INDIAN HEAD AGRICULTURAL RESEARCH FOUNDATION

2012 Annual Report

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Introduction

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 consisting of producers and industry stakeholders who volunteer their time and provide guidance to the organization. Residing all across South-Eastern Saskatchewan, IHARF Directors are dedicated to the betterment of the agricultural community as a whole. The 2012 IHARF Directors are:

- Scott Bonnor (President) – Sintaluta
- Franck Groeneweg (Vice-President) – Edgeley
- Terry Rein (Secretary/Treasurer) – Indian Head
- Barry Rapp – Regina
- Brian Acton – Lemberg
- Gus Lagace – Balcarres
- Ivan Ottenbreit – Grayson
- Keith Stephens – Balcarres
- Cameron Gibson – Kendal

Ex-Officio

IHARF receives additional guidance from an experienced team of Agriculture and Agri-Food Canada (AAFC) personnel at the Indian Head Research Farm. They include:

- David Gehl – Officer in Charge
- Dr. Guy Lafond – Research Scientist
- Bill May – Research Scientist
- Chris Omoth – Research Assistant

IHARF Staff

The 2012 dedicated team of IHARF staff includes:

- Danny Petty – Executive Manager
- Chris Holzapfel – Research Manager
- Christiane Catellier – Research Associate
- Karter Kattler – Field & Plot Technician

Extension Events

Indian Head Crop Management Field Day

On July 24, 2012, IHARF hosted the annual Indian Head Crop Management Field Day. Over 160 producers and agronomists from across the Prairies came for tours led by IHARF, AAFC, Saskatchewan Ministry of Agriculture and industry specialists. Tours and presentations were provided by:

- Chris Holzapfel – IHARF
- Faye Dokken-Bouchard – Saskatchewan Ministry of Agriculture
- Dr. Guy Lafond – AAFC Indian Head
- Scott Hartley – Saskatchewan Ministry of Agriculture
- Dr. Ron DePauw – AAFC Swift Current
- Edgar Hammermeister – Western Ag Labs
- Bill May – AAFC Indian Head
- Dr. Ron Palmer – IHARF

Agri-ARM Research Update

As part of Crop Production Week in Saskatoon, Saskatchewan, a new event was held on January 11, 2013. IHARF, along with the Western Applied Research Corporation (WARC), Northeast Agriculture Research Foundation (NARF) and Wheatland Conservation Area (WCA) jointly hosted the first Agri-ARM Research Update. The event highlighted components of each organization's research and demonstration programs. Presenters for the day included:

- Anne Kirk – WARC, Scott, SK.
- Gary Kruger – ICDC, Outlook, SK.
- Dr. Ron Palmer – IHARF
- Stu Brandt – NARF, Melfort, SK.
- Bryan Nybo – WCA, Swift Current, SK.
- Chris Holzapfel – IHARF

Presentations from each speaker are available for download at www.iharf.ca

IHARF Soil and Crop Management Seminar

On February 6, 2013, IHARF hosted its annual winter seminar, highlighting the results of the 2012 season. Close to 120 guests participated in the event which featured presentations delivered by:

- Dr. Guy Lafond – AAFC Indian Head
- Chris Holzapfel – IHARF
- Brent Flaten – Saskatchewan Ministry of Agriculture
- Bill May – AAFC Indian Head
- Etienne Soulodre – Water Security Agency
- Jim Gerhart – Water Security Agency
- Dr. Ron Palmer – IHARF
- Corinna Mitchell-Beaudin – Farm Credit Canada

Presentations from each speaker are available for download at www.iharf.ca

2012 IHARF Partners

Platinum

Agriculture & Agri-Food Canada – Indian Head Research Farm
Bayer CropScience
Canada / Saskatchewan ADOPT Program
Canadian Agricultural Adaptation Program
Canola Agronomic Research Program
Canola Council of Canada
Saskatchewan Canola Development Commission
Saskatchewan Ministry of Agriculture
Saskatchewan Pulse Growers
Western Grains Research Foundation

Gold

BASF
Manitoba Canola Growers Association
Mosaic
Viterra

Silver

Agrisoma Biosciences
Agrium Advanced Technologies
Canaryseed Development Commission of Saskatchewan
Dow AgroSciences
International Plant Nutrition Institute
Saskatchewan Sunflower Committee
Syngenta
Town of Indian Head
Western Ag Labs

Bronze

Brett Young Seeds
CEAPRO Inc.
Ducks Unlimited Canada
DuPont
Engage Agro
HCI Ventures
Markusson New Holland
Monsanto / Dekalb
Nite Hawk Trucking
NorthStar Genetics
Paterson Grain
Pioneer Hi-Bred
Saskatchewan Institute of Agrologists – Regina Branch
University of Saskatchewan
United Agri-Products
Wheatland Financial – Paul Kuntz

Agri-ARM

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

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

The eight Agri-ARM sites found throughout Saskatchewan include:

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

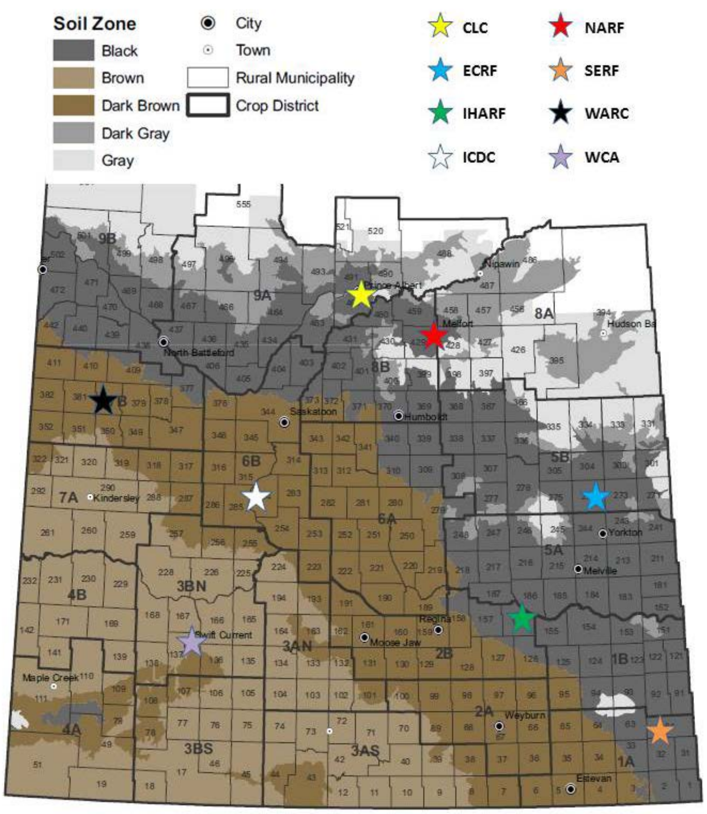

Figure 1. Saskatchewan Agri-ARM network

Environmental Data

Weather data for Indian Head, Melfort, Scott, and Swift Current, Saskatchewan, are provided, as many of the studies were conducted at these locations and the data were combined for analyses. Data were obtained from an Environment Canada weather station found at each site, and accessed online [http://www.climate.weatheroffice.gc.ca/climateData/canada_e.html].

Mean temperatures at Indian Head were near to above normal for the 2012 growing season (Table 1). Temperatures were relatively low during crop establishment in May, and relatively high in July. Over the four month period from May-August, precipitation was well above normal at Indian Head; however the distribution of the precipitation varied from month to month (Table 2). In particular, precipitation was 185% of normal in July and only 58% of normal in August. The combination of above average moisture and heat in July was highly conducive to the development of disease in the 2012 growing season.

Table 1. Mean monthly *temperatures* for the 2012 growing season and long-term normals (1971-2000).

		April	May	June	July	August	September	October	Average
		°C							
Indian Head	2012	4.1	9.9*	16.5	19.2	17.1	12.6*	2.1	11.6
	normal	4.0	11.4	16.1	18.4	17.5	11.4	4.6	11.9
Melfort	2012	2.6*	9.6	15.2	18.9	17.1	12.4	1.1	11.0
	normal	2.5	10.8	15.7	17.4	16.4	10.5	3.6	11.0
Scott	2012	3.8*	9.7	15.1	18.6	17.0*	12.2	0.9	11.0
	normal	3.6	10.9	15.2	17.0	16.3	10.4	3.8	11.0
Swift Current	2012	5.1*	9.4*	15.5	20.0	19	13.8	2.9	12.2
	normal	4.9	11.1	15.6	18.1	17.9	11.8	5.5	12.1

* = The value displayed is based on incomplete data

Table 2. Total monthly *precipitation* for the 2012 growing season and long-term normals (1971-2000).

		April	May	June	July	August	September	October	Average
		mm							
Indian Head	2012	45.4	79.4*	51.0	124.6	30.4	0.0*	19.8*	350.6
	normal	24.6	55.7	78.9	67.1	52.7	41.3	24.3	344.6
Melfort	2012	24.7*	55.2*	112.3	97.8*	68.1	12.6*	29.2*	399.9
	normal	24.5	45.6	65.8	75.7	56.8	39.9	24.7	333.0
Scott	2012	38.4*	50.6*	164.6	56.4	51.4*	24.4	12.3*	398.1
	normal	23.6	35.9	62.5	70.9	43.1	31.4	14.3	281.7
Swift Current	2012	63.0*	98.3*	107.0	17.2	8.2	4.9*	13.2*	311.8
	normal	22.3	49.5	66.0	52.0	39.9	30.2	16.2	276.1

* = The value displayed is based on incomplete data

Research

IHARF research trials were located on rented land north of the AAFC-Indian Head Research Farm (SE 31-18-12 and NE 30-18-12), and at the newly acquired IHARF Farm (NE and SE 31-18-12). Each trial consisted of numerous plots, each representing a specific treatment being evaluated in that particular trial (eg. rates, seed treatments, varieties, etc.). Plots were cared for using best management practices (unless dictated otherwise by the protocol) and in a manner which was consistent to normal or typical practices in the Indian Head area. Overall, plots were seeded as early as possible in early to mid-May, with 8' x 35' plots and 12" row spacing using a SeedMaster air drill, or with 12' x 35' plots and 12" row spacing using a ConservaPak air drill. Cultivars and varieties were representative of those used by producers in the area, and seeds for each trial (with seed treatments applied where required) and recommended seeding practices (i.e. rate, depth) were typically used (unless otherwise required by the protocol).

Fertility and insect, weed and disease levels were normally kept non-limiting using commercial fertilizers and registered pesticides to minimize potential effects on the specific treatments being evaluated. Plots were desiccated or swathed when required, and harvested as closely as possible to the appropriate timing using a Wintersteiger plot combine, Kincaid-8 XP plot combine, or MF300 plot combine. Deviations in agronomy and crop management have been specified where required as a result of the study objectives and are indicated in the description of each trial. Apart from the treatment being evaluated, agronomy and crop management were consistent for every plot within each trial, in order to isolate treatment effects and minimize potential biases.

Statistical Analyses

The majority of trials were conducted using a randomized complete block design (RCBD), or a modified version of this experimental design, meaning each treatment is randomly assigned to plots within replicates (blocks). The treatments in each IHARF field trial were replicated 3-5 times, allowing for the statistical analyses of results to assess whether observed differences in the responses (eg. plant density, height, yield) are an effect of the treatment or due to random and natural variability or experimental error. Inferential statistics are used to determine whether treatments significantly differ from each other. If a difference between two treatments is significant, it should be repeatable and reasonably expected, *under the conditions in which the trial was conducted*. For agricultural research, a significance level of α=0.05 is generally used, which more specifically indicates a 95% probability that an observed effect was caused by the treatment and was not due to random variability.

In this report, statistical differences between treatments are represented by letters of the alphabet next to the observed mean (average) for each treatment. Treatment means with the same letter do not significantly differ, while means with different letters are significantly different from one another (eg. Table 3).

Table 3. Example of statistical significance.

Treatment	**Plant density** *(not significant)*	**Yield** *(significant)*
Treatment 1	87 *a*	32 *b*
Treatment 2	89 *a*	45 *a*

Units

Some data are reported in metric terms (i.e. yield responses shown in kilograms per hectare), particularly in cases where it was not practical to convert the values to bushels per acre (bu/ac), as in certain figures. For reference, yield values ranging from 1000 to 6000 kg/ha are shown in Table 4 with the corresponding values in bu/ac for each crop.

Table 4. Conversion of kg/ha to bu/ac.

		kg/ha										
		1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
Barley	bu /ac	18.6	27.9	37.2	46.5	55.8	65.1	74.3	83.6	92.9	102.2	111.5
Canola		17.8	26.8	35.7	44.6	53.5	62.5	71.4	80.3	89.2	98.1	107.1
Faba beans		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2
Flaxseed		15.9	23.9	31.9	39.8	47.8	55.8	63.7	71.7	79.7	87.6	95.6
Oats		26.2	39.4	52.5	65.6	78.7	91.8	105.0	118.1	131.2	144.3	157.4
Peas		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2
Soybeans		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2
Wheat		14.9	22.3	29.7	37.2	44.6	52.0	59.5	66.9	74.3	81.8	89.2

Disclaimer

Disclosure of trade names does not imply any endorsement or disapproval of any specific product(s) and is only intended to differentiate treatments and allow producers to identify the specific technologies being demonstrated in the marketplace.

Brassica carinata (Ethiopian Mustard) Advanced Yield Trial

C. Holzapfel[1], Daryl Males[2] and Rick Bennet[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]Agrisoma Biosciences Inc., Saskatoon, SK

Overview

Brassica carinata, commonly known as Ethiopian mustard, has an oil profile optimized for use in the biofuel industry, specifically for bio-jet fuel. This crop exhibits good resistance to biotic stressors, such as insects and disease, as well as abiotic stressors, such as heat and drought, and is well suited to production in semi-arid regions. This study was implemented to evaluate the relative performance of 24 experimental *B. carinata* lines relative to Agrisoma's current commercial variety (AAC A100).

Methods

The trial was seeded into wheat stubble on May 21, 2012. A pre-seed application of Cleanstart was applied, with Edge broadcast over the trial area prior to seeding. Urea, monoammonium phosphate, ammonium sulphate and potassium chloride were side-banded at seeding to provide 115-26-13-13 lb/ac of $N-P_2O_5-K_2O-S$. In-crop herbicides included Muster and Assure II applied at the 4 leaf stage and no fungicides were applied.

Results

There were no significant differences in plant density between varieties, while varietal differences in days to flowering, maturity, height, lodging and seed yield were detected (Table 5).

Table 5. 2012 Performance of 25 *B. carinata* varieties at Indian Head, SK.

Variety	Plant density	Days to Flowering	Days to Maturity	Height	Lodging	Seed yield
	plants / m^2	----- days from seeding -----		cm	1=low 5=high	bu/ac
EXP (Trt. 1)	79 *a*	46.3 *abc*	102.3 *abc*	143 *a*	2.3 *abc*	29.1 *cd*
EXP (Trt. 2)	94 *a*	45.3 *cd*	100.7 *abcdef*	133 *abcd*	2.2 *abcd*	31.7 *bc*
EXP (Trt. 3)	110 *a*	46.3 *abc*	99.7 *bcdefg*	126 *abcdefg*	1.5 *cde*	33.3 *bc*
EXP (Trt. 4)	93 *a*	46.3 *abc*	101.2 *abcd*	146 *a*	2.2 *abcd*	33.0 *bc*
EXP (Trt. 5)	80 *a*	45.0 *de*	98.7 *cdefg*	101 *fgh*	1.7 *cde*	31.0 *bc*
EXP (Trt. 6)	834 *a*	44.0 *e*	99.0 *bcdefg*	103 *efgh*	1.5 *cde*	28.8 *cd*
EXP (Trt. 7)	88 *a*	44.0 *e*	96.3 *g*	112 *bcdefgh*	1.5 *cde*	25.3 *cd*
EXP (Trt. 8)	104 *a*	45.0 *de*	98.7 *cdefg*	101 *fgh*	2.2 *abcd*	28.1 *cd*
EXP (Trt. 9)	88 *a*	44.0 *e*	98.3 *defg*	106 *defgh*	1.2 *de*	27.4 *cd*
EXP (Trt. 10)	86 *a*	44.0 *e*	97.2 *efg*	99 *gh*	1.0 *e*	24.1 *cd*
EXP (Trt. 11)	112 *a*	45.0 *de*	100.5 *abcdef*	107 *cdefgh*	1.7 *cde*	30.4 *c*
EXP (Trt. 12)	90 *a*	44.0 *e*	98.3 *defg*	101 *fgh*	1.2 *de*	19.7 *d*
EXP (Trt. 13)	111 *a*	44.0 *e*	97.0 *fg*	96 *h*	1.8 *bcde*	24.8 *cd*
EXP (Trt. 14)	92 *a*	45.3 *cd*	100.3 *abcdef*	130 *abcde*	2.8 *ab*	34.0 *bc*
EXP (Trt. 15)	114 *a*	45.3 *cd*	100.3 *abcdef*	135 *abc*	2.2 *abcd*	30.7 *bc*
EXP (Trt. 16)	101 *a*	45.7 *bcd*	100.3 *abcdef*	129 *abcdef*	1.8 *bcde*	28.9 *cd*
EXP (Trt. 17)	86 *a*	45.0 *de*	102.2 *abcd*	144 *a*	2.2 *abcd*	24.8 *cd*
EXP (Trt. 18)	72 *a*	45.3 *cd*	100.8 *abcdef*	138 *ab*	2.2 *abcd*	29.5 *cd*
EXP (Trt. 19)	83 *a*	45.0 *de*	99.0 *bcdefg*	145 *a*	1.8 *bcde*	30.2 *c*
EXP (Trt. 20)	104 *a*	44.7 *de*	99.7 *bcdefg*	130 *abcde*	2.3 *abc*	28.1 *cd*
EXP (Trt. 21)	90 *a*	44.7 *de*	101.3 *abcd*	114 *bcdefgh*	1.7 *cde*	32.5 *bc*
EXP (Trt. 22)	73 *a*	47.3 *a*	102.7 *ab*	129 *abcdef*	3.0 *a*	44.7 *a*
EXP (Trt. 23)	85 *a*	46.7 *ab*	104.0 *a*	136 *ab*	3.0 *a*	40.7 *ab*
AAC A100	87 *a*	45.7 *bcd*	101.5 *abcd*	144 *a*	2.5 *abc*	28.4 *cd*
EXP (Trt. 25)	91 *a*	45.7 *bcd*	101.0 *abcde*	148 *a*	2.2 *abcd*	32.1 *bc*

Conclusion

After the second year of testing at Indian Head, *B. carinata* appears to be an agronomically viable and productive crop for this region. Seed yields were lower in 2012 than that of 2011 where *B. carinata* yielded consistently over 50 bu/ac (2011 IHARF Annual Report), but still consistent with canola yields in adjacent trials which also yielded lower in 2012. Management practices are similar to canola and the crop exhibits superior shattering resistance and is exceptionally well suited to straight-combining. A variation of this trial will again be conducted at Indian Head in 2013 and more details on *B. carinata* production are available online (http://agrisoma.com/images/pdfs/CarinataProductionGuide.pdf).

