2017

Irrigation Crop Diversification Corporation Research and Demonstration Report






ICDC

Irrigation Crop Diversification Corporation

Through innovation, the Irrigation Crop Diversification Corporation stimulates and services the development and expansion of sustainable irrigation in Saskatchewan.

Research and Demonstration Program Report 2017

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ICDC Research and Demonstration Report 2017

This report is published annually. Copies of this report can be found on our website. If you would like to be added to our mailing list, please contact us:

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VISION

Through innovation, the Irrigation Crop Diversification Corporation
stimulates and services the development and expansion
of sustainable irrigation in Saskatchewan.

OBJECTIVES AND PURPOSES OF ICDC

a) to research and demonstrate to producers and irrigation districts profitable agronomic practices for irrigated crops;

b) to develop or assist in developing varieties of crops suitable for irrigated conditions;

c) to provide land, facilities and technical support to researchers to conduct research into irrigation technology, cropping systems and soil and water conservation measures under irrigation and to provide information respecting that research to district consumers, irrigation districts and the public;

d) to co-operate with the Minister in promoting and developing sustainable irrigation in Saskatchewan.

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BOARD OF DIRECTORS

Director	Position	Irrigation District	Development Area Represented	Term Expiry (current term)
Jay Anderson	Chairman	SSRID	LDDA	2017 (2nd)
Anthony Eliason	Vice Chairman	Individual Irrigators	Non-District	2018 (1st)
Kevin Plummer	Director	Moonlake	NDA	2017[1]
David Bagshaw	Director	Luck Lake	SEDA	2016 (2nd)
Paul Heglund	Director	Consul-Nashlyn	SWDA	2017 (1st)
Nigel Oram	Director	Grainland	NDA	2017[2]
Greg Oldhaver	Director	Miry Creek	SWDA	2017 (2nd)
Joel Vanderschaaf	Director	SSRID	SIPA representative	Appointed
Aaron Gray	Director	Miry Creek	SIPA representative	Appointed
Kelly Farden	Director	N/A	SA representative	Appointed
Penny McCall	Director	N/A	SA representative	Appointed

[1] Pursuant to Bylaw 7, Kevin Plummer was appointed to a one year term

[2] Pursuant to Bylaw 7, Nigel Oram was appointed to a one year term

The four Development Areas (DA), as defined in ICDC's bylaws, are:

Northern (NDA),
South Western (SWDA),
South Eastern (SEDA), and
Lake Diefenbaker (LDDA).

ICDC Directors are elected by District Delegates who attend the annual meeting. Each Irrigation District is entitled to send one Delegate per 5,000 irrigated acres or part thereof to the annual meeting. Two Directors are elected from LDDA, two from SWDA and one each from NDA and SEDA. Non-district irrigators elect one representative.

The Saskatchewan Irrigation Projects Association (SIPA) and the Saskatchewan Ministry of Agriculture (SA) appoint two directors each to the ICDC board.

In accordance with the *Irrigation Act, 1996*, the majority of the ICDC board must be comprised of irrigators.

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FIELD CROP VARIETY TRIALS 2017

Irrigated Field Pea Regional Variety Trial

Funding

This project was funded by the Irrigation Crop Diversification Corporation and the Saskatchewan Variety Performance Group.

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Saskatchewan Variety Performance Group

Objectives

The objectives of this study were to:

(1) Evaluate experimental pea lines pursuant to registration requirements;
(2) Assess entries for suitability to irrigated production; and
(3) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Research Plan

Pea Regional variety trials were conducted at a single location in the Outlook irrigation area. The site and soil type are as follows:

CSIDC Off-station: Elstow loam (Pederson)

Pea varieties were tested for their agronomic performance under irrigation. The CSIDC Off-station site was seeded on May 19. Plot size was 1.5 m x 4 m. All plots received 35 kg P_2O_5/ha as 12-51-0 as a side banded application and Nodulator granular inoculant at a rate of 3.7 kg/ha as a seed place application during the seeding operation. Weed control consisted of a spring pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergence application tank mix of Odyssey (imazamox + imazethapyr) and Equinox (tepraoxydim). Supplemental hand weeding was conducted as required. The trial was arranged in a randomized complete block design with three replicates.

Thirty-six pea varieties representing seven market classes were evaluated in 2017. Fourteen registered varieties and three unregistered entries were Yellow pea market class, ten registered and two unregistered were Green market class, two registered Red cotyledon entries, two registered Maple varieties, two registered varieties in the Maple market class, one registered Dun market class variety and one unregistered entry in an exploratory class CDC has designated as wrinkled.

Results

Varieties included in the trial were as follows;
Yellow Market Class – CDC Golden, Agassiz, AAC Ardill, AAC Carver, AAC Lacombe, CDC Amarillo, CDC Athabaska, CDC Canary, CDC Inca, CDC Meadow, CDC Pluto, CDC Saffron, CDC Spectrum, Hyline, CDC 3525-5, CDC 4061-4, P0520-116.
Green Market Class – AAC Comfort, AAC Radius, AAC Royce, CDC Greenwater, CDC Limerick, CDC Patrick, CDC Raezer, CDC Striker, CDC Spruce, CDC Tetris, CDC 3422-8, CDC 4499-1.
Red Market Class – Redbat 8, Redbat 88
Maple Market Class – AAC Liscard, CDC Blazer
Dun Market Class – CDC Dakota
Forage Market Class – CDC 3548-2
Wrinkled Market Class – CDC 4140-4

Unfortunately, this trial was lost to a severe hail storm on July 27 and no conclusions can be made.

Western Canada Irrigated Canola Co-operative Trials
XNL1 and XNL2

Funding

This project was funded by the Canola Council of Canada.

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Western Canada Canola/Rapeseed Recommending Committee
- Canola Council of Canada

Objectives

The objectives of this study were to:

(1) Evaluate crop varieties for intensive irrigated production; and

(2) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Research Plan

The canola co-operative trials were conducted on an irrigated site at Broderick (G. Pederson). Twenty-one canola hybrids were evaluated in each XNL1 and XNL2 trials, check varieties 45H29 and 5440 where included each trial. Trials were seeded on May 19. Plot size was 1.5 m x 6 m. The seed was treated with Helix XTra (thiamethoxam, difenoconazole, metalaxyl & fludioxonil) for seed borne disease and early season flea beetle control. Supplemental nitrogen fertilizer was not applied as soil sample analysis indicated 221 kg N/ha available soil N to 60 cm (100 kg N/ha had been applied the previous fall as 82-0-0), phosphorus at 35 kg P_2O_5/ha, as 12-51-0, side-banded at the time of seeding. Weed control consisted of a pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergent tank-mix application of Muster Toss-N-Go (ethametsulfuron-methyl) and Poast Ultra (sethoxydim) and supplemented by periodic hand weeding.

Both trials where swathed on August 31 and combined on September 11.

Results

Both trials were severely damaged by a hail storm event occurring on July 20. As per contractual agreements the Canola Council was informed, and usually the trials would be abandoned. The Canola Council requested that the trials be maintained and harvested out of scientific curiosity, however the yield data obtained is unusable for registration purposes. Yield data presented below in Tables 1 & 2 is merely for posterity and record keeping purposes. No further discussion will be provided.

Table 1. Yield and Agronomic Data for the Irrigated Canola Cooperative Trial XNL1, 2017.

Entry		Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)
5440		***1235***	***41.9***	***65.9***	***4.2***	***NC***	***46***	***NC***
45H29		1351	44.7	63.8	4.1	NC	46	NC
XNL1 – 3		997	42.7	63.8	4.3	NC	47	NC
XNL1 – 4		1507	45.1	64.9	4.0	NC	48	NC
XNL1 – 5		1170	46.3	64.0	4.1	NC	44	NC
XNL1 – 6		1384	43.0	62.8	4.1	NC	46	NC
XNL1 – 7		1711	42.8	44.4	4.0	NC	45	NC
XNL1 – 8		1421	45.3	66.5	4.3	NC	46	NC
XNL1 – 9		1036	44.6	59.8	4.6	NC	47	NC
XNL1 – 10		1199	44.0	64.3	4.2	NC	47	NC
XNL1 – 11		1432	42.9	63.3	4.6	NC	47	NC
XNL1 – 12		1413	44.4	65.1	4.5	NC	47	NC
XNL1 – 13		1222	44.5	64.7	4.3	NC	46	NC
XNL1 – 14		1556	44.7	63.6	4.7	NC	47	NC
XNL1 – 15		1356	47.5	63.4	4.6	NC	46	NC
XNL1 – 16		1382	43.7	62.1	4.7	NC	46	NC
XNL1 – 17		1295	41.6	64.1	4.6	NC	48	NC
XNL1 – 18		1185	44.0	64.9	4.1	NC	45	NC
XNL1 – 19		1408	46.9	64.3	3.9	NC	48	NC
XNL1 – 20		1120	46.3	63.5	4.3	NC	48	NC
XNL1 – 21		1526	43.7	64.7	4.1	NC	47	NC
LSD (0.05)		276	2.6	12.0	0.3		1.3	
CV (%)		12.6	3.6	11.5	3.9		1.7	

NC = Not Collected

Table 2. Yield and Agronomic Data for the Irrigated Canola Cooperative Trial XNL2, 2017.

Entry	Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)
5440	***1192***	***41.7***	***65.4***	***4.0***	***NC***	***46***	***NC***
45H29	1141	45.0	63.8	4.0	NC	45	NC
XNL2 – 3	886	43.9	64.1	4.0	NC	47	NC
XNL2 – 4	1731	46.0	65.2	3.9	NC	47	NC
XNL2 – 5	1103	44.9	64.5	4.1	NC	44	NC
XNL2 – 6	1082	43.5	63.2	4.0	NC	46	NC
XNL2 – 7	1410	43.5	63.2	4.1	NC	45	NC
XNL2 – 8	1169	44.5	62.5	4.1	NC	47	NC
XNL2 – 9	1223	46.5	61.5	4.4	NC	45	NC
XNL2 – 10	1163	45.9	65.0	4.5	NC	47	NC
XNL2 – 11	1505	45.4	65.5	4.2	NC	47	NC
XNL2 – 12	1379	45.7	65.4	4.2	NC	48	NC
XNL2 – 13	1222	45.1	64.9	4.0	NC	47	NC
XNL2 – 14	1113	45.9	65.0	4.3	NC	47	NC
XNL2 – 15	1497	43.9	65.6	4.2	NC	48	NC
XNL2 – 16	1344	45.1	65.1	3.8	NC	47	NC
XNL2 – 17	1501	43.7	65.7	4.1	NC	47	NC
XNL2 – 18	1141	42.9	65.4	4.0	NC	49	NC
XNL2 – 19	1533	43.7	64.9	4.1	NC	46	NC
XNL2 – 20	1509	44.3	65.3	4.4	NC	47	NC
XNL2 – 21	1276	45.2	65.4	4.1	NC	48	NC
LSD (0.05)	332	NS	0.9	0.3		1.6	
CV (%)	14.7	3.6	0.8	3.9		2.1	

Irrigated Canola Performance Trial

Funding

This project was funded by the Canola Council of Canada.

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canola Council of Canada

Objectives

The objectives of this study were to:

(1) Evaluate experimental lines and registered canola hybrids for regional performance;
(2) Assess entries for suitability to irrigated production; and
(3) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Research Plan

The irrigated canola performance trial was conducted on rented land owned by G. Pederson and located approximately 16 km from CSIDC. Canola varieties were tested for their agronomic performance under irrigation. Four Clearfield, three Liberty and fifteen Roundup tolerant canola hybrids where evaluated in 2017. Seeding date was May 19. Plot size was 1.5 m x 6.0 m, varieties were blocked into their respective herbicide tolerance grouping for purpose of comparison and appropriate post emergent herbicide applications. The seed was treated with Helix XTra (thiamethoxam, difenoconazole, metalaxyl & fludioxonil) for seed borne disease and early season flea beetle control. Supplemental nitrogen fertilizer was applied at 122 kg N/ha as 82-0-0 applied the previous fall, and phosphorus at 35 kg P_2O_5/ha as 12-51-0 side-banded at the time of seeding. Weed control consisted of post emergent applications of the appropriate herbicide per herbicide tolerant entries. Clearfield entries received an application of Odyssey (imazamox + imazethapyr) tank mixed with Equinox (tepraloxydim) and Merge adjuvant. Liberty Link entries received an application of Liberty 150SN (glufosinate ammonium) tank mixed with Centurion (clethodim) and Merge adjuvant. Roundup Ready entries received an application of Round Up (glyphosate). All herbicide applications occurred on June 20.

Unfortunately, this trial was lost to a severe hail storm on July 27 and no conclusions can be made. However, the trial was maintained out of curiosity.

Varieties were swathed August 31 and harvested September 11.

Results

Due to the hail event no conclusions can be drawn from these results.

Table 1. Yield and agronomic data for the 2017 Irrigated Canola Performance Trial.

Variety	Type	Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)	Lodge rating (1=erect; 5=flat)
Clearfield-tolerant									
5545 CL	HYB	1423	44.3	65.1	4.4	NC	NC	NC	NC
46H75	HYB	1385	44.8	62.9	4.4	NC	NC	NC	NC
CS 2200	HYB	1244	44.8	64.6	4.4	NC	NC	NC	NC
PV 200	HYB	1601	44.1	64.3	4.5	NC	NC	NC	NC
Liberty-tolerant									
5440	HYB	1121	43.6	65.1	4.2	NC	NC	NC	NC
L241C	HYB	1477	42.2	64.7	4.5	NC	NC	NC	NC
L252	HYB	1565	45.0	65.6	4.5	NC	NC	NC	NC
Roundup-tolerant									
6074 RR	HYB	1248	43.4	64.8	4.1	NC	NC	NC	NC
6076 RR	HYB	1037	43.4	64.3	4.3	NC	NC	NC	NC
6080 RR	HYB	1124	44.8	63.3	4.2	NC	NC	NC	NC
CS2000	HYB	1208	43.7	64.1	4.2	NC	NC	NC	NC
CS2100	HYB	1753	45.3	65.2	4.3	NC	NC	NC	NC
V12-1	HYB	1427	44.2	63.4	4.4	NC	NC	NC	NC
PV 540	HYB	1316	43.7	63.8	4.2	NC	NC	NC	NC
PV 581		1395	44.0	63.6	4.6	NC	NC	NC	NC
74-44	HYB	1296	45.5	64.6	4.2	NC	NC	NC	NC
DL 1512	HYB	1159	43.8	64.7	4.4	NC	NC	NC	NC
DL 1630		1408	43.7	64.6	4.4	NC	NC	NC	NC
DL 1634		1055	43.2	64.4	4.3	NC	NC	NC	NC
45H33	HYB	1365	42.7	63.6	4.3	NC	NC	NC	NC
45M35	HYB	1730	46.0	64.4	4.4	NC	NC	NC	NC
SY4187	HYB	1414	45.2	64.6	4.2	NC	NC	NC	NC
LSD (0.05)		NS	1.5	0.8	0.3				
CV (%)		16.3	2.5	0.9	4.4				

HYB = Hybrid
NS = Not Significant
NC = Observation Not Captured

Irrigated Canola Variety Trial

Funding

This project was funded by the Agriculture Development Fund, Western Grains Research Foundation and the Irrigation Crop Diversification Corporation.

