfur fertilizers were applied at the same rate over all treatments. Odyssey DLX was applied in-crop for weed control. All treatments were swathed before harvest due to logistical challenges. The seed varieties used were CDC Golden field pea and 45H73 Clearfield canola.

Table 5: Treatments evaluated at Indian Head.

Monocrop Treatments (100% seeding rate)	**Intercropped Treatments** (67% seeding rate)
1. Canola (0% N)	6. Mixed Rows (0% N)
2. Canola (33% N)	7. Mixed Rows (33% N)
3. Canola (67% N)	8. Mixed Rows (67% N)
4. Canola (100% N)	9. Mixed Rows (100% N)
5. Field Pea (0% N)	10. Alternating Rows (0% N)
-	11. Alternating Rows (33% N)
-	12. Alternating Rows (67% N)
-	13. Alternating Rows (100% N)

Results

The site received well above average precipitation in late May and early June, but warm and dry conditions followed in July and August, allowing the crops to recover reasonably well.

There were no significant differences observed in crop establishment between the intercropped treatments. However, an overall decline was observed in plant populations in the monocropped canola as nitrogen rates increased, likely due to NH_3 toxicity and wet soil conditions. In regards to individual crops within the intercropped treatments, neither canola nor field pea establishment was significantly affected by either row-crop configuration or N fertility level (Figure 5).

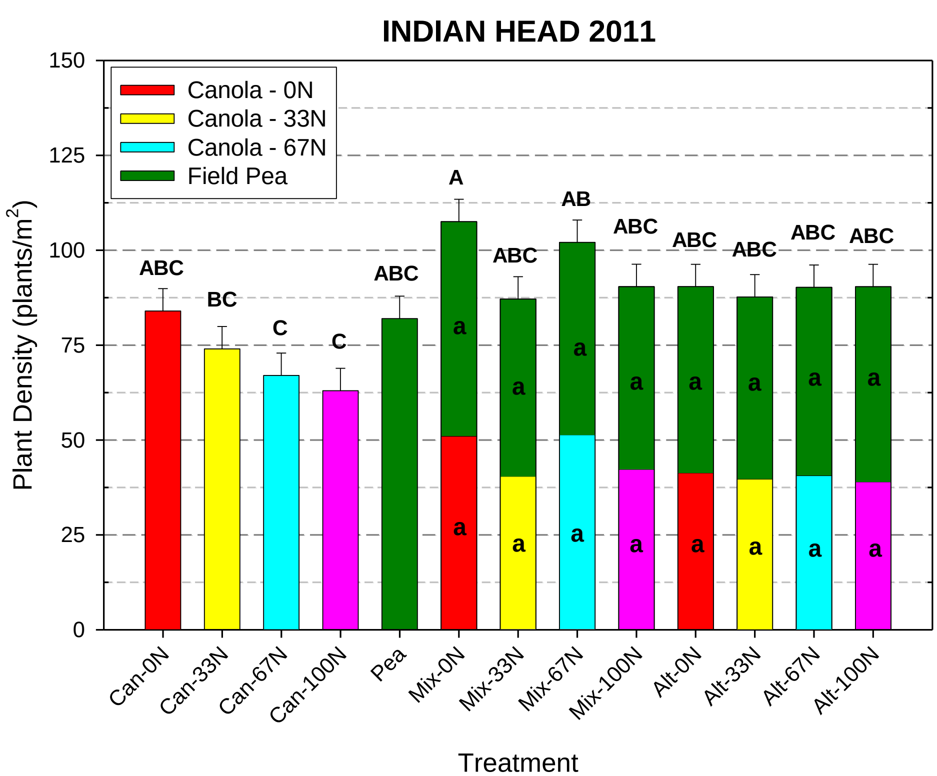

Figure 5: Plant populations at Indian Head.

As expected, the unfertilized canola monocrop had a significantly lower yield than all other treatments. The intercropped treatments tended to have similar yields to the field pea monocrop and higher yields than the canola monocrop but the differences were not always significant (Figure 6). In the intercropped treatments, the field pea and canola yields were affected by row-crop configuration, but the total seed yield was not. For canola, yields were higher with the alternating row configuration while the opposite was true for field pea, where mixed row yields were greater. The higher canola yield in the alternating row configuration could be explained by the increased N availability as the N fertilizer was applied exclusively to the canola rows.

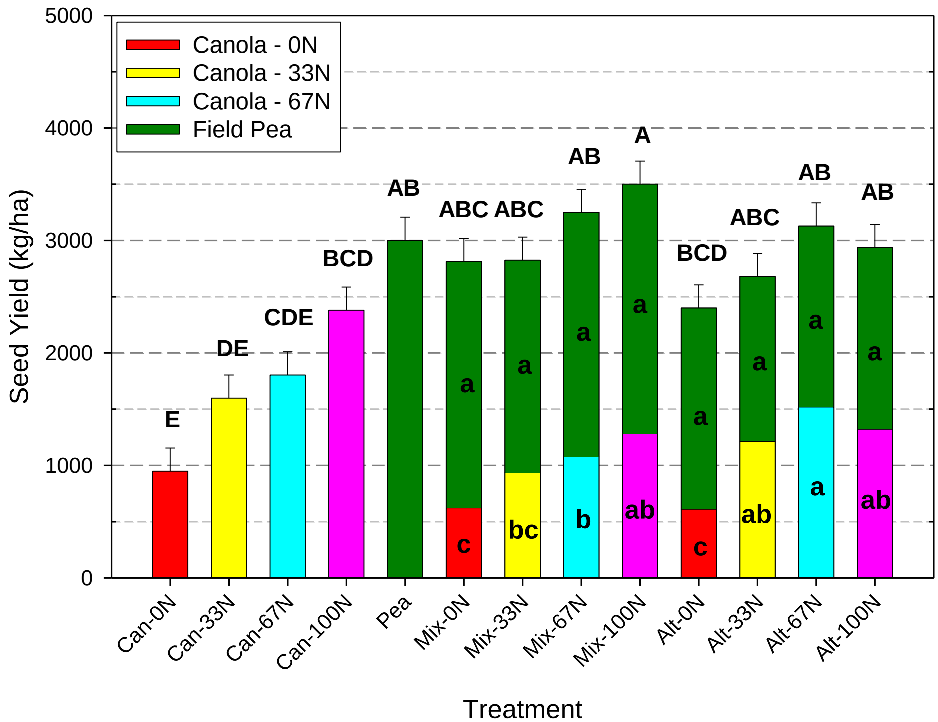

Figure 6: Seed yield at Indian Head.

The relative profitability was determined using the yield data from this project. The gross revenues were calculated with some variable expenses removed which include:

- ***Cost of Nitrogen fertilizer***: UAN - $410.00 / tonne (100% N rate = 111.56 lbs/ac actual N)
- ***Cost of Pea seed***: CDC Golden Field - $12.00 / bushel (100% seeding rate = 206 lbc/ac)
- ***Cost of Canola seed***: 45H73 CL - $377.50 / bag (100% seeding rate = 5 lbs/ac)
- ***Cost of cleaning***: $0.75 per bushel (separating the pea-canola)
- Therefore, the relative profits presented are equal to:
  (Relative Profits)=(Gross Revenues)-(N fertilizer)-(Pea seed)-(Canola seed)-(cleaning cost)
- The commodity prices used to determine the revenues were:
  Canola = $12.00/bu
  Yellow Pea = $7.50/bu

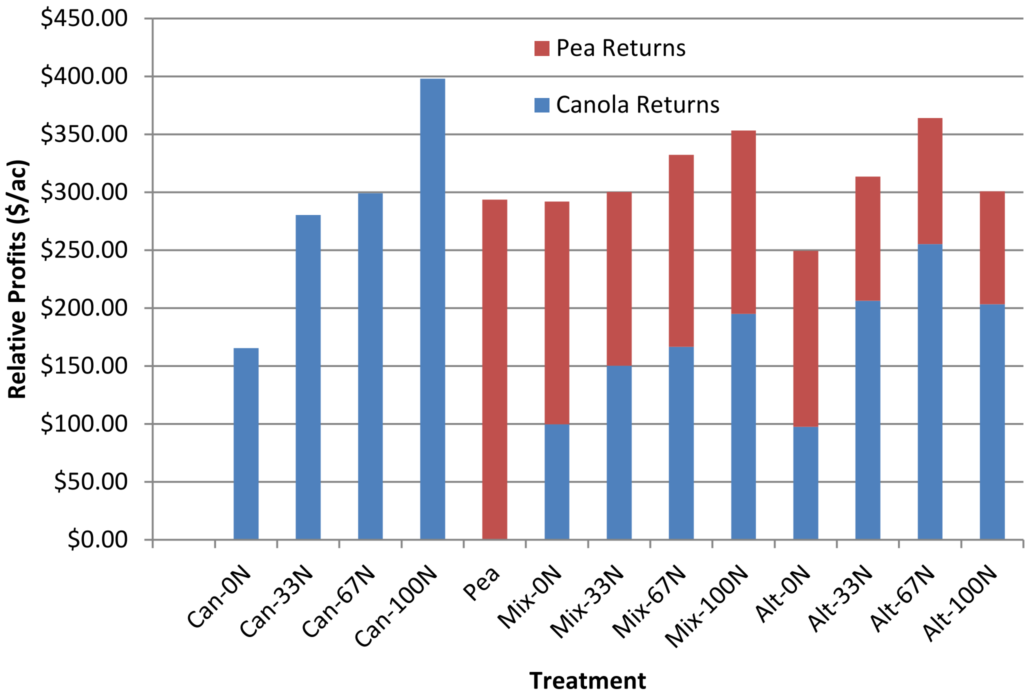

Figure 7: Relative profitability at Indian Head, 2011.

Conclusion

The results observed at Indian Head over the 2010 and 2011 growing seasons are not consistent with the results observed at other research sites across the prairies. Other locations found a significant benefit to intercropping field pea-canola, and as such, experienced greater returns in the intercropped systems. IHARF will be repeating the trial in 2012 in an attempt to further verify the results at Indian Head.

Meanwhile, there are various challenges facing producers who are considering intercropping. Crop establishment is the first concern and a compromise must be made when seeding in the mixed-row configuration. For this test, the mixed-row treatments were seeded at a minimum depth of 2.5cm, which could lead to problems for field pea germination if the weather is dry. Seeding in alternating rows is easier as it is possible to adjust the depth of every second opener on the drill.

Equipment capabilities are a concern when attempting to seed two crops into the same field. Various seeding depths, seed delivery, fertilizer application and inoculant application must be taken into consideration and may be limited by the seeding equipment available. It may be necessary to apply fertilizer to the soil before seeding the two crops.

Variety selection is also a factor to be considered as it is recommended to choose a canola variety that matures at relatively the same time as the field pea in an attempt to make harvest operations more manageable. However, the shorter season canola varieties that are available tend to yield lower than longer season varieties. Generally, a compromise must be made as it is necessary to either harvest the field pea too late or the canola too early. It may be possible to synchronize the development of the two crops by using the alternating row method and seeding the peas deeper than usual, thus delaying emergence and allowing the canola a longer period to reach maturity. The canola variety selected will also determine the herbicide options available for weed control. The producer will need to decide whether to select an Imi-tolerant (Clearfield®) variety, conventional variety, or a variety of another herbicide tolerant system and consider a trifluralin application.

Swathing or straight combining are both viable options for intercropping pea-canola. Combines can be set for field peas with slightly less air flow to prevent losing canola over the top of the sieves. It is often noted that harvesting pea-canola intercrops is easier than harvesting pure stands of field pea as the canola helps to keep the field peas upright.

One of the greatest challenges arises after harvest since the two crops cannot be stored together indefinitely due to the differing moisture contents required by both crops for safe storage (16% for pea, 10% for canola). Separating the two commodities at the time of harvest can be accomplished relatively quickly, but does require a capital investment in cleaning equipment and a greater amount of time being spent on the operation by farm workers. An alternative option is to store the mixed pea and canola in the same bin and keep aerating the material until it can be separated. This is a short-term solution and does result in extra handling and storage costs, but it is an option available to interested producers.

In any case, the growers who are seeing benefits to this practice have managed to find innovative ways of dealing with the logistical challenges of intercropping. If the demonstrated benefits are consistent and substantial enough to justify the extra management, growers will likely be rewarded for their efforts.

Figure 8: Mixed row and alternating row.

Quantifying the Genetic Differences in Seed Losses Due to Pod Drop and Pod Shattering in Canola

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[1]Indian Head Agricultural Research Foundation, Indian Head, SK
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[3]Wheatland Conservation Area, Swift Current, SK
[4]Agriculture and Agri-Food Canada, Indian Head, SK
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Overview

A study was initiated in 2011 to quantify the relative resistance to pod shattering and pod drop among high-yielding *Brassica napus* hybrids and to identify varieties which may be well suited for straight combining. Field trials were conducted at Indian Head, Scott and Swift Current. The 12 varieties which were evaluated included:

Table 6: 2011 canola varieties

Liberty Link®	*Roundup Ready®*		*Clearfield®*
1) Invigor 5440	4) Pioneer 45H29	7) Dekalb 73-45	10) Pioneer 46H75
2) Invigor L130	5) Pioneer 45H31	8) Brett Young 6060	11) Nexera 2012
3) Invigor L150	6) Dekalb 73-75	9) Proven 9553	12) Brett Young 5525

Past research on canola harvest management issues has largely overlooked genetic variability in resistance to shattering, but has rather focused on other aspects including harvest methods, equipment considerations, timing of harvest operations and general crop management. While some studies have made broader comparisons of oilseed crops, they were not focused on the *B. napus* canola species, which now comprise the vast majority of oilseed acres in Saskatchewan and Western Canada. Varietal differences in resistance to pod shattering and pod drop are important to growers who are interested in minimizing the risks associated with straight-combining canola.

The goal of this study was to expand upon previous work evaluating varietal differences of *B. napus* canola by:

- Quantifying overall losses in a broadened range of geographic and climatic regions;
- Evaluating a wide range of modern *B. napus* hybrid varieties that are representative of what producers are currently growing;
- Differentiating between seed loss contributions from pods dropping versus pod shattering;
- Evaluating different methods of measuring seed losses.

Materials and Methods

Although the trials were randomized, modifications were made in order to simplify field operations. Blocks were created with varieties belonging to the same herbicide resistant category adjacent to one another. The plots were seeded in two passes to ensure that they were wide enough for two separate harvest dates. Fertilizer formulations varied depending on the location; however, all fertilizer was placed in the soil prior to or during seeding. The first harvest date was targeted at, or slightly before the optimal harvest stage of approximately 10-12% moisture content, while the second harvest date was targeted for 2-3 weeks past optimal. Environmental seed losses from pods shattering and/or pods dropping were measured using shatter trays at two separate times; once prior to the first harvest date and again 2-3 weeks later, prior to the second harvest date. Losses were recorded separately to distinguish between pods shattering and pods dropping. As well, the yields between the two harvest dates were compared, assuming that any yield reduction was due to environmental seed losses. Grain yields were reported on a clean seed, moisture corrected basis with the samples from both harvest dates subjected to further quality analysis.

Results

The timing of the first harvest operation was targeted at, or slightly before the optimal stage for straight combining canola and before any significant yield losses had occurred. On average, the second harvest operation was completed three weeks after the first, with the actual lengths of time being 25 days at Indian Head, 20 days in Scott and 17 days in Swift Current. The yield results presented below in Table 7 have been determined using the least squares means method of determining average yields of all three sites as there was no interaction between cultivar and site, indicating that the cultivars performed similarly to one another regardless of the location.

Table 7: Least squares means canola yield.