Acknowledgements

Funding for this project was provided by Agrisoma Biosciences.

Soybean Variety Trial for Southeast Saskatchewan

C. Holzapfel[1], Claude Durand[2]

[1]Indian Head Agricultural Research Foundation, Indian Head, SK; [2]NorthStar Genetics, Winnipeg, MB

Overview

As new varieties are developed that are suited for growing conditions in this province, Saskatchewan farmers are becoming increasingly interested in producing soybeans. Although varieties with higher heat requirements may have increased yield potential, they are risky to grow in Saskatchewan due to a short growing season and the high risk of frost prior to maturity. This study was implemented in collaboration with NorthStar Genetics to evaluate the performance and adaptation of 10 commercial soybean cultivars in Saskatchewan.

Methods

The trial was seeded on May 21, 2012, using a SeedMaster drill on 12" row spacing, with a target depth of approximately one inch and a seeding rate of 50 seeds/m^2 (200,000 seeds/ac). The soybeans were double inoculated with a seed applied liquid inoculant and a granular inoculant applied in the seed-row. A fertilizer blend was also side-banded, delivering 19-27-13-13 lbs/ac of N-P_2O_5-K_2O-S. No foliar fungicides were applied to the trial, partially to avoid prolong maturity.

Results

The 2012 season provided ideal growing conditions for soybeans, resulting in quite high yields (Table 6). The soybeans were left to naturally mature, and all varieties were straight-combined on September 24. There were no issues with seed quality.

Table 6. Soybean growth and yield at Indian Head, SK. 2012.

Cultivar	**Plant Density** (plants/m^2)	**Pod Clearance** (cm)	**Days to Maturity** (days from seeding)	**Seed Yield** (bu/ac)
NSC Reston RR2Y	56.3 *a*	5.4 *ab*	109.2 *e*	39.2 *ab*
Competitor #1	51.9 *a*	4.7 *b*	111.3 *cd*	39.6 *ab*
Competitor #2	55.8 *a*	7.7 *a*	110.7 *d*	39.9 *ab*
NSC Warren	55.2 *a*	4.9 *b*	112.0 *cd*	34.5 *abc*
NSC Anola RR2Y	48.1 *a*	5.0 *b*	113.7 *ab*	40.8 *a*
NSC Libau RR2Y	56.3 *a*	5.0 *b*	114.3 *a*	38.5 *abc*
NSC Elie RR2Y	53.6 *a*	4.9 *b*	111.3 *cd*	37.9 *abc*
NSC Vito R2	62.9 *a*	6.9 *ab*	112.7 *bc*	33.8 *bc*
NSC Tilston RR2Y	61.0 *a*	6.8 *ab*	112.3 *bc*	34.7 *abc*
NSC Richer RR2Y	55.2 *a*	5.3 *ab*	114.3 *a*	32.1 *c*

Conclusion

2012 was an ideal year for soybeans and impressive yields were achieved. The soybeans did not seem affected by disease and foliar fungicide applications are generally not recommended in southeast Saskatchewan as they could delay maturity. General tips for producing soybeans include seeding shallow (0.75"-1.5") into moisture and relatively warm (>10°C) soil, inoculating well (i.e. liquid plus granular) and rolling fields if stones are a concern. This and several other soybean trials will be conducted in 2013.

Acknowledgement

Funding for this project was provided by NorthStar Genetics.

Field Pea Input Study

A. Kirk[1], E. Johnson[2], S. Brandt[3], B. Davey[1], S. Phelps[4], C. Holzapfel[5], B. Nybo[6]

[1]Western Applied Research Corporation, Scott, SK; [2]Agriculture and Agri-Food Canada, Scott, SK; [3]Northeast Agriculture Research Foundation, Melfort, SK; [4]Saskatchewan Ministry of Agriculture, Scott, SK; [5]Indian Head Agricultural Research Foundation, Indian Head, SK; [6]Wheatland Conservation Area, Swift Current, SK

Overview

Most previous research on field pea production in Saskatchewan has focused on only one aspect of field pea agronomy, rather than investigating the effects on field pea yield when several different agronomic factors are combined. Combining agronomic practices may bring about positive interactions that result in a greater benefit than would be found for the individual factors. The objectives of this study were to determine which agronomic practices or combination of practices contribute the most to field pea yield, thus providing insight into the factors that are currently limiting the yield potential of field pea in Saskatchewan.

Methods

To determine field pea responses to agronomic practices such as seeding rate (SR), seed treatment (ST), granular inoculant (GI), starter fertilizer (Fz), and foliar fungicide (Fn), treatments were compared that included each of these components alone or in combination, as summarized in Table 7.

Table 7. Treatments evaluating field pea response to different combinations of agronomic practices.

Treatment	**Seeding Rate** (SR)	**Seed Treatment** (ST)[1]	**Innoculant** (GI)[2]	**Starter Fertilizer** (Fz)[3]	**Foliar Fungicide** (Fn)[4]
Empty	60 seeds/m^2	No	Liquid	No	No
Full	120 seeds/m^2	Yes	Granular	Yes	Yes
ST	60 seeds/m^2	Yes	Liquid	No	No
SR	120 seeds/m^2	No	Liquid	No	No
GI	60 seeds/m^2	No	Granular	No	No
Fz	60 seeds/m^2	No	Liquid	Yes	No
Fn	60 seeds/m^2	No	Liquid	No	Yes
ST + SR	120 seeds/m^2	Yes	Liquid	No	No
ST + GI	60 seeds/m^2	Yes	Granular	No	No
Fz + GI	60 seeds/m^2	No	Granular	Yes	No
Fz + SR	120 seeds/m^2	No	Liquid	Yes	No
SR + Fn	120 seeds/m^2	No	Liquid	No	Yes
Fz + Fn	60 seeds/m^2	No	Liquid	Yes	Yes
GI + Fn	60 seeds/m^2	No	Granular	No	Yes
ST + Fz	60 seeds/m^2	Yes	Liquid	Yes	No
SR + GI	120 seeds/m^2	No	Granular	No	No
ST + SR + GI + Fn	120 seeds/m^2	Yes	Granular	No	Yes
SR + GI + Fn	120 seeds/m^2	No	Granular	No	Yes
ST + GI + Fn	60 seeds/m^2	Yes	Granular	No	Yes
ST + SR + GI	120 seeds/m^2	Yes	Granular	No	No
ST + SR + Fn	120 seeds/m^2	Yes	Liquid	No	Yes

[1]Seed treatment = Apron Maxx RTA
[2]Granular inoculant = Optimize; liquid inoculant = Boost N
[3]Starter fertilizer = 46-0-0 side-banded at 30 lbs/ac
[4]Headline EC at the beginning of flowering, and Priaxor DS 7-14 days after the first application

Results

Results from all four sites were combined and are reported in Table 8. Treatment differences were detected for plant density, yield, protein content, and thousand seed weight, but not test weight. The individual inputs that contributed most to yield were granular inoculant, foliar fungicide and increased seeding rate; however, the contribution of different inputs varied. In general and as expected, plant densities were lower in the treatments with lower seeding rates than in those where higher seeding rates were used. The full input package yielded 19 bu/ac more than the empty input package, and the full input package without starter fertilizer had the greatest overall yield (Table 8). The individual inputs that resulted in a significant yield increase from the empty input package were granular inoculant, foliar fungicide and increased seeding rate.

Table 8. Treatment effects of input combinations on field pea (least squares means).

	Plant Density (plants/m^2)	Yield (bu/ac)	Protein (%)	TKW (g)	TW (g/0.5L)
Empty	46 *f*	32.6 *j*	23.1 *efgh*	176.0 *b*	411
Full	90 *abc*	51.7 *ab*	23.1 *fgh*	185.2 *a*	416
ST	50 *ef*	32.0 *j*	23.2 *defgh*	174.0 *bc*	416.5
SR	90 *abc*	41.5 *defg*	23.4 *cdef*	172.2 *bcd*	415
GI	51 *ef*	37.7 *ghi*	23.6 *abc*	170.6 *cdef*	414.5
Fz	50 *ef*	35.4 *ij*	23.6 *bc*	173.1 *bc*	415.5
Fn	50 *ef*	41.4 *defg*	22.9 *hij*	189.2 *a*	415
ST + SR	92 *ab*	37.3 *hi*	23.4 *cdef*	166.5 *f*	415
ST + GI	56 *e*	38.8 *fghi*	23.5 *bcde*	173.7 *bc*	416.5
Fz + GI	49 *ef*	38.1 *ghi*	24.0 *a*	169.6 *cdef*	415.5
Fz + SR	86 *bc*	42.8 *def*	23.8 *ab*	171.2 *cde*	415
SR + Fn	83 *c*	48.3 *bc*	22.8 *hij*	187.1 *a*	415.5
Fz + Fn	52 *ef*	44.1 *de*	23.4 *cdefg*	188.6 *a*	414.5
GI + Fn	49 *ef*	45.3 *cd*	23.0 *ghi*	186.9 *a*	417
ST + Fz	70 *d*	38.5 *ghi*	23.5 *bc*	170.9 *cdef*	415.5
SR + GI	94 *a*	40.6 *efgh*	23.5 *bcd*	168.3 *def*	413
ST + SR + GI + Fn	89 *abc*	54.9 *a*	22.9 *hij*	188.1 *a*	417.5
SR + GI + Fn	92 *ab*	53.2 *a*	22.8 *hij*	188.7 *a*	416
ST + GI + Fn	50 *ef*	48.7 *bc*	22.9 *hij*	188.3 *a*	416
ST + SR + GI	96 *a*	43.3 *de*	23.6 *abc*	167.2 *ef*	382
ST + SR + Fn	90 *abc*	48.2 *bc*	22.7 *ij*	189.7 *a*	411

We examined the yield increase or decrease that resulted from adding individual inputs to the empty package and compared that to the yield of the full input package (Figure 2). Adding these yield gains and losses together allowed us to calculate a theoretical yield when all inputs were applied. The actual yield of the full input package (51.7 bu/ac) is less than the predicted yield of 57.6 bu/ac (3,872 kg/ha) (Figure 2), which suggests that the inputs in the full package may be acting antagonistically or that there are other factors limiting yield. Removing starter fertilizer and seed treatment from the full input package resulted in a slight yield increase; however, the gain was not statistically significant (Table 8). The gain in yield when starter fertilizer and seed treatment are removed from the full input package suggests that these inputs may be acting antagonistically with the other inputs in the full input package. There was also no significant difference between the full input package and full minus granular inoculant and seeding rate, indicating that foliar fungicide was the input that contributed most to the full input package. Disease levels were high at Melfort, Scott and Indian Head and fungicide applications significantly reduced disease levels at these locations (data not show). When no fungicides were applied, high seeding rates tended to have higher levels of disease than lower seeding rates (data not shown). The contributions to yield of different inputs varied to some extent across locations with seeding rate and granular inoculant being the most important inputs at Scott and Swift Current while fungicides resulted in the biggest yield gains at Indian Head and Melfort (data not shown).

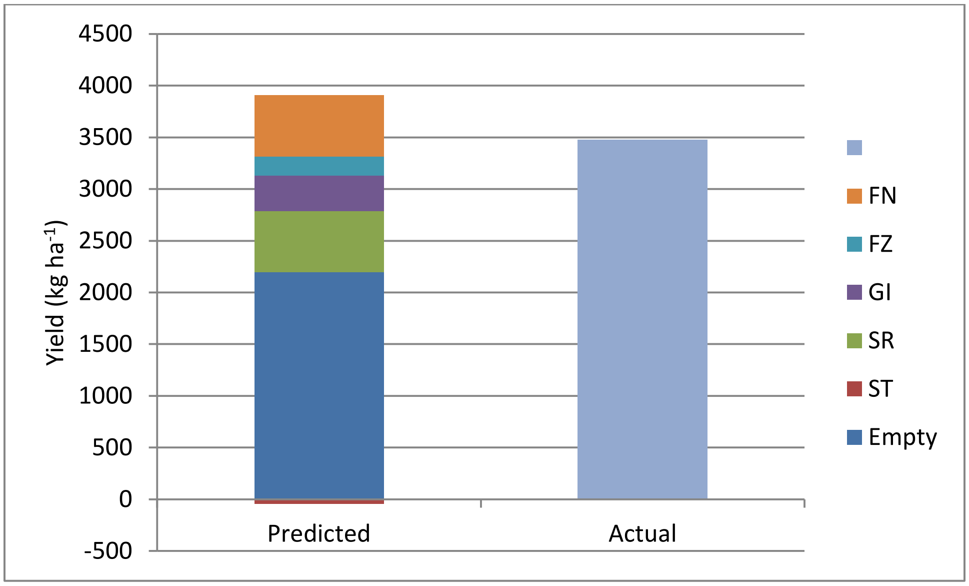

Figure 2. Contribution of inputs to predicted field pea yield and actual yield of full input package.

Conclusion

The individual inputs that contributed most to yield were granular inoculant, foliar fungicide and increased seeding rate. Adding starter fertilizer and fungicide seed treatment to the empty input package did not result in a significant yield increase in 2012. The yield of the full input was not as high as expected, which may be due to possible antagonistic effects of seed treatment and starter fertilizer and other factors limiting yield. The highest yield was achieved when starter fertilizer was removed from the full input package. Foliar fungicide was the most important input for protecting yield since removing foliar fungicide from the full input package resulted in a significant yield reduction. Input interactions will be investigated further, when more site years are available for analysis. This project will be conducted again in 2013.

Acknowledgement

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Canola performance trials

In 2012, IHARF took part in the Canola Council of Canada's Canola Performance Trials. The trials represent the next generation in variety evaluation for Western Canadian canola growers. The trials provide relevant and unbiased performance data that reflects actual production practices and comparative data on leading varieties and newly introduced varieties. To view the results, please visit: www.canolaperformancetrials.ca

Evaluating the Response of Hybrid Canola to Low Plant Populations

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Overview

Poor emergence combined with frost or insect damage of canola early in the spring frequently result in lower than optimal plant populations. As a result of traits such as herbicide tolerance, disease resistance and improved stress tolerance, research has indicated that, hybrid canola may be able to more fully compensate for low plant densities in comparison to open-pollinated varieties. However, yield and grain quality may be affected when plant populations are too low for the crop to recover. In severe cases, it may be desirable to reseed but producers require research to help guide such decisions. The objectives of this study were: 1) To determine the minimum plant density where hybrid canola yields are reduced; 2) To evaluate the effects of low plant population on maturity, seed size, and green seed content; 3) To determine the minimum density at which reseeding would be recommended.

Methods

Trials were conducted at Scott, Swift Current, Indian Head, Melfort, and Saskatoon in 2010 through 2012. Seven seeding rates were included targetting 5, 10, 20, 40, 80, 150, and 300 viable seeds/m^2. At the two lowest seeding rates, elemental sulphur was added to the seed as a bulking agent to ensure even seed distribution, and eight replicates of these treatments were included to account for greater variability in seed distribution.

Results

Seeding rate had large effects on yield across sites and years (Table 9). The minimum plant density found to produce a seed yield equivalent to the maximum ranged from only 7 plants/m^2 at Scott in 2011 up to 47 plants/m^2 at Saskatoon in 2011. When all sites in each year were combined, the maximum yield points were 24, 20 and 30 plants/m^2 in 2010, 2011 and 2012, respectively (Table 9).

Table 9. Plant density where maximum yield was achieved. Some data lost due to environmental effects.