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)

Objectives

The objectives of this study were to:

(1) Evaluate registered canola hybrids for which ICDC has limited data;
(2) Assess entries for suitability to irrigated production; and
(3) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Every year ICDC conducts the Irrigated Canola Variety Trial. Selection of canola varieties is based upon results obtained prior seasons through canola coop trials conducted by ICDC for the Canola Council of Canada. Once varieties are commercially available companies are invited to provide seed of those varieties that prior observations have shown to be agronomically suitable for irrigation production. Companies approached for seed are also invited to provide an additional variety (registered or experimental) of their choosing for inclusion. Results from these trials are used to update the irrigation variety database at CSIDC and provide recommendations to irrigators on the best canola varieties suited to irrigation conditions and will be used in the development of the annual publication *"Crop Varieties for Irrigation".*

Research Plan

Two irrigated canola variety trials were conducted at two locations in the Outlook irrigation area. Each site and soil type are as follows:

CSIDC: Bradwell loam-silty loam (Field #11)
CSIDC Off-station: Asquith sandy loam (Knapik NW)

A total of seventeen canola varieties were tested for their agronomic performance under irrigation. Varietal selection was based upon prior variety agronomic performance and solicitation of seed companies for entries they deemed suitable to intensive irrigation production practices. Seeding dates for the sites were: CSIDC trial #1 May 12, CSIDC Off-station May 24. Plot size was 1.5 m x 4.0 m, all plots were seeded on 25 cm row spacings. All seed was treated by the seed suppliers for seed borne disease and early season flea beetle control. At CSIDC supplemental fertilizer was applied at an application rate of 110 kg N/ha as 46-0-0 and supplemental phosphorus at 25 kg P_2O_5/ha as 12-51-0, all fertilizer was side banded. At CSIDC Off-station supplemental fertilizer was applied at an application rate of 80 kg N/ha as 46-0-0 and supplemental phosphorus at 35 kg P_2O_5/ha as 12-51-0, all fertilizer was side banded. Weed control consisted of a pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergent tank-mix application of Muster Toss-N-Go (ethametsulfuron-methyl) and Poast Ultra (sethoxydim) and supplemented by periodic hand weeding. CSIDC plots were swathed August 22 and after proper dry down harvested August 30, the CSIDC Off-station trial was swathed September 1 and combined September 13. Total in-season rainfall at CSIDC from May through August was 128.8 mm. Total in-season irrigation at CSIDC was 162.5 mm and at CSIDC Off-station 192.5 mm.

Results

Results obtained at the CSIDC location are shown in Table 1, those of the Off-station site in Table 2, and combined site analyses in Table 3. Canola varieties in the CSIDC trial were not statistically significantly different from each other. Median yield of varieties was 3809 kg/ha (68.0 bu/ac). Yields in 2017 were lower than traditionally achieved for small plot testing at this site and attributed to the hot temperatures and extreme sunlight intensity experienced through flowering. Flower abortion was noted in all plots. Disease and insects were not an issue in 2017.

Percent oil content ranged from 44.7% (5545 CL) to 48.5% (45M35). Median oil content of all varieties was 46.1%. Median test weight was 63.9 kg/hl and thousand seed weight 4.1 gm. Hybrids CS2100 and L230 were the first varieties to flower (10% flower), DL 1512 RR and L252 the last. Any hybrid with days to 10% flowering greater than 46 was statistically later than the check 5440. Median days to 10% flower was 46 days. Any variety with days to maturity greater than 102 days was statistically later maturing than the control. Median days to mature for canola hybrids was 102 days. Plant heights varied from the shortest with plant height of 135 cm (CS 2100) to the tallest height of 157 cm (45H33). Hybrids did not differ statistically in lodging at this location.

At the Off-station location varieties did differ statistically from one another. Dl 1512 RR obtained the highest yield, 45CS40 the lowest. Only 45CS40 differed statistically from the check variety, 5440. Median yield of varieties was 3187 kg/ha (56.8 bu/ac).

Percent oil content ranged from 45.9% (5440) to 50.3% (45M35). Median oil content of all varieties was 46.1%. Median test weight was 64.2 kg/hl and thousand seed weight 3.9 gm. Median days to 10% flower was 43 days. CS 2100 was the earliest to flower, L252 the latest. Any hybrids that flowered within 43 days, or later than 45 days were statistically different than the check 5440. Median days to maturity was 98 days, hybrid 45CS40 was the earliest to mature, DL 1512 RR the latest. Hybrids at this location did not statistically differ in either plant height or lodging.

Comparison between the two site location trials found that the CSIDC trial had yields and seed weights significantly higher than the Off-station trial, % oil and test weights were, on average, higher at the Off-station trial. Hybrids at the CSIDC trial were statistically longer to flower, to mature, had greater plant height and exhibited a higher degree of lodging compared to the Off-station trial.

Median days to flower was 45 days, to maturity 101 days. 45CS40 was statistically taller than the control 5440, while CS 2100 and 6080 RR were significantly shorter. Hybrids did not differ in lodging upon combined site analysis.

Table 1. Yield and agronomic data for the 2017 ICDC Irrigated Canola Variety Trial, CSIDC Site.

Entry	Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)	Lodge rating (1=erect; 5=flat)
5440	***3715***	***45.9***	***63.7***	***4.0***	***142***	***46***	***101***	***2.0***
L252	4410	48.2	63.7	3.9	138	48	102	2.3
L230	4009	46.8	64.2	4.1	140	45	101	2.0
5545 CL	3531	44.7	64.7	4.7	144	46	104	2.5
6076 CR	3607	44.9	63.9	3.8	144	47	103	2.0
6080 RR	3480	45.8	63.1	4.0	136	46	102	2.0
CS2000	3838	45.6	59.8	4.2	139	46	101	2.0
CS2100	3828	46.7	64.4	4.4	135	45	102	2.3
CS2200 CL	3765	46.2	64.6	4.0	145	47	102	2.5
DL 1512 RR	3881	45.5	64.1	4.2	154	48	104	2.0
PV 200 CL	4304	45.6	62.8	4.2	147	47	102	2.3
PV 533 G	3655	46.3	63.9	4.3	143	46	103	2.0
PV 540G	3887	45.5	63.4	4.0	151	46	103	2.0
PV 560GM	4009	47.6	63.8	4.3	148	46	103	2.3
45CS40	4033	46.2	62.6	4.1	154	47	102	2.5
45H33	4273	46.4	62.6	3.9	157	47	102	2.3
45M35	3996	48.5	63.8	4.2	137	46	102	2.0
LSD (0.05)	NS	1.0	2.4	0.3	8.3	0.7	0.9	NS
CV (%)	13.4	1.5	2.6	5.2	4.1	1.1	0.6	17.0

NS = Not Significant

Table 2. Yield and agronomic data for the 2017 ICDC Irrigated Canola Variety Trial, CSIDC Off – Station Site.

Entry	Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)	Lodge rating (1=erect; 5=flat)
5440	***3100***	***45.9***	***65.1***	***3.8***	***123***	***44***	***99***	***1.0***
L252	3546	49.1	64.9	3.8	116	46	100	2.0
L230	3502	48.5	64.6	3.8	117	43	97	1.5
5545 CL	3283	46.9	64.7	3.3	126	43	99	2.5
6076 CR	3326	46.3	63.8	3.9	123	43	99	1.8
6080 RR	2874	46.0	63.9	3.8	113	43	99	2.0
CS2000	3102	48.2	63.7	3.8	125	43	99	1.8
CS2100	2895	48.5	64.6	4.2	114	42	98	2.0
CS2200 CL	3041	48.3	64.4	3.9	119	45	99	1.3
DL 1512 RR	3597	47.1	64.7	4.2	123	45	101	1.8
PV 200 CL	3425	47.5	64.4	3.9	120	46	100	2.0
PV 533 G	3013	47.7	64.2	4.3	118	43	97	2.0
PV 540G	2961	46.1	63.3	4.0	116	43	99	2.5
PV 560GMM	3362	48.3	64.4	4.0	126	43	98	1.5
45CS40	2285	47.1	62.9	4.0	129	45	96	2.0
45H33	2667	47.2	62.2	3.8	119	43	98	2.3
45M35	3519	50.3	63.7	4.0	123	43	98	1.5
LSD (0.05)	629	1.6	0.6	NS	NS	0.9	1.9	NS
CV (%)	14.1	2.3	0.7	12.2	6.3	1.5	1.4	38.5

NS = Not Significant

Table 3. Yield and agronomic data for the 2017 ICDC Irrigated Canola Variety Trial, Combined Site Analysis, 2017.

Location / Entry	Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)	Lodge rating (1=erect; 5=flat)
Trial Site								
CSIDC	3895	46.2	63.5	4.1	144	46	102	2.2
CSIDC – Off station	3147	47.6	64.1	3.9	121	44	98	1.8
LSD (0.05)	***470***	***1.1***	***NS***	***0.16***	***6.7***	***0.5***	***0.7***	***NS***
CV (%)	***13.7***	***2.0***	***1.9***	***9.2***	***5.1***	***1.3***	***1.1***	***28.2***
Variety								
5440	***3408***	***45.9***	***64.4***	***3.9***	***133***	***45***	***100***	***1.5***
L252	3978	48.6	64.3	3.9	127	47	101	2.1
L230	3755	47.7	64.4	3.9	129	44	98	1.8
5545 CL	3407	45.8	64.7	4.0	135	44	101	2.5
6076 CR	3467	45.6	63.8	3.9	133	45	101	1.9
6080 RR	3177	45.9	63.5	3.9	124	44	101	2.0
CS2000	3470	46.9	61.8	4.0	132	44	100	1.9
CS2100	3361	47.6	64.5	4.3	124	44	100	2.1
CS2200 CL	3403	47.3	64.5	4.0	132	46	100	1.9
DL 1512 RR	3739	46.3	64.4	4.2	139	46	102	1.9
PV 200 CL	3865	46.5	63.6	4.0	134	46	101	2.1
PV 533 G	3334	47.0	64.1	4.3	130	44	100	2.0
PV 540G	3424	45.8	63.4	4.0	133	45	101	2.3
PV 560GM	3685	47.9	64.1	4.2	137	45	100	1.9
45CS40	3159	46.6	62.7	4.1	141	46	99	2.3
45H33	3470	46.8	62.4	3.8	138	45	100	2.3
45M35	3757	49.4	63.8	4.1	130	44	100	1.8

LSD (0.05)	***480***	***0.9***	***1.2***	***NS***	***6.7***	***0.6***	***1.1***	***NS***
Location x Variety Interaction								
LSD (0.05)	***NS***	***NS***	***NS***	***NS***	***S***	***S***	***S***	***NS***

S = Significant

NS = Not Significant

Irrigated Flax Variety Trial

Funding

Funded by the Irrigation Crop Diversification Corporation and the Saskatchewan Variety Performance Group

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)

Objectives

The objectives of this study were to:

(1) Evaluate registered and experimental flax varieties

(2) Assess entries for suitability to irrigated production; and

(3) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Research Plan

The irrigated flax trials were conducted at two locations, on the main CSIDC station and at the CSIDC Off-station (Knapik) location.

Thirteen flax varieties, eight registered and five experimental entries, were tested for their agronomic performance under irrigation. The CSIDC site was seeded May 31 and the CSIDC Off-station site on May 15. Plot size was 1.5 m x 4.0 m. Each trial received supplemental fertilizer applied application rates of 120 kg N/ha, as 46-0-0, and 25 kg P2O5/ha as 12-51-0, all fertilizer was side-banded at the time of seeding. Weed control consisted of post-emergence applications of Badge II (bromoxynil +MCPA ester) + Centurion (clethodim), supplemented by some hand weeding. Both sites also received a season end desiccant application of Reglone (diquat), prior to combining. Combining occurred on October 17 at both trial locations. Total in-season irrigation at CSIDC and at CSIDC off-station consisted of 137.5 mm and 150.0 mm respectively.

Results

Results obtained at the CSIDC location are shown in Table 1. The variety WESTLIN 72 was the highest yielding entry at CSIDC, statistically higher than all other entries with yields > 3150 kg/ha. Varieties CDC Buryu and CDC Plava were statistically lower yielding than all other variety entries. Test weight of entries FP2401 and CDC Glas were statistically lower than all other entries. AAC Bravo had the highest 1000 Kernal Weights (TKW), NuLin VT50 the lowest. Varieties differed up to 7 days in times to achieve 50% flower, the experimental line FP2454 was the earliest to mid-flower, CDC Glas the latest. NuLin VT50 was significantly later maturing than all other entries requiring 111 days, CDC Plava was the earliest maturing entry at 103 days. CDC Glas was statistically significantly taller than all varieties less than 84 cm in height, CDC Plava was the shortest entry. The tallest and shortest entries differed by 15 cm in height. Though entries varied in plant heights no difference in lodging was evident.

The CSIDC Off-station location results for plant growth attributes are shown in Table 2. This trial was lost days before harvest due to severe deer damage and feeding. No usable harvest yields were obtained. Time to 50% flower differed by only 4 days between the earliest and latest flowering entries at this test location, differences between the earliest and latest flowering entries were statistically significant. Westlin 71 & 72 were the latest maturing entries, three experimental entries the earliest maturing. Entries varied in plant heights, with 10 cm differences between the shortest and tallest entries. No lodging of any entries occurred at the trial location in 2017.

Combined site analysis is shown in Table 3. Yield or grain attributes cannot be discussed due to the loss of data at the CSIDC Off-station trial. Mean maturity at the off-station trial was significantly longer than the mean maturity of entries from the CSIDC trial, this is attributed primarily due to the date of seeding which occurred 16 days earlier at the off-station location. NuLin VT50 and WESTLIN 71 & 72 were significantly later to mature, CDC Plava was the earliest registered variety to mature. CDC Glas was the tallest entry, experimental FP2401 and registered entry CDC Plava the shortest. Lodging differences did not occur at either test location.

Results from these trials are used to update the irrigation variety database at ICDC and provide recommendations to irrigators on the best flax varieties suited to irrigation conditions and will be used in the development of the annual publications *Crop Varieties for Irrigation* and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2017.*

Table 1. Yield and agronomic data for the Saskatchewan Variety Performance Group Irrigated Flax Regional Trial, CSIDC site, 2017.

Variety	Yield (kg/ha)	Test weight (kg/hl)	Seed weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1=erect; 9=flat)
CDC Bethune (check)	***3235***	***67.8***	***6.8***	***52***	***105***	***83***	***1.0***
AAC Bravo	2958	68.0	7.4	51	106	82	1.0
CDC Buryu	2410	68.3	6.7	55	106	85	1.0
CDC Glas	3291	67.0	6.2	55	106	87	1.0
CDC Plava	2644	67.6	6.3	50	103	72	1.0
NuLin VT50	3060	68.1	5.8	54	111	80	1.0
WESTLIN 71	3187	68.0	6.7	54	108	82	1.0
WESTLIN 72	3632	67.9	6.2	52	108	83	1.0
FP2388	3348	67.7	7.0	51	107	81	1.0
FP2401	3041	67.3	6.4	49	105	77	1.0
FP2454	3108	68.3	6.1	48	104	73	1.0
FP2457	3087	67.9	6.6	52	105	86	1.0
FP2513	3275	67.7	7.3	52	108	84	1.0
LSD (0.05)	483	0.6	0.5	1.0	2.5	4.1	NS
CV (%)	9.3	0.5	4.7	1.1	1.4	3.0	

NS = Not Significant

Table 2. Yield and Agronomic Data for the Saskatchewan Variety Performance Group Irrigated Flax Regional Trial, CSIDC Off-Station Site, 2017.