Seed Yield (bu/ac)		
Cultivar	***Harvest T1***	***Harvest T2***
5440 LL	53.85*ab*	54.08*a*
L130 LL	53.14*ab*	52.82*a*
L150 LL	52.46*ab*	53.10*a*
45H29 RR	52.60*ab*	52.62*a*
45H31 RR	51.30*ab*	51.48*abc*
73-75 RR	56.71*a*	53.82*a*
73-45 RR	49.11*ab*	52.98*a*
6060 RR	50.41*ab*	47.23*bc*
9553 RR	50.27*ab*	51.89*ab*
46H75 CL	51.34*ab*	51.48*abc*
2012 CL	46.38*b*	46.59*c*
5525 CL	53.00*ab*	52.87*a*
Std. Error	1.75	1.21

Seed losses due to both pods shattering and pods dropping were measured and reported. The contributions to these two loss mechanisms were evaluated separately to determine the amount of seed loss attributable to each mechanism. Total losses due to both shattering and pod drop were affected by site but not by cultivar, allowing the data from all three sites to be combined and analyzed using the least squares means method of determining the amount of seed loss for each variety, shown in Table 8.

Table 8: Varietal seed losses, all sites.

	Seed Loss (bu/ac)					
Cultivar	***Pod Shatter*** *T1*	***Pod Drop*** *T1*	***Total Losses*** *T1*	***Pod Shatter*** *T2*	***Pod Drop*** *T2*	***Total Losses*** *T2*
5440 LL	0.26*a*	0.09*a*	***0.35****a*	0.85*a*	0.32*de*	***1.17****b*
L130 LL	0.24*a*	0.15*a*	***0.39****a*	0.66*a*	0.60*bcde*	***1.26****b*
L150 LL	0.28*a*	0.15*a*	***0.43****a*	0.83*a*	0.45*cde*	***1.28****b*
45H29 RR	0.20*a*	0.18*a*	***0.38****a*	1.02*a*	1.89*a*	***2.91****a*
45H31 RR	0.20*a*	0.16*a*	***0.36****a*	1.05*a*	1.26*abcd*	***2.31****ab*
73-75 RR	0.21*a*	0.25*a*	***0.46****a*	1.27*a*	1.29*abc*	***2.56****ab*
73-45 RR	0.35*a*	0.20*a*	***0.55****a*	1.65*a*	1.43*ab*	***3.08****a*
6060 RR	0.27*a*	0.12*a*	***0.39****a*	1.65*a*	1.53*ab*	***3.18****a*
9553 RR	0.17*a*	0.22*a*	***0.38****a*	0.69*a*	1.14*abcde*	***1.82****ab*
46H75 CL	0.16*a*	0.12*a*	***0.29****a*	0.74*a*	0.90*bcde*	***1.64****ab*
2012 CL	0.30*a*	0.04*a*	***0.34****a*	0.90*a*	0.29*e*	***1.19****b*
5525 CL	0.21*a*	0.18*a*	***0.38****a*	0.86*a*	1.16*abcde*	***2.02****ab*
Std. Error	0.06	0.05	***0.10***	0.23	0.20	***0.36***

Pod lengths were also measured to determine if there was a correlation between pod size and seed loss. Positive linear relationships were detected between pod length and pod shatter, drop and total seed losses. The results indicate that pod length has a greater impact on resistance to pod shattering as opposed to whole pods breaking off and dropping to the ground. Green seed content was lower at the second harvest date, as expected, and varied between sites (Table 9).

Table 9: Least squares means green seed content.

Green Seed (%)		
Cultivar	***Harvest T1***	***Harvest T2***
5440 LL	0.83*bc*	0.18*a*
L130 LL	0.59*c*	0.13*a*
L150 LL	1.71*bc*	0.77*a*
45H29 RR	1.83*bc*	0.68*a*
45H31 RR	0.77*c*	0.22*a*
73-75 RR	1.86b*c*	0.52*a*
73-45 RR	1.64*bc*	0.88*a*
6060 RR	4.70*a*	1.21*a*
9553 RR	1.76*bc*	0.29*a*
46H75 CL	2.50*b*	0.79*a*
2012 CL	1.28*bc*	0.35*a*
5525 CL	0.94*bc*	0.17*a*
Std. Error	0.408	0.290

Conclusion

All varieties yielded competitively with one another, with the only significant yield difference between the highest and lowest yielding varieties. The performance of the varieties was similar regardless of the location, thus the data from all sites was combined and analyzed. Overall, the environmental seed losses measured using shatter trays was relatively low, even after the canola had been left standing for more than three weeks past the optimal harvest stage. Initial results indicate that there are differences amongst varieties in regards to seed losses from pod shatter and pod drop, but the amount of seed lost through this mechanism is very low. It should be noted that the 2011 harvest season was relatively fair in terms of weather, which resulted in less strain on the standing canola. Had the weather been more unfavorable with heavy rain, snow or wind, the results could have been drastically different. As this trial has only taken place for one year, the results of this study are still considered preliminary and field trials will continue at all three locations for a minimum of one more growing season.

Conventional *Brassica carinata* (Ethiopian Mustard) Variety Testing

C. Holzapfel[1]

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Overview

In the summer of 2011, IHARF conducted a field trial at Indian Head in collaboration with Agrisoma Biosciences Inc. with the objective of evaluating the performance of *Brassica carinata* varieties in southeast Saskatchewan and two mustard varieties currently being grown in the province. The project included 10 experimental *B. carinata* lines and two oriental mustard (*Brassica juncea*) lines and was replicated three times.

Table 10: *Brassica carinata* & mustard varieties

1) 080814EM	4) 100880EM	7) 090866EM	10) 090863EM
2) 080820EM	5) 100879EM	8) 080816EM	11) Cutlass
3) 080822EM	6) 090867EM	9) 100878EM	12) AC Vulcan

Materials and Methods

All cultivars were seeded into wheat stubble on May 19, 2011, using a zero-till air drill with 12 inch row spacing. Granular fertilizer was side banded at a rate of 115-30-14-14 actual pounds of nutrient per acre. Weeds were aggressively controlled with applications of Edge, Avadex MicroActiv, Muster Toss-N-Go and Assure II; however, no pre-harvest glyphosate or desiccants were applied as the plots were terminated by frost on September 13. The harvested samples were cleaned and the moisture content was corrected to determine the net yield. Additional response variables measured included plant density, days to flower, plant height, lodging and days to maturity.

Results

The 2011 growing season at Indian Head was cooler than normal and experienced 150% of normal precipitation during May and June. The excessive moisture caused stressful conditions for the young plants until the flowering stage, but conditions were warm and dry in the latter half of the growing season allowing the *B. carinata* to recover well during the reproductive growth stages. Significant varietal differences were observed in crop establishment and the overall average plant density was 100 plants/m^2 (Table 11). Though the plants were relatively short, significant differences in height were observed amongst varieties during pod filling. The *B. juncea* varieties began flowering and matured significantly earlier than the *B. carinata* varieties, which may be due in part to the *B. juncea* varieties appearing to be more affected by *Alternaria* black spot, which did not seem to affect the *B. carinata* varieties at the same level. When averaged across all treatments, yields were relatively high with *B. carinata* out-yielding the *B. juncea* by 22%.

Table 11: Variety comparisons, 2011.

Variety		Plant Density	Height	Lodging	Days to Flower	Days to Maturity	Seed Yield
		plants/m2	*cm*	*1 - 5*	*-- days from seeding --*		*bu/ac*
1	080814EM	76.0*bc*	93.3*abc*	1.83*ab*	48.7*a*	101.3*bc*	51.23*ab*
2	080820EM	95.7*b*	83.3*abc*	2.33*ab*	48.0*a*	98.7*d*	54.10*a*
3	080822EM	77.6*bc*	88.8*abc*	1.83*ab*	48.7*a*	100.7*c*	53.48*a*
4	100880EM	88.6*bc*	91.5*abc*	2.00*ab*	49.0*a*	102.0*ab*	54.53*a*
5	100879EM	55.8*bc*	96.2*a*	1.83*ab*	49.0*a*	101.7*bc*	52.07*ab*
6	090867EM	92.9*bc*	87.2*abc*	2.17*ab*	48.3*a*	101.7*bc*	50.71*ab*
7	090866EM	72.2*bc*	75.7*bc*	2.17*ab*	47.3*a*	100.7*c*	54.28*a*
8	080816EM	59.6*bc*	84.3*abc*	2.00*ab*	48.7*a*	100.7*c*	47.27*ab*
9	100878EM	83.1*bc*	93.8*ab*	2.67*a*	48.0*a*	100.7*c*	54.03*a*
10	090863EM	53.0*c*	73.3*c*	1.50*b*	48.3*a*	103.0*a*	52.30*ab*
11	Cutlass	221.4*a*	91.8*abc*	2.17*ab*	44.0*b*	88.0*e*	44.34*ab*
12	AC Vulcan	226.9*a*	93.2*abc*	1.67*b*	44.0*b*	88.0*e*	41.60*b*
	Standard Error	*7.9*	*3.95*	*0.17*	*0.39*	*0.25*	*2.19*

Conclusion

Despite considerable stress levels during the first part of the growing season, the *B. carinata* performed well at Indian Head in 2011, with the first frost effectively terminating the plants on September 13. Although the *B. carinata* varieties tended to be shorter than the *B. juncea*, no *B. carinata* lines were significantly shorter and lodging was not severe enough to have a negative impact on harvest operations. The *B. carinata* also seemed to be less affected by *Alternaria* black spot and this may have played a role in the earlier maturity and lower yield of *B. juncea* varieties relative to *B. carinata*. Based on one year of data, *B. carinata* appears to be an agronomically viable and productive crop for heavy clay soils in the thin black soil zone of Southeast Saskatchewan.

2011 Lentil Fertility Trial

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Overview

In 2011, IHARF initiated a field trial at Indian Head in collaboration with the Mosaic Company. The objective of the trial was to evaluate the response of lentil to applications of various rates and forms of side-banded phosphorus (P), potassium (K) and sulphur (S).

Materials and Methods

The treatments that were evaluated are provided in Table 12.

Table 12: Description of treatments.

Trt #	*Forms and Rates (lbs/ac)*	*N - P_2O_5 - K_2O - S (lbs/ac)*
1	Check	0 - 0 - 0 - 0
2	19.1 MAP[Z]	1.8 - 9.8 - 0 - 0
3	18.2 KCl	0 - 0 - 10.7 - 0
4	19.1 MAP + 18.2 KCl	1.8 - 9.8 - 10.7 - 0
5	24.9 MESZ + 18.2 KCl	3.6 - 9.8 - 10.7 - 2.7 + 0.26 Zn
6	49.8 MESZ + 18.2 KCl	6.2 - 19.6 - 10.7 - 5.3 + 0.52 Zn
7	99.7 MESZ + 18.2 KCl	12.5 - 40.1 - 10.7 - 9.8 + 0.98 Zn
8	19.1 MAP + 10.7 AS + 18.2 KCl	4.5 - 9.8 - 10.7 - 2.7
9	38.3 MAP + 20.5 AS + 18.2 KCl	8.9 - 19.6 - 10.7 - 5.3
10	19.1 MAP + 49.8 K-Mag	1.8 - 9.8 - 10.7 - 10.7 + 5.3 Mg
11	19.1 MAP + 99.7 K-Mag	1.8 - 9.8 - 22.3 - 22.3 + 10.7 Mg
12	30.3 MES15 + 149.5 K-Mag	3.6 - 9.8 - 32.9 - 37.4 + 16.5 Mg

[Z] AS – ammonium sulphate (21-0-0-24); KCl – potassium chloride (0-0-60);
MAP – monoammonium phosphate (11-52-0); K-Mag – (0-22-11-22);
MES15 – MicroEssentials S15 (13-33-0-15); MESZ – MicroEssentials SZ (12-40-0-10-1Zn)

A composite soil test was taken for the entire study area from 0-60 cm and sent for analysis to the ALS Laboratory Group in Saskatoon (Table 13). CDC Maxim, a Clearfield lentil variety, was seeded using a no-till air drill with 12 inch row spacing and a targeted seed depth of 1-1.5 inches. A granular inoculant was used and fertilizer treatments were applied below and to the side of the seed. Weed control consisted of pre-seed glyphosate and Avadex applications, an in-crop application of Odyssey DLX and a later application of Centurion. Headline was applied to minimize the potential impacts of disease.

Table 13: Soil test characteristics and nutrient levels at Indian Head, 2011.

	Soil Depth (cm)		
	0-15	***15-30***	***30-60***
pH	7.7	8.0	8.1
E.C. (mS/cm)	0.2 (non-saline)	0.2 (non-saline)	0.3 (non-saline)
Organic Matter (%)	4.5	-	-
		lbs / ac	
NO_3-N	10.68	7.12	8.90
P_2O_5	16.02	-	-
K	>508	-	-
SO_4-S	16.02	11.57	23.14
Cu	3.56	-	-
Mn	16.38	-	-
Zn	2.49	-	-
B	2.13	-	-
Fe	33.82	-	-
Cl	6.23	3.56	6.23

Test weights were determined from cleaned subsamples according to Canadian Grain Commission standards. Yields were calculated with corrections for varying moisture contents.

Results

Temperatures were below normal for the first half of the growing season, along with above average precipitation. Moisture levels were extremely high in early June, resulting in stressful conditions for the young plants. Flooding eventually led to the first replicate of the trial being excluded from the results. Most of the crops in the region recovered well later in the season as the weather turned warmer and drier; however, the lentils tended to yield well below average. The side-banded fertilizer treatments did not have a significant effect on plant establishment, severity of lodging or seed yield. The contrasts comparing the unfertilized check to the fertilized treatments as a whole were not significant for any of these three variables. The test weight of the harvested lentil was affected by fertilizer treatment.

Table 14: Fertilizer treatment effects for lentil at Indian Head, 2011.

Trt #	*Fertilizer Forms and Rates (lbs/ac)*	*Plant Density*	*Test Weight*	*Seed Yield*
		Plants/m²	*g/0.5L*	*bu / ac*
1	Check (0-0-0-0)	138.9*a*	402.5*a*	18.32*a*
2	19.1 MAP (1.8-9.8-0-0)	127.9*a*	398.5*cd*	17.18*a*
3	18.2 KCl (0-0-10.7-0)	129.6*a*	401.1*ab*	19.05*a*
4	19.1 MAP + 18.2 KCl (1.8-9.8-10.7-0)	118.7*a*	399.5*bcd*	16.76*a*
5	24.9 MESZ + 18.2 KCl (3.6-9.8-10.7-2.7+0.26Zn)	141.1*a*	399.9*bc*	20.84*a*
6	49.8 MESZ + 18.2 KCl 6.2-19.6-10.7-5.3+0.52Zn)	125.2*a*	399.9*bc*	16.64*a*
7	99.7 MESZ + 18.2 KCl (12.5-40.1-10.7-9.8+0.98Zn)	122.5*a*	400.1*bc*	22.41*a*
8	19.1 MAP + 10.7 AS + 18.2 KCl (4.5-9.8-10.7-2.7)	136.2*a*	398.5*cd*	17.84*a*
9	38.3 MAP + 20.5 AS + 18.2 KCl 8.9-19.6-10.7-5.3)	140.0*a*	400.1*bc*	22.40*a*
10	19.1 MAP + 49.8 K-Mag (1.8-9.8-10.7-10.7+5.3Mg)	125.2*a*	399.3*bcd*	16.06*a*
11	19.1 MAP + 99.7 K-Mag (1.8-9.8-22.3-22.3+10.7Mg)	147.1*a*	397.4*d*	18.10*a*
12	30.3 MES15 + 149.5 K-Mag (3.6-9.8-32.9-37.4+16.5Mg)	111.5*a*	399.2*bcd*	18.91*a*
	Standard Error	11.97	0.81	1.84

Conclusion

Consistent with similar studies completed at Indian Head over the past two years, lentils did not have a yield response to the application of fertilizer, regardless of the fertilizer formulation or application rate. Based on the results of this study, fertilizer would not be expected to improve lentil development or yields on the heavy clay soils in the Indian Head area. That said, a lentil crop yielding 29.97 bu/ac will remove 17-19 lbs/ac of P_2O_5; therefore producers may choose to apply a maintenance application of P in order to avoid depleting residual P levels. It is possible that some nutrients leached below the rooting zone as a result of the unusually high precipitation early in the season, but at the same time, the lentils were sufficiently stressed indicating that nutrient availability was most likely not the limiting factor in the study.