Site/Year	2010		2011		2012	
	density at max yield (plants/m^2)	max yield plateau (bu/ac)	density at max yield (plants/m^2)	max yield plateau (bu/ac)	density at max yield (plants/m^2)	max yield plateau (bu/ac)
Scott	22	17.7	7	42.6	-	-
Melfort	-	-	26	42.1	-	-
Saskatoon	16	35.1	47	42.8	35	43.1
Indian Head	32	48.4	13	60.9	11	34.3
Swift Current	12	33.3	19	40.5	16	29.6
All Sites Combined	**24**	**30.4**	**20**	**44.3**	**30**	**34.3**

Conclusion

In general, days to maturity and percent green seed increased as plant density decreased; however, the plant densities at which maturity and quality were affected were lower than the plant density required to produce maximum yield (data not shown). Canola at lower plant densities was able to compensate for the reduced plant stand by increased branching and podding. A plant density of 45 plants/m^2 should be the targeted plant population, producing maximum yield 95 per cent of the time; however, the plant density found to produce maximum yield ranged from 7 to 47 plants/m^2 at individual sites. Seeding rates for canola should be high enough to account for potential emergence or establishment problems and it is possible that higher plant populations will cope better with late season stresses such as drought. It is important to note that for the majority of locations, precipitation levels were above normal for all three years of the study.

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Evaluating the Risks of Reseeding Hybrid Canola

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Overview

Producers may choose to reseed canola when low emergence, frost or insect damage on the crop in the early spring results in a poor stand. Previous research has recommended using early maturing canola varieties, as reseeding at a later date increases the risk of crop damage in the fall. However, little research has assessed the performance of hybrid varieties relative to lower yielding, earlier maturing canola varieties when they are seeded at a later date. To evaluate the risks associated with various reseeding options, two varieties of hybrid canola and one variety of polish canola were reseeded into existing stands of low density canola in early and mid-June.

Methods

For the two initial (not reseeded, high yielding cultivar) treatments, InVigor 5440 was seeded in early May at a rate of 150 seeds/m^2, and 40 seeds/m^2 to simulate a poor crop stand. For the reseeded treatments, InVigor 5440 was seeded in all plots in early May at a rate of 40 seeds/m^2, and the crop was then terminated with glyphosate prior to reseeding to one of three different cultivars (InVigor 5440, 9350RR, and ACS18 polish canola) at two later dates (early June and mid-June) and a rate of 150 seeds/m^2 (Table 10). The cultivar 9350RR is an early maturing Argentine hybrid while ACS18 is an open pollinated, very early maturing Polish variety.

Table 10. Treatments examining the risks of reseeding hybrid canola.

Trt.	Seeding date	Variety	Seeding rate (seeds/m^2)
1	early May	5440 LL	150
2	early May	5440 LL	40
3	early June	ACS-C18	150
4	early June	5440 LL	150
5	early June	9350 RR	150
6	mid-June	ACS-C18	150
7	mid-June	5440 LL	150
8	mid-June	9350 RR	150

Results

Reseeding to the Polish canola variety ACS-C18 was of no advantage, as yields were similar or lower than the low plant populations seeded in May, and often even lower than the hybrid varieties that were re-seeded later in the season (Table 11). Reseeding to hybrid varieties (9350 RR or 5440 LL) in early June produced yields that were similar and in some cases, higher than the low plant stands seeded in early May (Table 11). Reseeding in mid-June was a high risk option, even with high-yielding hybrids. The mid-June seeding date had lower yields in all site years with no advantage over the low population seeded in May. In some years, zero yields occurred because the crop did not reach maturity. At Swift Current in 2012 there was a terminal drought that caused plant death before seed set. Even though same seeding rates were used, the plant densities were lower for the mid-June seeding date compared to the earlier seeding dates, likely due to poorer seeding conditions or less than favourable conditions for emergence.

Table 11. Plant density and seed yield for each treatment in 2010-2012

Seeding Date	Variety	Seeding Rate (seeds m^{-2})	2010 Plant density (plants/m^2)	2010 Yield (bu/ac)	2011 Plant density (plants/m^2)	2011 Yield (bu/ac)	2012 Plant density (plants/m^2)	2012 Yield (bu/ac)
Early May	5440	150	84	36.0	61	38.9	88	40.3
Early May	5440	40	31	21.9	21	30.0	20	31.5
Early June	5440	150	102	40.4	75	37.0	101	34.0
Early June	9350	150	90	35.4	75	29.4	92	32.5
Early June	Polish	150	72	17.4	61	22.6	70	19.7
Mid-June	5440	150	67	24.3	49	17.9	73	26.7
Mid-June	9350	150	65	24.2	53	20.6	67	24.1
Mid-June	Polish	150	44	19.0	44	17.7	47	11.1

Conclusion

Reseeding to hybrid Argentine canola in early June produced higher yields than the early seeded, lower plant population in only one out of 3 years, therefore reseeding was rarely a profitable decision. There was no advantage to reseeding to early maturing Polish canola in early June as yields were lower than the treatments with low plant populations. Reseeding in mid-June was the riskiest option as yields of all reseeded varieties were lower than the early established but poor stand of canola. We conclude that when plant stands are 20 plants/m^2 or higher, with fairly uniform distribution and good weed control, there is no advantage to reseeding canola. Under conditions where populations are extremely low and reseeding is the best option, there is no advantage to Polish canola over hybrid Argentine cultivars, even when seeding is postponed to mid-June. When reseeding is required, it is recommended that producers do so as early as possible to reduce the risk of poor stand establishment and fall frost.

Acknowledgement

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

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Overview

Early season phosphorus (P) nutrition is critical for optimum crop yield. Phosphorus is taken up by plant roots in the form of H_2PO_4 and HPO_4 found in the soil solution, which is supplied by soil inorganic and organic P sources, and by 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 determine the effect of the commercially available phosphate-solubilizing inoculant *Penicillium bilaii* (JumpStart®), applied with and without monoammonium phosphate (MAP) fertilizer, on the growth, phosphorous uptake, yield, and quality of canola under field conditions in Manitoba and Saskatchewan.

Methods

The experiment was conducted at locations in southwestern Manitoba and in Saskatchewan from 2010 to 2012. Sixteen treatments were evaluated which varied in the amount and placement of P fertilizer (MAP), and in the application of Jumpstart (Table 12). The total nitrogen fertilizer application rate was kept constant and adjusted for N provided by the monoammonium phosphate. The N source used at each site was a blend of 25% urea and 75% ESN placed in a side-band.

Table 12. Canola response to Jumpstart® treatment list.

P_2O_5 (lbs/ac)	Placement	Jumpstart®
0	banded	✓
9	banded	✓
18	banded	✓
27	banded	✓
36	banded	✓
9	seed placed	✓
18	seed placed	✓
18/18	18 seed + 18 banded	✓
0	Banded	×
9	Banded	×
18	Banded	×
27	Banded	×
36	Banded	×
9	seed placed	×
18	seed placed	×
18/18	18 seed + 18 banded	×

Results

In 8 of 9 site-years, treatments inoculated with *P. bilaii* had lower plant stands than uninoculated treatments, and in 4 of 9 site-years, lower plant stands were associated with seed-placed monoammonium phosphate (Table 13). However, plant stands were always within recommended levels and therefore not expected to impact yield, especially given the flexible growth of canola.

Table 13. Plant density by P management in Manitoba and Saskatchewan (2010-12).

	2010			2011	2012				
	Phillips	MZTRA	Indian Head	Indian Head	Brandon	Phillips	Indian Head	Melfort	Scott
	plants/m^2								
Jumpstart®									
✕	117	135	107	89	115	132	90	131	110
✓	100	102	93	90	108	123	82	119	84
P Fertilizer									
0 lbs/ac	108	131	97	93	104	134	86	113	97
9 lbs/ac side-banded	117	121	100	90	120	137	89	126	105
18 lbs/ac side-banded	115	126	99	88	115	131	86	133	91
27 lbs/ac side-banded	111	128	101	91	117	133	89	125	99
36 lbs/ac side-banded	113	122	100	90	111	135	85	132	98
9 lbs/ac seed-placed	106	116	103	85	115	120	86	112	103
18 lbs/ac seed-placed	92	104	97	87	103	110	87	124	86
18 lbs/ac side-banded + 18 lbs/ac seed-placed	110	99	105	89	109	120	80	131	97

Positive responses to P fertilizer application were evident in the majority of site-years. Phosphorus fertilizer application increased yield in 6 of 9 site-years, with yield responses evident at 5 of 5 sites containing low levels of P (<10 ppm at 0-15 cm) and at 1 of 4 sites containing moderate levels of P (10-14 ppm at 0-15 cm). Phosphorus fertilizer application resulted in the greatest yield increases at sites with the lowest soil test P levels (Table 14). Inoculation with *P. bilaii* had limited effects on yield. Inoculation with *P. bilaii* tended to increase yield in 1 of 9 site-years, and decreased yield in 1 of 9 site-years. In both of these site-years, canola had responded positively to P fertilizer, and the yield difference between inoculated and un-inoculated treatments was approximately 7% (Table 14).

Table 14. Seed yield by P management in Manitoba and Saskatchewan (2010-2012).

	2010			2011	2012				
	Phillips	MZTRA	Indian Head	Indian Head	Brandon	Phillips	Indian Head	Melfort	Scott
	bu/ac								
Jumpstart®									
×	20.5	33.0	45.0	56.2	25.7	33.3	52.3	18.4	67.7
✓	21.8	33.0	44.8	55.3	26.0	33.5	53.2	17.3	67.7
P Fertilizer									
0 lbs/ac	17.2	29.0	44.7	51.9	22.7	24.5	52.4	8.7	66.7
9 lbs/ac side-banded	19.5	34.4	46.0	58.0	23.8	29.4	53.8	14.6	67.5
18 lbs/ac side-banded	22.5	33.8	44.6	56.1	27.0	34.9	50.6	20.3	66.0
27 lbs/ac side-banded	22.4	33.9	44.8	57.1	27.0	40.7	55.2	21.9	70.3
36 lbs/ac side-banded	24.6	34.3	44.5	55.9	26.8	36.1	51.3	23.4	68.8
9 lbs/ac seed-placed	21.0	31.3	43.2	55.6	25.8	29.8	54.4	13.9	69.3
18 lbs/ac seed-placed	20.2	32.3	46.4	56.8	26.9	34.2	51.6	18.0	66.9
18 lbs/ac side-banded + 18 lbs/ac seed-placed	22.0	34.7	44.8	54.9	26.8	37.9	52.6	22.2	66.1

Conclusion

Phosphorus fertilizer is an important component to maintaining yields and soil fertility. The results of this study show that canola yield responses to P fertilizer application can be reasonably expected in the majority of cases. Side-banded P fertilizer resulted in similar yields as seed-placed P fertilizer. This study did not show an agronomic benefit to inoculation of canola seed with *P. bilaii* and this product should not be used as a replacement for P fertilizer. This study has concluded and a full report will be available through either the study authors or SaskCanola.

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Seeding Rates for Precision Seeded Canola

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Overview

The establishment of a uniformly distributed canola stand is essential to yield, as uneven seed distribution within the row can lead to increased plant to plant competition. Further, the uniform distribution of plants within the row may potentially allow reduced seeding rates due to reduced seedling mortality, resulting from the lower completion amongst canola plants. SeedMaster's UltraPro canola meter has been marketed to help lower seed requirements by more evenly spacing the seed within each row, as opposed to the more conventional bulk metering systems which can lead to clusters and gaps in seedling distribution. The objectives of this project were to: 1) determine if the UltraPro canola roller produces more uniform canola seed placement, and 2) determine if more uniform seed placement has the potential for allowing lower canola seeding rates.

Methods

The study was conducted at 3 sites in Saskatchewan; Indian Head, Melfort, and Redvers. The study was also initiated at Scott, but was destroyed by hail prior to harvest. The uniformity of plant distribution when seeded with the UltraPro seed metering system was compared to uniformity with the more traditional Valmar roller at seeding rates targeting 10, 20, 40, 80, 160, and 320 viable seeds/m^2. Canola establishment, yield and seed quality were compared between the two seed metering systems and across seeding rates.

Results

The standard deviation of the measured distances between individual plants was calculated to determine uniformity at each seeding rate. Plant uniformity differed between sites, and there was no difference in plant uniformity between the two types of rollers at Indian Head or Redvers. At Melfort, the UltraPro roller resulted in greater uniformity at seeding rates of 10 and 320 seeds/m^2, while the Valmar roller resulted in greater uniformity at a seeding rate of 160 seeds/m^2. When data from all locations was combined there were no significant differences between the two rollers (Table 15).

Table 15. Effect of seeding rate and roller on within-row plant-spacing standard deviation (SD). A larger standard deviation indicates lower plant uniformity.

Seed Rate (seeds/m^2)	**Indian Head**		**Melfort**		**Redvers**		**All Sites**	
	Valmar	UltraPro	Valmar	UltraPro	Valmar	UltraPro	Valmar	UltraPro
10	48 *a*	40 *a*	87 *a*	46 *b*	29 *a*	23 *a*	38 *A*	29 *AB*
20	19 *b*	20 *b*	31 *bcd*	42 *bc*	20 *ab*	19 *ab*	20 *CD*	21 *BC*
40	11 c	10 *c*	27 *cd*	25 *d*	14 *bc*	12 *cd*	14 *DE*	13 *E*
80	5 *de*	6 *d*	10 *e*	13 *e*	9 *cd*	8 *d*	8 *F*	8 *F*
160	3 *ef*	3 *f*	4 *fg*	9 *e*	4 *ef*	5 *e*	4 *GH*	4 *G*
320	1 *g*	2 *g*	5 *f*	3 *g*	2 *g*	3 *fg*	2 *HI*	3 *I*

There was no significant difference in canola yield between the rollers at any location. At Indian Head, yield decreased as seeding rate increased, an unusual result and most likely due to increased lodging and greater disease pressure at higher seeding rates along with higher shattering losses. There were no significant yield differences between rollers at any given seed rate when sites were combined (Table 16).

Table 16. Plant density and roller effects on canola yield.

Seed Rate (seeds/m^2)	**Indian Head**		**Melfort**		**Redvers**		**All Sites**	
	bu/ac							
	Valmar	UltraPro	Valmar	UltraPro	Valmar	UltraPro	Valmar	UltraPro
10	34.0 *ab*	36.6 *a*	45.4 *c*	47.5 *bc*	24.3	20.1	31.8	32.8
20	35.1 *a*	32.7 *abc*	57.1 *abc*	55.8 *abc*	24.2	22.7	33.4	32.3
40	31.7 *abc*	35.9 *a*	54.1 *abc*	59.1 *a*	23.2	25.6	30.6	34.8
80	26.8 *cde*	28.6 *bcd*	61.6 *a*	59.5 *a*	27.7	26.4	29.3	30.1
160	25.0 *de*	28.9 *bcd*	61.3 *a*	60.6 *a*	26.4	26.8	27.7	30.5
320	21.2 *e*	21.8 *e*	64.6 *a*	62.0 *a*	27.5	28.3	25.7	26.1

Conclusion

After the first year of study, the UltraPro canola roller was not found to produce more uniform canola seed placement than the traditional Valmar roller. When sites were combined, there was no significant difference in canola seedling uniformity between the two roller types. At individual sites where there were a few significant differences in plant density, seedling uniformity and plant maturity did not tend to favor one roller over the other. There were no significant yield differences between the two types of rollers for any individual site or when averaged across seeding rates. This study will continue at multiple locations in 2013 and our conclusions will be refined as more data is accumulated. With respect to commercial drills, there may be differences amongst specific models in the distribution of seed to individual sections and openers that are not reflected in this study.

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Quantifying Differences in Shattering Resistance amongst Canola Varieties

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Overview

Information on potential cultivar differences in resistance to pod shattering and pod drop is useful to growers who are interested in straight-combining canola and minimizing the risks associated with this practice. Canola growers interested in straight-combining would also benefit from an improved understanding of the potential frequency and extent of environmental seed losses in standing, mature canola, particularly when harvest is delayed past the optimal stage. This study was implemented to: 1) quantify the frequency and magnitude of environmental seed losses in straight-combined *B. napus,* and 2) evaluate the relative resistance to pod shatter and pod drop among twelve modern *B. napus* hybrid canola cultivars in a range of geographic and climatic regions.

Methods

The study was conducted in Indian Head, Scott, and Swift Current in 2011 and 2012. All plots were lost to hail at Scott in 2012. The 12 cultivars evaluated in this trial included representatives of each of the Liberty Link®, Roundup Ready®, and Clearfield® herbicide groups (Table 17). Half of each plot was straight-combined at the optimal harvest stage for each different cultivar, and the other half was straight-combined 3-4 weeks later. The quantities of shattered seeds and dropped pods in each plot were measured prior to both harvest dates using trays placed below the crop canopy in each of the plots. Any observed yield reductions between the two harvest dates were assumed to be a result of environmental seed losses.

Table 17. Varieties evaluated for resistance to pod shattering and pod drop.

Liberty Link®	Roundup Ready®		Clearfield®
InVigor 5440	45H29	Dekalb 73-75	46H75
InVigor L130	45H31	Dekalb 73-45	Nexera 2012
Invigor L150	6060	Proven 9553	5525

Results

When averaged across sites and cultivars, environmental seed losses observed with straight-combining were 5.5% at the optimal harvest stage and 17.4% when harvest was delayed. Total environmental seed losses were affected by both environment (site) and cultivar, but differences between cultivars were not always consistent amongst sites. Environmental factors (i.e. differences in weather) had a larger effect on the magnitude of seed losses than cultivar. The magnitude of environmental seed losses increased substantially when harvest was delayed. At the first harvest date, where optimal timing was targeted, canola yield losses varied from less than 1% to 21% for individual sites, and increased to 57% with a 3-4 week delay in harvest. Averaged across sites, relatively few cultivar differences were detected. Percent total yield losses were highest with 6060 and lowest with 46H75 (Figure 3); however, with significant site by cultivar interactions in all cases and similar to losses at the first harvest date, these results do not necessarily reflect those observed at individual sites.