Variety	Yield (kg/ha)	Test weight (kg/hl)	Seed weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1=erect; 9=flat)
CDC Bethune (check)	***NC***	***NC***	***NC***	***56***	***112***	***67***	***1.0***
AAC Bravo	NC	NC	NC	53	114	64	1.0
CDC Buryu	NC	NC	NC	57	112	69	1.0
CDC Glas	NC	NC	NC	57	116	68	1.0
CDC Plava	NC	NC	NC	55	112	65	1.0
NuLin VT50	NC	NC	NC	53	116	62	1.0
WESTLIN 71	NC	NC	NC	57	118	65	1.0
WESTLIN 72	NC	NC	NC	56	118	64	1.0
FP2388	NC	NC	NC	55	110	61	1.0
FP2401	NC	NC	NC	54	110	60	1.0
FP2454	NC	NC	NC	56	113	64	1.0
FP2457	NC	NC	NC	56	110	68	1.0
FP2513	NC	NC	NC	57	115	70	1.0
LSD (0.05)				1.7	2.6	3.5	NS
CV (%)				1.8	1.4	3.2	

NC = Observation Not Captured
NS = Not Significant

Table 3. Yield and Agronomic Data for the Saskatchewan Variety Performance Group Irrigated Flax Regional Trial, Combined Site Analysis, 2017.

Treatment	Yield (kg/ha)	Test weight (kg/hl)	Seed weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1=erect; 9=flat)
Trial Site							
CSIDC	NC	NC	NC	52	106	81	1.0
CSIDC – Off station	NC	NC	NC	56	114	65	1.0
LSD Yield (0.10) LSD (0.05)				***0.6***	***4.4***	***2.6***	***NS***
CV				***1.5***	***1.4***	***1.0***	
Variety							
CDC Bethune (check)	***NC***	***NC***	***NC***	***54***	***109***	***75***	***1.0***
AAC Bravo	NC	NC	NC	52	110	73	1.0
CDC Buryu	NC	NC	NC	56	109	77	1.0
CDC Glas	NC	NC	NC	56	111	78	1.0
CDC Plava	NC	NC	NC	52	107	68	1.0
NuLin VT50	NC	NC	NC	54	114	71	1.0
WESTLIN 71	NC	NC	NC	55	113	74	1.0
WESTLIN 72	NC	NC	NC	54	113	73	1.0
FP2388	NC	NC	NC	53	109	71	1.0
FP2401	NC	NC	NC	52	107	69	1.0
FP2454	NC	NC	NC	52	108	69	1.0
FP2457	NC	NC	NC	54	108	77	1.0
FP2513	NC	NC	NC	54	111	77	1.0
LSD (0.05)				0.9	1.8	2.6	NS
Location x Variety Interaction							
LSD (0.05)				S	S	S	NS

S = Significant
NS = Not Significant

Irrigated Wheat Variety Trial

Funding

Funded by the Agriculture Development Fund, Western Grains Research Foundation and the Irrigation Crop Diversification Corporation.

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)

Objectives

The objectives of this study were to:

(1) Evaluate registered wheat varieties for which ICDC has limited data;

(2) Assess entries for suitability to irrigated production; and

(3) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Research Plan

The irrigated wheat variety trials were conducted at two locations in the Outlook area. Each site and soil type are as follows:

CSIDC (SW15-29-08-W3): Bradwell loam – silty loam (Field #13)
CSIDC Off-station (NW12-29-08-W3): Asquith sandy loam (Knapik SW quadrant)

Seventeen spring wheat varieties of three different market classes and three durum varieties were tested for their agronomic performance under irrigation. The CSIDC site was seeded on May 30, CSIDC Off-station site was seeded on May 12. Plot size was 1.5 m x 4.0 m (final harvest area). The seed was treated with Cruiser Maxx Cereals (thiamethoam + difenoconazole + metalaxyl-M) for seed and soil borne disease and wireworm control. Nitrogen fertilizer at CSIDC was applied at a rate of 110 kg N/ha as 46-0-0 as a sideband application and 25 kg P_2O_5/ha as 12-51-0 seed placed. At the CSIDC Off-station location nitrogen fertilizer was applied at a rate of 120 kg N/ha as 46-0-0 as a sideband application and 25 kg P_2O_5/ha as 12-51-0 seed placed. Weed control at both sites consisted of a post-emergence tank mix application Simplicity (pyroxsulam) and Badge II (bromoxynil +MCPA ester). Both trials were desiccated with Reglone. Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and seed moisture content was <20%. The CSIDC was harvested on September 18 and the off-station trial on September 15. Total in-season irrigation at CSIDC was 137.5 mm (5.5"), at CSIDC Off-station 150 mm (6.0").

Results

Results obtained at the CSIDC location are shown in Table 1, the CSIDC off-station location in Table 2 and combined site analysis in Table 3.

Results of the CSIDC are provided in Table 1. Not surprisingly the highest yield was obtained with the CWSWS variety AAC Indus, the lowest yield with the CWRS variety AAC Connery. Within the CWRS class 5605HR CL was the highest yielding, however no CWRS variety, within the statistical analysis defined by the range of varieties within this test, were statistically differing in yield from the control Carberry.

Within the durum varieties AAC Spitfire was the lowest yielding, CDC Precision the highest. Median grain yield of the CSIDC trial was 5036 kg/ha (74.9 bu/ac). Protein content generally followed the order of CWRS > CWAD > CWSP > CWSWS. AAC Jatharia VB had the highest test weight, AAC NRG097 the lowest. Durum varieties had the highest seed weights, CWRS varieties the lowest. In general, the CWAD and CWSWS varieties were the latest maturing. AAC Cameron VB was the tallest variety and exhibited the greatest degree of lodging.

Results from the off-station trial are shown in Table 2. At the CSIDC Off-station trial every variety with a grain yield exceeding 5500 kg/ha was statistically higher yielding than the check Carberry. The CWRS variety Thorsby had the lowest yield, the CWAD variety AAC Spitfire the highest. Median grain yield at CSIDC Off-station 5558 kg/ha (82.6 bu/ac). Among market classes the CWRS varieties, in general, had higher protein contents as compared to other entries. Test weight, seed weight, days to heading and maturity, plant height and lodging varied within and between classes.

Combined site analysis is given in Table 3. Yield, test weight and lodging of varieties behaved similarly between test locations. All other measured agronomic parameters indicated that varieties differed between the two test locations.

Results from these trials, when deemed valid, are used to update the irrigation variety database at ICDC and provide recommendations to irrigators on the best wheat varieties suited to irrigation conditions and will be used in the development of the annual publication *Crop Varieties for Irrigation.*

Table 1. Yield and Agronomic Data for the ICDC Irrigated Wheat Variety Trial, CSIDC Site, 2017.

Variety	Yield (kg/ha)	Yield % of Carberry	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Canada Western Red Spring (CWRS)									
Carberry	***4846***	***100***	***15.6***	***81.3***	***35.3***	***45***	***89***	***83***	***1.0***
5605HR CL	5185	107	15.6	82.1	37.0	48	93	102	3.0
AAC Brandon	5054	104	15.3	81.1	36.3	46	89	82	1.0
AAC Cameron VB	4854	100	15.4	81.1	39.5	48	89	110	3.8
AAC Connery	4381	90	16.3	80.4	38.1	47	88	86	1.0
AAC Jatharia VB	4629	96	15.8	82.3	38.6	45	94	101	1.0
AAC Redberry	4744	98	15.7	81.7	35.5	45	86	91	1.0
AAC W1876	4406	91	16.3	80.3	36.9	48	93	85	1.3
CDC Bradwell	4975	103	15.7	81.4	34.7	48	96	98	2.0
CDC Titanium VB	4541	94	16.4	80.8	37.6	45	86	99	3.8
CDC Utmost VB	5069	105	15.2	80.7	38.7	48	89	95	3.8
SY479 VB	4513	93	15.5	80.9	40.4	49	92	94	2.0
Thorsby	4870	101	15.5	80.9	36.5	49	91	102	2.5
Canada Western Amber Durum (CWAD)									
AAC Spitfire	5078	105	14.6	80.8	44.8	51	94	94	1.0
CDC Credence	5717	118	14.0	80.5	47.3	53	100	110	1.8
CDC Precision	6148	127	14.4	81.3	44.9	52	97	105	2.3
Canada Western Spring Prairie (CWSP)									
AAC NRG097	5493	113	12.8	79.3	39.5	48	92	89	1.3
SY087	5563	115	15.0	81.0	37.5	48	89	90	1.0
Canada Western Soft White Spring CWSWS)									
AAC Indus	6315	130	11.6	80.6	41.4	53	99	94	1.0
AAC Paramount VB	5809	120	11.7	80.9	41.3	50	95	90	1.0
LSD (0.05)	716		0.7	0.7	3.5	0.97	2.2	5.9	1.4
CV (%)	9.9		3.1	0.6	6.3	1.4	1.7	4.4	54.4

Table 2. Yield and Agronomic Data for the ICDC Irrigated Wheat Variety trial, CSIDC Off-Station Site, 2017.

Variety	Yield (kg/ha)	Yield % of Carberry	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Canada Western Red Spring (CWRS)									
Carberry	***4961***	***100***	***14.9***	***77.3***	***34.2***	***55***	***99***	***83***	***1.0***
5605HR CL	5940	120	15.5	78.4	35.2	58	101	101	3.0
AAC Brandon	5446	110	14.9	76.6	30.5	56	97	82	1.0
AAC Cameron VB	5357	108	14.9	75.4	36.3	57	99	98	3.0
AAC Connery	4872	98	16.1	74.7	35.4	58	99	89	1.0
AAC Jatharia VB	5320	107	15.2	78.2	35.4	54	100	96	1.0
AAC Redberry	5194	105	15.1	77.6	33.7	54	96	91	1.0
AAC W1876	4853	98	16.1	74.7	31.1	58	101	81	1.3
CDC Bradwell	5198	105	15.4	77.4	32.4	59	100	90	1.0
CDC Titanium VB	5358	108	16.2	75.8	35.2	54	97	93	2.0
CDC Utmost VB	5447	110	15.2	75.6	33.6	57	98	91	1.3
SY479 VB	5038	102	15.6	77.1	35.2	59	99	98	2.0
Thorsby	4749	96	15.1	76.7	33.6	60	98	97	1.3
Canada Western Amber Durum (CWAD)									
AAC Spitfire	6727	136	15.1	74.6	38.8	60	98	92	1.8
CDC Credence	6115	123	14.3	74.9	37.2	60	100	95	1.8
CDC Precision	6452	130	14.9	78.0	37.4	60	103	88	2.8
Canada Western Spring Prairie (CWSP)									
AAC NRG097	6524	132	12.5	76.1	35.8	56	102	81	1.0
SY087	6362	128	14.4	75.1	32.8	57	99	87	1.3
Canada Western Soft White Spring CWSWS)									
AAC Indus	6673	135	11.7	76.4	32.9	63	107	91	1.0

AAC Paramount VB	6237	126	12.0	75.8	33.4	61	102	88	1.0
LSD (0.05)	918		0.4	2.0	2.5	1.2	2.1	5.6	1.3
CV (%)	11.5		2.0	1.8	5.1	1.5	1.5	4.4	58.7

Table 3. Yield and Agronomic Data for the ICDC Irrigated Wheat Variety trial, Combined Sites, 2017.

Location / Variety	Yield (kg/ha)	Yield % of Location/ Carberry	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Trial Location									
CSIDC	5109	100	14.9	81.0	39.1	48	92	95	1.8
CSIDC – Off Station	5641	110	14.7	76.3	34.5	58	100	91	1.5
LSD (0.05)	385		NS	1.0	1.9	0.9	0.7	1.8	NS
CV	10.8		2.6	1.3	5.8	1.5	1.6	4.4	56.4
Variety									
Canada Western Red Spring (CWRS)									
Carberry	***4903***	***100***	***15.2***	***79.3***	***34.8***	***50***	***94***	***83***	***1.0***
5605HR CL	5562	113	15.5	80.2	36.1	53	97	101	3.0
AAC Brandon	5250	107	15.1	78.8	33.4	51	93	82	1.0
AAC Cameron VB	5106	104	15.1	78.2	37.9	52	94	104	3.4
AAC Connery	4626	94	16.2	77.5	36.7	53	93	88	1.0
AAC Jatharia VB	4974	101	15.5	80.2	37.0	49	97	98	1.0
AAC Redberry	4969	101	15.4	79.6	34.6	49	91	91	1.0
AAC W1876	4630	94	16.2	77.5	34.0	53	97	83	1.3
CDC Bradwell	5087	104	15.5	79.4	33.5	53	98	94	1.5
CDC Titanium VB	4949	101	16.3	78.3	36.4	50	91	96	2.9
CDC Utmost VB	5258	107	15.2	78.1	36.2	52	93	93	2.5
SY479 VB	4775	97	15.5	79.0	37.8	54	95	96	2.0
Thorsby	4809	98	15.3	78.8	35.0	54	94	99	1.9

Canada Western Amber Durum (CWAD)									
AAC Spitfire	5902	120	14.8	77.7	41.8	55	96	93	1.4
CDC Credence	5916	121	14.1	77.7	42.2	57	100	102	1.8
CDC Precision	6300	128	14.6	79.6	41.2	56	100	97	2.5
Canada Western Special Purpose (CWSP)									
AAC NRG097	6008	123	12.6	77.7	37.6	52	97	85	1.1
SY087	5963	122	14.7	78.0	35.2	52	94	89	1.1
Canada Western Soft White Spring CWSWS)									
AAC Indus	6494	132	11.6	78.5	37.2	58	103	92	1.0
AAC Paramount VB	6023	123	11.8	78.3	37.4	56	98	89	1.0
LSD (0.05)	576		0.4	1.0	2.1	0.8	1.5	4.0	0.9
Location x Variety Interaction									
LSD (0.05)	NS		S	NS	S	S	S	S	NS

S = Significant
NS = Not Significant

Saskatchewan Variety Performance Group
Irrigated Wheat, Durum, Barley and Oat Regional Variety Trials

Funding
Funded by the Irrigation Crop Diversification Corporation and the Saskatchewan Variety Performance Group

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Saskatchewan Variety Performance Group

Objectives
The objectives of this study were to:

(1) Evaluate experimental cereal lines pursuant for registration requirements;
(2) Assess entries for suitability to irrigated production; and
(3) Update ICDC's annual *Crop Varieties for Irrigation* guide.

Research Plan
The Saskatchewan Variety Performance Group (SVPG) wheat, durum, barley and oat regional trials were seeded between May 15 and 30. Plot size was 1.5 m x 4.0 m. Nitrogen fertilizer was applied to CSIDC located trials at a rate of 110 kg N/ha as 46-0-0 as a sideband application and 25 kg P_2O_5/ha as 12-51-0 seed placed (Hex1, Hex2, Durum, Barley, Soft White Spring), the second durum trial and the oat trial located at the CSIDC off-station location received 120 kg N/ha as 46-0-0 as a sideband application and 25 kg P_2O_5/ha as 12-51-0 side banded. Separate trials were conducted for common wheat (Hex 1 - CWRS), high yield wheat (Hex 2 – CWRS, CPSR, CWSWS and CWGP), durum wheat (CWAD) and 2-row barley. The soft white spring wheat (CWSWS Coop) is not part of the SVPG program but rather a separate evaluation but included here for an inclusive cereal report. Weed control consisted of a post-emergence tank mix application Simplicity (pyroxsulam) and Buctril M (bromoxynil +MCPA ester) with wheat, Bison (tralkoxydim) and Buctril M (bromoxynil +MCPA ester) with barley and Badge II (bromoxynil +MCPA ester) only was applied to the oat trial. Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and seed moisture content was <20%. Total in-season irrigation at CSIDC consisted of a 137.5 mm.