2011 Canola Fertility Study

C. Holzapfel[1]

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Overview

This study examined canola fertility and was initiated at Indian Head by IHARF in collaboration with the Mosaic Company. The objective of the trial was to evaluate the response of canola (*Brassica napus*) to applications of various rates and forms of seed-applied phosphorus (P), potassium (K), sulphur (S), zinc (Zn) and magnesium (Mg).

Materials and Methods

The fertilizer treatments evaluated are provided in Table 15.

Table 15: Description of treatments.

Trt #	*Forms and Rates (lbs/ac)*	*N - P_2O_5 - K_2O - S (lbs/ac)*
1	Check	0 - 0 - 0 - 0
2	248 Urea[Z]	114 - 0 - 0 - 0
3	219 Urea + 100 MES15[Y]	114 - 33 - 0 - 15
4	206 Urea + 100 MES15 + 31 AS	114 - 33 - 0 - 22
5	220 Urea + 100 MES15 + 34 K-Mag	114 - 33 - 7 - 22 + 3.7 Mg
6	233 Urea + 63 MAP	114 - 33 - 0 - 0
7	204 Urea + 63 MAP + 62 AS	114 - 33 - 0 - 15
8	204 Urea + 63 MAP + 62 AS + 2.3 $ZnSO_4$	114 - 33 - 0 - 15 + 0.8 Zn
9	227 Urea + 82 MESZ	114 - 33 - 0 - 8 + 0.8 Zn
10	212 Urea + 82 MESZ + 31 AS	114 - 33 - 0 - 15 + 0.9 Zn
11	227 Urea + 82 MESZ + 34 K-Mag	114 - 33 - 7 - 15 + 0.8 Zn + 3.7 Mg

[Z] Granular urea was side-banded while all other fertilizer products seed-placed
[Y] AS – ammonium sulphate (21-0-0-24); KCl – potassium chloride (0-0-60);
MAP – monoammonium phosphate (11-52-0); K-Mag – (0-22-11-22);
MES15 – MicroEssentials S15 (13-33-0-15); MESZ – MicroEssentials SZ (12-40-0-10-1Zn);
$ZnSO_4$ – Zinc Sulfate (0-0-0-16.5-36Zn)

A composite soil test for the study area was collected and the results are presented in Table 13. Invigor 5440 was direct seeded into wheat stubble with 12 inch row spacing at a rate of 5.75 lbs/ac. Weeds were aggressively controlled with pre-seed applications of glyphosate and Avadex MicroActiv and two separate in-crop applications of Liberty. A full rate application of Astound was applied to reduce potential disease impacts. The harvested sample for each plot was cleaned and weighed with yields corrected to a moisture content of 10%.

Results

As in the lentil study above, the data from the entire first replicate was excluded from analysis due to flooding damage experienced early in the season. Canola plants in the remaining three replicates recovered very well over the growing season, producing above average yields. There were no significant differences between treatments for plant emergence, plant density and green seed; however, yields were significantly affected by fertilizer treatment (Table 16).

Table 16: Fertilizer treatment effect for canola at Indian Head, 2011.

Trt #	*Fertilizer Forms and Rates (lbs/ac)*	*Plant Density*	*Emergence Score*	*Seed Yield*	*Green Seed*
		Plants/m²	*1 - 10*	*bu / ac*	*%*
1	Check (0-0-0-0)	92*a*	10*a*	15.7*f*	0.3*a*
2	248 Urea (114-0-0-0)	95*a*	10*a*	41.4*e*	1.5*a*
3	219 Urea + 100 MES15 (114-33-0-15)	89*a*	10*a*	52.6*cd*	0.9*a*
4	206 Urea + 100 MES15 + 31 AS (114-33-0-22)	86*a*	10*a*	51.8*cd*	0.6*a*
5	220 Urea + 100 MES15 + 34 K-Mag (114-33-7-22+3.7 Mg)	94*a*	10*a*	52.7*bcd*	0.4*a*
6	233 Urea + 63 MAP (114-33-0-0)	88*a*	10*a*	50.1*d*	0.8*a*
7	204 Urea + 63 MAP + 62 AS (114-33-0-15)	91*a*	10*a*	54.7*abcd*	0.9*a*
8	204 Urea + 63 MAP + 62 AS + 2.3 $ZnSO_4$ (114-33-0-15+0.8 Zn)	92*a*	9.7*a*	57.8*ab*	0.9*a*
9	227 Urea + 82 MESZ (114-33-0-8+0.8 Zn)	103*a*	10*a*	52.8*bcd*	0.6*a*
10	212 Urea + 82 MESZ + 31 AS (114-33-0-15+0.9 Zn)	85*a*	10*a*	52.4*cd*	0.3*a*
11	227 Urea + 82 MESZ + 34 K-Mag (114-33-7-15+0.8 Zn + 3.7 Mg)	89*a*	10*a*	53.1*abcd*	0.9*a*
	Standard Error	5.18	0.07	1.76	0.25

Despite the excellent emergence for all treatments, differences between treatments were visually apparent at the early bolting stage, with substantial responses to N, P and, to a lesser extent, S observed. The addition of Zn or Mg at seeding did not result in a statistically significant yield increase over treatments with the same rates of N-P-K-S. These results are consistent with those of many canola fertility trials completed on the Canadian prairies. Canola is recognized as a large user of N and yield response to N fertilizer is generally experienced in most years. While less consistent on a year-to-year basis relative to N additions, canola does generally respond well to P fertilizer applications. Canola is recognized as a large user of S and the response of canola to S fertilizer applications is generally greater at higher N rates. Nonetheless, many soils in Saskatchewan are less responsive to S fertilizer and yield responses can be variable. It was observed that the treatment which received N fertilizer but no P was visibly less mature than the other treatments just before swathing (Figure 9). As well, the treatments with no P applied also tended to have higher green seed content.

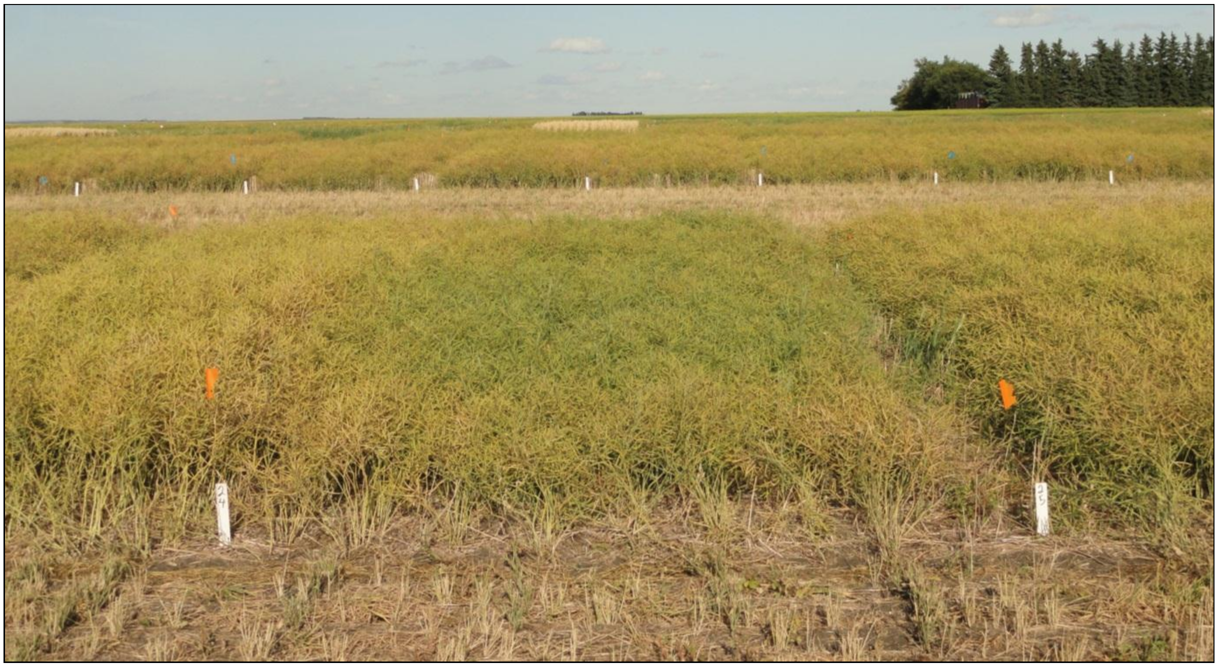

Figure 9: Delayed maturity of canola potentially due to phosphorus deficiency at Indian Head, 2011.

Conclusion

No treatment effects on plant establishment were observed even though all fertilizer products except urea were seed placed. This indicates that the fertilizer placement provided adequate separation between the canola and the side-banded urea. This also indicates that all of the seed placed products were applied at safe rates for the heavy clay soils and moist conditions experienced at Indian Head in 2011. The canola responded well to the addition of N, P and S with the greatest yield increase being attributable to the N. As long as all three nutrients were provided (N,P,S) no significant yield differences were observed, regardless of the formulation. There was no statistically significant increase in seed yield resulting from the addition of small quantities of Zn and Mg.

2011 Canola Seed Safety Trial

C. Holzapfel[1]

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Overview

IHARF collaborated with the Mosaic Company to complete a trial comparing the effects of seed-placed phosphorus (P) and sulphur (S) fertilizers on canola emergence and yield. The trial consisted of different treatments incorporating blends of monoammonium phosphate (MAP), ammonium sulphate (AS) and Mosaic's MicroEssentials S15 (MES15) and K-Mag fertilizers.

Materials and Methods

The fertilizer treatments evaluated in this trial are shown in Table 17. Results of a composite soil test for the entire study area are presented above (Table 13). Invigor 5440 was direct seeded into wheat stubble using 12 inch row spacing at a rate of 5.75 lbs/ac. Granular fertilizer was applied in all treatments with the urea side-banded and all other fertilizers applied with the seed. Yield for the harvested sample of each plot was corrected to a moisture content of 10%.

Table 17: Description of treatments.

Trt #	*Forms and Rates (lbs/ac)*	*N - P_2O_5 - K_2O - S (lbs/ac)*
1	138 Urea[Z] + 160 MAP[Y] +157 AS	114-83-0-37
2	161 Urea + 127 MAP + 125 AS	114-66-0-30
3	182 Urea + 96 MAP + 95 AS	114-50-0-23
4	204 Urea + 63 MAP + 62 AS	114-33-0-15
5	226 Urea + 33 MAP + 32 AS	114-17-0-8
6	178 Urea + 251 MES15	114-83-0-37
7	192 Urea + 200 MES15	114-66-0-30
8	205 Urea + 152 MES15	114-50-0-23
9	220 Urea + 100 MES15	114-33-0-15
10	234 Urea + 52 MES15	114-17-0-8
11	Check	0-0-0-0
12	248 Urea	114-0-0-0
13	220 Urea + 100 MES15 + 34 K-Mag	114-33-7-22 + 3.7 Mg
14	205 Urea + 152 MES15 + 34 K-Mag	114-50-7-30 + 3.7 Mg

Z Granular Urea was side-banded while all other fertilizer products were seed-placed
Y MAP – monoammonium phosphate (11-52-0); AS – ammonium sulphate (21-0-0-24); MES15 – MicroEssentials S15 (13-33-0-15); K-Mag (0-22-11-22)

Results

The number of canola plants successfully established was affected by the fertilizer treatment, regardless of whether the measurements were completed in the spring or fall. In the spring, canola plant populations were up to 20% higher in the unfertilized check than the fertilized treatments (Table 18). Seed-placing a blend of MAP+AS resulted in slightly lower plant densities when compared to the MES15 at similar fertility levels in both the spring and fall counts, though the results were only significant at the highest fertility level (114-83-0-37). The observed reduction in plant populations was less severe than expected considering the high rates of P and S fertilizer applied with the seed. This may be attributable to the well above normal precipitation experienced early in the growing season. There were no significant differences in plant vigor observed between the MAP+AS and MES15 blends when averaged across the five P and S rates. It should be noted that even though total S rates were balanced between the fertilizer formulations, half of the S in MES15 is in the elemental form and is not immediately available to the plants. Lodging appeared to be more severe in the unfertilized check, which may be due to the plants having weaker stems in the absence of fertilizer, as well as being more mature at the time of swathing.

Table 18: Fertilizer treatment effects for canola at Indian Head, 2011.

Trt #	***Forms and Rates (lbs/ac)***	***Plant Density***		***Vigor***	***Lodging***	***Seed***
		Spring	*Fall*	***Score***	***Score***	***Yield***
		plants / m²		*1 - 5*	*1 - 5*	*bu/ac*
1	160 MAP +157 AS (114-83-0-37)	63*h*	76*f*	3.7*c*	2.2*ab*	42.9*e*
2	127 MAP + 125 AS 114-66-0-30)	71*gh*	70*ef*	4.2*ab*	2.2*ab*	52.1*abcd*
3	96 MAP + 95 AS 114-50-0-23)	73*fgh*	76*bcdef*	4.2*ab*	2.0*b*	47.4*cde*
4	63 MAP + 62 AS (114-33-0-15)	82*defg*	76*bcdef*	4.2*ab*	2.0*b*	58.4*a*
5	33 MAP + 32 AS (114-17-0-8)	96*abc*	80*bcde*	4.2*ab*	2.0*b*	54.9*ab*
6	251 MES15 (114-83-0-37)	83*def*	84*bcd*	4.0*abc*	2.3*ab*	51.5*abcd*
7	200 MES15 (114-66-0-30)	78*efg*	72*def*	4.2*ab*	2.0*b*	52.5*abcd*
8	152 MES15 (114-50-0-23)	82*defg*	75*cdef*	4.3*a*	2.0*b*	52.7*abcd*
9	100 MES15 (114-33-0-15)	92*abcd*	84*bcd*	4.2*ab*	2.0*b*	56.3*a*
10	52 MES15 (114-17-0-8)	89*bcde*	88*ab*	3.8*bc*	2.2*b*	48.0*bcde*
11	Check (0-0-0-0)	102*a*	86*bc*	1.0*e*	2.5*a*	17.3*f*
12	248 Urea (114-0-0-0)	101*ab*	100*a*	2.5*d*	2.3*ab*	46.4*de*
13	100 MES15 + 34 K-Mag (114-33-7-22 + 3.7 Mg)	88*ced*	88*ab*	4.2*ab*	2.0*b*	54.0*abc*
14	152 MES15 + 34 K-Mag (114-50-7-30 + 3.7 Mg)	87*ced*	80*bcdef*	4.0*abc*	2.0*b*	51.8*abcd*
	Standard Error	4.1	4.4	0.15	0.12	2.465

Seed yields were highly affected by the fertilizer treatments relative to the unfertilized check. When averaged across rates, MAP+AS blended treatments yielded similarly to the MES15 treatments. At the 114-33-0-15 fertility level, the MAP+AS yielded higher than the MES15 treatments, while having a lower plant density. This could be due to the lower salt index of the MES15 resulting in less seedling toxicity, while at the same time, the elemental S component of the MES15 not meeting the canola plants requirements for S. While elemental S will oxidize and become available to the plant over time, yield reductions could be expected in S deficient soils. Where S deficiencies do not exist, yield reductions may not be expected.