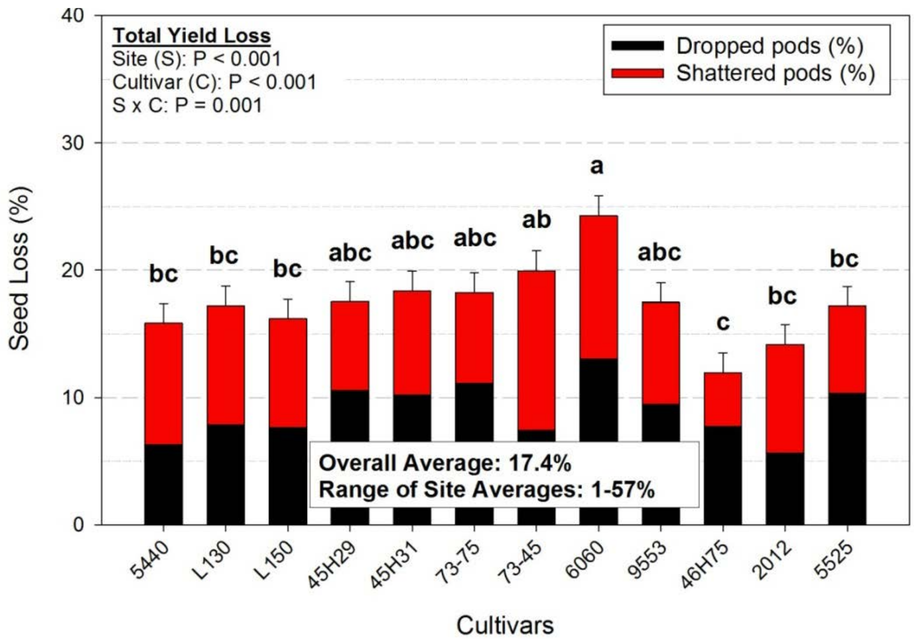

Figure 3. Total seed loss (dropped and shattered) at delayed harvest stage, compared to optimal harvest stage.

To help interpret cultivar differences at each of the sites and provide recommendations to growers, the cultivars at each site were ranked from 1-12 (where 1 = lowest losses and 12 = highest losses) and the average ranking for each cultivar was calculated (Figure 4). Ranging from 3.0-4.6, the cultivars 5440, L130, L150, 46H75 and 2012 achieved the best rankings, while losses were most consistently high with 6060 which scored an averaged ranking of 11.6 with a relatively small standard deviation. Rankings for the cultivars 45H29, 45H31, 73-75, 73-45, 9553 and 5525 ranged from 6.6-9.6 and were considered intermediate and variable. Standard deviations for these rankings ranged from 0.9-3.5 indicating that the relative performance of most cultivars varied across sites.

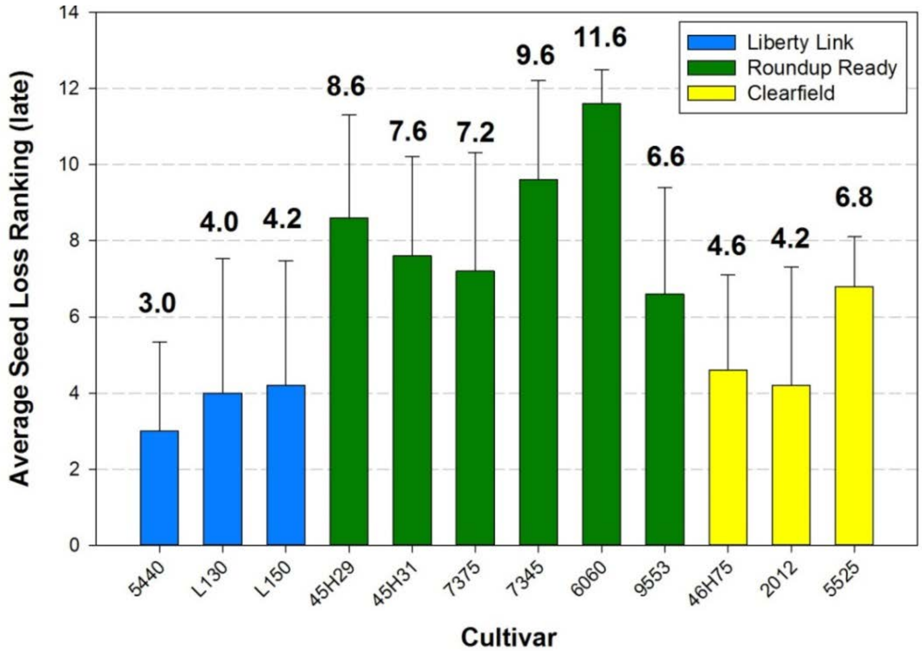

Figure 4. Average seed loss ranking for cultivars.

Conclusion

In general, losses for each of the individual cultivars were relatively low at sites where overall environmental seed losses were low, while the opposite was true in environments where severe losses were observed. Over the next few years, several canola cultivars with improved shattering resistance are scheduled for release and will be of great interest to canola growers interested in straight-combining or delayed swathing. This research will continue for two more years (2013-2014) at four locations (Indian Head, Melfort, Scott and Swift Current) with updated cultivars and minor protocol improvements.

Acknowledgement

Funding for this project was provided by the Saskatchewan Canola Development Commission, with in-kind support provided by Bayer CropScience, Pioneer Hi-Bred, Monsanto/Dekalb, Brett Young, Viterra and Dow AgroSciences.

Pod Sealant Effects on Milling Quality of Spring Wheat

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Overview

Pod-sealants are believed to help prevent moisture transfer into the heads and are presumed to prevent sprouting damage in crops such as wheat or barley, in the event of delayed harvest due to precipitation and prolonged wet conditions. The objective of this study was to determine whether applying a pod-sealant (Desikote Max) at physiological maturity has a positive effect on the quality (grade, protein content, dockage, and falling number) of spring wheat, and to distinguish whether acceptable efficacy can be achieved with reduced spray solution volumes.

Methods

Desikote Max was applied to spring wheat at the hard dough stage at either the full recommended solution volume (20 imp gal/ac) or half the recommended solution volume (10 imp gal/ac). Grain quality of the two treatments was compared to an untreated check. 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

In 2012, no rain events occurred after the Desikote Max treatments were applied, reducing the perspective quality enhancing benefits of the product. Consequently, the pod-sealant had no effect on the yield or quality of the spring wheat tested (Table 18). However, this test was conducted in 2011, with two significant rain events taking place after application and prior to harvest (Table 19). No effect was seen on dockage, yield, ergot and falling number; however, test weights and protein concentrations appeared to differ across treatments.

Table 18. Pod-sealant effects on spring wheat, 2012.

Treatment	**Dockage** (%)	**Yield** (bu/ac)	**Protein** (%)	**Test Weight** (g/0.5L)	**Ergot** (%)	**DON** (ppm)	**Falling Number** (sec)
Check	2.7 *a*	43.1 *a*	15.5 *a*	389.5 *a*	0.012 *a*	5.35 *a*	376.4 *a*
DMAX (10 gpa)	2.6 *a*	42.8 *a*	15.9 *a*	387.0 *a*	0.007 *a*	5.73 *a*	382.8 *a*
DMAX (20 gpa)	2.8 *a*	44.3 *a*	15.7 *a*	389.5 *a*	0.004 *a*	5.28 *a*	383.1 *a*

Table 19. Pod-sealant effects on spring wheat, 2011.

Treatment*	**Dockage** (%)	**Yield** (bu/ac)	**Protein** (%)	**Test Weight** (g/0.5L)	**Ergot** (%)	**Falling Number** (sec)
Check	0.9 *a*	55.2 *a*	14.9 *b*	418.8 *a*	0.010 *a*	379.4 *a*
DMAX (10 gpa)	0.9 *a*	56.2 *a*	15.2 *a*	417.3 *b*	0.012 *a*	376.9 *a*
DMAX (20 gpa)	1.0 *a*	54.5 *a*	15.0 *b*	418.0 *ab*	0.014 *a*	374.9 *a*

Conclusion

No significant treatment effects were observed in 2012 and the differences detected in 2011 are not likely attributed to the application of the pod-sealant. 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. Despite experiencing rain in one of the two test years, with no effect on quality, it appears that weather conditions were not conducive of crop damage. Consequently, no benefit to the application of pod-sealant was observed in either test year.

Acknowledgement

Funding for this project was provided by Engage Agro.

Optimal Seeding Rate for Spring Wheat

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Overview

Producers targeting higher spring wheat yields may see a benefit to increasing the seeding rate above what is typically recommended. Higher seeding rates may also optimize the yield potential in newer and more productive varieties. Generally, a denser stand allows the crop to better compete with weeds and reduces tillering, thus making head emergence more uniform, reducing the number of days to maturity, and making insecticide and fungicide applications easier to stage. Previous research has shown that wheat yield increases with seeding rates, however a maximum yield benefit may be reached at higher seeding rates. The objective of this study was to investigate the potential yield benefits associated with increasing seeding rates in wheat. The cultivar Unity VB was seeded at rates of 60, 120, 180, 240, 300, 420, or 480 seeds/m^2, which corresponded to 18-143lbs/ac.

Results

Seeding rate of spring wheat significantly affected spring plant density, lodging, grain yield and test weight, but did not significantly affect seed size at Indian Head (Table 20).

Table 20. Results of various seeding rates in spring wheat at Indian Head, 2012.

Seeding Rate (seeds/m^2)	**Plant Density** (plants/m^2)	**Lodging Rating** (Scale 1-9)	**Grain Yield** (bu/ac)	**TKW** (g)	**Test Weight** (g/0.5 L)
60	61 *g*	1.1 *c*	41.6 *bc*	27.8 *a*	363.0 *d*
120	137 *f*	1.5 *c*	42.5 *bc*	27.6 *a*	374.7 *c*
180	153 *f*	1.1 *c*	49.8 *a*	28.1 *a*	378.5 *abc*
240	205 *e*	1.6 *c*	46.9 *ab*	29.0 *a*	382.3 *a*
300	258 *d*	1.6 *c*	42.6 *bc*	28.4 *a*	379.8 *ab*
360	336 *c*	2.4 *b*	40.3 *bc*	27.9 *a*	378.4 *abc*
420	397 *b*	2.6 *b*	37.6 *c*	27.8 *a*	379.3 *ab*
480	445 *a*	3.4 *a*	38.1 *c*	27.9 *a*	377.1 *bc*

Seeding rate calculator: www.agric.gov.ab.ca/app19/calc/crop/otherseedcalculator.jsp
1 m^2 = 10.7639 ft^2

Wheat yield at Indian Head was maximized at the relatively low seeding rate of 180 seeds/m^2 and, unexpectedly, was significantly lower at the highest seeding rates, presumably a result of increased lodging. At a seeding rate of 180 seeds/m^2, yield was significantly higher than at seeding rates over 300 seeds/m^2. The yield response at Swift Current differed from Indian Head and appeared to be the expected and more typical response to increased seeding rates (Figure 5). The trial was lost at Scott due to weather problems.

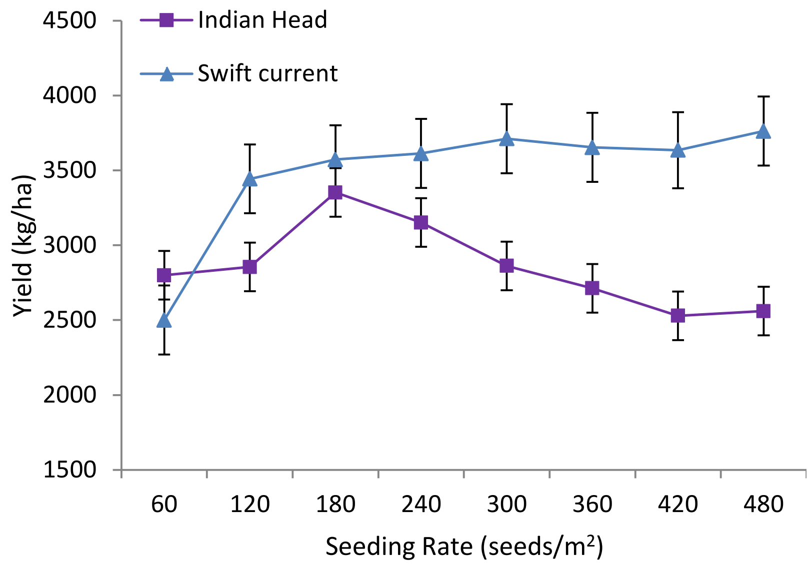

Figure 5. Response of yield to seeding rate at Indian Head and Swift Current.

Conclusion

The effects of seeding rate on grain yield of spring wheat at Indian Head in 2012 were somewhat unusual and would not be expected on a year-to-year basis. While the improved stand-ability at the lower plant populations was of interest and value in 2012, lodging was only significant at seeding rates of 360 seeds/m^2 or higher. Thus, we would not recommend reducing seeding rates in an attempt to reduce the risk of lodging, as there are practical reasons for targeting plant populations of 250 plants/m^2 or higher in spring wheat. This project will be carried out again at multiple locations in 2013.

Acknowledgement

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement.

Effects of Seed-Applied Fertilizer Products on Spring Wheat Emergence, Early-Season Growth, Maturity, Yield and Grain Quality

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Overview

Seed-applied fertilizer products are typically marketed to improve early season crop establishment, especially when seedlings are emerging under stressful conditions, for example, cold and wet soil. Potentially, this results in better root systems, more rapid crop development, and earlier maturity. The products are usually recommended based on tests of soil fertility or seed nutrient concentrations, and Zinc (Zn) is the most common component among the different products available. The objective of this study was to evaluate the effects of various commercially available seed-applied nutrient products and granular $ZnSO_4$ application on emergence, early season biomass accumulation and grain yield in hard red spring wheat.

Methods

The trial was conducted in Indian Head, Melfort, Scott, and Swift Current. Five different seed-applied products were assessed relative to untreated seed, and to untreated seed with an application of granular $ZnSO_4$ fertilizer (Table 21). Untreated seed went through the same physical processes as the treated seed and distilled water was applied instead of the seed dressings. Early seeding was targeted in order to increase the likelihood of encountering cool, potentially stressful conditions. Emergence counts were completed within the same section of row five times over a two week period during emergence to assess whether the seed applied products had an impact on the rate and extent of emergence. Biomass samples were harvested prior to stem elongation (at the 3-5 leaf stage). The number of days to physiological maturity, severity of lodging at maturity, and the grain yield were determined.

Table 21. Description of treatments in seed-applied nutrients demonstration.

Trade Name	Description / Rate / Nutrient Analyses[Z]
Untreated check	N/A
EZ20 Essential Zn®	$ZnSO_4$ (2-0-0-14 + 20% Zn) applied in-furrow at 12 kg/ha
Awaken ST®	Seed-applied at 325 mL / 100 kg seed; 6-0-1-0 + 5% Zn + 0.8% B, Cu, Fe, Mn & Mo
Alpine Seed Nutrition®	Seed applied at 510 ml / 100 kg seed; 6-22-2-0 + Zn
Protinus®	Seed applied at 323 g / 100 kg seed; 40% Zn, 10% Mn + Fe
Undisclosed - Zn	Seed-applied; commercial product containing Zn
Undisclosed - Cu	Seed-applied; commercial product containing Cu

[Z]Macro and micro-nutrient concentrations are provided wherever possible; however, each product may or may not contain additional proprietary materials and the concentrations do not reflect potential differences in nutrient solubility and availability

Results

Plant densities differed between sites over the entire emergence period (effect of site was significant). This is a function of the different environmental conditions as well as variation in measurement dates (targeted dates were 1, 3, 5, 8, and 14 days following initial emergence). The treatment effect on plant emergence over the entire emergence period, and averaged across sites, is shown graphically in Figure 6. The response to treatments did not differ between sites over the emergence period (site by treatment interaction was not significant), thus plant density is averaged across all sites. A significant treatment effect was observed only on the final count day, and a slight significant treatment effect was observed on day five. In either case, the significant treatment effect was not the result of an increase in plant density in treated over untreated seed, but rather of differences in plant density between seed-applied nutrient treatments (Table 22).

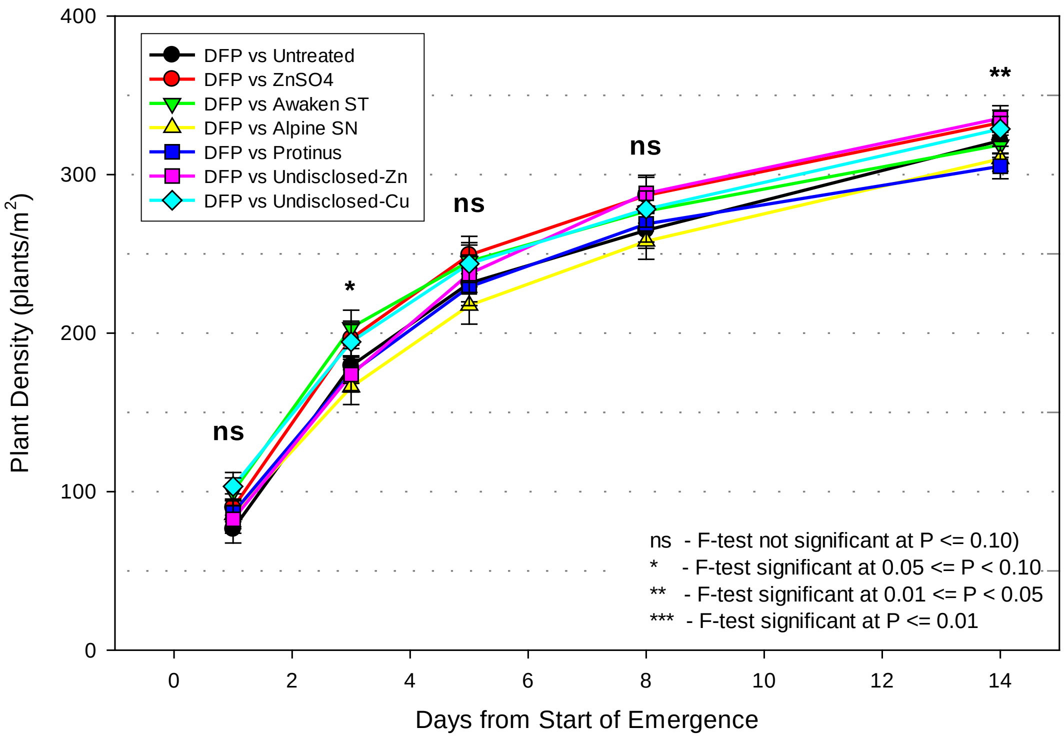

Figure 6. Treatment effects on spring wheat emergence (averaged across four locations in 2012).