Results
Hex 1, Hex 2 and CWSWS are shown in Tables 1, 2 and 3, respectively. Results of the CSIDC, CSIDC Off-station and the Combined Site Analysis for the SVPG Durum trials are shown in Tables 4, 5 and 6 respectively. Results of the 2-row barley are shown in Table 7. Results of oat evaluation are shown in Table 8.

Results of these trials are used for registration purposes. Further, results from these trials are used to update the irrigation variety database at ICDC and provide recommendations to irrigators on the best wheat and barley varieties suited to irrigation conditions and will be used in the development of the annual publications *Crop Varieties for Irrigation* and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2017.*

Table 1. Saskatchewan Variety Performance Group Irrigated Hex 1 Wheat Regional Variety Trial, CSIDC Site, 2017.

Variety	Yield (kg/ha)	Yield % of Carberry	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Carberry	***3842***	***100***	***15.2***	***78.6***	***38.6***	***45***	***87***	***79***	***1.0***
5605HR CL	5713	149	15.8	80.2	38.5	47	92	96	1.0
AAC Cameron VB	4620	120	15.5	78.3	42.0	48	91	97	3.0
AAC Concord	4453	116	15.6	77.2	44.9	50	95	99	5.7
AAC Connery	3723	97	16.0	77.1	36.4	48	88	86	1.0
AAC Jatharia VB	4595	120	15.9	78.9	41.8	42	92	101	1.0
AAC Prevail VB	4441	116	15.5	78.1	38.4	49	94	104	3.3
AAC Redberry	4324	113	15.3	78.9	36.8	45	85	86	1.0
AAC Tradition	4874	127	15.8	80.5	43.4	44	93	90	1.0
AAC Viewfield	5310	138	15.4	79.2	38.2	48	90	77	1.0
AAC W1876	4294	112	16.4	77.5	36.3	47	91	85	1.0
AAC Whitefox	4409	115	14.9	78.6	36.7	45	87	96	1.3
CDC Bradwell	4203	109	15.6	78.2	35.9	50	96	94	3.3
CDC Hughes VB	4869	127	15.5	78.6	41.9	43	89	85	1.0
CDC Kinley	4393	114	15.8	78.9	37.9	46	87	87	1.0
CDC Landmark VB	4853	126	15.7	79.5	42.4	46	91	88	1.0
CDC Titanium VB	3983	104	16.4	77.8	42.8	45	85	90	2.0
Coleman	4419	115	15.4	78.4	32.5	46	89	100	3.0
Go Early	4523	118	15.3	77.3	37.9	44	83	98	1.3

Parata	4546	118	16.2	77.1	39.3	44	86	91	1.0
SY479 VB	3960	103	17.0	79.6	38.6	50	93	98	1.0
SY637	4801	125	16.2	79.5	38.6	48	92	99	2.0
SY Slate	4820	125	16.4	77.6	40.4	45	89	91	1.0
SY Sovite	3556	93	15.3	78.5	42.2	41	92	85	1.0
Thorsby	3782	98	15.4	77.4	38.1	48	88	95	1.7
BW488 VB	5007	130	15.8	77.9	38.7	47	92	89	1.3
BW5005	4718	123	15.0	78.7	39.1	48	95	95	1.0
BW5007	4706	122	14.9	78.9	40.2	47	88	83	1.0
BW968	5024	131	14.8	79.2	39.8	45	87	81	1.0
BW980	4069	106	15.7	78.2	40.8	47	90	88	1.0
HW388	4577	119	15.1	80.2	33.6	48	88	84	1.0
PT250	4626	120	16.9	78.7	40.0	45	89	86	3.0
LSD (0.05)	826		0.5	1.3	3.5	3.8	3.1	7.9	1.9
CV (%)	11.3		1.9	1.0	5.5	5.1	2.2	5.3	73.5

Table 2. Saskatchewan Variety Performance Group Irrigated Hex 2 Wheat Regional Variety Trial, CSIDC Site, 2017.

Variety	Yield (kg/ha)	Yield % of Carberry	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Canada Western Red Spring (CWRS)									
Carberry	***3510***	***100***	***15.9***	***74.4***	***36.7***	***44***	***88***	***74***	***1.0***
Canada Northern Hard Red (CNHR)									
Faller	4663	133	13.8	80.5	38.4	48	90	77	1.0
Prosper	5669	162	13.9	81.0	39.0	49	91	86	1.0
Canada Prairie Spring – Red (CPSR)									
AAC Crossfield	5227	149	14.6	79.1	40.3	48	88	81	1.0
AAC Entice	3880	111	14.9	78.4	39.0	48	88	83	1.0
AAC Penhold	3992	114	15.0	79.9	40.2	48	89	71	1.0
AAC Tenacious VB	3464	99	14.0	79.7	34.2	54	95	113	6.0
CDC Terrain	4382	125	14.2	79.1	41.4	49	91	84	1.3
Alderon	5230	149	11.6	70.7	36.8	56	104	80	1.0
Charing VB	5680	162	12.3	78.3	38.2	52	100	86	1.0
HY2003 VB	5538	158	15.1	78.6	37.9	45	89	83	1.0
SY995	4440	127	13.4	78.3	38.9	49	93	83	1.0
SY Rowyn	4562	130	14.7	79.9	32.7	46	88	71	1.0
Canada Western Special Purpose (CWSP)									
AAC Awesome VB	5574	159	11.6	81.6	39.3	54	96	90	1.0
SY087	5186	148	15.3	80.4	37.1	45	89	84	1.0
WFT603	5125	146	13.5	78.3	43.4	50	101	97	1.7
WFT1109	5806	166	11.4	78.1	40.4	56	102	89	1.0
Canada Western Soft White Spring (CWSWS)									
AAC Indus	5896	168	11.4	79.9	38.2	52	100	93	1.0
AAC Paramount VB	5386	154	11.6	80.9	39.1	50	93	87	1.0
Canada Western General Purpose (CWGP)									
AAC Foray VB	4975	142	14.2	79.9	46.1	50	94	90	1.0
AAC NRG097	4212	120	12.6	79.6	39.7	45	88	77	1.0
Elgin ND	4230	121	15.1	80.2	34.6	46	89	85	1.0
GP131	5210	149	13.4	79.3	41.0	48	92	82	1.7

Sparrow VB	5568	159	11.9	77.7	37.7	53	100	81	1.0
LSD (0.05)	822		0.6	3.8	2.8	1.2	4.0	9.6	0.7
CV (%)	10.2		2.8	2.9	4.3	1.4	2.6	6.9	32.2

Table 3. Soft White Spring Wheat Irrigated Coop Variety Trial, CSIDC Site, 2017.

Variety	Yield (kg/ha)	Yield % of AC Andrew	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Carberry	3874	74	15.6	81.8	36.7	46	89	85	1.0
AC Andrew (SWS 241)	***5252***	***100***	***11.5***	***80.7***	***35.6***	***52***	***95***	***89***	***1.0***
AC Meena (SWS 234)	5403	103	11.5	81.3	35.7	51	96	91	1.0
AC Chiffon (SWS 408)	5977	114	10.9	81.4	42.7	56	101	105	1.0
Sadash (SWS 349)	4874	93	11.2	81.2	37.3	49	91	86	1.0
AAC Indus (SWS 427)	5363	102	11.4	80.6	39.7	53	99	96	1.0
SWS 455	6093	116	11.1	81.6	38.4	50	94	94	1.0
SWS 456	5345	102	11.1	81.0	37.9	50	94	89	1.0
SWS 460	5474	104	11.0	81.4	40.0	51	95	93	1.0
SWS 461	4337	83	10.8	80.6	33.9	50	92	85	1.0
SWS 462	5545	106	11.1	82.0	36.1	51	95	94	1.0
SWS 464	5273	100	11.5	81.6	37.4	49	92	90	1.0
SWS 465	5758	110	10.3	77.6	36.7	56	102	99	1.0
SWS 466	4610	88	11.7	82.0	33.4	51	93	80	1.0
SWS 467	4297	82	11.5	80.7	36.6	50	91	85	1.0
SWS 468	4684	89	11.5	81.5	34.5	47	89	79	1.0
SWS469	5145	98	11.8	80.6	33.9	51	92	84	1.0
LSD (0.05)	803		0.3	1.1	1.7	1.2	2.3	6.2	NS
CV (%)	11.0		1.8	1.0	3.3	1.7	1.7	4.8	1

Table 4. Saskatchewan Variety Performance Group Irrigated CWAD Wheat Regional Variety Trial, CSIDC 2017.

Variety	Yield (kg/ha)	Yield % of Strongfield	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
CSIDC Site									
Carberry	4697	94	15.7	81.0	36.0	44	89	84	1.0
Strongfield	***4980***	***100***	***15.4***	***79.9***	***42.0***	***50***	***94***	***92***	***1.7***
AAC Cabri	4242	85	14.8	80.2	44.9	54	98	99	1.0
CDC Carbide VB	4409	88	15.6	78.9	40.0	51	94	96	4.0
AAC Congress	5546	111	14.5	80.7	41.7	52	96	99	2.7
AAC Durafield	4923	99	15.3	80.0	42.1	52	96	97	3.7
AAC Marchwell VB	5263	106	14.9	80.1	41.9	54	101	97	1.7
AAC Spitfire	4579	92	14.9	78.8	42.3	51	92	91	2.3
AAC Stronghold	5780	116	14.7	80.5	44.3	51	100	94	1.3
CDC Alloy	4250	85	15.4	79.7	40.7	50	94	90	3.0
CDC Credence	4427	89	14.3	79.6	43.0	53	98	107	3.3
CDC Dynamic	5176	104	15.3	80.9	41.6	53	95	102	1.0
CDC Fortitude	4164	84	15.4	78.8	39.5	52	99	91	6.3
CDC Precision	4787	96	15.2	79.9	42.7	52	100	101	6.0
DT587	5592	112	15.6	79.5	44.4	54	100	110	4.7
DT871	4193	84	14.6	79.0	43.7	52	93	95	2.7
LSD (0.05)	NS		NS	1.3	3.4	1.5	5.1	10.2	3.2
CV (%)	14.0		4.0	1.0	4.8	1.7	3.2	6.4	65.4

Table 5. Saskatchewan Variety Performance Group Irrigated CWAD Wheat Regional Variety Trial, CSIDC-Off Station Site 2017.

Variety	Yield (kg/ha)	Yield % of Strongfield	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect 9=flat
CSIDC Site									
Carberry	4117	73	14.6	79.1	30.2	56	99	77	1.0
Strongfield	***5644***	***100***	***15.6***	***75.1***	***36.3***	***60***	***101***	***86***	***1.7***
AAC Cabri	5695	101	15.4	76.2	36.1	61	103	89	2.7
CDC Carbide VB	5920	105	15.3	75.6	35.3	59	99	91	2.7
AAC Congress	6405	113	14.7	76.6	36.0	60	103	90	1.7
AAC Durafield	5944	105	15.3	76.1	34.5	60	102	87	2.3
AAC Marchwell VB	5755	102	15.7	74.2	33.7	60	99	89	2.7
AAC Spitfire	6341	112	15.3	75.8	38.0	60	100	83	1.7
AAC Stronghold	7239	128	14.7	77.0	38.5	61	103	88	1.0
CDC Alloy	6551	116	15.2	76.0	35.6	60	103	92	2.3
CDC Credence	5576	99	15.0	74.2	34.7	61	101	92	2.3
CDC Dynamic	6726	119	15.5	76.7	36.3	60	101	88	2.3
CDC Fortitude	5755	102	15.1	76.6	35.9	60	102	83	1.7
CDC Precision	6083	108	14.7	77.6	38.1	59	103	85	2.0
DT587	6220	110	15.6	75.1	35.6	60	101	89	1.3
DT871	5457	97	15.7	74.5	36.2	60	98	90	2.3
LSD (0.05)	1000		0.3	1.6	2.7	0.7	1.8	5.3	NS
CV (%)	10.1		1.3	1.2	4.5	0.7	1.1	3.7	45.7

Table 6. Saskatchewan Variety Performance Group Irrigated CWAD Wheat Regional Variety trial, Combined Site Analysis, 2017.

Location / Variety	Yield (kg/ha)	Yield % of Strong field	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
CSIDC	4812		15.1	79.8	41.9	52	96	97	2.9
CSIDC Off-Station	5964		15.2	76.0	35.7	60	101	87	2.0
LSD (0.05)	514		NS	0.6	2.2	1.3	1.5	4.8	NS
CV (%)	11.9		2.9	1.1	4.7	1.3	2.3	5.3	60.9
Variety									
Carberry	4407	83	15.2	80.0	33.1	50	94	81	1.0
Strongfield	***5312***	***100***	***15.5***	***77.5***	***39.1***	***55***	***98***	***89***	***1.7***
AAC Cabri	4969	94	15.1	78.2	40.5	58	100	94	1.8
AAC Carbide VB	5163	97	15.5	77.3	37.7	55	97	94	3.3
AAC Congress	5976	112	14.6	78.7	38.8	56	99	94	2.2
AAC Durafield	5433	102	15.3	78.1	38.3	56	99	92	3.0
AAC Marchwell VB	5509	104	15.3	77.2	37.8	57	100	93	2.2
AAC Spitfire	5460	103	15.1	77.3	40.2	56	96	87	2.0
AAC Stronghold	6510	123	14.7	78.8	41.4	56	101	91	1.2
CDC Alloy	5400	102	15.3	77.9	38.2	55	98	91	2.7
CDC Credence	5001	94	14.6	76.9	38.9	57	100	99	2.8
CDC Dynamic	5951	112	15.4	78.8	39.0	57	98	95	1.7
CDC Fortitude	4960	93	15.3	77.7	37.7	56	101	87	4.0
CDC Precision	5435	102	14.9	78.7	40.4	56	102	93	4.0
DT587	5906	111	15.6	77.3	40.0	57	101	99	3.0
DT871	4825	91	15.2	76.8	39.9	56	96	92	2.5
LSD (0.05)	737		0.5	1.0	2.1	0.8	2.7	5.7	1.7
Location x Variety Interaction									
LSD (0.05)	NS		S	S	NS	S	S	S	NS

S = Significant NS = Not Significant

Table 7. Saskatchewan Variety Performance Group Irrigated 2-Row Barley Regional Variety Trial, CSIDC Site, 2017.