Conclusion

Slight overall reductions in canola plant populations were observed with the application of seed-placed S and P fertilizers. Averaged across rates, plant populations were 5-10% higher for MES15 than they were for the MAP-AS blend, presumably as a result of the lower quantities of seed-placed N and SO_4-S with the MES15 at any given rate. The response to the N+P+S was evident early in the growing season with significant differences in plant vigor observed between the unfertilized check and N only treatment, as well as between the N only treatment and N+P+S treatments. Averaged across rates, MAP-AS and MES15 treatments produced similar yields.

Suitability of New Mid-Oleic and High-Oleic Hybrid Sunflower across Saskatchewan

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Overview

This project was developed by the Saskatchewan Sunflower Committee to evaluate new hybrid sunflower varieties based on yield, maturity and rate of dry down after reaching physiological maturity throughout Saskatchewan. Due to the small acreage of sunflowers seeded across the province (approximately 10,000 acres), new hybrids that have been bred and released in the United States and Europe have not been tested in Saskatchewan.

Results

The project took place at Indian Head, Swift Current, Melfort and Saskatoon in 2011. In 2010, this project took place at Indian Head, Canora, Swift Current, Redvers, Melfort, Tribune and Outlook. Seeding methods varied from location to location based on the capabilities of each site. No-till plot drills seeded into standing cereal stubble at some sites while at others, small plot disk drills seeded into tilled soil. Weather conditions greatly varied from location to location; therefore some caution must be taken in using this information until further data can be collected in the coming years. The overall performance of the cultivars is presented in Table 19. At first glance, it appears that 63A21 is one of the top varieties available to producers; however, the hybrid 63A21 is a traditional oil sunflower and the majority of the market is moving to a Nusun oil profile as found in the 803 DMR and 2930 NS varieties. These two hybrids appear to be the most promising new varieties available as other hybrids seem to be limited to the warmer growing regions of Saskatchewan.

Table 19: Performance of hybrids and cultivars averaged across 3 locations in Saskatchewan, 2011.

	Grain Yield	***Days to First Bloom***	***Maturity***	***Kernel Moist. at Harvest***	***Kernel Weight***	***Height***	***Plant Density***	***Test Weight***	***Oil***
Variety	*lbs/ac*	*days*	*days*	*%*	*g/1000 kernels*	*cm*	*plants / ac*	*g / 0.5L*	*%*
63A21[Z]	1,432	70.0	114.2	19.3	44.4	128.2	40,490	180.2	38.6
63A21[X]	1,146	69.8	115.0	25.6	50.8	126.7	23,752	178.0	37.7
AC Sierra	972	64.8	110.0	13.5	52.8	116.1	27,021	195.2	42.1
803 DMR/NS	1,180	75.8	117.2	19.1	45.5	139.3	19,413	174.2	39.5
306 DMR/NS	1,186	76.9	121.1	28.3	48.7	144.5	23,667	175.4	40.1
2930 NS/DM	NA	76.7	119.2	21.7	48.4	140.8	15,169	171.9	37.5
7120 HO/DM	1,097	77.2	121.1	30.7	55.4	140.3	17,450	171.9	38.1
8N270 CLDM	1,253	74.8	116.9	26.4	50.0	140.5	20,774	183.3	39.0
Defender Plus	NA	79.4	118.7	NA	NA	120.2	9,111	NA	NA
LSD	234	2.3	1.6	6.8	4.7	12.5	4,790	6.3	1.2

[Z] 63A21 seeded at 11.1 plants/m^2
[X] 63A21 seeded at 6 plants/m^2

Effects of Pod Sealants on Milling Quality of Spring Wheat

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Overview

Initiated in 2011, the objective of this trial was to determine whether applying a pod-sealant at physiological maturity can help maintain the falling number (a measure of sprouting damage) of hard red spring wheat under unfavourable harvest conditions, as well as to determine whether the same level of efficacy can be achieved with pod-sealants applied at the full rate, 20imp gal/ac of water and at 10imp gal/ac of water.

Materials and Methods

Pod-sealants were applied at both the full rate and half rate water volume to spring wheat at the hard dough stage and left to mature naturally, with no pre-harvest desiccant or glyphosate applied. All harvested samples were corrected for moisture contents and evaluated using Canadian Grain Commission standards. The samples were sent to Intertek Canada for grading and determination of test weight, protein concentration and falling number. The falling number is affected by the amount of sprouting damage in spring wheat and generally, a falling number value of 350 seconds or longer indicates low enzyme activity and very sound wheat. As enzyme activity increases, the falling number decreases, as does the baking quality of the wheat.

Results

Two major precipitation events occurred between application of the pod-sealant and harvest. Six days after application, the site received 9mm of rain and an additional 21mm three weeks later. Although the grain yield was measured in this trial, the intent of the project was to determine if the pod-sealants would prevent sprouting damage in the event of precipitation or prolonged wet conditions during harvest. Consequently, the pod-sealants had no effect on grain yield (Table 20). Dockage, ergot levels and the falling number were not significantly affected by any treatment. Test weight and protein levels were significantly affected by the application of pod-sealants; however, it is unlikely that these differences were a result of the treatment applications. Protein concentrations are a function of nitrogen and the amount of protein a crop can produce is not affected by the specific weather conditions a crop may experience at or beyond physiological maturity.

Table 20: Pod-sealant effects on spring wheat, 2011.

	Grain Yield	***Dockage***	***Test Weight***	***Protein***	***Ergot***	***Falling Number***
Treatment	*bu/ac*	*%*	*kg/hl*	*%*	*%*	*seconds*
Check	55.2*a*	0.9*a*	83.75*a*	14.9*b*	0.010*a*	379.4*a*
Pod-Sealant (10 gal/ac)	56.2*a*	0.9*a*	83.45*b*	15.2*a*	0.012*a*	376.9*a*
Pod-Sealant (20 gal/ac)	54.5*a*	1.0*a*	83.60*ab*	15.0*b*	0.014*a*	374.9*a*
Std. Error	1.24	0.07	0.05	0.07	0.0039	2.27

Conclusion

The two substantial precipitation events that occurred post-application should have provided an opportunity to evaluate the ability of pod-sealants to preserve the grain quality of spring wheat. Of the quality parameters measured, only the test weight and protein levels were statistically significant and it is unlikely that the observed differences were attributable to the pod-sealants. It is possible that despite the substantial amount of rain prior to harvest, the overall weather conditions were sufficiently warm and dry, reducing the chance for sprouting to occur. Consequently, no benefit to the application of pod-sealant was observed.

Response of Canola to the Application of Phosphorus Fertilizer and *Penicillium bilaii* (Jumpstart®)

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Overview

Early season phosphorus nutrition is critical for optimum crop yield. Phosphorus (P), in the form of H_2PO_4 and HPO_4, is taken up by the plant roots from the soil solution which, in turn, is supplied by soil inorganic and organic P sources as well as applied P fertilizer. While the total P content in prairie soils can be large, only a small proportion of the total soil P may be plant available. *Penicillium bilaii* (Jumpstart®) is a fungus that occurs naturally in the soil and lives in association with plant roots. Jumpstart® has been shown to increase P uptake in various crops by solubilizing P through an acidification process. The objective of this study was to assess the effect of P fertilizer with and without Jumpstart® on growth, P uptake, yield and quality of canola in Saskatchewan (Indian Head) and Manitoba (Brandon and Carberry). This was the second year of the study.

Materials and Methods

Soil samples were taken at all sites and in each replicate (0-15, 15-30 and 30-60 cm) which were combined to produce one sample for each depth increment per field replicate. Treatments were randomly arranged with and without Jumpstart® as well as with the P seed-placed and side-banded (Table 21). Nitrogen levels were adjusted depending on the amount of P fertilizer being applied to ensure that 130 lbs/ac of N was supplied with all treatments.

Table 21: Canola response to Jumpstart® treatment list.

Trt #	*P - Placement*	*P rate (lbs P_2O_5 ac^{-1})*	*Jumpstart® Applied*
1	Banded	0	Yes
2	Banded	9	Yes
3	Banded	18	Yes
4	Banded	27	Yes
5	Banded	36	Yes
6	Seed-Placed	9	Yes
7	Seed-Placed	18	Yes
8	Banded / Seed-Placed	18/18	Yes
9	Banded	0	No
10	Banded	9	No
11	Banded	18	No
12	Banded	27	No
13	Banded	36	No
14	Seed-Placed	9	No
15	Seed-Placed	18	No
16	Banded / Seed-Placed	18/18	No

Invigor 5440 was seeded at all sites, with plant populations targeted for 150 plants/m^2. Seeding rates were adjusted to account for the greater weight of seed after the inoculant was applied. Plant densities were determined at the three leaf stage and early season biomass was determined three to four weeks after emergence by hand harvesting the plants that were initially counted. All seed yields were calculated with clean seed corrected to a moisture content of 10%.

Results

All locations experienced extremely wet conditions in the spring, resulting in the Brandon and Carberry sites relocating the trials and delaying field operations. As a result of the delayed seeding at the Carberry site, the trial experienced frost damage prior to harvest. Regardless of treatment, plant densities were within the recommended levels at all sites and no significant effects on plant densities were observed. As shown in Table 22, neither inoculant nor P application affected seed yield, test weight, or percent green seed at any of the three sites in 2011.

Table 22: Phosphorus and Jumpstart® inoculant effects on canola, 2011.

Phosphorus Placement	P-Rate (lbs/ac)	Inoc	Plant Density			Early Season Biomass			Seed Yield		
			Brandon	Carberry	I.H.	Brandon	Carberry	I.H.	Brandon	Carberry	I.H.
			plants / m^2			kg / ac			bu / ac		
Banded	0	Y	112	106	89	398	643	505	32.8	16.2	52.5
Banded	9	Y	133	110	94	483	724	622	30.0	18.0	60.3
Banded	18	Y	118	106	89	406	771	558	31.6	16.8	54.6
Banded	27	Y	111	111	96	403	683	600	32.9	17.3	57.3
Banded	36	Y	127	110	90	464	732	597	31.2	18.6	52.7
Seed-Placed	9	Y	106	100	82	342	757	582	31.8	17.8	56.1
Seed-Placed	18	Y	94	95	87	435	765	568	31.3	18.6	54.8
Band / S.P.	18/18	Y	95	101	91	431	648	552	32.2	17.9	54.7
Banded	0	N	112	106	97	449	751	552	31.0	16.9	51.3
Banded	9	N	106	110	86	485	762	520	32.5	16.8	55.7
Banded	18	N	127	118	88	508	735	611	33.4	16.5	57.6
Banded	27	N	123	108	85	417	773	535	33.2	17.7	56.8
Banded	36	N	139	103	90	497	830	799	30.7	18.5	59.1
Seed-Placed	9	N	112	99	88	439	609	510	31.8	15.5	55.0
Seed-Placed	18	N	99	103	88	462	790	640	31.8	17.9	58.8
Band / S.P.	18/18	N	92	83	86	407	800	539	30.4	19.7	55.1

Conclusion

This was the second year of this study and the project will be continued in 2012 at all three locations. The above average precipitation received at all three sites early in the growing season may have had an effect on the outcome of the trial. Responses to P fertilizer have historically been very seldom at Indian Head, likely do to the heavy clay soils and high calcium levels found in area soils.

Evaluating the Effects of Glyphosate and Pod-Sealants on the Yield of Straight-Combined Canola on a Large Field-Scale

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Overview

The generally accepted recommendations for harvesting canola have been to swath at 40-60% seed color change and harvest when the seed has matured and dried to 10% moisture content or less. Early harvest management research with this crop primarily focussed on the timing effect of swathing on days to maturity, seed quality and yield. For many growers, canola is the only crop grown which they routinely swath.

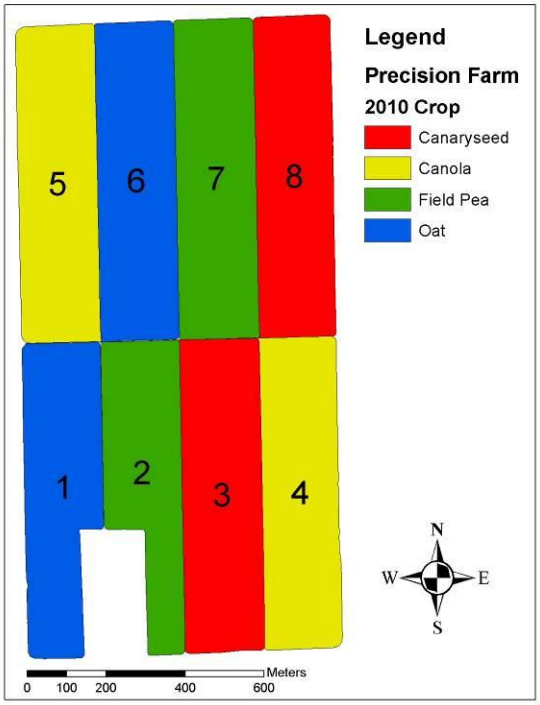
The alternative to swathing is to straight-combine. Traditionally in western Canada, straight-combining *Brassica napus* canola has not been recommended due to the risk of yield loss from pod shattering. Research data and grower experiences alike have shown that, while it is possible to slightly increase yield by straight-combining canola, substantial losses can occur and have been reported as high as 50% compared to swathing. While there are potential benefits to straight-combining canola, this practice is not without risk.

One of the first considerations for growers planning to straight-combine canola is selecting a variety that is relatively resistant to shattering. Recent research has shown that considerable variation in resistance to shattering exists among *B. napus* varieties. It has also been suggested that canola crops with high yield potentials are better suited for straight-combining as higher plant densities, uniform maturity and dense crop canopies generally result in somewhat lodged, intertwined fields, thus helping to reduce the risk of shatter loss.

Various technologies are available to producers to help reduce the amount of shatter loss experienced when straight-combing canola, including pushing the crop, pod-sealants, desiccants and glyphosate. Although there has been uncertainty regarding which method is the most effective when compared to swathing, an appreciable number of canola acres in Western Canada have been straight-combined in recent years. The objectives of this study were to evaluate the effects of harvest method on pod shattering and grain yields of canola under commercial field-scale conditions.

Materials and Methods

The trial was completed in 2010 and 2011 at the IHARF Precision Farm, located east of Indian Head. The Precision Farm encompasses a total area of 309 acres, divided into eight fields (Figure 10). Each plot in this trial was replicated four times and measured approximately 2 acres in size and all field operations were completed using full-sized, commercial farm equipment.



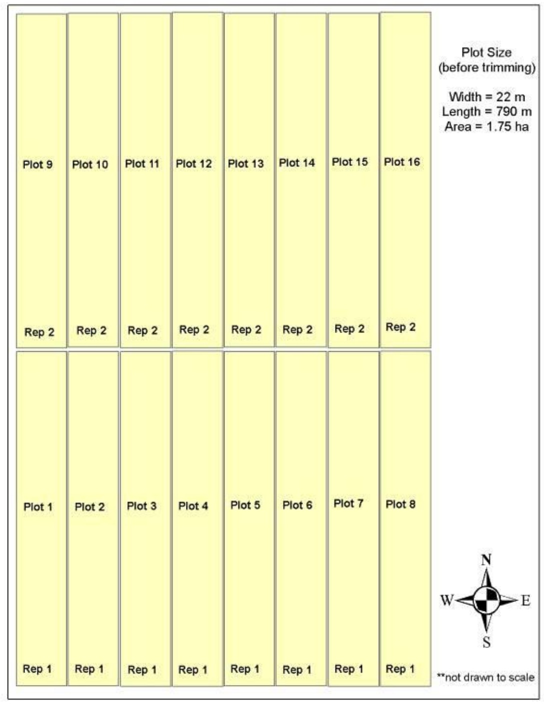


Figure 10: Precision Farm legend and plot layout.