Table 22. Treatment effects on final plant density of spring wheat.

Treatment	Indian Head	Melfort	Scott	Swift Current	All Sites
			plants/m^2		
Untreated check	375 *a*	325 *ab*	337 *a*	249 *a*	321 *ab*
Granular $ZnSO_4$	382 *a*	368 *a*	338 *a*	243 *a*	333 *ab*
Awaken ST®	376 *a*	336 *ab*	315 *a*	249 *a*	319 *ab*
Alpine Seed Nutrition®	350 *ab*	328 *ab*	312 *a*	250 *a*	310 *ab*
Protinus®	366 *a*	278 *b*	315 *a*	262 *a*	305 *b*
Undisclosed - Zn	385 *a*	377 *a*	342 *a*	238 *a*	336 *a*
Undisclosed - Cu	386 *a*	348 *ab*	330 *a*	251 *a*	329 *ab*

For all other variables measured (early season biomass, days to maturity, severity of lodging, and grain yield), absolute values differed between sites (effect of site was significant), as would be expected, but the extent of the response to treatments did not differ between sites (site by treatment interaction was not significant), and there were no treatment effects when data was combined across sites. In some cases, there were differences observed between treatments within each site individually, however, the differences were inconsistent and never occurred between untreated check and treated seeds. A slight yield increase was observed with granular, in-furrow Zn fertilizer at Indian Head.

Conclusion

With cool and wet conditions through May and early June along with potentially low Zn levels at three of the four study locations (soil test results not shown), the 2012 growing season provided a good opportunity to evaluate seed-applied fertilizer products and soil-placed granular $ZnSO_4$. In conclusion, there was no measureable benefit observed for any of the seed-applied fertilizer products in this particular demonstration. As with many crop inputs, the challenge will be to predict when, where and to what extent a response to seed-applied fertilizer products is likely to occur. Until we can reasonably predict this response, recommended steps for producers hoping to improve crop establishment would be to: 1) ensure that they are managing crop residues sufficiently (i.e. good chaff and straw spreading, heavy harrowing if necessary), 2) use high quality seed, 3) ensure that seed is being placed at an appropriate depth, 4) follow provincial guidelines for seed-placed fertilizer, and 5) make sure that overall fertility levels are adequate. Growers who are considering investing in this technology are encouraged to establish check strips to objectively evaluate whether or not they are getting the desired results and return on their investment.

Acknowledgement
This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement.

Fungicide Effects on Flax Yield

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Overview

Without third-party data, it is difficult for producers to determine which conditions are most conducive to fungicide applications and which of the available products will be the most effective. In 2012, the trial took place only at Indian Head and looked at Headline® and Acapella®. Acapella® is not currently registered for use on flax and was included in this demonstration for experimental purposes.

Results

As in previous years (Table 23), flax responded well to the application of fungicide at Indian Head in 2012 (Figure 7), with ideal conditions for the development of disease. At Swift Current and Canora in 2010 and 2011, no significant effects on yield were detected; however, yields did tend to be higher with fungicide at Canora in 2011.

Table 23. Effects of fungicide application on flax yield, 2010 & 2011.

Treatment	**Flax Yield** (bu/ac)						
	Canora		**Indian Head**		**Swift Current**		All Sites
	2010	2011	2010	2011	2010	2011	
Untreated	13.3 *a*	18.3 *a*	24.9 *a*	32.6 *a*	10.1 *a*	25.5 *a*	20.8 *a*
Headline®	17.3 *a*	18.7 *a*	31.7 *b*	34.3 *b*	10.3 *a*	26.9 *a*	23.1 *b*

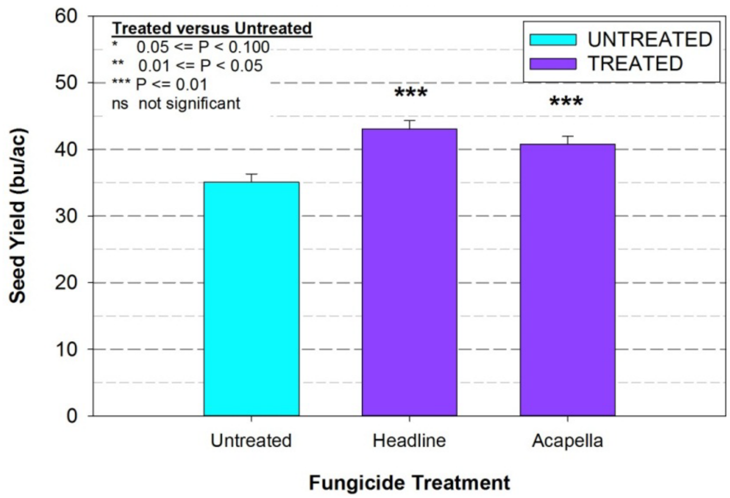

Figure 7. Effects of fungicide application on flax yield at Indian Head, 2012.

Conclusion

While flax does appear to respond well to a fungicide application in certain environments, we have not achieved the desired benefits in cases where disease is not present or when other factors are more limiting to yield. The 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 and if environmental conditions are conducive of the development of disease. Leaving check strips and comparing yield response between treated and untreated strips will allow producers who spray a fungicide on their flax, or any crop, to confirm that the practice is in fact cost effective.

Acknowledgement

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Fungicide Effects on Canola Yield

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Overview

Many producers are considering fungicide applications on canola because of tightening rotations, high commodity prices and wet growing conditions in recent years. While the economics of annual fungicide applications to canola are questionable throughout much of Saskatchewan, disease levels have been relatively high in recent years and have resulted in appreciable yield losses for many growers. Without third-party data, it is difficult for producers to distinguish which situations are most conducive to fungicide applications and which of the many available products will be the most effective under certain environmental conditions. The objective of this study was to evaluate the effects of various fungicide treatments on disease prevalence and canola seed yield. Positive yield responses observed in Indian Head in 2011 were of interest as fungicides have not been traditionally applied to canola in the area and overall disease levels appeared to be low. In 2012, six fungicide treatments were assessed relative to an untreated check (Table 24).

Table 24. Description of treatments in canola fungicide trial.

Trade Name	Description / Application Rate / Application Timing
Untreated check	N/A
Headline EC	250 g/L pyraclostrobin; 0.16 L/ac; 4-6 leaf stage
Lance WDG	70% boscalid; 142 g/ac; 20-50% bloom stage
Lance WDG + Headline EC	142 g/ac and 0.12 L/ac; 20-50% bloom stage
Proline 480 SC	480 g/L prothioconazole; 0.15 L/ac; 20-50% bloom stage
Astound	37.5% cyprodinil and 25% fludioxonil; 395 g/ac; 20-50% bloom stage
Vertisan[1]	200 g/L penthiopyrad; 0.50 L/ac; 20-50% bloom stage

[1]not included in 2011

Results

The incidence and severity of sclerotinia was assessed prior to harvest using the rating scale developed by Kutcher and Wolf (2004). Sclerotinia incidence is defined as the percentage of plants showing some level of infection while severity is the average rating of all the plants that were surveyed. Intensive disease ratings were not completed at Swift Current; however, canola was scouted both prior to fungicide application and again at maturity and no disease symptoms were observed at either stage. The effect of treatment on sclerotinia stem rot incidence and severity were similar, thus the results are shown below for incidence only. Sclerotinia stem rot severity overall was higher at Indian Head than at Melfort or Scott (Table 25). At Indian Head, treatments 3-6 (Lance, Lance + Headline, Proline, and Astound) resulted in significantly less severity of sclerotinia stem rot than where no fungicide was applied, while there were no observed differences between treatments at Melfort or Scott (Table 25). When combined across sites, overall differences in treatments reflected the differences observed in Indian Head and do not reflect the observed results at individual sites.

Table 25. Effects of foliar fungicide on sclerotinia stem rot incidence in canola at three locations in 2012.

Treatment	Indian Head	Melfort	Scott	All Sites
	% infected plants			
All Treatments	**43.8** ***a***	**2.7** ***b***	**5.2** ***b***	—
Untreated check	65.2 *ab*	2.5 *e*	6.3 *e*	**23.1** ***ab***
Headline EC	74.2 *a*	2.1 *e*	13.8 *de*	**27.8** ***a***
Lance WDG	35.3 *c*	3.3 *e*	1.9 *e*	**13.2** ***c***
Lance WDG + Headline EC	24.6 *cd*	1.7 *e*	2.5 *e*	**9.5** ***c***
Proline 480 SC	35.2 *c*	2.9 *e*	1.9 *e*	**13.1** ***c***
Astound	32.5 *c*	3.3 *e*	2.5 *e*	**12.6** ***c***
Vertisan	57.3 *b*	2.9 *e*	7.5 *e*	**21.4** ***b***

Seed yield differed between all sites when averaged across treatments (Table 26). Treatment effects were not significantly different when averaged across sites. Individually within sites, differences among treatments were only observed at Indian Head, where treatment 3 (Lance) yielded higher than the untreated check (Table 26).

Table 26. Effects of foliar fungicide effects on canola seed yield at four locations in 2012.

Treatment	Indian Head	Melfort	Scott	Swift Current	All Sites
			bu/ac		
All Treatments	**40.3** ***c***	**60.4** ***b***	**74.9** ***a***	**26.8** ***d***	—
Untreated check	35.3 *g*	60.1 *cd*	75.8 *a*	27.6 *hi*	**49.7** ***a***
Headline EC	37.2 *fg*	60.9 *cd*	73.9 *ab*	26.1 *i*	**49.5** ***a***
Lance WDG	46.6 *f*	58.1 *de*	75.9 *a*	26.2 *hi*	**51.7** ***a***
Lance WDG + Headline EC	43.8 *fg*	62.5 *bcd*	77.6 *a*	27.0 *hi*	**52.7** ***a***
Proline 480 SC	43.2 *fg*	59.5 *cd*	71.7 *abc*	27.4 *hi*	**50.4** ***a***
Astound	37.5 *fg*	60.9 *cd*	78.7 *a*	26.4 *hi*	**50.9** ***a***
Vertisan	38.5 *fg*	61.0 *cd*	70.7 *abc*	27.2 *hi*	**49.3** ***a***

Conclusion

The results from this demonstration confirm that fungicides are an effective measure for minimizing the impact of sclerotinia stem rot on canola yield; however, benefits may only be realized when disease severity is sufficiently high to cause significant yield reductions. Our data suggests that annual, preventative applications of foliar fungicides to control sclerotinia in canola may not be economically viable over the long-term throughout much of Saskatchewan; however, losses may be drastic in years with high incidence of the disease. Some of the most important factors for determining the extent to which sclerotinia stem rot will develop in canola are the temperature and humidity within the crop canopy through flowering and early pod filling and, consequently, the weather conditions encountered during this period. The decision to apply foliar fungicide can wait until environmental conditions are known and growers are in a position to assess the overall risk. An example of a disease forecasting checklist for assessing the risks of sclerotinia in canola, along with a guide to scouting for this disease is available online from the Canola Council of Canada at https://canola-council.merchantsecure.com/canola_resources/product11.aspx.

Acknowledgement

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement, with in-kind support provided by Bayer CropScience, BASF, Syngenta and DuPont.

Intercropping Canola with Field Pea and Faba Bean

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Overview

Intercropping can potentially increase net profits and reduce fertilizer use in canola production. Substantial gains in both grain yield and land equivalent ratios (a measure of the productivity of intercrops versus monocrops on a per land area basis) have been reported on the prairies by producers and researchers in recent years. Similar studies examining the feasibility of intercropping field pea and canola were conducted in Indian Head in 2010 and 2011, and the research is being continued to obtain more conclusive results. In further exploring the options available for producers interested in this practice, the study was expanded to include faba bean-canola intercropping. The objective was to evaluate the performance of two different row configurations of intercrops of field pea or faba bean with canola, relative to monoculture production of the three crops.

Methods

Seven treatments were included which consisted of monocrops of field pea, faba bean, and canola along with intercrops of field pea with canola and faba bean with canola in either a mixed-row configuration (both crops seeded together in the same row) or an alternating-row configuration (Table 27). The seeding rates used for each crop in the intercropped treatments were 67% of the rates used in the corresponding monocrops (100 seeds/m^2 for field pea and 115 seeds/m^2 for canola). The N fertilizer rate in the intercropped treatments was 50% of the rate in the canola monocrop (110 lbs/ac actual N). Nitrogen fertilizer was side-banded exclusively to the canola rows in alternating row configuration and was banded equally across rows in mixed row configuration.

Table 27. Summary of treatments for row-crop configuration and N-fertility in pea-canola intercrops.

Crop	Row configuration	Nitrogen Rate (lbs actual N/ac)	Seeding Rate (%)
Canola	Monocrop	110	100
Field pea	Monocrop	0	100
Faba bean	Monocrop	0	100
Canola-field pea	Alternating	55	67(x2)
Canola-field pea	Mixed	55	67(x2)
Canola-faba bean	Alternating	55	67(x2)
Canola-faba bean	Mixed	55	67(x2)

Results

Field pea yields were significantly higher in mixed-row intercrops than in pea monocrops or alternating-row intercrops, while faba bean yield was significantly lower in both intercropped treatments when compared to the monocrop. Adjusted canola yields were higher in the alternating row intercrop treatments than in the mixed row or monocrop treatments, presumably due to the more concentrated placement of N fertilizer. There was an overall yield advantage in mixed-row intercrops of canola and field pea over the monocrops; however, a significant yield advantage was not observed in alternating row intercrops. While canola performed better in the alternating rows, field peas performed considerably worse, possibly a result of the canola being a more competitive species once it is established. Intercropping canola and faba beans did not result in the same yield benefits observed with canola and field pea. While canola performed reasonably well when grown with faba beans, the faba bean yields were greatly reduced when grown at reduced populations and intercropped with canola (Figure 8). Further research would be required to investigate options for improving the performance of canola-faba bean intercrops.

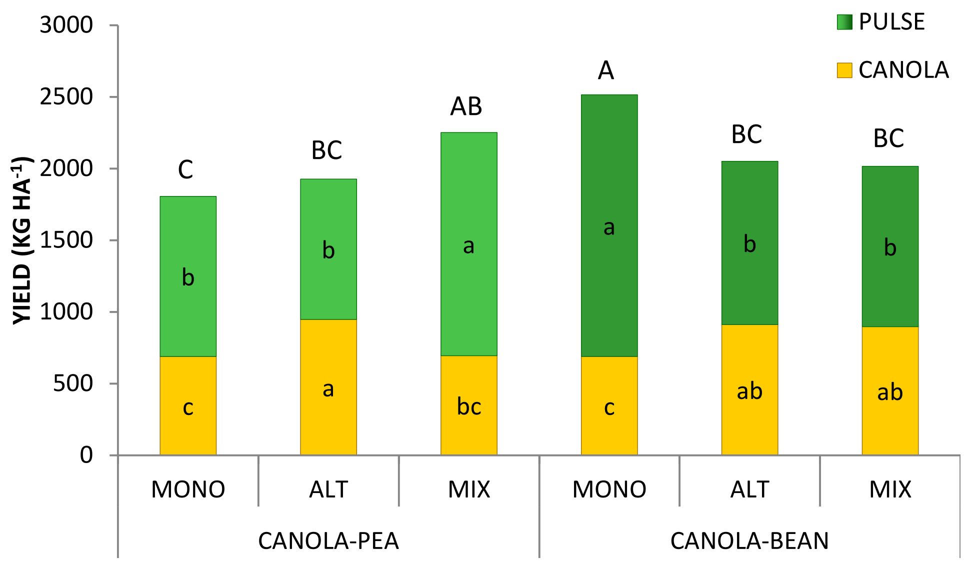

Figure 8. Yield responses of row configuration in intercrops of canola and field pea, and canola and faba bean. Yields from monocrop plots of each crop were halved and combined in order to fairly and accurately compare to yields from intercrop plots on a per area basis (i.e. 1 ha of intercrop compared to 0.5 ha canola monocrop plus 0.5 ha pulse monocrop).

Conclusion

Overall, intercropped field pea and canola performed as well or better than the same two crops grown in a monoculture. Interestingly, field pea yields were higher when intercropped with canola in mixed row configuration, but were significantly reduced in alternating row configurations. Canola tended to prefer the alternating row configuration, but overall total yields were highest in the mixed row intercropped treatments. With intercropped faba bean and canola, total yields were lower than those achieved with monocropping. Faba bean yields were substantially reduced with intercropping while canola performed relatively well when grown with faba beans. We speculate that higher seeding rates for the faba beans may result in higher faba bean yields but it is uncertain what the effect on canola yield would be. Refer to the following research report for a discussion of more general conclusions about intercropping ("*Row-crop configuration and nitrogen fertility interactions in field pea –canola intercrops*").