Variety	Yield (kg/ha)	Yield % of AC Metcalfe	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Malt									
AC Metcalfe	***6429***	***100***	***14.4***	***69.0***	***42.6***	***52***	***80***	***83***	***4.3***
CDC Bow	7558	118	12.8	69.4	46.9	53	79	89	1.0
CDC PlatinumStar	6776	105	13.2	68.0	46.5	53	81	90	3.0
Feed-Hulled									
Altorado	7560	121	13.6	69.6	45.9	52	80	78	1.0
Amisk	8212	128	13.4	64.6	42.9	50	82	80	2.7
Canmore	6833	106	13.0	69.8	45.1	54	84	81	2.0
Claymore	7712	120	13.1	69.2	47.6	52	82	86	2.0
Muskwa	7008	109	13.8	66.3	38.5	53	85	79	3.7
Oreana	8073	126	12.9	70.7	45.8	52	82	69	2.0
Other (malting market may exist)									
AAC Connect	7759	121	13.1	68.5	48.3	51	78	79	2.0
CDC Ascent	7360	114	15.2	79.2	42.0	54	85	83	1.0
CDC Fraser	7401	115	12.4	68.7	47.1	54	81	84	1.7
CDC Goldstar	8064	125	13.4	69.6	43.9	52	79	86	3.3
Lowe	7309	114	13.2	66.7	49.5	54	86	93	1.7
Sirish	7034	109	13.0	70.3	46.3	53	83	69	1.0
Experimental Entries									
TR10214	7282	113	13.7	68.5	45.0	53	80	85	4.7
TR13606	8143	127	13.5	68.6	45.6	54	80	87	4.3
LSD (0.05)	NS		0.6	1.6	3.0	0.97	1.8	7.1	NS
CV (%)	10.1		2.7	1.4	4.0	1.1	1.3	5.2	78.0

NS = Not Significant

Table 8. Saskatchewan Variety Performance Group Irrigated Oat Regional Variety trial, CSIDC-Off station Site 2017.

Variety	Yield (kg/ha)	Yield % of CDC Dancer	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Heading (days)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
CDC Dancer	***5428***	***130***	***12.4***	***52.9***	***33.9***	***63***	***94***	***102***	***1.0***
AAC Justice	5829	107	12.3	55.1	34.8	63	96	109	1.0
CS Camden	6671	123	13.5	50.3	35.1	63	96	103	1.3
CDC Haymaker	5655	104	13.8	43.7	37.4	72	98	104	5.0
CDC Morrison	5497	101	15.3	51.7	32.1	63	95	103	1.0
CDC Norseman	6106	112	13.5	50.4	35.8	62	94	103	1.3
Akina	6326	117	13.0	48.8	34.1	63	95	100	1.3
Kara	6464	119	14.1	51.8	33.1	64	96	93	1.0
Kyron	6401	118	13.8	52.1	33.5	64	96	100	1.0
Pomona	6241	115	12.4	55.2	34.2	63	95	105	1.3
Ore3541M	5718	105	13.7	54.4	36.6	62	95	101	1.3
Ore3542M	5951	110	13.0	52.7	37.4	63	96	106	1.0
OT3085	7048	130	13.7	52.8	37.1	63	95	115	1.0
LSD (0.05)	NS		0.4	1.7	2.3	1.2	1.0	7.7	0.9
LSD (0.10)	994								
CV (%)	9.7		1.8	1.9	3.9	1.1	0.6	4.4	38.0

NS = Not Significant

Winter Wheat Variety Evaluation for Irrigation vs Dry Land Production

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Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)
- Co-investigators: Dr. Robert Graf, AAFC Lethbridge Research Centre

Organizations

- Irrigation Crop Diversification Corporation (ICDC)

Objectives

This project's objectives are to identify the top producing or best adapted varieties of winter wheat for irrigation production. Winter wheat varieties were last evaluated for their irrigation production potential approximately 25 years ago. No variety at that time suited intensive irrigation management. Genetic improvements to the latest winter wheat varieties warrant a renewed assessment for their potential under irrigation management. Results from these trials will also be used to develop a data base on winter wheat varieties for entry into the *Crop Varieties for Irrigation* publication.

Research Plan

Seed of fourteen winter wheat varieties were acquired from winter wheat breeder Dr. R. Graf, AAFC-Lethbridge. Varieties were direct seeded into canola stubble on September 16, 2016. Winter wheat varieties were established in a small plot replicated and randomized trial design, replicated 3 times. All varieties are being evaluated under both irrigated and dry land systems. At seeding each trial received 80 kg N/ha as urea side banded and 25 kg P_2O_5/ha seed placed monoammonium nitrate, in the spring upon regrowth an additional 40 kg N/ha was broadcast on the irrigated trial. Weed control involved a single fall preseed application of glyphosate, no other herbicide was required. No foliar fungicides were applied for either leaf disease or Fusarium Head Blight. Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and seed moisture content was <20%. Harvest occurred on August 11, 2017. Total in-season precipitation from May through July was 121.4 mm. Total in-season irrigation at CSIDC consisted of a 100 mm.

Results

Results obtained for the Irrigated trial are shown in Table 1, the dry land trial in Table 2 and a comparison of irrigated vs dry land in Table 3.

Results obtained for the Irrigated trial are shown in Table 1. Statistical procedures concluded that AAC Elevate variety was the highest yielding variety and significantly higher yielding than all varieties yielding less than 9100 kg/ha. AAC Icefield was significantly lower yielding than all other varieties excepting Flourish. Median yield was 9416 kg/ha (140 bu/ac). Grain protein ranged from a low of 11.8% (Pintail) to a high of 13.6% (AC Emerson), this result mimics results obtained in 2016. Median test weight and seed weights for all evaluated varieties was 77.2 and 35.8, respectively. Heading of all varieties occurred within a period of 6 days from earliest to latest, maturity was spread over a duration of 4 days. AC Flourish was the earliest maturing variety, AAC Icefield the latest. Entry W522 was the shortest variety, CDC Chase the tallest variety. CDC Buteo and CDC Chase exhibited the greatest degree of lodging.

Results obtained for the Dry Land trial are shown in Table 2. Statistical procedures concluded that AAC

Elevate variety was the highest yielding variety and significantly higher yielding than all varieties yielding less than 8300 kg/ha. AAC Icefield was significantly lower yielding than all other varieties excepting AAC Wildfire. Median yield was 8127 kg/ha (120.8 bu/ac). Grain protein ranged from a low of 12.3% (Pintail) to a high of 14.6% (AAC Wildfire). Median test weight and seed weights for all evaluated varieties was 77.2 and 33.2, respectively. Heading of all varieties occurred within a period of 6 days from earliest to latest, maturity was spread over a duration of 7 days. CDC Buteo was the earliest maturing variety, AAC Icefield the latest. Entry W522 was the shortest variety, CDC Chase the tallest variety. Pintail exhibited the greatest degree of lodging, AAC Wildfire the least.

A comparison of irrigation and dry land production systems are shown in Table 3. The mean yield of all varieties produced under irrigation was statistically higher yielding than the mean yield of dry land production. Irrigation produced 1271 kg/ha (18.9 bu/ac) more winter wheat grain yield than dry land, or 16% greater production. Although unknown, it is possible that this irrigation benefit to grain production is less than would be obtained with spring wheat or other conventional spring crops when compared to dry land production. This, if true, could be a result of earlier growth making better use of spring moisture and the crop maturing prior to the dry, hot conditions usually experienced in August. Under both production systems AAC Elevate was the highest yielding winter wheat variety, AAC Icefield the lowest yielding, in 2017. No production system by variety interaction was detected indicating varieties responded to irrigation additions in a similar manner. Yields of all varieties are graphically illustrated in Figure 1.

Grain protein was significantly higher under dry land production. Test weights did not statistically differ between the two production systems but individual seed weight was greatest with irrigation. Irrigation resulted in varieties requiring, on average, 1 additional day to heading and maturity. No differences were observed with respect to plant height, unexplainably dry land production exhibited a higher degree of lodging.

ADOPT funding to repeat this experiment for the 2017-18 growing season was applied for and funding granted so the study will be continued.

Table 1. Winter Wheat Variety Evaluation, Irrigated Site, 2017.

Variety	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Date of Heading	Date of Maturity	Height (cm)	Lodging 1=erect; 9=flat
CDC Buteo	**9225**	**100**	**12.9**	**78.4**	**36.2**	**June 15**	**July 27**	**91**	**2.7**
Emerson	9079	98	13.6	77.5	31.6	June 14	July 28	95	1.0
Flourish	8411	91	12.6	74.4	33.0	June 14	July 29	78	1.7
Radiant	9338	101	12.2	77.4	35.7	June 16	July 28	90	1.0
AAC Elevate	10419	113	12.1	77.2	39.1	June 16	July 27	84	1.3
AAC Gateway	8939	97	13.2	76.6	35.8	June 17	July 28	80	1.0
AAC Icefield	7598	82	12.5	75.9	37.7	June 18	August 1	78	1.3
AAC Wildfire	9402	102	13.1	76.5	38.4	June18	July 29	88	1.3
CDC Chase	9544	103	13.0	78.4	38.2	June 15	July 31	106	2.7
Moats	9704	105	12.8	78.3	34.8	June14	July 27	96	2.0
Pintail	9693	105	11.8	76.5	31.2	June 18	July 29	92	1.3
W520	9446	102	12.3	75.6	32.5	June 17	July 28	90	1.7
W522	9486	103	12.3	75.3	37.6	June 12	July 27	73	1.7
AAC Goldrush	9538	103	12.8	76.2	36.4	June 17	July 27	88	1.3
LSD (0.05)	1223		0.5	1.9	3.7	1.2 days	3.0 days	7.0	0.9
CV (%)	7.9		2.2	1.5	6.2	0.4	0.9	4.8	35.5

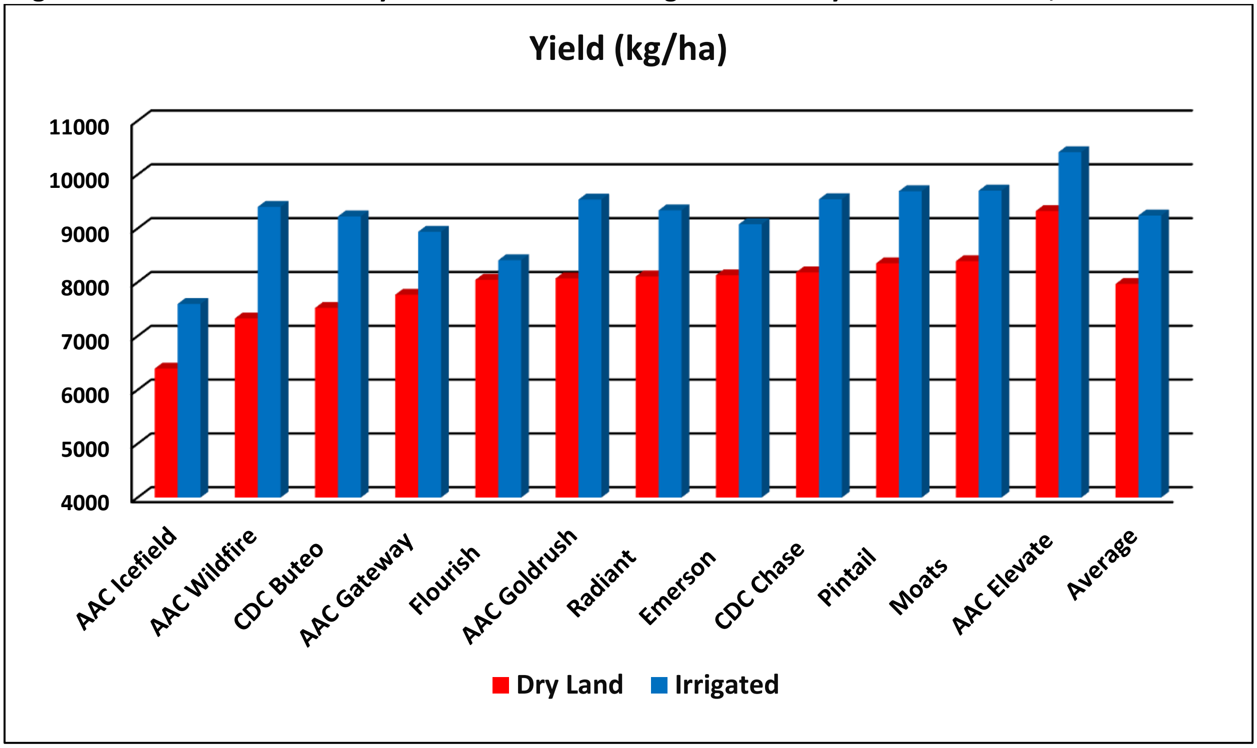
Table 2. Winter Wheat Variety Evaluation, Dry Land Site, 2017.

Variety	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Date of Heading	Date of Maturity	Height (cm)	Lodging 1=erect; 9=flat
CDC Buteo	***7524***	***100***	***13.8***	***77.2***	***30.0***	***June 15***	***July 24***	***97***	***3.3***
Emerson	8131	108	14.0	79.2	32.4	June 16	July 29	90	1.7
Flourish	8047	107	13.6	75.1	34.0	June 14	July 26	84	2.7
Radiant	8109	108	13.1	75.8	31.4	June 16	July 26	92	1.3
AAC Elevate	9325	124	12.7	77.3	38.2	June 15	July 27	81	2.3
AAC Gateway	7770	103	14.1	77.0	28.2	June 15	July 25	77	1.7
AAC Icefield	6397	85	12.8	77.6	36.1	June 16	July 31	74	3.3
AAC Wildfire	7329	97	14.6	73.8	31.3	June 18	July 26	91	1.0
CDC Chase	8185	109	13.2	78.9	34.5	June 14	July 28	97	4.0
Moats	8394	112	13.1	77.8	33.0	June 14	July 27	93	3.7
Pintail	8353	111	12.3	74.1	27.8	June 17	July 28	96	4.3
W520	8563	114	12.5	78.2	33.5	June 15	July 27	81	2.3
W522	8538	113	12.6	75.9	34.6	June 12	July 26	67	3.7
AAC Goldrush	8073	107	13.3	76.8	33.0	June 17	July 27	88	2.3
LSD (0.05)	1101		0.6	2.0	4.9	1.4 days	2.2 days	5.9	1.0
CV (%)	8.2		2.5	1.6	8.9	0.5	0.6	4.1	21.1

Table 3. Winter Wheat Variety Evaluation, Irrigated vs Dry Land, 2017.

Variety	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Date of Heading	Date of Maturity	Height (cm)	Lodging 1=erect; 9=flat
Trial Site									
Irrigated	9273	115	12.66	76.7	35.6	June 17	July 28	88	1.6
Dry Land	8053	100	13.26	76.8	32.7	June 16	July 27	86	2.7
LSD (0.05)	811		0.60	NS	2.4	0.4	NS	NS	0.5
CV	8.0		2.3	1.5	7.6	0.5	0.8	4.5	26.4
Variety									
CDC Buteo	**8374**	**100**	**13.4**	**77.8**	**33.1**	**June 16**	**July 26**	**94**	**3.0**
Emerson	8605	103	13.8	78.4	32.0	June 16	July 29	92	1.3
Flourish	8229	98	13.1	74.7	33.5	June 15	July 26	81	2.2
Radiant	8724	104	12.7	76.6	33.6	June 17	July 27	91	1.2
AAC Elevate	9872	118	12.4	77.3	38.6	June 17	July 27	83	1.8
AAC Gateway	8354	100	13.7	76.8	32.0	June 17	July 26	79	1.3
AAC Icefield	6997	84	12.7	76.7	36.9	June 17	July 27	76	2.3
AAC Wildfire	8365	100	13.8	75.2	34.9	June 18	July 28	89	1.2
CDC Chase	8865	106	13.1	78.7	36.4	June 16	July 29	102	3.3
Moats	9049	108	13.0	78.0	33.9	June 15	July 27	95	2.8
Pintail	9023	108	12.0	75.3	29.5	June 18	July 29	94	2.8
W520	9005	108	12.4	76.9	33.0	June 17	July 28	85	2.0
W522	9012	108	12.5	75.6	36.1	June 13	July 27	70	2.7
AAC Goldrush	8805	105	13.0	76.5	34.7	June 17	July 27	88	1.8
LSD (0.05)	803		0.4	1.4	3.0	0.9 days	1.8 days	4.5	0.7
Location x Variety Interaction									
LSD (0.05)	NS		S	S	NS	S	NS	S	S

Figure 1. Winter Wheat Variety Grain Yields under Irrigation and Dry Land Production, 2017



2017 Corn Variety Demonstration for Grain Production

Funding

Funded by the Irrigation Crop Diversification Corporation (ICDC).