The treatments are shown in Table 23. The targeted time of application for all pre-harvest treatments was at the 30-40% pod color change. Invigor 5020 was selected as this hybrid is moderately prone to shattering and as a result, more likely to show the results of shatter loss among the treatments evaluated.

The entire field was seeded at the same time and received a fertilizer blend of 120-30-0-15. The plots were superimposed on to the field just prior to the application of the pre-harvest treatments. Weeds were controlled using registered products at their recommended rates and the pod-sealant + glyphosate treatments tank mixed for application. In the untreated plots, the sprayer was driven through the crop to equalize the yield loss resulting from the sprayer's wheel tracks.

Table 23: Straight-combined vs swathed treatments, 2010-11.

Trt #	Harvest Method	Pre-harvest Treatment	Water Volume (US gal/ac)	Product Rate[Z]
1)	swathed	untreated	-	-
2)	swathed	pod-sealant	20	0.5 l/ac
3)	swathed	glyphosate	10	365 g/ac
4)	swathed	pod-sealant + glyphosate	20	0.5 l/ac + 365 g/ac
5)	straight-combined	untreated	-	-
6)	straight-combined	pod-sealant	20	0.5 l/ac
7)	straight-combined	glyphosate	10	365 g/ac
8)	straight-combined	pod-sealant + glyphosate	20	0.5 l/ac + 365 g/ac

[Z] Pod Ceal DC, formerly available from Brett Young; Roundup Transorb HC

Both the 2010 and 2011 growing seasons received above average precipitation. In 2010, frequent rains fell in late August and September, creating challenging harvest conditions. The fall of 2011 was significantly drier than that of the previous year. Shatter ratings were completed twice each year to reflect the different harvest dates for the straight-combined and swathed treatments.

Results

The shatter ratings for both the swathed and straight-combined treatments were averaged, as shatter ratings followed the same trend for both harvest methods (Table 24). Overall, there appeared to be less visual pod shattering in 2011 than the previous year. This may be attributable to better timing of harvest operations and/or more favourable weather leading to harvest.

Table 24: Pod shatter ratings, 2010 & 2011.

Foliar Treatment	2010	2011	Average
	Pod Shatter Ratings (1-5)[Z]		
Untreated	1.98*b*	1.15*c*	1.56*b*
Pod-Sealant	1.28*c*	1.05*c*	1.16*c*
Glyphosate	2.65*a*	1.30*c*	1.98*a*
Combination	2.10*b*	1.04*c*	1.57*b*
Average	2.00*a*	1.14*b*	-

[Z] (1=0-2%), (2=3-5%), (3=5-10%), (4=11-25%), (5=25-50%)

There were no consistent differences in seed moisture content among the pre-harvest treatments within each field and for any given harvest method. Moisture content for the treatments were always within 1% of each other, thus neither pod-sealant nor glyphosate appeared to have affected seed moisture content at the time of harvest.

Swathing produced significantly higher yields than straight-combining in both years (Table 25).

Table 25: Canola yields at Indian Head.

Harvest Method	Pre-Harvest Treatment	2010	2011
		bu / ac	
Swathed	Untreated	44.4*ab*	42.4*abc*
Swathed	Pod-Sealant	47.4*a*	42.5*abc*
Swathed	Glyphosate	45.5*ab*	35.9*cdefg*
Swathed	Combination	42.2*abcd*	42.1*abcd*
Straight-Combined	Untreated	39.9*bcde*	30.9*fg*
Straight-Combined	Pod-Sealant	42.5*abc*	30.0*g*
Straight-Combined	Glyphosate	35.2*defg*	34.4*efg*
Straight-Combined	Combination	32.4*fg*	37.1*cdef*
Standard Error		2.80	

Averaged across treatments in 2010, plots treated with a pod-sealant yielded higher than other treatments; however, the differences were not statistically significant. In 2011, yields were similar for all plots, regardless of the pre-harvest treatment. The patterns observed from year to year are somewhat inconsistent and while it is possible that pod-sealants could play a role in canola production, the data did not show this to be the case.

Conclusion

These results affirm that straight-combining canola can potentially result in substantial yield losses relative to swathing, especially when harvest is postponed past the optimal crop stage. While the visual shatter ratings provided some evidence that pod-sealants can reduce the risk of shattering, it was not confirmed with significant gains in yield. Though a yield effect would not necessarily be expected from a pre-harvest glyphosate application, glyphosate can accelerate and provide uniform maturity. There may have been improved success with straight-combining if a variety with greater shattering resistance had been seeded. The variety used in this study was specifically chosen due to previous research showing greater susceptibility to shatter losses, thus using this variety should have improved the ability to detect any potential benefits of using pod-sealants or other foliar treatments. Header types are another consideration for producers interested in straight-combining. A draper header was used in this study and has shown to perform slightly better (less shatter loss) than a rigid type header, but not nearly as well as an extended header (ie: BISO) where the cutter bar is moved 45-65 cm forward compared to more conventional types. The major considerations for canola growers interested in straight-combining canola are header types, cultivars, sufficiently high seeding rates to ensure uniformity, an early maturing stand and controlling weed and disease pressure.

Response of Canola and Spring Wheat to High Rates of Side-Banded Polymer Coated Urea

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Overview

This trial was performed in collaboration with Agrium and was in its first year of study, examining varying rates of side-banded polymer coated urea (ESN) compared to untreated urea in spring wheat and canola.

Materials and Methods

The project included 12 different treatments evaluating six different rates of ESN and urea (Table 26). All six of the ESN treatments were comprised of a blend of 25% urea and 75% ESN. The rates and forms of N fertilizer were varied according to protocol and were side-banded during seeding along with 34 lbs/ac P_2O_5 (MAP).

Table 26: Polymer coated urea trial treatment list, 2011

1) Urea (54 lbs N/ac)	7) ESN[Z] (54 lbs N/ac)
2) Urea (80 lbs N/ac)	8) ESN (80 lbs N/ac)
3) Urea (107 lbs N/ac)	9) ESN (107 lbs N/ac)
4) Urea (143 lbs N/ac)	10) ESN (143 lbs N/ac)
5) Urea (170 lbs N/ac)	11) ESN (170 lbs N/ac)
6) Urea (196 lbs N/ac)	12) ESN (196 lbs N/ac)
13) Check (no N fertilizer)	

[Z] N fertilizer in the ESN treatments were a blend of 25% urea and 75% ESN

Invigor 5440 and Unity wheat were seeded on May 14 at 5.8 lbs/ac and 120 lbs/ac respectively. Weeds were controlled using registered products and fungicide was applied on both crops to control disease and isolate any crop response to the fertilizer treatments.

Spring plant counts were completed to evaluate any effects on crop establishment. A GreenSeeker™ optical sensor was also used to determine the normalized difference vegetation index (NDVI) of the crop, a measurement of the above-ground biomass and chlorophyll density which is correlated to N uptake and yield potential. Plant height and grain yield were also evaluated and seed moisture content was corrected to 10% for canola and 14.5% for spring wheat. Sub samples were collected for determination of protein level in spring wheat but the results have not yet been analyzed.

Results

For canola, overall plant densities were lower for all treatments receiving fertilizer, regardless of the rate and product. Notably, plant populations were reduced by 25.7% with the application of urea; while on average the ESN treatments experienced a 13.5% plant density reduction (Table 27). Average plant populations for wheat were not significantly affected by either the urea or ESN treatments.

Table 27: Effects of formulation and rate of N fertilizer on crop establishment at Indian Head, 2011.

Treatment	Canola		Spring Wheat	
	Urea	*ESN*	*Urea*	*ESN*
	plants / m			
0 lbs N/ac	97.9*a*		318.3*a*	
54 lbs N/ac	71.1*a*	86.4*a*	316.6*a*	310.1*a*
80 lbs N/ac	71.1*a*	85.8*a*	331.4*a*	302.7*a*
107 lbs N/ac	71.6*a*	83.1*a*	316.6*a*	333.9*a*
143 lbs N/ac	80.9*a*	84.2*a*	332.2*a*	327.3*a*
170 lbs N/ac	77.7*a*	80.9*a*	319.1*a*	321.5*a*
196 lbs N/ac	64.0*a*	87.5*a*	285.5*a*	304.3*a*
Average	***72.7***	***84.7***	***316.9***	***316.6***

As expected, the addition of N fertilizer had a significant effect on canola yields, in some cases doubling the yield over the unfertilized check. On average, canola fertilized with ESN yielded 6% higher than canola fertilized with untreated urea. Yield advantages with ESN tended to be more prominent at N rates of 107 lbs/ac or higher, though not all differences were statistically significant.

Similar results were observed for spring wheat but the overall response to N was smaller than that of canola. ESN fertilized spring wheat plots yielded significantly higher than that of urea at N rates of 54 lbs/ac and 196 lbs/ac, but not significantly greater at the other N rates.

While the observed response to N fertilizer was excellent for both crops, the quadratic responses were significant, indicating a diminishing yield response at the higher rates of N (Figure11, 12).

Table 28: Effects of formulation and rate of N fertilizer on yield at Indian Head, 2011.

Treatment	Canola		S. Wheat	
	Urea	*ESN*	*Urea*	*ESN*
	bu/ac			
0 lbs N/ac	29.9*e*		48.6*e*	
54 lbs N/ac	50.9*d*	51.1*d*	55.3*e*	67.2*d*
80 lbs N/ac	54.9*cd*	56.9*cd*	67.8*d*	68.8*cd*
107 lbs N/ac	59.6*bc*	67.5*a*	69.2*cd*	76.4*abcd*
143 lbs N/ac	65.9*ab*	65.3*ab*	76.0*abcd*	80.3*ab*
170 lbs N/ac	61.1*bc*	68.5*a*	78.6*abc*	78.3*abc*
196 lbs N/ac	64.5*ab*	69.6*a*	71.4*bcd*	82.3*a*
Average	***59.5***	***63.1***	***69.7***	***75.5***

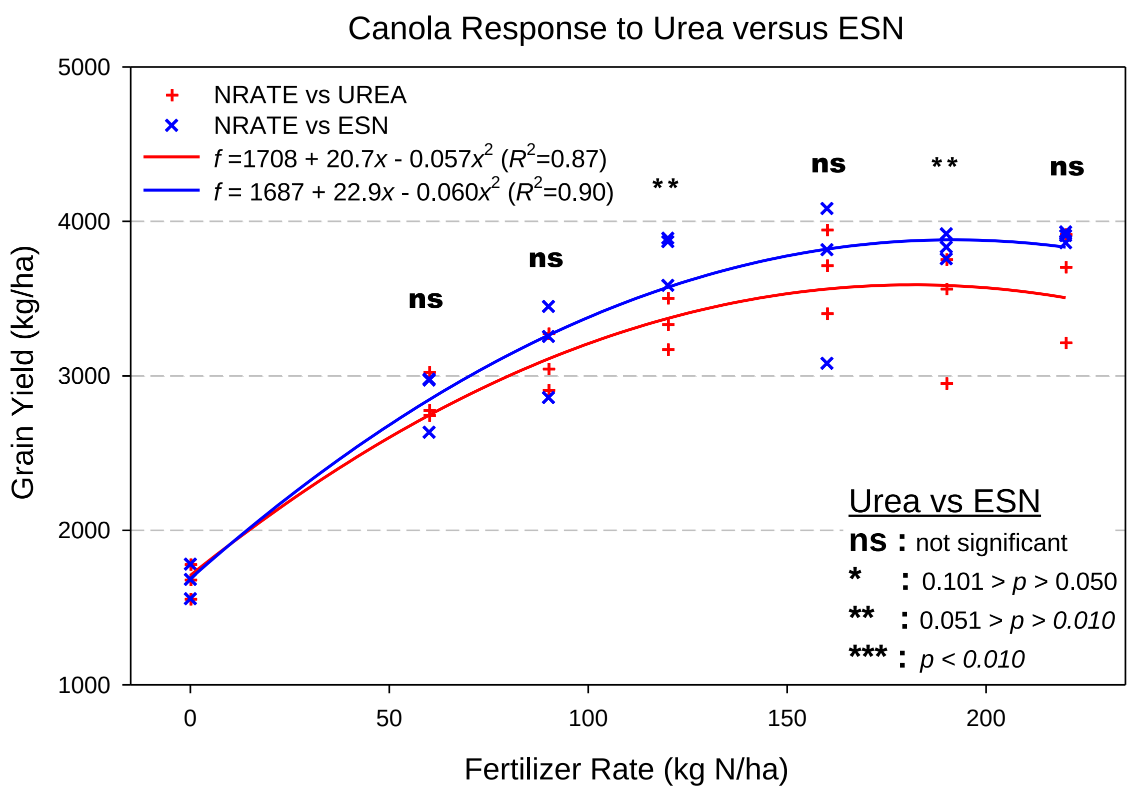

Figure 11: Canola N response curve, Indian Head, 2011.

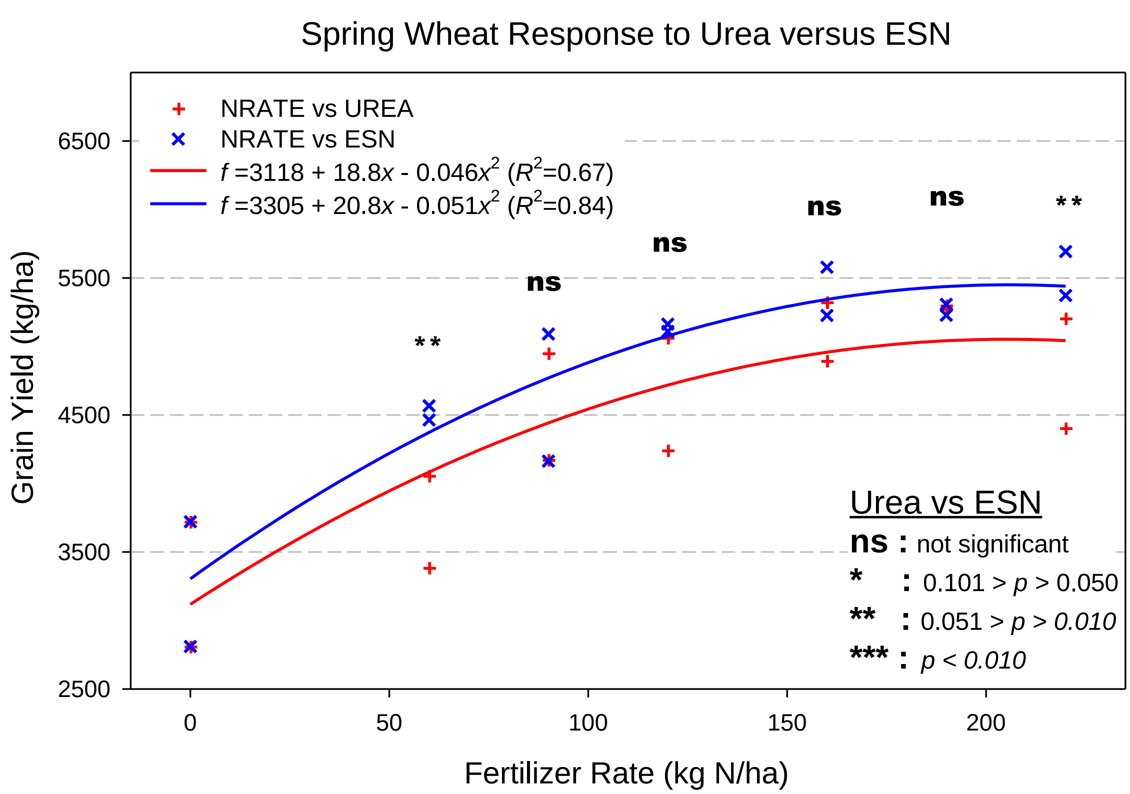

Figure 12: Spring wheat N response curve, Indian Head, 2011.