Acknowledgement

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Row-Crop Configuration and Nitrogen Fertility Interactions in Field Pea-Canola Intercrops

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Overview

Intercropping can potentially increase net profits and reduce 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 producers who are interested in the practice. The objective of this project was to evaluate the effects of row-crop configuration (mixed versus alternating rows of canola and field pea) and the interactions with N fertility on the performance of pea-canola intercrops, and to evaluate the agronomic and economic merits of this practice.

Methods

This project was conducted in Indian Head and Melita in 2011 and 2012; however, the site at Melita was abandoned in 2012 due to technical issues during seeding. Wherever possible, data from all three site-years were included in the analyses to more completely demonstrate the response under varying environmental conditions. Thirteen treatments were evaluated, which consisted of monocrops of field pea and canola, mixed pea-canola intercrops (seeded together in the same row), and alternating rows of pea and canola. The 100% nitrogen rate used was 110 lbs/ac actual N. The 100% seeding rate for canola was targeted at 115 seeds/m^2, and 100 seeds/m^2 for field pea. Seeding rates used for the intercropped treatments were 67% of the rates used in the corresponding monocrops. N fertilizer was applied exclusively to the canola rows in alternating row configuration, and was applied evenly to all rows in mixed row configuration.

Table 28. Summary of treatments.

Row-Crop Configuration	N fertility
Canola monocrop	0%
Canola monocrop	33%
Canola monocrop	67%
Canola monocrop	100%
Field pea monocrop	n/a
Mixed row	0%
Mixed row	33%
Mixed row	67%
Mixed row	100%
Alternate row	0%
Alternate row	33%
Alternate row	67%
Alternate row	100%

Results

Spring plant density was not significantly affected by the rate of N fertilizer, however it was affected by row-crop configuration, and this effect differed between sites (Figure 9). The response at Indian Head was similar in both years; mixed and alternating-row intercrops generally had higher canola, field pea, and total plant density than the monocrops, and plant density did not differ significantly between the two types of intercropping. At Melita, field pea and total plant density was higher in the mixed-row intercrop than the monocrop, but neither significantly differed from the alternating-row intercrop, and canola densities were consistent across all three treatments. Due to the higher total seeding rates, higher plant populations in the intercropped treatments were not unexpected.

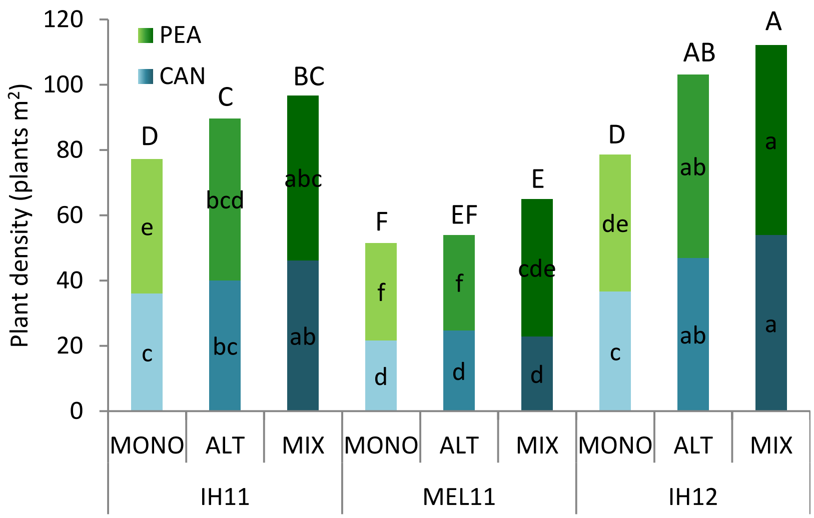

Figure 9. The effect of row-crop configuration on spring plant density at Indian Head in 2011 and 2012 and Melita in 2011. Lower-case letters indicate differences between each crop individually and upper-case letters indicate differences between total plant densities in each treatment.

Seed yield in general was affected by row-crop configuration and by the rate of N fertilizer. The effect of row configuration on seed yield differed between sites (Figure 10). Canola yield was highest in the alternating row configuration in both years at Indian Head, but did not differ between treatments in Melita. On the other hand, field pea yield was highest in the mixed-row intercrop at all three sites, and pea yields in the alternating-row intercrops were lower than for the monocrop at Melita while the pea yields for monocrop and alternating row treatments were similar at Indian Head. Total yield was always higher in mixed-row intercrops than in monocrops. At Indian Head in both years, yield was also higher in alternating-row intercrops than monocrops, and did not differ significantly from mixed-row intercrops in 2012. However, yields were not significantly higher in alternating row intercrops than in monocrops at the Melita site in 2011.

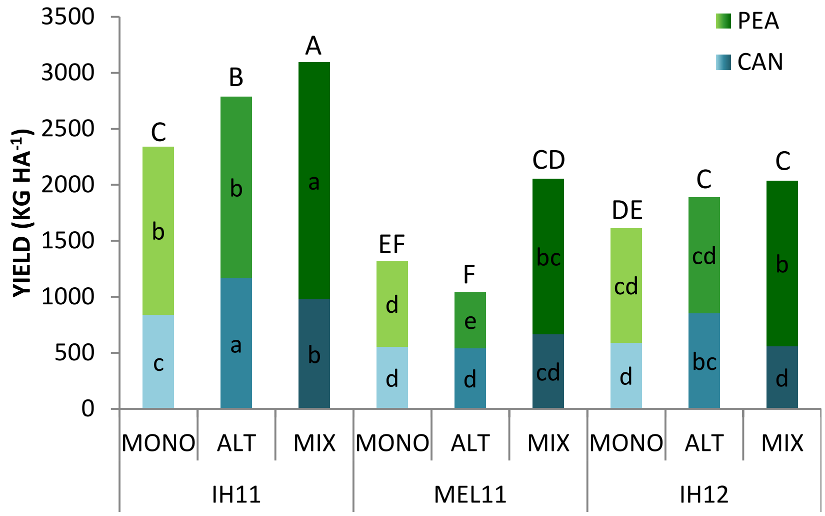

Figure 10. The effect of row-crop configuration on seed yield of canola and field pea at Indian Head in 2011 and 2012 and Melita in 2011.

The effect of N fertilizer rate also differed between sites (Figure 11). Canola yield generally increased with N rate at all sites, but the magnitude of increase from lower to higher N rates was less pronounced at Melita. At Indian Head, there appeared to be a linear increase in canola yield with N-rate in 2012, but the increase tended to taper off at higher rates in 2011. Pea yield was not affected by N-rates in Melita or Indian Head in 2011; however, pea yield started to decline at high N rates at Indian Head in 2012.

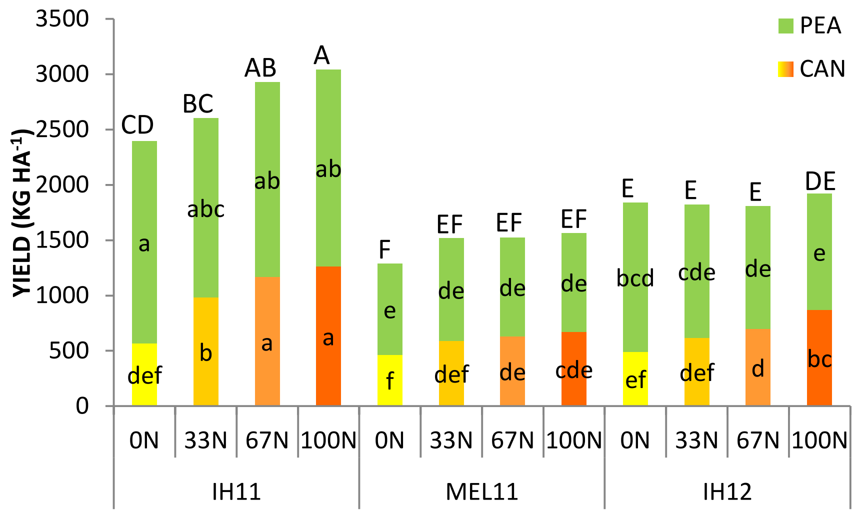

Figure 11. The effect of N fertilizer rate on seed yield of canola and field pea at Indian Head in 2011 and 2012 and Melita in 2011. Lower-case letters indicate differences between each crop individually and upper-case letters indicate differences between total yield in each treatment.

The effect of N fertilizer also differed between row-crop configurations (Figure 12). Canola yield generally increased with N fertilizer rate and the increase appeared to be linear in mixed-row intercrops and monocrops, while the increase appeared quadratic in alternating-row intercrops. This difference in response was due to the fact that we were able to apply N solely to the canola rows in the alternating row intercropped treatment and therefore N fertilizer was more concentrated in these treatments at any given N rate. Therefore, N likely became not limiting to the canola in the alternating rows at lower fertilizer rates compared to the mixed row treatments where the same total quantities of urea were distributed amongst twice the number of rows. Pea yield did not differ between N rates in any of the crop configurations, thus the general increase in total yield with increasing rates of N fertilizer mimicked the increase in canola yields, though the effect was less pronounced. As a result, total yield did not differ significantly between N rates in the mixed row intercrop, and only differed significantly between the 0 and 100% N rate in the alternating row intercrop and the monocrops.

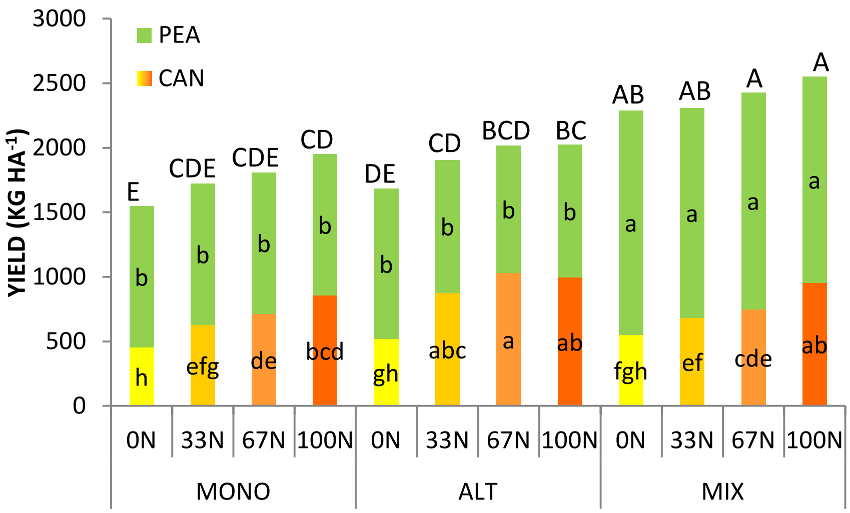

Figure 12. The effect of N fertilizer rate on seed yield of canola and field pea in monocrops, alternating-row intercrops, and mixed-row intercrops. Lower-case letters indicate differences between each crop individually and upper-case letters indicate differences between total yield in each treatment.

Conclusion

Intercropping typically resulted in slightly higher yields than monocrop field pea and canola and the total yields tended to be higher with mixed as opposed to alternating rows. Generally speaking, canola was favoured in the alternating row treatments while field peas performed significantly better in mixed rows. Nitrogen fertilizer significantly increased canola yields in the alternating-row intercropped treatments and, in mixed row configurations, intercropped canola responded to N fertilizer in a similar manner as the canola monocrops. By side-banding N exclusively to the canola rows in alternating row intercropping, N fertilizer rates could potentially be reduced by 35-50% (relative to monocrop canola) without having a significant impact on canola yields or total yields.

Other general observations with intercropped field pea and canola included visibly less shattering in the intercropped canola relative to the monocrop canola at similar N levels, presumably due to the heavier, more densely entangled crop canopy. Field peas grown with canola stood much taller than monocrop peas and continued to stand well after reaching maturity, thereby making combining easier and reducing potential harvest losses in field peas. Sclerotinia stem rot was a serious problem for canola at Indian Head in 2012 and, while detailed ratings were not completed, disease incidence was at least as severe or possibly worse in the intercropped canola relative to the monocrop canola. It is possible that the field pea, which matured slightly ahead of the canola, provided an additional source of dead plant material thereby extending the window / increasing the risk of sclerotinia infection in the canola. When the risk of disease is moderate to high, growers who are intercropping field pea and canola should monitor disease in a similar manner as for monocultures of these crops and apply registered foliar fungicide as required. Finally, environmental conditions were wetter than normal at the sites where these projects were conducted and relative performance may vary under dry conditions.

In conclusion, intercropping field pea and canola performed well overall with similar or higher yields than monocropping observed in all cases. The biggest hurdles for commercial adoption will be logistic challenges with seeding and fertilizing the two crops in a single pass and the additional requirement of separating the seed after harvest. However, these challenges have already been overcome by a handful of producers utilizing relatively simple and inexpensive equipment modifications and cleaning technology. Research to determine optimum plant populations of field pea and canola and to develop strategies for managing disease in addition to evaluating different combinations of field crops may result in even higher yields and reduced risks with intercropping. In addition, evaluating the performance of field pea-canola intercrops under a broader range of environments (i.e. soil types and weather conditions) would allow us to better assess the overall stability this practice over locations and years.

Acknowledgement

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NutriSphere Research for the Canadian Market

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Overview

Nutri-Sphere-N® is a nitrogen fertilizer additive that is marketed to reduce potential losses from leaching, volatilization and denitrification. Nutri-Sphere's mode of action involves complexing multi-valent cations and removing them from bio-chemical processes. More specifically, the product combines with N to decrease urease activity and with Fe and Cu to decrease micro- organism metabolic activity delaying nitrification. The objective of this study was to evaluate the Nutri-Sphere technology for side-banded urea under western Canadian conditions using spring wheat, barley and canola as test crops.

Methods

Nutri-Sphere treated urea was evaluated against untreated urea and Super-Urea, a competitive product in the Canadian market, at three levels of N-fertility (40, 80, and 120 lbs/ac N) for each of the three crops (spring wheat, malting barley, and canola), summarized in Table 29. A check with no N fertilizer added was included to evaluate linear responses of yields in the three treatments to N fertility rates but was not included in all analyses.

Table 29. N fertilizer additives and rates on spring wheat, malting barley, and canola.

N-Form	N-Rate (lbs/ac N)
Untreated urea	40
Untreated urea	80
Untreated urea	120
Nutri-Sphere urea	40
Nutri-Sphere urea	80
Nutri-Sphere urea	120
Super-Urea	40
Super-Urea	80
Super-Urea	120
None	0

Results

Spring wheat

Averaged across the three N formulations, spring plant density, plant height and yield did not differ significantly at varying rates of N (Table 30). However, when all N rates were combined, plant density was significantly higher in untreated urea plots than in either Super-U or Nutri-Sphere-N plots. Spring wheat height and yield did not differ between the three forms of fertilizer. Plant height was increased with N fertilizer but no differences amongst any of the fertilized plots were detected. The overall response to N was weak for spring wheat in 2012 and, while yields of the fertilized treatments tended to be higher for the check, no individual treatment differences were significant for grain yield.

Table 30. Response of spring wheat to varying N rates and forumations in 2012.

	Plant Density (plants/m^2)	**Plant Height** (cm)	**Grain Yield** (bu/ac)
Check (0 N)	282 *a*	96.6 *b*	28.2 *a*
Untreated Urea			
40 lbs N/ac	302 *a*	108 *a*	36.0 *a*
80 lbs N/ac	290 *a*	107 *a*	37.5 *a*
120 lbs N/ac	277 *a*	106 *a*	36.2 *a*
Nutris-Sphere N			
40 lbs N/ac	270 *a*	106 *a*	34.6 *a*
80 lbs N/ac	252 *a*	107 *a*	39.2 *a*
120 lbs N/ac	258 *a*	105 *a*	36.3 *a*
Super Urea			
40 lbs N/ac	257 *a*	107 *a*	35.8 *a*
80 lbs N/ac	283 *a*	105 *a*	30.8 *a*
120 lbs N/ac	276 *a*	104 *a*	33.7 *a*

Malting barley

When combined across the three forms of fertilizer, N rate had a significant effect on spring plant density, plant height, and yield (Table 31). Treatment effects on plant density did not follow any specific patterns and there was no evidence of reduced plant populations with side-banded N fertilizer. Grain yields were significantly higher with fertilizer N and tended to peak at the 80 lbs/ac rate. When combined across N rates, no significant differences between the three forms of N fertilizer were detected for any of the variables measured.

Table 31. Response of barley to varying N rates and formulations in 2012.

	Plant Density (plants/m^2)	Plant Height (cm)	Grain Yield (bu/ac)
Check (0 N)	196 *abc*	72 *d*	45.7 *c*
Untreated Urea			
40 lbs N/ac	226 *a*	84 *bc*	56.0 *ab*
80 lbs N/ac	212 *ab*	85 *bc*	61.9 *a*
120 lbs N/ac	182 *abc*	80 *c*	56.6 *ab*
Nutri-Sphere N			
40 lbs N/ac	185 *abc*	90 *ab*	55.7 *ab*
80 lbs N/ac	144 *c*	89 *ab*	57.2 *ab*
120 lbs N/ac	177 *abc*	88 *ab*	54.5 *ab*
Super Urea			
40 lbs N/ac	173 *abc*	91 *ab*	53.3 *bc*
80 lbs N/ac	165 *bc*	92 *a*	60.0 *ab*
120 lbs N/ac	189 *abc*	91 *ab*	57.7 *ab*

Canola

When combined across the three forms of fertilizer, N rate had a significant effect on canola plant height and yield, but not on plant density (Table 32). With no effect on plant densities, there was no evidence of seedling damage or reductions in emergence associated with high rates of side-banded N. Plant height was lowest in the check and significantly lower at 40 lbs/ac than at the higher rates of N, and canola yield increased significantly with N-rate at all levels. When combined across N rates, there was no significant different in plant density or height between the three forms of N fertilizer, but there was a significant effect of yield. Canola yield was significantly lower in plots treated with Nutri-Sphere-N than in the untreated urea (Figure 13).