Project Lead

- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Garry Hnatowich, PAg, Research Director, ICDC

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre

Objectives

The objective of this project was to demonstrate corn varieties with low corn heat unit requirements, suitable to growing conditions in the Lake Diefenbaker area, for grain yield potential under irrigation.

Research Plan

The grain corn trial was established in the spring of 2017 at CSIDC. The soil, developed on medium to moderately coarse-textured lacustrine deposits, is classified as Bradwell loam to silty loam.

The trial was established in a randomized complete block with four replications, with ten grain corn hybrids. Target plant populations were 79,100 plants/ha (32,000 plants/ac). Seeding rates were calculated on the basis of hybrid % germination and seed weight. Plots consisted of two rows seeded at 75 cm row spacing. Both trials received 40 kg N/ha of supplemental N fertilizer, as 46-0-0, applied in a side banded position and 30 kg/ha P_2O_5/ha, as 12-51-0, as seed placed at the time of seeding. The trial received an addition 200 kg N/ha as 46-0-0, the fertilizer was top dressed as a broadcast application and immediately irrigated to incorporate in early June.

The trials were seeded on May 18. The varieties and CHU requirements are listed in table 1. Weed control consisted of spring pre-plant and post emergence applications of Roundup (glyphosate) supplemented by hand weeding. Grain yield was obtained by hand harvesting both rows to a length of 6m. Corn was harvested October 19. Grain samples were dried and then stationary combined October 31.

Growing season rainfall (May through September) and irrigation was 103 mm (4 inch) and 243 mm (9.6 inch), respectively. Cumulative Corn Heat Units (CHU) was 2482 for the period May 15 - October 3.

Table 1. Grain corn varieties and CHU requirements included in 2017 ICDC trial

Company	Variety	CHU requirement
Elite	X16-0470	NA
Elite	E46J77R	2150
DEKALB	26-28 RIB	2150
DEKALB	23-17 RIB x	2075
DEKALB	23-21	2075
DEKALB	26-25 RIB	2125
DEKALB	27-55 RIB	2200
Thunderseed	7673VT2	2050
Thunderseed	7574 VT2	2100
Dow Seeds	Baxxos RR (Check)x	2275

Figure 1. Grain Corn Plots on Sept 7th

Figure 2. Grain Corn Cob development Sept 7th

Results and Discussion

The Results of this demonstration are listed in table 2 and 3 for this trial.

The average plant stand in the plots in this trial was 31690 plants/acre which was very close to the target of 32000 plants/acre. The average yield among the varieties was 8678 kg/ha (138 bu/ac) which is lower than the average yield from the 2016 trial.

In the 2017 ICDC grain corn variety trial, the Dow variety Baxxos RR, which was the check, produced the highest yield at 9306kg/ac (148 bu/ac). Yield from the other varieties were fairly consistent ranging from 8024 kg/ha (127.8 bu/acre) to 9011 kg/ha (144 bu/acre). The breakeven yield for growing grain corn under irrigation is 129 bu/acre if the price is at $3.58/bu (taken from the ICDC 2018 Irrigation Agronomics and Economics).

Table 2. Agronomic Data of Irrigated Grain Corn, 2017

Hybrid	Yield @ 15.5% Moisture (kg/ha)	Yield @ 15.5% Moisture (bu/ac)	Oil (%)	Protein (%)	Starch (%)	Test Weight (kg/hl)
Baxxos RR	***9306***	***148.2***	***4.9***	***10.3***	***70.4***	***77.0***
23-17 RIB	9011	143.5	4.5	9.8	70.7	79.4
23-21 RIB	8009	127.6	4.5	9.9	71.0	78.9
26-25 RIB	8124	129.4	4.4	9.6	71.3	76.3
26-28 RIB	8024	127.8	4.7	9.8	70.9	74.9
27-55 RIB	9592	152.8	4.7	9.6	71.0	77.4
7574VT RIB	8587	136.8	4.5	9.9	70.5	77.7
7673VT RIB	8962	142.8	4.6	9.9	70.8	79.3
E46J77R	8327	132.7	4.9	10.5	70.1	81.3
X16-0470	8833	140.7	4.6	10.0	70.8	78.4
LSD (0.05)	1002	16.0	0.2	0.2	NS	1.7
CV (%)	8.0	8.0	3.1	1.7	0.7	1.5

NS = not significant

Table 3. Agronomic Data of Irrigated Grain Corn, 2017

Hybrid	Seed Weight (g/1000)	10% Anthesis (days)	50% Silking (days)	Seed Harvest Moisture (%)	Plant Stand (plants/ha)	Plant Stand (plants/ac)
Baxxos RR	***224***	***69***	***72***	***16.3***	***75,278***	***30,465***
23-17 RIB	187	69	72	11.7	83,889	33,950
23-21 RIB	210	70	74	12.2	75,278	30,465
26-25 RIB	208	70	74	13.1	81,111	32,825
26-28 RIB	206	71	74	14.2	78,611	31,814
27-55 RIB	187	69	74	14.2	81,944	33,163
7574VT RIB	200	71	75	11.8	68,611	27,766
7673VT RIB	189	70	73	12.0	79,445	32,151
E46J77R	200	70	74	12.5	78,333	31,701
X16-0470	209	71	74	12.4	80,556	32,600
LSD (0.05)	NS	1.7	1.2	1.9	NS	NS
CV (%)	10.2	1.7	1.1	9.9	7.7	7.7

NS = not significant

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Corn Variety Demonstration for Silage and Grazing

Project Lead

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Co-investigators

- Garry Hnatowich, PAg, Research Agronomist, ICDC

Industry Co-operators

- Al Vancaeseele, Brett Young
- Carmen Gruber, Monsanto
- Neil Mcleod, Northstar Seeds Ltd.

Project Objective

The objective of this project was to evaluate corn varieties suitable to growing conditions in the Lake Diefenbaker Development Area for silage yield potential under irrigation management. Results of this trial are added to a variety performance data base and are included in the Crop Varieties for Irrigation publication.

Project Background

Growing corn for silage or winter grazing is a potential alternate winter feeding strategy for Saskatchewan beef producers. The challenge with corn production in Saskatchewan is that it is not a crop adapted to Western Canadian growing conditions. Variety selection is an integral component of ensuring success when growing corn, and producers must know which varieties are available locally and how those varieties perform under local growing conditions.

Demonstration Site

The trial was established at CSIDC on medium to moderately coarse-textured lacustrine soil, classified as a Bradwell loam to silty loam.

Project Methods and Observations

The ICDC irrigated silage hybrid performance trials was established on May 18, 2017. All seeding operations were conducted using a specially designed small plot, six row, disc press drill with two sets of discs. One set of discs was used for seed placement while the second set of discs allowed for sideband placement of fertilizer.

Fertilizer was broadcast and incorporated prior to seeding at a rate of 200 kg N/ha. An additional 40 kg N/ha was side banded at seeding. As well, phosphorus fertilizer was seed placed at a rate of 20 kg P_2O_5/ha as 12-51-0 during the seeding operation. Weed control consisted of spring pre-plant and a post emergence application of Roundup (glyphosate).

Varieties of selected corn hybrids available at retail distributers within the Lake Diefenbaker Irrigation District were included into the demonstration (Table 1). The corn was seeded on 75 cm (30 inch) row spacing. Silage corn plots consisted of two rows and measured 1.5 m x 6 m. A seeding rate of ~79,000 plants/ha or ~32,000 plants/acre was targeted. Target plant stands were calculated using seed weights and % germination. Treatments were arranged in a randomized complete block design and replicated four times.

Silage trials were harvested with a Hegi forage harvest combine, wet field yield was recorded and subsamples of chopped material sampled for processing. Silage harvest occurred on September 7. Growing season rainfall (April 1 to August 30) and irrigation was 148 mm and 252 mm, respectively. Cumulative Corn Heat Units (CHU) were 2482 for the period May 15 to September 30. Climatic conditions in 2017 were drier than historic normal.

Table 1. Corn Varieties Included in Silage Corn Variety

Company	Variety	Corn Heat Unit Rating
Dekalb	DKC 30-07RIB	2325
Dekalb	DKC 31-07RIB	2375
Dekalb	DKC 27-55 RIB	2200
Brett Young	E46J77R	2150
Brett Young	Fusion	2200
Brett Young	Yukon	2150
Dow Agro Scienes	X14008GH	not available
Dow Agro Sciences	X13002S2	not available
Dow Agro Sciences	Baxxos	2300

Results and Discussion

Based on the 2017 yield data, the variety that performed the best under irrigated conditions was DKC31-09 RIB (Table 2). Baxxos RR was used as the check variety to which all other corn varieties were compared. Whole plant harvest moisture was approximately 10% higher than typically expected. Dry matter yields are reported. Refer to the ICDC Crop Varieties for Irrigation publication for year to year comparisons and yield information.

Table 2. Agronomic Data of Irrigated Silage Corn, 2017

Hybrid	Dry Yield (T/ha)	Dry Yield (T/ac)	Plant Stand (plants/ac)	Harvest Whole Plant Moisture (%)	10% Anthesis (days)	50% Silking (days)
BAXXOS RR	***18.78***	***7.58***	***31,589***	***75.4***	***69***	***73***
DKC27-55 RIB	16.75	6.78	32,488	77.9	68	74
DKC30-07 RIB	17.95	7.30	32,039	78.0	74	78
DKC31-09 RIB	19.40	7.88	36,310	77.5	72	76
E46J77R	16.65	6.75	34,287	75.8	69	74
Fusion	18.75	7.60	31,476	76.8	71	74
X13002S2	17.83	7.23	33,837	78.3	72	76
X14008GH	18.63	7.55	34,736	78.6	80	85
Yukon	18.88	7.65	30,577	77.9	74	76
LSD (0.05)	1.79	0.73	NS	1.5	0.8	0.9
CV (%)	6.7	6.8	7.6	1.3	0.8	0.8

NS = not significant

Alberta Dry Bean Narrow Row and Wide Row Regional Variety Trials

Funding

Funded by the Irrigation Crop Diversification Corporation, partial funding provided by the Agriculture Development Fund and the Western Grains Research Foundation

Principal Investigator

- Garry Hnatowich, PAg, Research Director, ICDC (Project Lead)
- Co-investigators: Dr. P. Balasubramanian, Cathy Daniels and J. Braun
  AAFC Lethbridge Research Centre

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Agriculture & Agri-Food Canada

Objectives

The Alberta Dry Bean Narrow Row and Wide Row Regional variety trials are intended to evaluate the performance of registered dry bean varieties under both wide row and narrow row production systems. They are not intended to compare production systems as the varieties within each system can differ.

Research Plan

The Alberta Dry Bean Narrow Row and Wide Row Regional variety trials were established in the spring of 2017 at CSIDC and CSIDC Off-station sites.

The Narrow Row trial included eleven dry bean varieties consisting of three market classes (pinto, black and great northern) were evaluated. The Wide Row trial consisted of fourteen dry bean varieties in five market classes (pinto, black, yellow, cranberry and great northern) were evaluated. Individual plots consisted of four rows with 20 cm row spacing for the Narrow Row trial and two rows with 60 cm spacing for the Wide Row trial and measured 4 m in length. All seed was treated with Apron Maxx RTA (fludioxonil and metalaxyl-M and S-isomer) for various seed rots, damping off and seedling blights and with Stress Shield 600 (imidacloprid) for wireworm control. For both trials phosphorus fertilizer was side-banded at a rate of 25 kg P_2O_5/ha during the seeding operation. Granular inoculant was unavailable so nitrogen requirements were met by supplemental broadcast urea, applied and irrigated immediately, for a total application of 100 kg N/ha. The CSIDC trials were established on May 29, the Off-station trials on May 26. Weed control consisted of a fall pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergent application of Basagran (bentazon) + Assure II (quizalofop-P-ethyl) supplemented by one in-season cultivation, for wide row trials, and periodic in-row hand weeding. The trial received a tank-mix application of Priaxor DS (fluxapyroxad & pyraclostrobin) and Copper 53W (tribasic copper sulphate) fungicide at flowering for white mold, anthracnose and bacterial blight control. Yields were estimated by harvesting the entire plot. In all trials plots were under-cut and windrowed, allowed to dry in the windrow and then threshed to determine yield. CSIDC trials were undercut on September 6 and combined on September 25, at CSIDC Off-station undercutting occurred on September 5 and harvest September 28. Total in-season irrigation at CSIDC was 100 mm and at CSIDC Off-station 192.5 mm.

Results

Narrow Row

Agronomic data collected from each narrow row trial is shown in Tables 1 and 2. In general, dry bean yields were very high resulting from the warm seasonal growth experienced in 2017.

CDC Blackstrap Pinto class bean was the highest yielding variety while the Great Northern class variety AAC Whitestar was the lowest yielding variety at the CSIDC site. AC Island (Pinto) was also the highest yielding varieties while AC Resolute (Great Northern) was the lowest yielding variety at the CSIDC Off-station site. Median yield of all varieties at CSIDC was 6951 kg/ha and 5786 kg/ha at the CSIDC Off-station site. Other agronomic differences measured within sites are not discussed.

Combined narrow row site analysis is outlined in Table 3. Highest yield was obtained with the Pinto variety AAC Burdett which was significantly higher than all varieties yielding less than 6300 kg/ha. AC Resolute (Great Northern) was the lowest yielding registered variety. Median seed yield of all varieties, over both sites, was 6318 kg/ha.

Test weight did not differ between the two test sites. Varieties did statistically differ between entries with respect to test weight and also was variable between market classes. Varieties at the CSIDC trial matured earlier compared to those at CSIDC Off-station. Combined site analysis indicated the Black market class varieties AC Black Diamond and Black Diamond 2 with the Pinto variety AC Island were the longest to mature (days to maturity rounded to full days in Table 3), the Pinto bean variety AAC Burdett was statistically earlier to mature compared to all other varieties. No difference in mean plant height occurred between sites. The Great Northern entry AAC Whitestar was the tallest structured variety, AAC Tundra the shortest. Varieties grown at CSIDC exhibited a greater degree of lodging than plants grown at the off-station location. AAC Tundra exhibited the greatest degree of lodging, CDC Blackstrap the least. AAC Island had the least amount of pod clearance, CDC Blackstrap the greatest. Pod clearance was not statistically different between sites.

Wide Row

Agronomic data collected from each narrow row trial is shown in Tables 4 and 5.
In the wide row study at CSIDC the Pinto market bean AC Island was the highest yielding variety, this yield was statistically higher than any bean variety with a yield less than 4500 kg/ha. The Yellow class variety CDC Sol was the lowest yielding. AC Island (Pinto) bean was also the highest yielding variety at the CSIDC Off-station site, statistically significant from other varieties yielding less than 3300 kg/ha. The Cranberry class experimental entry L12CB004 was the lowest yielding. Median yield of all varieties at the CSIDC trial was 4062 kg/ha and 2855 kg/ha at the CSIDC Off-station site. Other agronomic differences measured within sites are not discussed.