Conclusion

The wet conditions in the first part of the growing season increased the potential for soil N losses due to leaching and denitrification, while warm conditions later in the season allowed the crops to recover reasonably well, producing above average yields.

Significant seedling injury was observed with side-banded N in canola, but not spring wheat. The reduction in canola plants was likely due in part to the wet conditions at seeding, resulting in poor separation of the seed and fertilizer. On average, side-banded ESN resulted in 16% more plants/m^2 than the untreated urea in canola, but no significant difference was observed in the spring wheat. This trial will be repeated during the 2012 growing season.

Crown Rust in Oats: When are Fungicide Applications to Control Crown Rust of Economic Benefit to Producers

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Overview

For three years from 2009 to 2011, a trial was conducted at four locations in Saskatchewan (Indian Head, Melfort, Saskatoon, Canora) and two locations in Manitoba (Brandon, Portage la Prairie). The trial focussed on determining if and when fungicides should be applied to oats in order to control crown rust and determining if fungicide applications are improving oat yields in the absence of crown rust.

Materials and Methods

The trial contained four replicates at all locations with two different seeding dates: May 5-15 and June 1-5. The trial was split in two different treatments, fungicide-applied (Headline) and no fungicide applied. Four different cultivars were seeded at all locations, including AC Morgan, CDC Orrin, CDC Boyer and Leggett, with targeted plant populations of 300 plants/m^2. Nitrogen fertilizer rates varied by site and soil test, with applied N fertilizer and soil residual N levels targeted at 71 lbs/ac of actual N. In addition, 18 lbs/ac P, 9 lbs/ac K and 9 lbs/ac S were applied at seeding. Crown rust ratings were conducted using a modified Cobb Scale on control plots as well as the fungicide-applied plots at the milk stage. Plant and panicle measurements, stem and leaf disease ratings, physiological maturity and lodging ratings were also completed. Each sample was cleaned to Canadian Grain Commission standards with yields corrected to 13% moisture content.

Results

The data was analysed by separating the sites with high levels of crown rust from sites with low levels of crown rust.

Sites with low levels of crown rust experienced significant cultivar effects on grain yield, test weight, lodging and crown rust. Despite there being low levels of crown rust present, on average the application of a fungicide increased yield by 7.3 bu/ac (Table 29). When the fungicide was applied, the difference between the two seeding dates was not statistically significant.

At the sites with high levels of crown rust, the fungicide, cultivar and seeding date all had significant implications on grain yield and test weight (Table 29). AC Morgan and CDC Boyer both had higher grain yields when the fungicide was applied. AC Morgan, CDC Boyer and CDC Orrin had significant increases in test weight with fungicide applications. As well, the application of fungicide reduced the severity of crown rust on both the flag and penultimate leaves in all cultivars except Leggett. Leggett was the only variety not affected by the application of the fungicide, likely due to the variety's greater natural resistance to the disease. Beta glucan content and further statistical analysis are currently underway and more results will become available in the future.

Table 29: Response of oat to fungicide application.

	Low Crown Rust		**High Crown Rust**			
			Fungicide	***No Fung.***	***Fungicide***	***No Fung.***
	Grain Yield[Z]	***Test Weight***	***Grain Yield***[Z]		***Test Weight***	
	bu / ac	*g / 0.5L*	*bu / ac*		*g / 0.5L*	
AC Morgan	144.4	245	103.7	85.8	240	216
CDC Boyer	126.0	237	90.4	82.4	238	229
CDC Orrin	135.2	248	96.0	91.8	243	234
Leggett	127.3	248	94.3	93.5	248	248
Avg. Fung.[Y]	136.9	245	-	-	-	-
Avg. No Fung.[Y]	129.6	244	-	-	-	-

[Z] Grain yield determined using a 34lb bushel weight

[Y] Average of all four varieties at sites with low levels of crown rust

Table 30: Effect of cultivar and seeding date on yield and test weight.

	May 5-15 Seeding Date		June 1-5 Seeding Date	
	Grain Yield (bu/ac)	Test Weight (g/0.5L)	Grain Yield (bu/ac)	Test Weight (g/0.5L)
AC Morgan	108.3	246	81.3	210
CDC Boyer	90.6	243	82.3	224
CDC Orrin	103.5	252	84.4	225
Leggett	102.2	255	85.8	240

Conclusion

Preliminary results indicate that seeding date had the largest effect on oat yield, with an average decrease of 17.7 bu/ac at the later seeding date. As would be expected, the cultivar with the greatest susceptibility to crown rust infection, AC Morgan, showed the greatest yield increase with the application of fungicide, 17.9 bu/ac. Under normal growing conditions, the benefits of a fungicide application on oats have been limited in the absence of crown rust, thus growers should be vigilant and scout fields for the disease accordingly.

Nitrogen Response of Hybrid Sunflowers Across Saskatchewan

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Overview

Previous research has shown that sunflowers do not require a large amount of N fertilizer to maximize grain yield. The goal of this project was to demonstrate the responsiveness of sunflowers to five different nitrogen rates and define an N response curve for sunflower.

Materials and Methods

The project took place at Indian Head, Outlook, Swift Current and Tribune in 2010, and Indian Head, Swift Current and Saskatoon in 2011. At Indian Head and Swift Current, the sunflowers were seeded into stubble using a no-till air drill and in Saskatoon the sunflowers were disk drill seeded into tilled soil. Five different N rates (9, 27, 45, 62 and 80 lbs N/ac) were replicated four times at each location and P, K and S applications were based on soil test recommendations at each location. Grain yield, plant density, days to first bloom, height, kernel weight, test weight, oil content and days to harvest were determined. In Saskatoon, the trial had not been harvested at the time this report was written due to an equipment breakdown.

Results

In 2011, there was a linear increase in grain yield, kernel weight and test weight at Indian Head with increased nitrogen rate, but there was no response to nitrogen in Swift Current. Plant density was not significantly affected at either site.

In 2010, there was a strong linear increase in grain yield at Indian Head and Swift Current. In contrast, there was a moderate decrease in grain yield in Outlook as the nitrogen rate increased. There was also a strong increase at all sites in the kernel and test weight as nitrogen rate increased.

Conclusion

Over the last two years there has been a consistent linear increase in grain yield as the nitrogen rate increased. The increase has been linear and not quadratic, indicating that the hybrid sunflowers respond well to higher rates of nitrogen application.

Response of Canola to Low Plant Populations and Evaluation of Reseeding Options

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Overview

There is limited data available on the response of hybrid canola to extremely low plant populations, as previous research has primarily looked at open pollinated varieties. Research has indicated that hybrid canola may be able to compensate more at lower plant densities than open pollinated varieties and thereby lower plant densities may be acceptable in hybrid canola. The purpose of this project is to identify the minimum plant stand required by hybrid canola to achieve 90% of the maximum yield, to evaluate the effects of plant population on maturity, seed size and green seed and to determine the minimum density at which reseeding would be recommended.

Materials and Methods

The project took place in Scott, Swift Current, Indian Head, Melfort and Saskatoon in 2010 and 2011, with Invigor 5440 seeded at all sites. Data collected during the growing season included spring plant densities, days from planting to the start and end of flowering, lodging, days to 60% seed colour change, grain yield, green seed content, thousand seed weight and fall plant density. Seven different seeding rates were included for targeted plant populations of 5, 10, 20, 40, 80, 150 and 300 plants/m^2. At the lower seeding rates, elemental sulphur was added to the seed as a bulking agent to ensure even seed distribution.

Results

At most sites in 2010, wet conditions resulted in greater canola emergence than the actual seeding rate, attributable to a large number of volunteer plants emerging from the seed-bank. Although volunteer canola was less of a problem in 2011, emergence rates were still very high for the lowest seeding rate of 5 plants/m^2 (Table 31). There was no significant difference in lodging severity between any of the seeding rates. Drawbacks to the lower seeding rates were the longer period of days to maturity as well as increased green seed content (Table 31, Table 32).

Table 31: Averaged results across all sites, 2010.

	Seeding Rate *(targeted plants/m²)*						
	5	***10***	***20***	***40***	***80***	***150***	***300***
Spring Plant Density (plants/m^2)	9	14	20	41	77	133	218
Fall Plant Density (plants/m^2)	8	10	16	25	44	63	105
Lodging Ratio	.89	.89	.92	.88	.89	.90	.91
TKW (g)	2.9	3.0	3.0	3.1	3.1	3.2	3.2
Green Seed (%)	2.0	1.3	0.3	0.3	0.1	0.1	0.1
Yield (bu/ac)	27.2	26.2	29.7	29.8	29.4	31.3	29.7

Table 32: Averaged results across all sites, 2011.

	Seeding Rate *(targeted plants/m²)*						
	5	***10***	***20***	***40***	***80***	***150***	***300***
Spring Plant Density (plants/m^2)	8	10	14	20	34	57	107
Fall Plant Density (plants/m^2)	10	12	17	24	42	63	103
Lodging Ratio	.72	.74	.78	.85	.85	.83	.82
60% Seed Colour Change (days)	139	138	137	134	133	130	128
TKW (g)	3.2	3.2	3.1	2.9	3.0	3.1	3.1
Green Seed (%)	1.8	1.4	1.7	1.0	0.9	0.3	0.7
Yield (bu/ac)	24.9	32.1	37.0	43.2	44.9	47.7	47.5

At all sites, yields were affected by plant population in both years. On average, plant densities lower than 20 and 24 plants/m^2 resulted in yield reductions. However, it is difficult to make a general conclusion on the plant density at which reseeding would be recommended as the plant density which yields were severely reduced ranged between sites.

Conclusion

Plant density has a large effect on canola yield. On average, plant densities lower than 20 to 24 plants/m^2 resulted in notable yield reductions. At this point, it is difficult to make a general conclusion on the plant density at which reseeding would be recommended. Because of the adverse effect lower seeding rates have on maturity, higher seeding rates will reduce the risk of yield and quality loss when early frosts occur. Another year of research will allow for better predictions of which environmental conditions require higher seeding rates in order to maximize yield.

Natural Air Grain Drying: Testing an Automatic Controller for Managing Bin Aeration Fans

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Overview

With increases in grain bin capacity, the potential for convection currents to develop within the bin is increasing, resulting in moisture mitigation and a larger potential for grain spoilage. To avoid this spoilage, grain can be aerated and cooled to disrupt convection currents and associated moisture mitigation. Producers are left with the strategy of simply running the fans continuously, which results in significant electricity charges. Through running this project over the past four years, it is estimated that the energy consumption of aeration fans can be reduced by 41% through operating the fans only when water will be removed from the grain.

The goal of this project is to determine if calculating the water holding capacity of the air as a function of temperature and relative humidity can be used as a control point for the operation of aeration fans. This involves comparing the mass of water in the air entering the bin to the mass of water in the air exiting the bin. If the air coming out of the bin contains more water than the air entering the bin, the fan keeps operating and the grain inside the bin will be dried.

Results

Over the past four years, IHARF has operated two bins with the aeration fans running continuously. The grain bins were instrumented with monitoring equipment involving sensors to separately monitor the temperature and relative humidity of the air going into and out of the bin, as well as the total airflow into the bin. Sampling tubes were installed into each bin allowing for grain to be collected at four different locations in the bin as a way to track the actual grain moisture content. A total of 13 bin-runs have been completed over the past four years involving three crops: wheat, barley and peas (Figure 13).

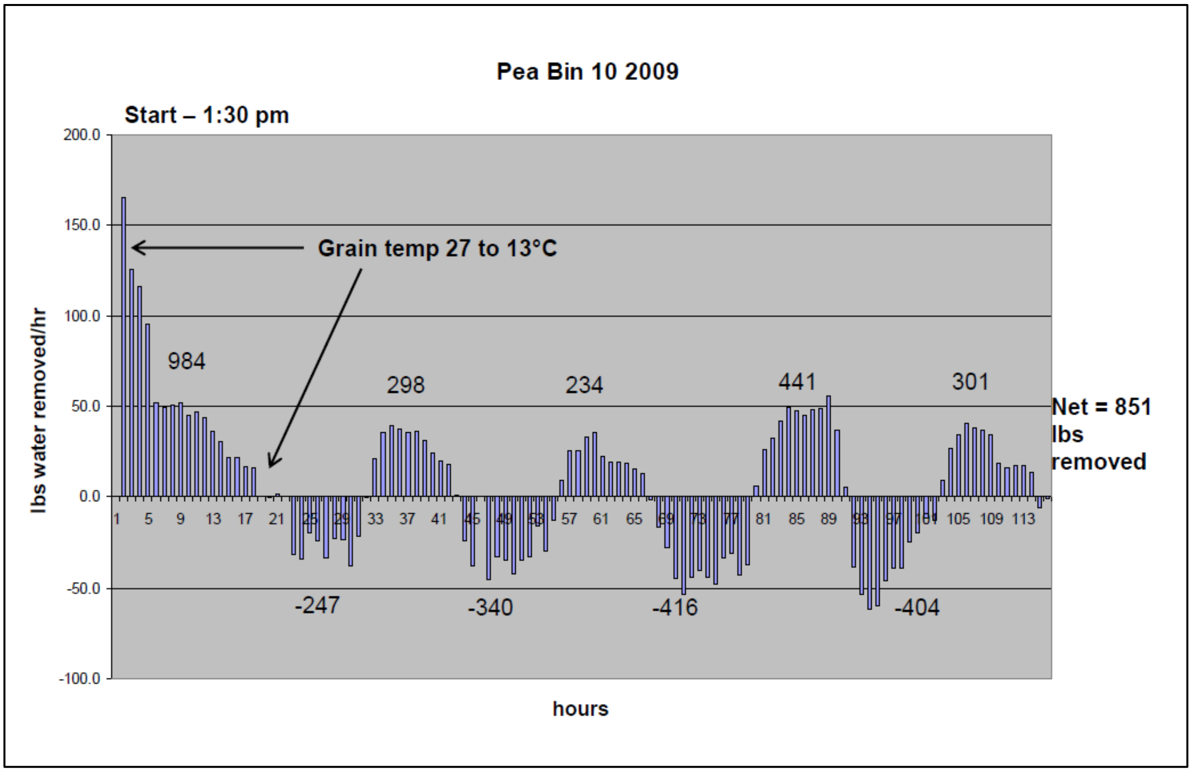

Figure 13: Water removal in field pea, 2009.

There was a strong daily pattern of water removal and addition of water to the grain, which was determined to be governed by the temperature and relative humidity of the air entering the bin. Consistently, the period of greatest grain moisture removal occurred during the coolest part of the day; i.e. night, while water was added to the grain during the warmest part of the day. This can be explained by the moisture holding capacity of air. Cool air physically cannot hold as much moisture as warm air (Figure 14). As cool air enters the bin and warms due to the warm grain, the relative humidity of the air drops creating a large vapour pressure deficit between the grain and the air, allowing for the removal of water from the grain. Therefore, loss of grain moisture occurs as the grain is cooling.