Table 32. Response of canola to varying N rates and formulations in 2012.

	Plant Density (plants/m^2)	Plant Height (cm)	Grain Yield (bu/ac)
Check (0 N)	79 *a*	96 *d*	18.3
Untreated Urea			
40 lbs N/ac	74 *a*	121 *abc*	31.6 *bc*
80 lbs N/ac	90 *a*	124 *abc*	36.6 *a*
120 lbs N/ac	78 *a*	129 *ab*	36.0 *ab*
Nutri-Sphere N			
40 lbs N/ac	81 *a*	116 *bc*	28.0 *c*
80 lbs N/ac	78 *a*	128 *abc*	32.6 *bc*
120 lbs N/ac	71 *a*	127 *abc*	37.4 *a*
Super Urea			
40 lbs N/ac	84 *a*	115 *c*	28.8 *c*
80 lbs N/ac	75 *a*	125 *abc*	35.3 *ab*
120 lbs N/ac	77 *a*	133 *a*	39.1 *a*

Conclusion

The overall response to N in 2012 was relatively weak and yields for all crops were typically below average for the region. No differences amongst N forms were detected under these conditions but some benefits have previously been detected, particularly when potential N losses and yield potential are high. The 2012 growing season marked the conclusion of this study which was first initiated in 2008 for the cereals and 2009 for canola. A detailed, comprehensive summary of this research will be available in the coming months.

Acknowledgement

Funding for this project was provided by JR Simplot and the project in being administered through the International Plant Nutrition Institute.

Evaluating the Response of Spring Wheat and Canola to ESN Fertilizer

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Overview

ESN® is a polymer-coated urea fertilizer that allows controlled release of urea to the crop. Benefits to using a slow-release N fertilizer include greater seed safety at higher rates of seed-placed or side-banded N fertilizer with spring seeding, minimizing N losses through volatilization, nitrification, and leaching, and enhancing N availability to the crop in the later stages of the growing season. This study was initiated in collaboration with Agrium Advanced Technologies in order to evaluate the response of spring wheat and canola to varying rates of side-banded polymer-coated urea (ESN®) relative to untreated urea under western Canadian field conditions.

Methods

The project included 13 treatments for each of the two crops; spring wheat and canola, that included six different rates of ESN and urea (54, 80, 107, 143, 169, 196 lbs/ac), and an untreated check (0 lbs/ac N). The N fertilizer used in the ESN treatments was a blend of 25% urea and 75% ESN.

Results

Spring wheat plant densities were not affected by side-banded fertilizer in either year, nor were there any differences between urea and ESN® (Table 33).

Table 33. Effect of year, N rate, and N formulation on spring wheat plant density.

N-Rate	2011		2012		Combined	
	Urea	ESN	Urea	ESN	Urea	ESN
	---------- Spring Wheat Plant Density (plants/m^2) ----------					
0	318 *a*		283 *a*		301 *A*	
54	317 *a*	310 *a*	310 *a*	289 *a*	313 *A*	300 *A*
80	331 *a*	303 *a*	301 *a*	281 *a*	316 *A*	292 *A*
107	317 *a*	334 *a*	292 *a*	310 *a*	305 *A*	322 *A*
143	332 *a*	327 *a*	300 *a*	308 *a*	316 *A*	318 *A*
169	319 *a*	322 *a*	285 *a*	297 *a*	302 *A*	309 *A*
196	285 *a*	304 *a*	285 *a*	293 *a*	285 *A*	299 *A*

In contrast, canola plant densities in 2011 were significantly reduced with side-banded urea but were unaffected by ESN®, even at high rates. In 2012, where spring soil conditions were slightly drier and more optimal for accurate seed and fertilizer placement, neither (side-banded) urea nor ESN® impacted canola plant densities, even at very high application rates (Table 34).

Table 34. Effect of year, N rate, and N formulation on canola plant density.

N-Rate	2011		2012		Combined	
	Urea	ESN	Urea	ESN	Urea	ESN
	---------------------------------- Canola Plant Density (plants/m^2) ----------------------------------					
0	98 *a*		73 *ab*		85 *A*	
54	71 *b*	86 *ab*	69 *b*	82 *ab*	70 *AB*	84 *A*
80	71 *b*	86 *ab*	76 *ab*	69 *b*	73 *AB*	77 *AB*
107	72 *ab*	83 *ab*	80 *ab*	75 *ab*	76 *AB*	79 *AB*
143	81 *ab*	84 *ab*	74 *ab*	75 *ab*	77 *AB*	80 *AB*
169	78 *ab*	81 *ab*	77 *ab*	78 *ab*	77 *AB*	79 *AB*
196	64 *b*	87 *ab*	66 *b*	63 *b*	65 *B*	75 *AB*

For both crops, grain yields and the overall responses to N were considerably higher in 2011 than in 2012. In 2011, wheat yields increased by an average of 49% with N fertilizer; however, in 2012, where both lodging and fusarium head blight were major limiting factors, there was no yield response to N fertilizer (Figure 14). In 2011, an 8% yield benefit was detected with ESN over untreated urea when averaged across N rates; however there was no difference in yield between the two N formulations in 2012.

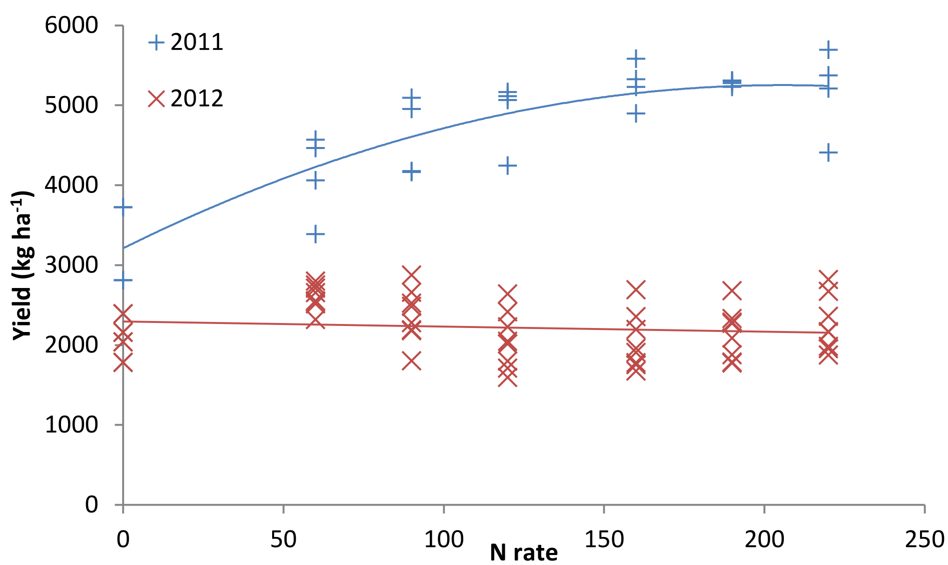

Figure 13. Spring wheat yield response to N rate in 2011 and 2012.

Table 35. Effect of year, N rate and N formulation on spring wheat yield.

N-Rate	2011		2012		Combined	
	Urea	ESN	Urea	ESN	Urea	ESN
	------------------------------------- Grain Yield (bu/ac) -------------------------------------					
0	48.6 *cd*		31.1 *ef*		39.8 *C*	
54	55.3 *bc*	67.1 *ab*	38.2 *def*	39.2 *cde*	46.8 *BC*	53.2 *AB*
80	67.8 *ab*	68.8 *ab*	33.2 *def*	37.4 *def*	50.5 *AB*	53.1 *AB*
107	69.2 *ab*	76.4 *a*	29.6 *ef*	31.5 *ef*	49.4 *AB*	53.9 *AB*
143	76.0 *a*	80.3 *a*	32.5 *def*	28.0 *f*	54.2 *AB*	54.2 *AB*
169	78.6 *a*	78.3 *a*	29.6 *ef*	33.8 *def*	54.1 *AB*	56.1 *A*
196	71.4 *a*	82.3 *a*	36.5 *def*	30.3 *ef*	54.0 *AB*	56.3 *A*

Canola yields were increased on average by 105% with N fertilizer in 2011 and by 57% in 2012 (Table 36). There was an average yield benefit of 6% with ESN over untreated urea in 2011, but no significant yield benefit in 2012 (Figure 15).

Table 36. Effect of year, N rate and N formulation on canola yield.

N-Rate	2011		2012		Combined	
	Urea	ESN	Urea	ESN	Urea	ESN
	------------------------------------- Seed Yield (bu/ac) -------------------------------------					
0	29.9 *ij*		27.2 *j*		28.5 *E*	
54	50.9 *efg*	51.1 *efg*	38.5 *hi*	38.3 *hi*	44.7 *D*	44.7 *D*
80	54.9 *def*	56.9 *cde*	41.6 *gh*	41.0 *gh*	48.3 *CD*	48.9 *CD*
107	59.6 *bcde*	67.5 *ab*	43.4 *gh*	43.3 *gh*	51.5 *BC*	55.4 *AB*
143	65.9 *abc*	65.3 *abc*	44.9 *fgh*	44.3 *fgh*	55.3 *AB*	54.8 *AB*
169	61.1 *abcd*	68.5 *ab*	43.2 *gh*	45.8 *fgh*	52.1 *ABC*	57.1 *A*
196	64.5 *abc*	69.6 *a*	44.7 *fgh*	44.9 *fgh*	54.6 *AB*	57.3 *A*

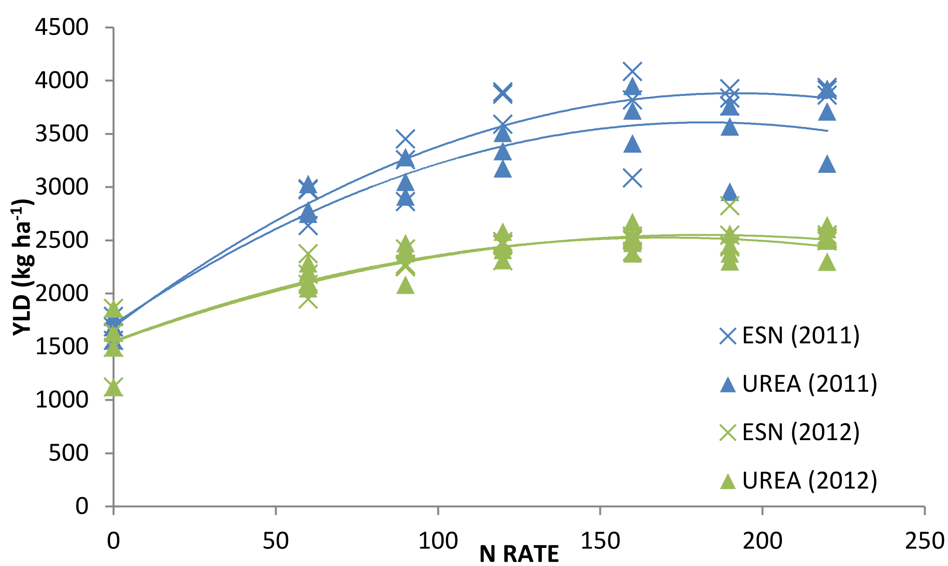

Figure 14. Canola yield response to N rate and N formulation in 2011 and 2012. The solid curves indicate the yield response to ESN while the dashed lines indicate yield responses to untreated urea in each respective year.

Conclusion

Overall, these results suggest that there may be seed safety and yield benefits to side-banded ESN® under western Canadian field conditions; however, these benefits are not likely to be realized every year. Benefits to side-banded, slow release N are most likely to be realized in fields where both the potential crop response to N fertilizer and the potential for N losses (i.e. leaching, denitrification) are high. There may be additional benefits resulting from lower N losses and increased N carryover to the following growing season with ESN®, and this is also being investigated. As with any technology, management decisions should be based on the potential economic return on investment taking into account both the short-term and long-term benefits along with any added costs associated with a practice or technology.

Acknowledgement

Funding for this project was provided by Agrium Advanced Technologies.

Canola Row Spacing Study: Implications for Side-Banded Nitrogen Fertilizer, Seeding Rate Recommendations, and Weed Competition

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Overview

There has been considerable interest among canola growers and equipment manufacturers regarding wider row spacing in canola. With larger implements, producers will be able to increase the timeliness of seeding and reduce fuel use and tractor hours as utilizing fewer openers significantly reduces the draft requirements for seeding on a per acre basis. Also, wider row spacing will make it easier to seed between the stubble rows and allow growers to capture the benefits of taller stubble with greater ease. Past research on canola row spacing has led to varied conclusions in regards to canola yield response and agronomic implications, thus, revisiting the topic of row spacing in canola is well justified with all of the changes in canola varieties, fertilizer management and seeding equipment over the past twenty years. Under no-till or minimum till continuous cropping systems, which utilize seeding equipment capable of side-banding fertilizer, along with modern herbicide tolerant hybrids, increased row spacing has the potential to reduce input costs by: 1) increasing nitrogen-use efficiency because the fertilizer is concentrated in close proximity to the seed rows and thereby, less susceptible to immobilization and less available to weeds, and 2) reducing seeding rates and minimizing the negative impact on plant populations associated with wide-row spacing. On the other hand, the fact that banded fertilizer becomes more concentrated as row spacing increases could increase the potential for seedling injury in cases where seed-fertilizer separation is inadequate. From a weed management perspective, it is generally accepted that canola would not compete as well against weeds as row spacing is increased, especially early in the growing season, though this may not be an issue of great concern with modern, herbicide tolerant hybrid canola varieties.

The objectives of this study are to 1) evaluate the production of canola when grown at wider row spacing, 2) investigate any implications for management of side-banded fertilizer, 3) investigate any implications for seeding rate recommendations, and 4) investigate any implications for the ability of canola to compete with weeds, as row spacing increases. The project consisted of three separate experiments, examining interactions between row spacing in canola (10”, 12”, 14”, 16”, and 24”) with 1) side-banded N fertilizer rates (0, 45, 90 and 134 lbs N/ac), 2) seeding rates (1.3, 2.7, 4.0 and 5.4 lbs/ac) and 3) weed competition (no herbicide compared to in-crop herbicide application).

Methods

The treatments for the three experiments included every combination of the 5 row spacing treatments (10”, 12”, 14”, 16”, and 24”) with:

<u>Experiment #1</u>
Nitrogen rate treatments:
1) 0 lbs/ac N
2) 45 lbs/ac N
3) 90 lbs/ac N
4) 134 lbs/ac N
(*20 treatments total*)

<u>Experiment #2</u>
Seeding rate treatments:
1) 1.3 lbs/ac (29 seeds/m^2)
2) 2.7 lbs/ac (58 seeds/m^2)
3) 4.0 lbs/ac (87 seeds/m^2)
4) 5.4 lbs/ac (116 seeds/m^2)
(*20 treatments total*)

<u>Experiment #3</u>
Herbicide treatments:
1) In-crop herbicide
2) Up to 2 in-crop herbicide applications
(*10 treatments total*)

The applied N rate for experiments #2 and #3 was approximately 111 lbs/ac and seeding rates for experiments #1 and #3 were equivalent to 5.4 lbs/ac.

Conclusion

An error during seeding resulted in the loss of the entire set of 24” row spacing treatments from Experiment #1, and the 24” row spacing by 1.3 lbs/ac seeding rate treatment from Experiment #2. Also, an extreme wind event caused damage to many of the swaths, so it was not possible to obtain accurate yield data from many of these plots and data from some plots had to be removed before statistical analyses were completed. Consequently, the results from 2012 are preliminary and not conclusive.

Due to technical errors at seeding followed by unprecedented disease levels and severe wind damage to many of the swathed plots, results from the 1st year of the canola row spacing study at Indian Head were less conclusive than originally hoped.

This study will be continued until 2015, with more accurate results to be reported following the 2013 season, and years to come.

Acknowledgement

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

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Overview

Proper grain drying and storage is vital to prevent spoilage and mould development. A recent IHARF study looking at two bins with aeration fans running continuously found that there is a strong daily pattern of water removal and addition of water to the grain, 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 coldest part of the day; i.e. night. This can be explained by the moisture holding capacity of air. Cold air cannot hold as much moisture as warm air, which is seen when dew develops on the grass at night. 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.

Methods

In the summer of 2012, six bins were instrumented, allowing for three paired bin comparisons to be completed; between a bin with a fan running continuously and a bin equipped with a fan operating intermittently under the proposed control strategy. Each pair of bins was filled at the same time in order to obtain the same grain moisture content (MC). Once the bins were filled, the fans were started and twice a day (usually 7:00 am and 7:00 pm), the grain in the bins were sampled at four different heights in the bin using a specialized tube that allows for grain samples to be taken from the ground. The temperature (T) and relative humidity (RH) of the air coming in and out of each bin was recorded on an hourly basis. The control strategy involved compared the mass of water coming into the bin with the mass of water coming out of the bin. If the mass of water going out was greater than the mass coming in (net water removal from the bin), the fan continued to operate. If the opposite occurred, the fan would stop and would resume once the outside conditions were such that the water content of the air coming in was less than the mass of water coming out. A total of four runs were conducted in the fall of 2012; three runs with spring wheat and one run with barley.