Combined wide row site analysis is outlined in Table 6. Mean yield statistically differed between trial locations, with the CSIDC trial producing significantly higher wide row production yields. Highest yield was obtained with the Pinto variety AC Island, this yield was statistically significant from varieties with yields less than 4300 kg/ha. The Yellow class experimental variety CDC Sol was the lowest yielding variety. Across both sites the market class Yellow and Cranberry entries were the lowest yielding in wide row production. Median yield of the combined sites was 3554 kg/ha.

Test weight did not differ between sites, the Yellow entries CDC Sol, AAC Y015 and AAC Y012 had significantly higher test weights than all other entries, the experimental Cranberry entry L12CB004 had significantly lower test weights compared to all other trial entries. Varieties at the CSIDC Off-station trial matured later to those at CSIDC. Median days to maturity was 96.5 days. AAC Burdett was significantly earlier maturing than all other varieties, CDC Sol was the latest maturing. The Black variety AC Black Diamond produced the tallest plants, the Yellow variety CDC Sol the shortest. Lodging did not differ between test locations, AC Island exhibiting the greatest lodging, the Yellow and Cranberry class entries the least. Pod clearance was higher at the CSIDC site, the Yellow class varieties had the least pod clearance, AC Black Diamond exhibited the greatest pod clearance.

The results from these dry bean Narrow Row and Wide Row trials are used to update the irrigation variety database at ICDC and provide information to irrigators on the best dry bean varieties suited to irrigation conditions.

Table 1. 2017 Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial, CSIDC site.

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Plant Count (plant/m^2)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	7238	79.4	40	47	95	48	2.3	80
AAC Burdett	7470	80.4	52	49	93	45	2.5	80
AAC Explorer	6160	77.6	45	49	95	44	3.5	65
AC Island	7056	78.9	44	48	95	46	3.5	65
Black								
AC Black Diamond	6932	77.8	45	50	95	51	2.0	80
AAC Black Diamond 2	7240	79.5	39	49	95	47	2.0	80
CDC Blackstrap	7655	76.7	48	49	94	47	1.8	90
Great Northern								
AC Resolute	6405	79.1	44	47	95	47	3.0	75
AAC Tundra	6578	81.0	45	48	94	42	3.8	68
AAC Whitehorse	6147	77.8	35	47	95	47	3.3	70
AAC Whitestar	5755	79.6	42	47	95	52	2.3	84
LSD (0.05)	NS *	0.8	7.8	0.96	0.7	NS	0.8	8.6
CV (%)	12.9	0.7	12.5	1.4	0.5	9.8	20.1	7.9

NS = not significant * = Significant at P < 0.10

Table 2. 2017 Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial, CSIDC Off-station site.

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Plant Count (plant/m^2)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	5087	79.9	36	49	97	46	1.8	80
AAC Burdett	6750	79.7	45	51	94	48	1.8	80
AAC Explorer	6155	78.0	40	50	97	42	2.3	70
AC Island	6939	79.5	38	50	98	43	2.8	65
Black								
AC Black Diamond	5605	78.4	37	52	98	46	1.8	80
AAC Black Diamond 2	5494	79.9	33	52	99	43	1.8	80
CDC Blackstrap	5257	77.8	42	51	97	44	1.0	83
Great Northern								
AC Resolute	4329	77.7	31	49	96	44	2.0	80
AAC Tundra	6003	80.8	36	49	97	42	2.8	73
AAC Whitehorse	5776	78.0	31	50	97	47	2.0	76
AAC Whitestar	5588	77.9	38	49	97	47	1.8	80
LSD (0.05)	1043	0.9	4.4	0.4	0.7	4.5	0.7	4.2
CV (%)	12.6	0.8	8.3	0.6	0.5	7.0	26.0	3.7

Table 3. 2017 Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial, Combined site.

Location/Variety	Yield (kg/ha)	Test Weight (kg/hl)	Plant Count (plant/m^2)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Location								
CSIDC	6785	78.9	43	48	95	47	2.7	76
CSIDC – Off station	5726	78.9	40	50	97	45	2.0	77
LSD (0.05)	NS	NS	NS	0.4	0.5	NS	0.6	NS
CV (%)	12.8	0.7	10.9	1.1	0.5	8.6	22.6	6.1
Variety								
Pinto								
Winchester	6162	79.6	38	48	96	47	2.0	80
AAC Burdett	7110	80.0	48	50	93	46	2.1	80
AAC Explorer	6157	77.8	43	49	96	43	2.9	68
AC Island	6997	79.2	41	49	97	45	3.1	65
Black								
AC Black Diamond	6268	78.1	41	51	97	48	1.9	80
AAC Black Diamond 2	6367	79.7	36	51	97	45	1.9	80
CDC Blackstrap	6456	77.2	45	50	96	45	1.4	86
Great Northern								
AC Resolute	5367	78.4	37	48	95	45	2.5	78
AAC Tundra	6291	80.9	40	49	95	42	3.3	70
AAC Whitehorse	5961	77.9	33	48	96	47	2.6	73
AAC Whitestar	5672	78.8	40	48	96	49	2.0	82
LSD (0.05)	803	0.6	4.4	0.5	0.5	3.9	0.5	4.7
Location x Variety Interaction								
LSD (0.05)	S	S	NS	NS	S	NS	NS	NS

S = Significant NS = Not Significant

Table 4. 2017 Saskatchewan Irrigated Dry Bean Wide Row Regional Variety Trial, CSIDC site.

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Plant Count (plant/m^2)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	5171	79.9	20	45	95	47	1.8	80
AC Island	5289	79.0	22	48	96	50	3.0	68
AAC Burdett	4989	80.3	22	49	93	48	2.0	78
AAC Explorer	3960	77.8	20	46	94	47	2.3	78
Black								
AC Black Diamond	4325	77.9	20	49	95	49	1.5	84
AAC Black Diamond 2	4535	80.2	18	49	95	46	1.3	80
Great Northern								
AC Resolute	4159	80.0	20	46	94	53	2.0	80
AAC Tundra	4665	81.6	20	47	94	47	2.8	75
AAC Whitehorse	4061	77.9	16	46	95	48	2.5	75
AAC Whitestar	3890	79.2	21	45	95	49	2.0	83
Yellow								
CDC Sol	2679	83.2	17	45	97	39	1.0	68
AAC Y012	2684	84.1	16	44	96	39	1.0	70
AAC Y015	3372	83.0	17	45	97	43	1.0	78
Cranberry								
L12CB004	2905	73.0	17	44	94	43	1.0	80
LSD (0.05)	846	1.1	2.7	1.5	1.0	6.2	0.7	6.8
CV (%)	14.6	1.0	10.0	2.3	0.7	9.4	28.8	6.2

Table 5. 2017 Saskatchewan Irrigated Dry Bean Wide Row Regional Variety Trial, CSIDC Off – Station site.

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Plant Count (plant/m^2)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	2855	79.2	17	49	97	45	1.5	81
AC Island	3980	79.2	18	50	98	41	3.3	65
AAC Burdett	3771	77.8	20	51	95	45	2.0	80
AAC Explorer	3058	76.9	18	50	97	40	1.8	73
Black								
AC Black Diamond	3064	78.2	17	53	98	49	1.5	80
AAC Black Diamond 2	2779	80.0	15	52	98	40	1.3	80
Great Northern								
AC Resolute	2332	78.5	17	49	97	44	2.0	81
AAC Tundra	3337	77.6	16	49	97	41	2.5	73
AAC Whitehorse	2764	77.7	14	49	97	46	2.0	75
AAC Whitestar	3044	78.3	18	49	97	42	2.3	75
Yellow								
CDC Sol	1472	83.6	14	48	100	34	1.0	50
AAC Y012	1803	81.8	11	49	100	40	1.0	50
AAC Y015	1405	83.7	13	48	100	40	1.0	50
Cranberry								
L12CB004	1296	72.3	9	48	97	36	1.0	59
LSD (0.05)	650	3.4	2.3	1.0	1.0	7.0	0.7	6.7
CV (%)	17.2	3.0	10.6	1.5	0.7	11.7	29.8	6.7

Table 6. 2017 Saskatchewan Irrigated Dry Bean Wide Row Regional Variety Trial, Combined site.

Location/Variety	Yield (kg/ha)	Test Weight (kg/hl)	Plant Count (plant/m^2)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Location								
CSIDC	4049	79.8	19	46	95	46	1.8	77
CSIDC – Off station	2640	78.9	15	49	98	42	1.7	69
LSD (0.05)	654	NS	3.5	0.9	0.8	3.6	NS	2.7
CV (%)	15.8	2.2	10.2	1.9	0.7	10.5	29.2	6.5
Variety								
Pinto								
Winchester	4013	79.5	19	47	96	46	1.6	81
AC Island	4635	79.1	20	49	97	45	3.1	66
AAC Burdett	4380	79.1	21	50	94	47	2.0	79
AAC Explorer	3509	77.4	19	48	95	44	2.0	75
Black								
AC Black Diamond	3694	78.0	19	51	97	49	1.5	82
AAC Black Diamond 2	3657	80.1	16	50	96	43	1.3	80
Great Northern								
AC Resolute	3246	79.2	18	48	95	48	2.0	81
AAC Tundra	4001	79.6	18	48	96	44	2.6	74
AAC Whitehorse	3413	77.8	15	47	96	47	2.3	75
AAC Whitestar	3467	78.7	19	47	96	45	2.1	79
Yellow								
CDC Sol	2075	83.4	16	47	99	37	1.0	59
AAC Y012	2244	82.9	13	46	98	39	1.0	60
AAC Y015	2389	83.3	15	46	98	42	1.0	64
Cranberry								
L12CB004	2101	72.6	13	46	96	39	1.0	69
LSD (0.05)	525	1.7	1.8	0.9	0.7	4.6	0.5	4.7

Location x Variety Interaction								
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	S

S = Significant
NS = Not Significant

Saskatchewan Dry Bean Narrow Row Regional Variety Trial

Funding

Funded by the Irrigation Crop Diversification Corporation and the Crop Development Centre, U of S

Project Lead

- Garry Hnatowich, Research Director, ICDC
- Co-investigators: Dr. K. Bett, Crop Development Centre

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Crop Development Centre

Objectives

Regional performance trials provide information on the various production regions available in Saskatchewan to assess productivity and risk of dry bean. This information is used by extension personnel, pulse growers and researchers across Saskatchewan to become familiar with these new pulse crops.

Research Plan

Dry Bean Narrow Row Regional variety trials were conducted in the spring of 2017 at CSIDC and CSIDC Off-station locations. The trials were seeded May 29 at CSIDC and on May 26 at the off-station location. Nineteen dry bean varieties consisting of six market classes (pinto, black, navy, yellow, cranberry and fleur de jaune) were evaluated. All seed was treated with Apron Maxx RTA (fludioxonil and metalaxyl-M and S-isomer) for various seed rots, damping off and seedling blights and with Stress Shield 600 (imidacloprid) for wireworm control. For both trials phosphorus fertilizer was side-banded at a rate of 25 kg P_2O_5/ha during the seeding operation. Granular inoculant was unavailable so nitrogen requirements were met by supplemental broadcast urea, applied and irrigated immediately, for a total application of 100 kg N/ha. At no time during dry bean growth did plants exhibit symptoms of nitrogen deficiencies. Weed control consisted of a spring pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergent applications of Basagran Forte (bentazon) and Poast Ultra (sethoxydim) supplemented by one in-season cultivation, for wide row trials, and periodic in-row hand weeding. The trial received a tank-mix application of Priaxor DS (fluxapyroxad & pyraclostrobin) and Copper 53W (tribasic copper sulphate) fungicide at flowering for white mold, anthracnose and bacterial blight control. Individual plots consisted of four rows with 25 cm row spacing and measured 1.0 m x 4 m. Yields were estimated by harvesting the entire plot. All rows in each plot were under-cut and windrowed, allowed to dry in the windrow and then threshed when seed moisture content was <20%. The trial was undercut on September 6 at CSIDC and September 5 at the Off-station, and harvested on September 25 at CSIDC and September 28 at CSIDC Off-station. Total in-season irrigation at CSIDC and at CSIDC Off-station consisted of 100.0 mm and 192.5 mm, respectively.

Results

Results of the trials are shown in Table 1 for CSIDC, Table 2 for CSIDC Off-station.

Caution should be used when assessing the yield results obtained at the off-station trial. Analysis of variance procedures indicate a high degree of variation between variety yields and for most crops results would be dismissed as invalid. Trial results will be included in the report for documentation and record keeping only. Results of the off-station trial will not be used to update the ICDC variety data base nor used in any extension or variety guide.

Results of the CSIDC trial are shown in Table 1. The Pinto market class variety Medicine Hat was the highest yielding, statistically greater than any variety with yields less than 6400 kg/ha. Median seed yield for the trial was 5996 kg/ha. Varieties differed greatly with respect to test weight. The experimental Yellow class entry 3850-1 was the first variety to flower, CDC Jet the last, median days to flower for the test was 49 days. CDC Marmot and the experimental entry 3458-7 were the first varieties to mature, entries Bolt and AAC Shock the latest, median days to mature for the test was 95 days. Bolt produced the tallest plants, CDC Marmot was the shortest variety but CDC Marmot was one that exhibited a high degree of lodging. Median pod clearance of all entries was 80%.

Results from the off-station site (Table 2), will not be discussed due to the high degree of variation within the study.

The results from these trials are used to update (if applicable) the irrigation variety database at ICDC and provide recommendations to irrigators on the best dry bean varieties suited to irrigation conditions. Results of the 2017 Irrigated Dry Bean Regional Variety Trial will also be used in the development of the annual publications *Crop Varieties for Irrigation* and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2017.*

Table 1. Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial, CSIDC Site, 2017.

Variety	Yield (kg/ha)	Test weight (kg/hl)	Plant Stand (plant/m^2)	Flower (days)	Maturity (days)	Lodge rating 1=upright 5=flat	Pod clearance (%)	Height (cm)
Pinto								
Winchester	***6703***	***79.5***	***30***	***48***	***95***	***2.7***	***75***	***52***
AC Island	6938	79.0	47	49	96	3.0	63	48
CDC Marmot	5313	78.3	45	46	90	3.0	63	39
CDC Pintium	6056	77.0	42	48	94	2.3	73	46
CDC WM-2	6584	80.0	41	48	94	2.7	78	48
Medicine Hat	7504	79.2	39	52	96	2.7	73	49
Black								
CDC Blackstrap	6010	77.3	40	48	94	1.0	88	53
CDC Jet	5883	77.9	44	53	96	1.7	83	52
CDC Superjet	6249	78.0	43	53	97	2.3	75	52
Navy								
AAC Shock	5921	80.7	35	50	98	1.7	83	59
Bolt	6414	79.1	41	52	98	2.0	87	60
Envoy	5255	82	48	49	93	2.0	83	45
Portage	6052	79.9	42	49	96	1.3	87	57
2918-25	5171	80.6	43	49	93	1.0	93	52
3458-7	4683	80.1	47	48	90	3.0	70	43
Yellow								
CDC Sol	3646	83.4	35	45	97	1.0	63	43
3850-1	5734	82.4	46	44	93	2.3	77	45
Cranberry								
7ab-3bola-3	5953	77.4	52	46	95	1.7	80	41
Fleur de Jaune								
3620-3	6571	78.9	42	52	97	2.0	73	56
LSD (0.05)	1195	2.2	6.9	0.8	1.3	0.8	10.7	8.8
CV (%)	12.2	1.7	9.7	1.0	0.8	23.7	8.4	10.8

Table 2. Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial, CSIDC Off-Station Site, 2017.