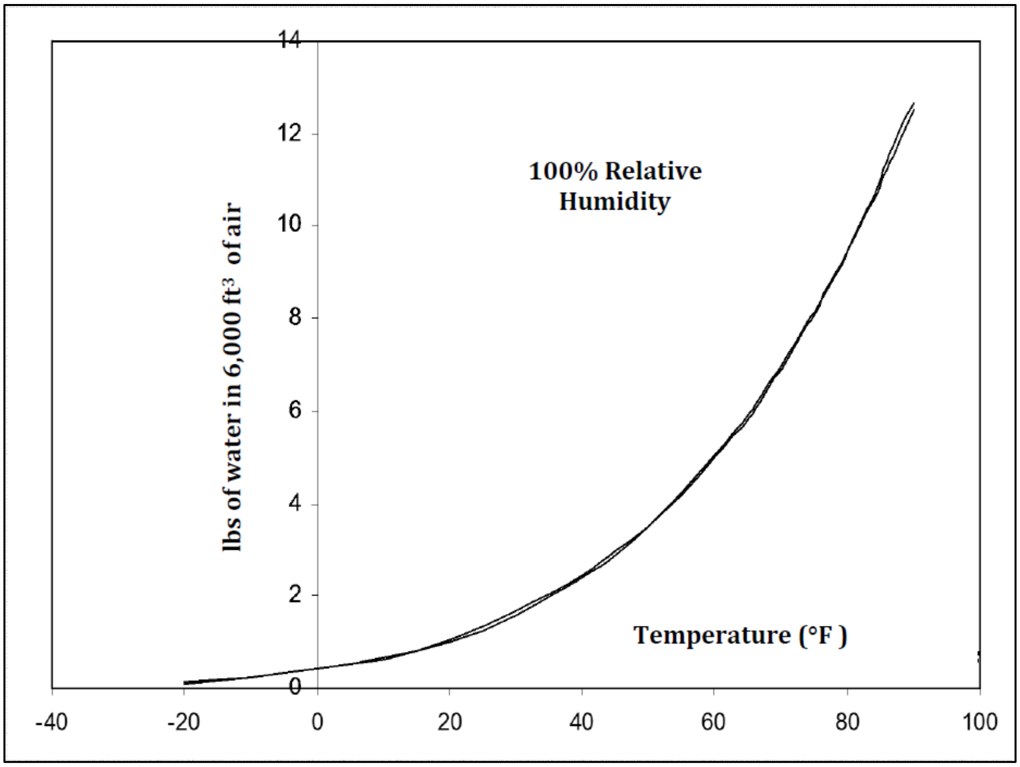

Figure 14: Psychrometric chart: maximum amount of water that 6,000 ft^3 of air can hold at 100% relative humidity.

Materials and Methods

Beginning in 2012, the project will be expanded bringing the total number of grain bins being utilized to six. This will consist of completing comparisons between three paired bins. One bin with the aeration fan operating continuously, while the other bin with the aeration fan only operated when it is determined that more moisture will be removed from the bin than enters through the fan. As in the past, the paired bins will be filled with grain at the same time, with barley, spring wheat, peas or oats (depending on the commodity available). Along with the temperature, relative humidity, air flow sensors and sampling tubes; prototype controllers being developed by Ron Palmer will be installed on all six bins, with the capability of turning the fans on or off based on the net removal of water from the bin. All data will be logged from the sensors found in the bins and recorded on an hourly basis. Daily measurements of the grain moisture content will be completed at four levels in each bin through the sampling tubes.

Conclusion

Currently, all the necessary information and equations exist to determine how much time is required to aerate grain in storage for safe-keeping based on air flow into the bin through the aeration fan as a function of crop type, height of grain column, grain moisture content, ambient relative humidity and temperature; however, it is based on static values (constant temperature and relative humidity). What is required and aimed to be determined is a system that can operate in real time, taking into consideration the changing temperature and relative humidity. The opportunity exists to develop a low-cost, real time controller for grain bin aeration fans that producers can use to monitor their grain in storage using ambient air conditions with or without supplemental heat.

Evaluating Canola Type for Reseeding Timing

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[7]Wheatland Conservation Area, Swift Current, SK

Overview

Previous research has recommended using early maturing varieties when reseeding canola, but little research has been completed looking at hybrid varieties when reseeding a poor stand. The objective of this trial was to determine the risks associated with each reseeding option in terms of maturity, yield and quality and to determine when a producer should switch their canola to a lower yielding, earlier maturing variety.

Materials and Methods

The study was conducted in Scott, Melfort, Swift Current, Indian Head and Saskatoon in 2010 and 2011. Three seeding dates were targeted in early-May, early-June and mid-June. Invigor 5440 was seeded in early-may at a rate of 150 seeds/m^2 while other seeding dates were seeded at a rate of 20 seeds/m^2 in order to duplicate poor crop establishment. All but one treatment of 20 seeds/m^2 were later terminated with glyphosate prior to reseeding. In the reseeded treatments, 5440LL, 9350RR and a Polish canola variety were replanted at the early-June and mid-June seeding dates at a rate of 150 seeds/m^2 (Table 33).

Table 33: Treatment list; 2010, 2011.

Treatment	Seeding Date	Cultivar	Seeding Rate (seeds/m²)
1	early-May	5440 LL	150
2	early-May	5440 LL	20
3	early-June	5440 LL	150
4	early-June	9350 RR	150
5	early-June	Polish	150
6	mid-June	5440 LL	150
7	mid-June	9350 RR	150
8	mid-June	Polish	150

Results

In 2010, the highest yielding treatment was 5440LL seeded in early June; however, the yield was not significantly higher than other seeding dates and varieties. The highest yielding treatments were also the ones with the greatest plant density (Table 34). In general, thousand seed weight decreased as seeding was delayed, while green seed content increased.

Table 34: Averaged results across sites, 2010.

Seeding Date	Variety	Seeding Rate (seeds/m²)	Plant Density (pl/m²)	Yield (bu/ac)	TKW (g)	Green Seed (%)
early-May	5440LL	150	84*ab*	36.0*a*	3.27*a*	0.0*a*
early-May	5440LL	20	31*d*	21.9*b*	2.98*b*	0.1*a*
early-June	5440LL	150	102*a*	40.4*a*	2.94*b*	1.0*a*
early-June	9350RR	150	90*a*	35.4*a*	2.77*bc*	0.9*a*
early-June	Polish	150	72*b*	17.4*b*	2.4*de*	0.7*a*
mid-June	5440LL	150	67*b*	24.3*b*	2.61*cd*	4.5*c*
mid-June	9350RR	150	65*bc*	24.2*b*	2.34*e*	4.4*bc*
mid-June	Polish	150	44*cd*	18.9*b*	2.29*e*	3.1*b*
LSD			22.8	8.0	0.231	1.4

In 2011, there was no significant yield difference between 5440LL planted in early-May and 5440LL and 9350RR seeded in early-June. Early-June seeded hybrid canola had significantly higher plant densities than mid-June seeded canola. In general, as the seeding date was pushed back, there was an increase in days to 60% seed colour change, decrease in 1000 seed weight and increase in green seed content.

Table 35: Averaged results across sites, 2011.

Seeding Date	Variety	Seeding Rate (seeds/m²)	60% SCC (days)	Plant Density (pl/m²)	Yield (bu/ac)	TKW (g)	Green Seed (%)
early-May	5440LL	150	235*ab*	61*ab*	38.9*a*	3.2*ab*	1.4*a*
early-May	5440LL	20	240*ab*	21*c*	30.0*ab*	3.3*a*	1.9*a*
early-June	5440LL	150	247*bc*	75*a*	37.0*a*	3.0*bc*	2.9*ab*
early-June	9350RR	150	246*bc*	75*a*	29.4*ab*	2.6*de*	2.1*a*
early-June	Polish	150	239*bc*	61*ab*	22.6*bc*	2.6*de*	2.1*a*
mid-June	5440LL	150	248*c*	49*b*	17.9*c*	2.8*cd*	5.8*c*
mid-June	9350RR	150	249*c*	53*b*	20.6*bc*	2.5*e*	6.0*c*
mid-June	Polish	150	246*bc*	44*b*	17.7*c*	2.4*e*	5.1*bd*
LSD			7.4	17.2	9.5	0.26	2.6

Conclusion

The data indicates that canola can be reseeded in early-June with no yield penalty. This is not consistent with previous research, which demonstrated that early seeding produces greater yields. The earlier maturing Polish canola did not provide a yield benefit over the hybrid varieties at any seeding date in the two years of the study. The trial will be continued in 2012 at all five locations and upon completion, 15 site years of data will have been generated.

IHARF Field-Scale Fungicide Trial Summary (2004-2011)

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Introduction and Methodology

Each year, IHARF manages land not being utilized for small plot research by the various programs at the AAFC Indian Head Research Farm, internally referred to as the Fill-Acres. On top of the AAFC Fill-Acres, IHARF also crops land that is owned or rented from various producers in the Indian Head area. In 2012, IHARF will be fill-cropping an estimated 1,200 acres of land with a mix of cereals, oilseeds and pulses. While this land is primarily being managed to provide suitable stubble for future small plot trials, IHARF strives to conduct field-scale research trials on these acres whenever possible. An important component of this field-scale research over the years has been fungicide trials and, since 2004, IHARF has accumulated an appreciable amount of fungicide response data for a variety of major crops grown in the region.

All trials were arranged in a randomized complete block design and, unless otherwise indicated, each treatment on a given test was replicated a minimum of three times throughout the field. Fungicide products were applied using a high-clearance sprayer (80 foot boom width) equipped with GPS and auto steering systems. The timing of the fungicide applications were always at the flag leaf stage for cereals, 20-50% bloom for canola and early flower for field peas. The crops were either straight-combined or swathed and while the specific combine used has varied over the years, a modern New Holland twin rotor combine was used in all cases, with yield data collected using a New Holland yield monitoring system and GPS. Weather conditions were monitored using data from an Environment Canada weather station located on the AAFC Indian Head Research Farm, within 5 km of any of the individual trials. Data were analyzed using Statistical Analysis Software (SAS 9.2) and subjected to an analysis of variance (ANOVA) with Fisher's protected least significant difference (LSD) test used to compare individual treatment means. All proportional data (i.e. percent dockage, protein concentrations and percent ergot) were subjected to an arcsine transformation prior to analyses. When more than one product was evaluated, the yield of the untreated check was also compared to the average of the treated plots using contrast statements. All fungicide effects on grain yield and differences between means were declared significant at $P \le 0.05$.

Weather and Climate

The mean monthly temperatures and precipitation amounts for the past seven growing seasons at Indian Head are summarized relative to the long-term (1971-2000) normal conditions in Tables 36 and 37. Indian Head has a humid continental climate, with warm summers and cold winters. Average daily temperatures range from −16 °C in January to 18 °C in July and, normally, summer lasts from late June through late August. Winter lasts from November to March and varies greatly in length and severity, while spring and autumn are short and highly variable. The mean annual precipitation at Indian Head is 447 mm (17.6 inches) and an average frost free period of 110 days.

Table 36: Mean monthly growing season temperatures at Indian Head, Saskatchewan (2004-2011) and with the long-term normals (1971-2000).

Year	May	June	July	August	Average
	-----------------------	-----------------------	˚C	-----------------------	-----------------------
2011	9.5	15.1	18.8	17.8	15.3
2010	9.6	15.6	17.4	16.3	14.7
2009	8.1	14.0	14.4	15.3	13.0
2008	8.6	13.9	16.8	17.5	14.2
2007	10.7	15.0	19.9	15.5	15.3
2006	11.2	16.0	17.9	17.3	15.6
2005	8.8	14.8	16.9	15.6	14.0
2004	6.8	12.6	16.3	13.1	12.2
Long-Term	11.4	16.1	18.4	17.5	15.9

Table 37: Total monthly growing season precipitation at Indian Head, Saskatchewan (2004-2011) and with the long-term normals (1971-2000).

Year	May	June	July	August	Total
	-------------------------------------	-------------------	mm ---------------	-------------------	------------------
2011	71	133	42	44	290
2010	63	122	28	93	306
2009	15	61	58	77	211
2008	21	60	90	47	218
2007	81	47	51	64	243
2006	39	80	6	12	137
2005	58	99	59	98	314
2004	105	85	75	71	336
Long-Term	56	79	67	53	255

Canaryseed Response to Fungicide

Canaryseed fungicide trials were completed in 2008, 2009, 2010 and 2011 (Table 38). The products evaluated included Tilt 250E (250 g/L propiconazole), Headline EC (250 g/L pyraclostrobin) and, in later years, Quilt (75 g/L azoxystrobin and 125 g/L propiconazole). Overall, canaryseed responded remarkably well to fungicide applications with significant yield increases observed each of the four years that trials were conducted. The yield increases observed with fungicide applications were highly variable, ranging from 4% in 2008 to 47% in 2010. In years where multiple products were evaluated, no significant differences amongst products were observed; however, in 2011 the yield observed with Tilt did not differ from that of the check (P = 0.227) while both Headline and Quilt resulted in significant increases (P = 0.031-0.008). In some years, most notably in 2009 and to a lesser extent 2010, it was noted that there was considerably less lodging when a fungicide was applied (Figure 15). No differences amongst products were visually apparent.

Table 38: Effects of fungicide treatment on canaryseed yield at Indian Head, Saskatchewan.

Year	Check	Tilt	Headline	Quilt	CV	Check vs Rest
	-------------------------	bu/ac	------------------------		%	- p-value -
2011	26.4*b*	29.5*ab*	34.3*a*	32.4*a*	10.8	0.016
2010	27.5*b*	36.0*a*	41.9*a*	43.3*a*	12.9	0.001
2009	34.3*b*	44.9*a*	47.9*a*	—	6.9	<0.001
2008	37.4*b*	38.9*a*	—	—	1.5	0.033

Figure 15: Visual response to fungicide observed for canaryseed at Indian Head in 2009.

Oat Response to Fungicide

Fungicide trials with oats were completed in 2007, 2010 and 2011, with two separate trials in 2011 (Table 39). The products tested included Headline (250 g/L pyraclostrobin), Tilt (250 g/L propiconazole), Stratego (125 g/L propiconazole plus 125 g/L Trifloxystrobin) and Carumba (90 g/L metconazole). No response to fungicide was observed in 2007 while a marginal response was observed in 2010, with a 6.4% yield increase when averaged across fungicide products (P = 0.062). In one trial in 2011, no yield response was detected for any of the products tested (Stratego, Tilt and Headline); however, a 13% yield increase with Carumba was observed in another field located approximately 3 km east of the other trial.

Table 39: Effects of fungicide treatment on oat yield at Indian Head, Saskatchewan.

Year	Check	Stratego	Tilt	Headline	Carumba	CV	Check vs Rest
	---------------------- bu/ac (34 lbs/bu)---------------------					%	p-value
2011[2]	113.1*b*	—	—	—	127.7*a*	1.5	0.001
2011[1]	111.3*a*	113.5*a*	110.3*a*	112.9*a*	—	6.9	0.828
2010	148.9*a*	157.9*a*	162.9*a*	156.8*a*	—	5.3	0.062
2007	122.8*a*	123.8*a*	116.6*a*	—	—	5.7	0.546

For the three oat trials completed in 2010 and 2011, sub-samples from each plot were collected and subjected to various quality analyses at the University of Saskatchewan. Some of the parameters evaluated were test weight, thousand kernel weights, percent plump and thin kernels, groat weight, oil concentration and protein concentration. In 2010, there were no differences amongst any individual treatments according the multiple comparisons test; however, percent groat weight was significantly higher for the combined fungicide treatments while protein also tended to be higher when fungicide was applied (Table 40). In the 2011 trial where multiple products were evaluated but the yield response was not significant, fungicide application significantly increased test weight, percent plump seed and groat weight (Table 41). In the second trial where only Carumba was evaluated and a 13% yield increase was observed, fungicide application resulted in a marginally significant increase in test weight and thousand kernel weight (P = 0.055-0.071) along with more plump kernels, fewer thin kernels, higher groat weight and higher protein concentration relative to the check (Table 42). In both cases where multiple fungicides were tested side by side, no significant differences were observed amongst products for any of the parameters measured. Furthermore, no individual treatments on their own resulted in sufficiently large responses to be considered significantly different from the check.