Results

The black-box approach (lbs water out – lbs water in = lbs water removed) accurately measured the amount of drying/wetting taking place inside the bin. It is an excellent tool in viewing the hourly dynamics of grain drying.

Using our data, the MC of the air was calculated. The driest air and best drying conditions were typically at night, while the wettest air and wetting conditions typically occurred during the day. Wetting never occurred at night. With the fans running continuously, the data showed that the drying during the night changed to wetting at about 9:00am. The wetting to drying transition was not as predictable but does occur sometime in the evening. There is clearly a diurnal cycle of drying and wetting of grain with the fan running continuously. Having the fan on continuously does eventually dry the grain, but for every 3 to 4 kg of water taken out at night, we put 1 kg back in as wetting takes place during the day.

Cooling the grain dries the grain. Using our data, we have quantified this to be: For every 10^{o}C that the grain temperature is lowered by blowing cold air through it, one percent MC is removed (10^{o}C/1%). For example, if we had grain that was 30^{o}C when it went into the bin and it was cooled to 0^{o}C, there would be 3% MC removed from the grain. The first night of aeration typically lowered the temperature of the grain by 10^{o}C. This lowered the MC by 0.5% to 1.5%.

There is no evidence of a 'drying or wetting front' but rather a 'drying gradient', caused by the compression of the air entering the bin. Working through the thermodynamic formula of $PV=nRT$, it can be shown that this compression results in a 4^{o}C rise at the bottom of the bin as compared to the top. This is a linear gradient of temperature from bottom to top, and thus we have a smooth gradient of drying at the bottom first. This temperature difference was confirmed with our temperature measurements, made at the bottom and top of the bin.

A simple, effective and safe control strategy would be to only have the fan ON when outside air temperature is less than or equal to grain temperature. We know that if we cool the grain, we will dry it; and logically the only way to cool the grain is when the air is colder than the grain. Therefore, to dry the grain, have the fan on only when the air temp is less than the grain temperature. This also has the added advantage of keeping the grain as cold as possible, reducing the risk of insect damage. The 'Yard Light' rule of having the fan on only at night will dry the grain. Some farmers have tried it and it does work, with about half of the fan time. It is also a safer means of storing the grain because the grain remains cool with no wetting taking place. Continuous operation of the fan results in heating and wetting of the grain during the day.

More attention should be paid to keeping the grain cold. This will ensure not only safe grain, but dry grain. There are two partners in safely stored grain. It should be cold and dry. The cold part is the more important part in safe storage and is the quickest to achieve.

There might be advantages in using smaller fans that are less than one cfm/bu. If we can get the grain cooled relatively quickly, then we have achieved safe storage. Smaller fans would have less plenum pressure, and consequently would decrease the pressure gradient, temperature gradient, and drying gradient throughout the bin.

With the fan off, the data showed that the temperature of the grain increased by 0.006^{o}C per hour, 0.144^{o}C per day or about 1^{o}C per week. There are three sources for this increase: biological activity, conduction of heat through the walls of the bin, and from reverse convection currents with cold air sinking in the bin and going out the fan. Probably, convection is responsible for most of this increase and is a function of a change in temperature (ΔT), the difference in temperature of the grain and the air. This increase in grain temperature per hour was determined to be: ΔTg =.0015ΔT1.5. Knowing this is important because it tells us that in order to get the most energy into the bin, we will want to keep the grain as cold as possible. Running the fans continuously, the grain ended up only slightly cooler than the mean outside temperature, which when applied to the formula above, gave us a 1^{o}C rise in a week. But if we can get the temperature of the grain well below the mean air temperature, where ΔT is large, then there will be a greater convection flow, and there will be more heating of the grain.

If the diurnal cycle of temperature is managed properly, we can use Mother Nature as a supplemental heat source and a refrigerator to achieve safe, dry grain with the least fan hours.

Table 37. Details of the four bin runs conducted in 2012.

Bin Run #	Bin ID #	Crop	Fan Start Date	Fan End Date	Fan Operation	Fan Operation (hours)	Bin Size (bu)	Fan Size (hp)
1	9	S. Wheat	17/08/2012	26/08/2012	Continuous	162	2200	5
1	10	S. Wheat	17/08/2012	07/09/2012	Controlled	62	2200	5
4	9	S. Wheat	13/09/2012	21/09/2012	Continuous	188	2200	5
4	10	S. Wheat	13/09/2012	21/09/2012	Controlled	187	2200	5
2	16	F. Barley	22/08/2012	03/09/2012	Continuous	262	3500	3
2	17	F. Barley	22/08/2012	07/09/2012	Controlled	98	3500	3
3	18	S. Wheat	04/09/2012	21/09/2012	Controlled	190	3500	5
3	19	S. Wheat	04/09/2012	21/09/2012	Continuous	327	3500	5

Table 38. Grain details of 2012 bin runs.

Bin Run #	Bin ID #	Crop	Fan Operation	Tough Grain Temp. (°C)	Dry Grain Temp. (°C)	Tough Grain MC (%)	Dry Grain MC (%)
1	9	S. Wheat	Continuous	30.2	11.0	16.9	13.6
1	10	S. Wheat	Controlled	29.9	12.0	17.9	14.0
4	9	S. Wheat	Continuous	21.0	11	17.1	13.6
4	10	S. Wheat	Controlled	23.0	11	16.3	13.7
2	16	F. Barley	Continuous	32.7	17.0	17.6	12.6
2	17	F. Barley	Controlled	34.6	12.9	18.8	14.7
3	18	S. Wheat	Controlled	26.8	11.0	17.6	14.2
3	19	S. Wheat	Continuous	30.0	12.0	18.9	12.9

Conclusion

Major findings from the 2012 bin runs were:

- Cooling the grain also dries it.
- An enormous amount of water is removed the first day as the grain is cooled.
- No evidence of a 'drying or wetting front', but rather a 'drying gradient'.
- Best drying time usually occurs at night while significant wetting usually occurs during the day, especially during hot days.
- It took more calendar days to dry the grain using the control strategy compared to the continuous fan operation; however, there was a reduction in fan operating time of approximately 50% when using the control strategy (Table 37).

This project is scheduled to continue in 2013 and 2014.

Acknowledgement

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Responsiveness of Oat to Nitrogen Fertilizer and Fungicides

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Overview

Recent research has shown that oats require considerably less N fertilizer than other cereal crops, as oat scavenges soil N more effectively than other cereals, such as wheat. Recent studies have also shown that oat does not respond well to the application of fungicides and the application of a fungicide when not required increases production costs as well as increases the risk that resistance will develop.

Methods

At Indian Head and Melfort in 2012, a 300 seeds/m^2 seeding rate of Triactor oat and VB Unity wheat were targeted. The main treatments being applied to oat included 1) no fungicide, 2) Headline, 3) Stratego, and 4) Headline applied to wheat. A sub-plot application of N fertilizer applied at a rate of 0-18-36-54-71-89-107-125 lbs N/ac, creating a total of 32 treatments for each site.

Results

At both locations, the 2012 growing season provided the conditions required for the development of disease; however, as in previous studies, the application of fungicide to oat did not affect yield at either location. Nitrogen fertilizer rate did have a significant effect on oat and wheat yield at both locations and, when averaged across all three fungicide treatments, provided a reliable response curve (Figure 16, Figure 17).

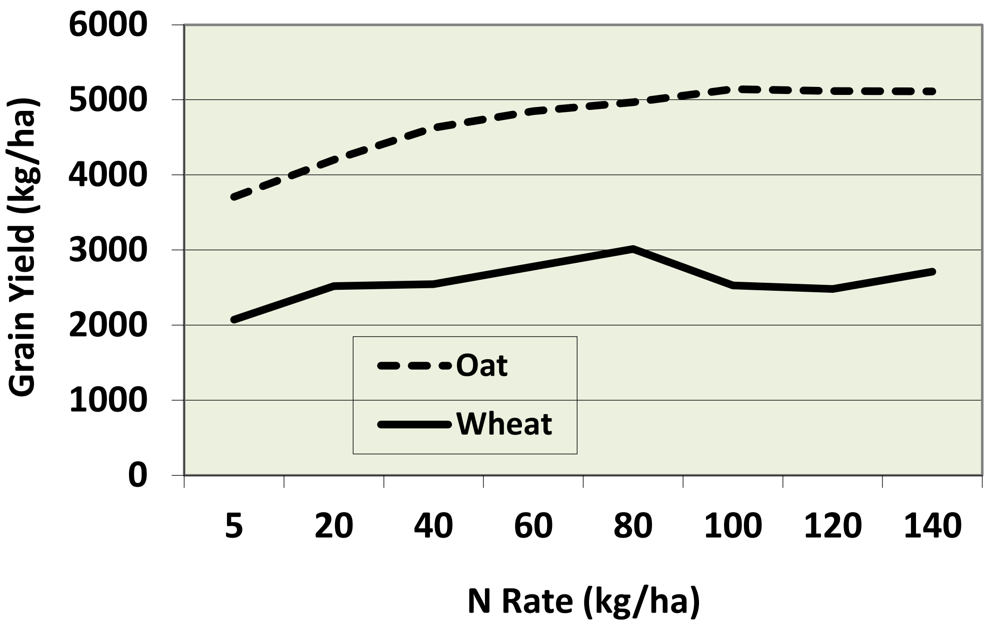

Figure 15. Oat and wheat yield response to N fertilizer at Indian Head, 2012.

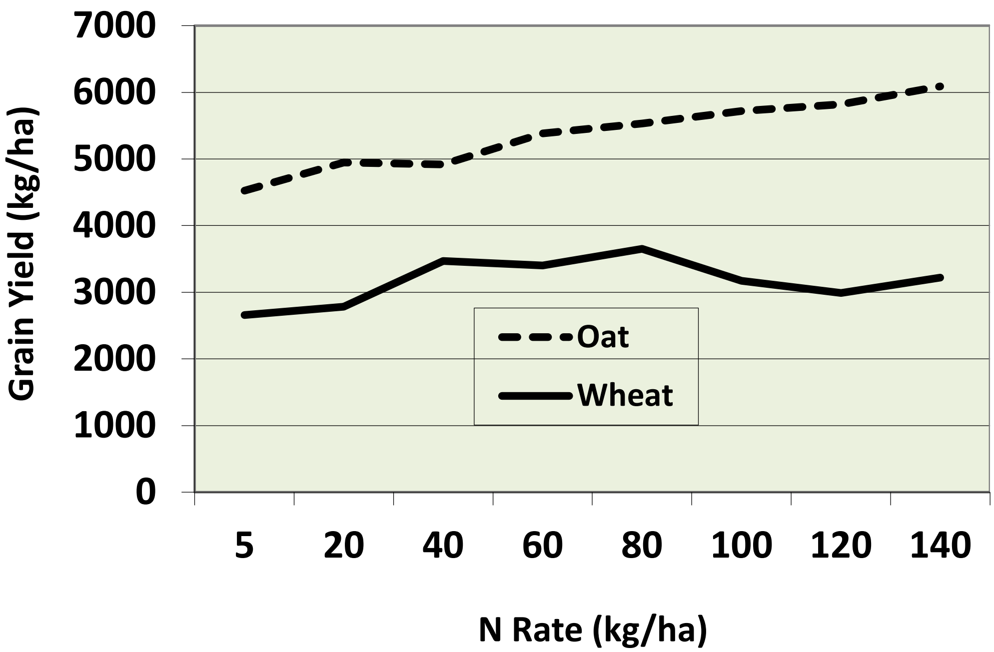

Figure 16. Oat and wheat yield response to N fertilizer at Melfort, 2012

Also at Indian Head, very little lodging was noted at N rates of 54 lbs/ac or less, while slight lodging was noted between 71 and 89 lbs/ac for both wheat and oat. At 107 lbs/ac and higher, oat lodging was much more severe. It is interesting to note, that the N rate at which yield approached the maximum was also the N rate where serious lodging began.

Conclusion

Results to date support other research on oat, concluding that this crop does not respond well to fungicides, although many growers claim it does. This discrepancy could be due to different varietal resistance to disease, as well as the implications of edge-effects sometimes experienced in small plot trials. The nitrogen response of oat seen in this trial again generally agrees with previous studies, in that oat yield was optimized at rates of 54 lbs N/ac or less, and that quality declines where N rates become excessive.

Acknowledgement

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement, with in-kind support provided by Bayer CropScience and BASF.

Optimum Camelina Seeding Depths

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Overview

Camelina is a new crop to Saskatchewan, with little known of its husbandry. Seeding depth is one of the agronomic factors that affects crop establishment and yield potential of camelina. As a small seeded crop with poor weed competition early in its lifecycle, seeding depth plays a large role in producing a uniform, competitive crop early in the season; however, fall seeding and very early spring seeding may produce a healthy, competitive crop.

Methods

The project took place at Indian Head and Scott in 2010 and 2011 with four seeding depths (surface, 0.5, 1.5, 2.5 cm) and two seeding dates, spring and fall. In 2012, the project took place at Indian Head alone, and included the same seeding depths, but only the spring seeding date. No-till drills were used at both locations. Glyphosate was applied prior to seeding, with Edge applied in the fall, prior to the first seeding date.

Results

In the fall seeded treatments, germination started as soon as there was enough moisture in the soil. The emergence of the radicle was observed at Indian Head in 2010 and 2011, but not at Scott.

Also at Indian Head in 2010 and 2011, seeding depth had very little effect on yield and development, while at Scott in 2010 and 2011 and Indian Head in 2012, seeding depth did affect grain. At Scott in 2010, the seeding depth had a greater effect on plant density and yield with the fall seeding date than the spring seeding date, and the lowest values were observed with the surface seeding depth. At Scott in 2011, the surface seeding treatment had lower grain yields and a lower plant density compared to the other seeding depths, when seeded in the spring. At Indian Head in 2012, the 2.5 cm seeding depth had the lowest yield and plant density with spring seeding. The difference in the success or failure of surface seeding between the two locations may be due to a number of factors, including: 1) the seeding equipment between the two sites is slightly different, 2) the heavy clay soil (Indian Head) has the ability to hold more moisture and not dry out as fast, 3) variations in environmental conditions.

In general, grain yield was higher when the camelina was seeded in the spring compared to the fall. The plant densities were often lower with fall seeding but the plant density was high enough in some locations and years to not be limiting yield.

To investigate the effects of spring environmental conditions on camelina seedlings, plant density was measured several times in the spring at Indian Head in 2011. Over the emergence period, the plant density of the fall seeded camelina declined. This indicates that the lower plant densities observed in fall seeded camelina compared to spring seeded camelina can partly be explained by the loss of plants in April and May. The loss of seedlings did not always appear to be uniform. A lack of uniformity in the plant stand when seeded in the fall may be a factor contributing to the lower yield. Significant shattering was observed in the fall seeded plots when they were fully ripe. It appears that cultivars that are more adapted to surviving the growing conditions of early spring in Saskatchewan are required to increase the consistency of fall seeded camelina.

Conclusion

The seeding depths that resulted in the most consistent responses were 0.5 and 1.5 cm; however, farmers will be able to successfully seed camelina to a depth of 2.5 cm, depending on equipment, soil texture and soil moisture conditions.

Acknowledgement

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement.

Innovative Soil and Crop Management Practices: Quantifying the Economic and Soil Quality Benefits of Long-Term No-Till

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Overview

A study was initiated in 2002 to quantify the long term benefits of no-till on canola and spring wheat production. Some of the questions posed at the start were: What can be expected from 33 years of continuous no-till cropping practices? Can soil organic matter content be brought back to, or even exceed, its original native level? Can the use of higher rates of N fertilizer (exceeding grain removal) build the productivity of soil and what impact does length of no-till have on the soil building process?

The objectives of this study were to: 1) compare two adjacent fields with different no-till cropping histories for their soil organic carbon content and their ability to mineralize soil organic nitrogen, 2) relate these measures to the responses of canola and spring wheat yields to different rates of N fertilizer over an eight-year period on grain yield and grain protein.

To complete the objectives detailed above, the project contains three different components: Economic Analysis, Soil Quality Analysis and Soil Building Effects.

Economic Analysis

The first component will be to conduct a detailed economic analysis quantifying the long-term and short-term economic benefits of no-till farming practices. It will quantify farm incomes associated with on-going no-till production by comparing 21 to 31 years of continuous no-till with 0 to 10 years of continuous no-till, using two on-going studies. It will take into account gross margins, net income variability, optimum nitrogen fertilizer rates and a range of N fertilizer and grain price scenarios.

Soil Quality Analysis

The second component of the study is to examine the impact of long-term and short-term no-till on measurable soil characteristics, and to identify soil quality characteristics that can serve as a specific index of overall soil health and productivity. The soil organic N pool will be examined as a function of length of no-till and N rates using a variety of measures of N release.

Soil Building Effects

The final component of the study is to determine the impact of using N rates at lower, equal to and greater than the N removal of the grain over a 10 year period under both long-term and short-term no-till. The study will employ the methods and the plots described above. The goal will be to determine if through varying N fertility rates exceeding what is removed in the grain, can soil building be accelerated and whether this approach may be feasible for improving degraded soils. It will also determine if this approach can be used as a strategy for continually improving soils and how the soil building response compares between long-term and short-term no-till.

Conclusion

Data analysis is ongoing and a more detailed summary of the results will be available in the 2013 IHARF Annual Report.

Acknowledgement

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