Table 40: Effects of fungicide treatment on oat quality at Indian Head, Saskatchewan in 2010.

Parameter	Check	Stratego	Tilt	Headline	CV	Check vs Rest
	---				%	p-value
Test Weight (kg/hL)	50.6*a*	50.7*a*	52.0*a*	51.5*a*	1.4	0.097
1000 Kernel Weight (g)	31.9*a*	31.4*a*	32.9*a*	33.0*a*	4.5	0.537
% Plump Seed (>5.5/65)	86.4*a*	88.1*a*	89.2*a*	88.8*a*	3.9	0.088
% Thin Seed (<5.0/64)	2.3*a*	2.7*a*	2.0*a*	2.6*a*	39.7	0.861
% Groat Weight	73.5*a*	74.6*a*	75.4*a*	74.3*a*	1.6	0.035
% Oil Content	6.6*a*	6.6*a*	6.7*a*	6.7*a*	1.3	0.245
% Protein Content	15.2*a*	14.6*a*	14.8*a*	14.8*a*	2.2	0.054

Table 41: Effects of fungicide treatment on oat quality at Indian Head, Saskatchewan in 2011.

Parameter	Check	Stratego	Tilt	Headline	CV	Check vs Rest
	---				%	p-value
Test Weight (kg/hL)	49.3*a*	50.5*a*	50.3*a*	50.0*a*	1.3	0.023
1000 Kernel Weight (g)	36.8*a*	37.8*a*	38.0*a*	38.2*a*	3.5	0.153
% Plump Seed (>5.5/65)	94.5*a*	95.2*a*	95.4*a*	95.8*a*	1.7	0.026
% Thin Seed (<5.0/64)	1.0*a*	1.0*a*	0.8*a*	0.8*a*	23.0	0.173
% Groat Weight	73.3*a*	74.8*a*	74.7*a*	74.6*a*	1.3	0.009
% Oil Content	7.0*a*	6.8*a*	6.5*a*	7.0*a*	5.1	0.239
% Protein Content	14.0*a*	14.5*a*	14.3*a*	14.5*a*	3.8	0.209

Table 42: Effects of fungicide treatment on oat quality at Indian Head, Saskatchewan in 2011.

Parameter	Check	Carumba	CV	Check vs Rest
	--		%	p-value
Test Weight (kg/hL)	51.5*a*	53.9*a*	2.1	0.055
1000 Kernel Weight (g)	34.3*a*	37.5*a*	4.5	0.071
% Plump Seed (>5.5/65)	86.4*b*	92.6*a*	4.3	0.027
% Thin Seed (<5.0/64)	3.2*a*	1.6*b*	22.3	0.025
% Groat Weight	73.7*b*	75.9*a*	1.6	0.044
% Oil Content	6.6*a*	6.5*a*	1.1	0.078
% Protein Content	14.4*a*	15.4*b*	2.2	0.021

Canola Response to Fungicide

Four separate trials have been conducted for canola over the past five years in 2007, 2008, 2009 and 2011. Due to the wet conditions in 2010, all of the canola fill-acres were considered too variable to be used for a reliable evaluation, therefore no trials were completed. The products tested from 2007-2009 have included Lance (70% boscalid), Proline (480 g/L prothioconazole), Rovral-Flo (240 g/L iprodione) and Headline (250 g/L pyraclostrobin). Astound (37.5% cyprodinil and 25.0% fludioxonil) was added to the treatment list in 2011. A canola yield increase with fungicide was observed in one out of the four years, with a 4% increase in 2008, but no detectable benefit in any of the other years. The multiple comparisons test revealed that in 2008, the greatest yield response occurred with Lance (3 bu/ac) while neither Proline nor Rovral-Flo had significantly higher yields than the check. That being said, both Proline and Rovral-Flo did have numerically higher yields than the check which did not significantly differ from the yield observed for Lance.

Table 43: Effects of fungicide treatment on canola yield at Indian Head, Saskatchewan.

Year	Check	Lance	Proline	Rovral-Flo	Astound	CV	Check vs Rest
	----------------------------	bu/ac	---------------------------			%	p-value
2011	29.1*a*	29.0*a*	30.1*a*	—	29.0*a*	9.3	0.866
2009	52.1*a*	53.3*a*	55.5*a*	52.8*a*	—	4.3	0.220
2008	54.7*b*	57.8*a*	56.4*ab*	57.2*ab*	—	3.1	0.044
2007	45.9*a*	43.8*a*	44.5*a*	45.7*a*	—	11.2	0.670

In 2011, a second trial with canola was completed where Headline and Lance were compared both separately and in a tank-mix. Similar to the other trial, no yield response to fungicide was observed for any products, separate or combined. It is important to emphasize that the all of the treatments in this trial were applied at the 40-50% flower stage which is at the latter end of the recommended window of application for preventing sclerotinia infection and considerably past the recommended stage for Headline, which is prior to bolting.

Table 44: Effects of fungicide treatment on canola yield at Indian Head, Saskatchewan.

Year	Check	Headline	Lance	Lance + Headline	CV	Check vs Rest
	------------------------ bu/ac			------------------------	--- % ---	p-value
2011	42.1*a*	41.8*a*	41.2*a*	41.8*a*	5.0	0.674

Spring Wheat Response to Fungicide

Field-scale fungicide trials with hard red spring wheat have been conducted by IHARF in five of the past six years (Table 45). The products tested included Stratego (125 g/L propiconazole plus 125 g/L Trifloxystrobin), Headline (250 g/L pyraclostrobin), Tilt (250 g/L propiconazole) and Quilt (75 g/L azoxystrobin and 125 g/L propiconazole). Over the five year period, spring wheat yields were increased in 2010 (P = 0.015) and marginally increased in 2006 (P = 0.058), but no response was observed in the remainder of the three years. No significant differences were observed amongst the products evaluated in any of the individual field trials.

Table 45: Effects of fungicide treatment on CWRS wheat yield at Indian Head, Saskatchewan.

Year	Check	Stratego	Headline	Tilt	Quilt	CV	Check vs Rest
	----------------------------		bu/ac		----------------------------	%	p-value
2010	60.8*b*	66.4*a*	65.3*ab*	66.0*a*	66.4*a*	5.1	0.015
2009	72.1*a*	74.1*a*	71.2*a*	68.2*a*	—	8.3	0.981
2008	53.2*a*	—	53.3*a*	—	—	5.2	0.939
2007	52.6*a*	53.3*a*	57.3*a*	58.0*a*	—	8.7	0.232
2006	43.5*a*	47.00*a*	—	—	—	2.4	0.058

Spring wheat samples from each plot were subjected to quality analyses completed at BioVision Seed Labs in 2009 and 2010. The effects on test weight, thousand kernel weight, protein, hard vitreous kernels, fusarium damage and blackpoint are presented in Tables 46 and 47. According to the contrast comparing all fungicide treatments to the check, spring wheat test weight and thousand kernel weights were consistently increased with fungicide application. In 2009, where no yield response was observed, the increases in test weight were not sufficient for any individual treatments to be considered significantly different from the check. Where there was significant yield increase in 2010, Headline, Tilt and Quilt all resulted in higher test weights and all of the products significantly increased thousand kernel weights. In 2010, the proportion of fusarium damaged kernels was lower with fungicides; however, percent hard vitreous kernels were also slightly lower and blackpoint was significantly higher with fungicide according to the check versus rest contrast. The effects of fungicide on hard vitreous kernels, fusarium damage and blackpoint were not large or consistent enough to be significant for any of the individual treatments. The coefficients of variation for these latter parameters (fusarium damage and blackpoint) were extremely high (34-46%) in all cases, therefore these results are considered somewhat inconclusive. Again, all fungicides were applied at the flag leaf stage, hence targeting leaf disease as opposed to fusarium head blight.

Table 46: Effects of fungicide treatment on spring wheat quality at Indian Head, Saskatchewan in 2009.

Parameter	Check	Stratego	Headline	Tilt	CV	Check vs Rest
	----------	----------	----------	----------	%	p-value
Test Weight (kg/hL)	83.9*a*	84.3*a*	84.3*a*	84.3*a*	0.3	0.024
1000 Kernel Weight (g)	34.5*a*	36.5*a*	36.0*a*	35.9*a*	1.9	0.003
% Protein Content	13.6*a*	13.5*a*	13.1*a*	12.8*a*	5.1	0.288
% Hard Vit. Kernels	81.4*a*	82.9*a*	76.8*a*	77.2*a*	9.1	0.457
% Fusarium damage	0.17*a*	0.15*a*	0.24*a*	0.16*a*	34	0.697
% Blackpoint	3.3*a*	5.3*a*	4.9*a*	3.0*a*	39	0.235

Table 47: Effects of fungicide treatment on spring wheat quality at Indian Head, Saskatchewan in 2010.

Parameter	Check	Stratego	Headline	Tilt	Quilt	CV	Check vs Rest
	----------	----------	----------	----------	----------	%	p-value
Test Weight (kg/hL)	80.5*c*	80.8*bc*	81.6*a*	81.3*ab*	81.4*a*	0.4	<0.001
1000 Kernel Weight (g)	29.7*c*	30.9*b*	31.8*a*	31.5*ab*	31.5*ab*	1.5	<0.001
% Protein Content	14.0*a*	14.3*a*	13.5*a*	13.8*a*	13.7*a*	3.1	0.574
% Hard Vit. Kernels	79.5*a*	77.0*a*	74.8*a*	78.5*a*	74.6*a*	4.8	0.024
% Fusarium damage	0.30*a*	0.15*a*	0.22*a*	0.17*a*	0.18*a*	45	0.050
% Blackpoint	0.8*a*	2.8*a*	2.5*a*	1.7*a*	2.7*a*	46	0.005

Field Pea Response to Fungicide

Field pea trials looking at the yield response to Headline (250 g/L pyraclostrobin) have been completed in six of the past eight growing seasons, with 2010 being excluded due to weather damage. In 2005, noticeable differences in colour and lodging were observed (Figure 16); however, yield data was not collected due to equipment problems. In 2010, conditions were wet and none of the field pea acres were considered suitable for conducting trials. Over the six years where trials were conducted and yield data collected, a field pea yield response to fungicides was observed in one year, 2009 (Table 48). The observed increase was marginally significant in 2008 (P = 0.056). Numerically, mean field pea yields always tended to be slightly higher with fungicide.

Table 48: Effects of fungicide treatment on field pea yield at Indian Head, Saskatchewan.

Year	Check	Headline	CV	Check vs Rest
	---------------------------- bu/ac	---------------------------	%	p-value
2011	29.4*a*	31.7*a*	8.1	0.275
2009	43.7*b*	49.6*a*	5.3	0.044
2008	48.4*a*	50.9*a*	2.4	0.056
2007	54.0*a*	56.0*a*	3.1	0.196
2006	54.2*a*	56.3*a*	6.5	0.516
2004	75.6*a*	79.3*a*	4.4	0.116

Figure 16: Visual response to Headline application on field pea at Indian Head in 2005. The untreated field peas were visibly darker in color and more severely lodged than the adjacent crop.

Barley Response to Fungicide

Replicated fungicide trials with 2-row malting barley were conducted in three separate years (2006, 2008 and 2009) while in 2007, single check strips were evaluated in two separate fields where Headline was applied (Table 49). The products that have been evaluated for barley are Headline (250 g/L pyraclostrobin), Stratego (125 g/L propiconazole and 125 g/L trifloxystrobin) and Tilt (250 g/L propiconazole). A significant yield response to fungicide was observed in one year (2006) where replicated trials were conducted. In 2005, where check strips were included in two small fields, the observed yields were consistently lower in the untreated checks than the adjacent areas where Headline was applied (63.7 vs 69.0 bu/ac).

Table 49: Effects of fungicide treatment on malt barley yield at Indian Head, Saskatchewan.

Year	Check	Headline	Stratego	Tilt	CV	Check vs Rest
	----------	---------- bu/ac	----------	----------	%	p-value
2009	92.2*a*	98.0*a*	98.3*a*	102.6*a*	8.9	0.172
2008	92.5*a*	97.3*a*	91.8*a*	94.7*a*	6.8	0.576
2007†	79.7	86.4	—	—	—	—
2006	80.4*b*	92.6*a*	—	91.4*a*	3.3	0.010

† Check strip compared with adjacent, treated crop at multiple locations

For the trial completed in 2009, harvest samples from each plot were sent for quality analyses to BioVision Seed Labs and the effects of fungicide application on malting barley test weight, thousand kernel weight and protein concentration are presented in Table 50. A marginal increase in test weight was observed when averaged across products (P = 0.079) and thousand kernel weights were significantly higher when fungicides were applied, but not to the extent where individual treatment differences were significant. This improvement in malting barley quality was observed in the absence of a significant yield response.

Table 50: Effects of fungicide treatment on malt barley quality at Indian Head, Saskatchewan in 2009.

Parameter	Check	Headline	Stratego	Tilt	CV	Check vs Rest
	---				%	p-value
Test Weight (kg/hL)	66.6*a*	67.2*a*	67.2*a*	67.1*a*	0.8	0.079
1000 Kernel Weight (g)	47.4*a*	49.2*a*	48.5*a*	48.5*a*	2.0	0.042
% Protein Content	10.6*a*	11.4*a*	11.5*a*	10.9*a*	6.1	0.140

Summary of Results

With the exception of canaryseed, significant yield responses with the application of a fungicide were observed at Indian Head less than 50% of the time (Table 51). In these particular trials, canaryseed has responded to fungicide 100% of the time with an overall yield increase of 24% when averaged across years. Malting barley was the next most responsive crop with yield increases of 10% observed 33% of the time. Average spring wheat yields were also 10% higher with fungicide, but with a frequency of 20%. A yield response with oat was observed 25% of the time with an overall average increase of 6% over the check when all years were averaged. For field peas, the average yield increase was also 6% but a response was only observed 17% of the time. In the case of canola, while a response to fungicide was observed 20% of the time, the observed yield increase when the response did occur was relatively small (4.4%; P = 0.044) and, when averaged across all years and products, canola yields with a fungicide application were only 1% higher than yields where no fungicide had been applied.

Table 51: General summary of all field-scale fungicide trials conducted by IHARF to date near Indian Head, Saskatchewan.

Crop Type	# of trials	Response Frequency[Z]	Check Yield[Y]	Treated Yield[X]	Treated Yield
		----- % -----	------------ bu/ac	-----------	--- % ---
Canaryseed	4	100	31.4	38.8	124
Spring Wheat	5	20	56.4	62.2	110
Oat	4	25	124.0	131.4	106
Malting Barley	3[w]	33[w]	86.2	95.2	110
Field Pea	6	17	50.9	54.0	106
Canola	5	20	44.8	45.3	101

[Z] Significant check versus rest contrast ($P \leq 0.05$)

[Y] Averaged across years

[X] Averaged across years and products

[W] Does not include data from 2007 check strips which were not replicated within the same field

In the cases where oat, wheat and malting barley quality parameters were evaluated, fungicides provided reasonably consistent benefits, generally resulting in increased test weights and thousand kernel weights relative to the check. For oat, groat weights were increased with fungicide applications, even when a significant yield response was not detected. Where significant yield responses were observed, the percentage of plump kernels were increased 66% of the time, while the percentage of thin kernels were decreased 33% of the time.