Variety	Yield (kg/ha)	Test weight (kg/hl)	Plant Stand (plant/m²)	Flower (days)	Maturity (days)	Lodge rating 1=upright 5=flat	Pod clearance (%)	Height (cm)
Pinto								
Winchester	4960	79.7	30	49	98	2.0	77	42
AC Island	4609	79.5	37	50	98	2.0	72	39
CDC Marmot	4551	76.9	44	47	92	3.0	50	33
CDC Pintium	2982	75.7	24	49	96	1.7	67	35
CDC WM-2	3985	78.0	27	50	96	2.3	70	39
Medicine Hat	6036	78.0	28	52	98	1.3	80	45
Black								
CDC Blackstrap	5026	76.9	40	51	97	1.0	78	37
CDC Jet	4852	78.4	48	53	99	1.0	82	44
CDC Superjet	4622	79.2	36	53	99	1.0	82	42
Navy								
AAC Shock	3362	80.5	32	50	98	1.3	78	41
Bolt	3076	80.1	28	52	100	1.0	77	46
Envoy	2809	79.6	31	51	94	2.7	57	31
Portage	4111	80.0	40	51	97	1.7	78	39
2918-25	2484	79.2	26	51	95	1.0	80	36
3458-7	3218	79.9	34	52	95	1.3	70	37
Yellow								
CDC Sol	2240	84.0	32	49	99	1.0	50	34
3850-1	2655	83.9	39	48	96	1.7	57	30
Cranberry								
7ab-3bola-3	2339	77.8	38	49	96	1.7	57	29
Fleur de Jaune								
3620-3	5155	78.7	34	53	100	2.0	53	38
LSD (0.05)	NS	2.1	10.4	1.7	2.3	0.8	8.8	7.1
CV (%)	27.9	1.6	18.4	2.0	1.4	29.1	7.7	11.4

NS = Not Significant

Soybean Regional Variety Trial

Funding

Funded by the Irrigation Crop Diversification Corporation, partial funding provided by the Agriculture Development Fund, the Western Grains Research Foundation and the Saskatchewan Pulse Growers.

Project Lead

- Garry Hnatowich, Research Director, ICDC
- Co-investigators: D. Lange, Manitoba Agriculture, Food & Rural Initiatives

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Saskatchewan Pulse Growers
- Manitoba Agriculture, Food & Rural Initiatives

Objectives

The objectives of this study are:

(1) To evaluate the potential of soybean varieties for production in the irrigated west-central region of Saskatchewan

(2) To assess the suitability of soybean to irrigation as opposed to dry land production

(3) To create a data base on soybean for Crop Varieties for Irrigation

Research Plan

Forty-eight soybean varieties were received through the Saskatchewan Pulse Growers for evaluation under both dry land and irrigation production assessment. Plot size was 1.2 m x 4 m. All plots received 35 kg P_2O_5/ha as 12-51-0 as a sideband application during the seeding operation. Granular inoculant (Cell-Tech) with the appropriate *Rhizobium* bacteria strain *(Bradyrhizobium japonicum)* specific for soybean was seed placed during the seeding operation at a rate of 10 kg/ha. Both trials were seeded on May 20. Weed control consisted of a pre and a post-emergence application of Roundup (glyphosate) supplemented by some hand weeding. First killing frost occurred on the morning of October 9. All entries had reached maturity. Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and the seed moisture content was <20%. Both trials were harvested on October 10. Total in-season precipitation at CSIDC from May through October 9 was 157.0 mm. Total in-season irrigation at CSIDC for the irrigated trial was 130 mm.

Results

Forty-eight Roundup Ready soybean varieties were evaluated. Plant emergence and seedling development was excellent; ideal conditions through the growing season established excellent yield potential. Seed yield, quality and agronomic data collected for the irrigated soybean are shown in Table 1. Yields were very high with a median yield of all forty-eight entries of 5019 kg/ha (74.6 bu/ac). Yields of irrigated soybean ranged from a low of 3210 kg/ha (47.7 bu/ac) to a high of 6084 kg/ha (90.5 bu/ac). Oil content varied dramatically among entries with a 6.6% difference between the lowest and highest % oil entries. Median protein content was 35.1%. Test weight and seed weight also exhibited a wide variance between entries. Average maturity was 116 days, all entries did reach physiological maturity (95% of pods had turned from green to yellow or brown) prior to the occurrence of a fall frost. Plant height varied among entries with the shortest at 63 cm to the tallest at 114 cm, median plant height of all varieties was 92 cm. Lodging resistance in most entries was very good, with only a single entry exhibiting a lodging score >3.0 which could result in harvest difficulties.

Seed quality and agronomic data collected for the dry land soybean are shown in Table 2. Median yield of all forty-eight entries was a very high 4007 kg/ha (59.6 bu/ac). Yields of dry land soybean ranged from a low of 2588 kg/ha (38.5 bu/ac) to a high of 5022 kg/ha (74.6 bu/ac). Oil content varied among entries with a 3.7% difference between the lowest and highest % oil entries. Median protein content was 34.2%. Test weight and seed weight also exhibited a wide variance between entries. Median maturity was 112 days and plant height 75 cm. Lodging resistance for dry land production with all entries was very good.

Combined test analyses between irrigation and dry land studies are shown in Table 3. Statistical analysis indicated that irrigated production produced greater yields than dry land production at the 10% confidence level. This is not surprising considering the below average precipitation received in 2017. Mean irrigated yield was 4990 kg/ha (74.2 bu/ac), mean dry land yield 4033 kg/ha (60.0 bu/ac). Irrigation resulted in lower mean % oil of soybean entries but did not affect % protein. Irrigation resulted in statistically greater test weight and seed weight compared to dry land. On average irrigation resulted in a five day delay in maturity, which was statistically significant at a 10% confidence level. Also, at the 10% confidence level irrigation induced a higher degree of lodging than the rain feed system. Irrigation also resulted in statistically taller plant height compared to dry land.

The results from these trials are used to update the variety database at ICDC and provide information to producers on soybean performance under west central Saskatchewan growing conditions. Annual testing of soybean varieties is essential for this potential crop.

Table 1. Agronomics of 2017 WC Soybean Performance Evaluation - Irrigated Soybean, 2017.

Variety	Yield (kg/ha)	% Oil	% Protein	Test weight (kg/hl)	Seed weight (g/1000)	Plants /m^2	Maturity (days)	Height (cm)	Lodge (1-5)
TH 33003 R2Y	***5043***	***17.4***	***34.3***	***71.6***	***166***	***46***	***117***	***106***	***2.3***
22-60 RY	4975	16.8	34.3	71.5	161	49	119	71	1.0
23-60RY	5581	15.7	34.6	72.1	166	53	116	102	2.2
Akras R2	5297	15.6	34.5	73.9	168	49	119	87	1.8
Barron R2X	4402	16.7	35.6	71.0	142	54	113	91	2.7
Bishop R2	4634	16.5	35.5	72.4	154	48	115	99	2.3
CFS17.1.03 R2	4032	15.9	35.8	71.8	156	48	113	89	1.3
CFS17.1.04 R2X	4949	17.1	33.8	70.9	176	46	119	86	1..0
Dario R2X	4820	16.9	35.9	73.5	150	43	116	99	3.0
DKB003-29	5642	16.4	34.8	71.3	194	42	118	94	1.8
DKB008-39	4850	16.8	35.8	72.4	163	45	118	95	1.8
DS0067Z1	4674	16.3	34.1	72.2	180	41	121	101	1.0
Dylano R2X	4776	17.2	35.2	72.1	168	47	119	87	1.0
EXP00418XRN	5386	16.2	34.8	72.5	159	48	116	99	1.7
HS 006RYS24	4467	15.9	34.5	71.9	188	44	120	105	1.7
Kosmo R2	5176	16.7	35.7	71.2	180	53	119	96	1.7

Lono R2	5018	16.3	34.4	73.1	162	40	120	91	2.8
LS 002R24N	5507	15.7	34.8	71.6	193	50	114	101	2.5
LS NorthWester	4685	18.0	35.3	71.2	175	53	117	114	2.5
LS TR17XT	4370	16.8	34.3	73.1	158	42	115	90	1.3
LS TR19R2Y	4600	17.6	34.5	71.3	146	49	114	83	1.0
Mahony R2	5059	17.2	34.7	70.5	169	50	119	97	2.2
Marduk R2	4992	16.2	30.7	71.8	196	48	116	101	2.0
McLeod R2	5785	16.0	35.5	72.3	194	52	117	107	2.0
NSC Belmont RR2X	5158	16.4	37.3	70.0	180	41	120	105	1.5
NSC Leroy RR2Y	3996	16.3	36.4	71.0	146	40	110	78	1.5
NSC Star City RR2X	4700	16.6	36.1	73.1	137	44	117	83	1.3
NSC Watson RR2Y	5488	17.9	34.3	70.9	164	52	112	84	1.0
P002A63R	6016	16.3	36.2	71.3	159	47	116	94	1.0
P002T04R	5367	17.4	36.0	71.5	146	51	115	92	1.5
P006T46R	5501	17.9	34.4	71.0	173	51	122	98	1.0
P0007A43R	3210	16.5	35.2	68.2	151	42	102	63	1.0
PS 0035 NR2	5171	15.4	35.7	71.1	215	47	118	107	2.2
PS 00095 R2	4549	18.5	33.6	70.2	159	46	111	84	2.0
PV 115001 RR2	5031	16.7	37.0	71.7	177	41	116	86	1.3
S001-B1	5079	17.6	35.9	71.7	172	46	114	90	1.3
S003-L3	5271	18.2	33.9	70.7	185	45	114	89	1.0
S006-W5	6084	17.3	36.1	71.2	147	50	115	89	1.8
S007-Y4	5425	15.8	36.4	72.0	176	45	120	87	1.3
S0009-D6	4277	18.0	33.8	69.8	128	42	113	85	1.0
S0009-M2	4811	18.8	33.9	70.7	145	47	112	82	1.0
SC17-2375R2	5613	16.3	34.2	71.9	147	44	126	90	2.8
TH 32004 R2Y	5513	17.2	35.1	71.3	174	45	120	92	2.5
TH 37004 R2Y	5201	17.5	34.7	70.9	164	48	124	89	1.3
TH 87000 RR2X	4664	16.2	36.4	73.7	133	50	114	91	3.5
TH 87003 RR2X	5097	16.2	35.5	71.5	172	41	118	94	2.7
TH 88005 RR2X	5300	16.6	34.4	71.6	170	46	123	99	1.3
Torro R2	4271	15.8	36.1	72.1	154	40	114	99	2.8
LSD (0.05)	747	0.6	1.6	1.0	12.2	8.5	3.9	10.5	1.1
CV (%)	9.2	2.2	2.8	0.9	4.6	11.3	2.1	7.0	37.9

Table 2. Agronomics of 2017 WC Soybean Performance Evaluation – Dry Land Soybean, 2017.

Variety	Yield (kg/ha)	% Oil	% Protein	Test weight (kg/hl)	Seed weight (g/1000)	Plants m^2	Maturity (days)	Height (cm)	Lodge (1-5)
TH 33003 R2Y	***4579***	***17.8***	***34.5***	***70.5***	***162***	***49***	***116***	***81***	***1.0***
22-60 RY	3312	18.0	33.9	70.0	146	44	111	57	1.0
23-60RY	4747	16.6	34.7	71.2	161	48	114	87	1.5
Akras R2	4658	16.0	34.6	72.8	172	49	117	75	1.7
Barron R2X	4208	17.7	35.7	70.5	143	51	112	74	1.7
Bishop R2	3797	17.7	34.5	70.1	150	50	109	79	1.3
CFS17.1.03 R2	3375	16.9	35.2	68.3	145	48	107	69	1.0
CFS17.1.04 R2X	4784	18.3	32.8	70.4	186	49	115	75	1.3
Dario R2X	4919	17.4	36.0	71.3	151	47	112	74	1.0
DKB003-29	4826	17.6	34.1	71.0	191	47	114	82	1.7
DKB008-39	4339	18.2	34.6	70.8	148	50	107	75	1.3
DS0067Z1	3890	16.9	33.9	71.1	174	39	118	79	1.3
Dylano R2X	3726	17.8	34.8	71.9	164	48	118	71	1.2
EXP00418XRN	4074	17.3	34.5	70.6	147	50	113	78	1.0
HS 006RYS24	3892	17.1	33.3	71.8	177	45	116	83	1.3
Kosmo R2	3662	18.7	33.3	70.3	160	47	113	74	1.0
Lono R2	4724	17.3	34.1	73.0	155	44	115	81	1.0
LS 002R24N	4385	16.7	33.9	69.8	180	47	115	83	2.0
LS NorthWester	4162	19.1	34.5	70.5	164	49	116	93	1.3
LS TR17XT	3498	17.7	33.8	71.2	147	47	111	75	1.0
LS TR19R2Y	3414	19.1	33.1	69.6	144	45	111	69	1.0
Mahony R2	4221	18.4	33.4	70.4	156	41	117	76	1.0
Marduk R2	3834	17.3	33.7	70.7	188	48	112	75	1.0
McLeod R2	3716	17.7	33.6	70.7	172	46	113	73	1.3
NSC Belmont RR2X	3548	18.7	34.7	69.8	161	41	112	79	1.0
NSC Leroy RR2Y	3277	17.2	36.1	69.0	141	43	105	61	1.0
NSC Star City RR2X	3687	17.7	35.1	71.2	135	47	107	66	1.0
NSC Watson RR2Y	3216	19.3	31.5	68.8	158	53	106	60	1.0
P002A63R	4820	17.7	34.8	70.2	157	53	113	84	1.0
P002T04R	3692	18.9	34.2	68.6	142	47	113	72	1.0
P006*T46R*	4959	18.7	34.2	69.7	166	52	114	82	1.0
P0007A43R	2588	19.4	31.5	66.0	135	45	97	57	1.0
PS 0035 NR2	4372	17.7	33.3	70.3	189	45	112	77	1.0

PS 00095 R2	4431	18.2	34.8	68.8	160	44	110	75	2.0
PV 115001 RR2	3114	18.3	35.4	69.8	155	44	110	67	1.0
S001-B1	4665	17.4	37.0	70.6	181	44	114	86	1.8
S003-L3	3363	19.7	31.9	69.0	162	42	111	64	1.0
S006-W5	4497	18.2	35.0	70.2	134	49	112	72	1.3
S007-Y4	5022	16.9	35.3	70.8	168	44	114	75	1.3
S0009-D6	3416	18.9	33.1	69.1	130	43	108	69	1.0
S0009-M2	3841	19.7	32.9	68.3	147	45	108	63	1.0
SC17-2375R2	4576	17.5	33.9	71.4	143	47	117	82	1.7
TH 32004 R2Y	4149	19.0	33.1	70.2	157	46	115	65	1.3
TH 37004 R2Y	4229	18.0	35.1	71.0	152	49	116	82	1.5
TH 87000 RR2X	3655	17.2	36.0	72.7	131	48	113	71	1.8
TH 87003 RR2X	4065	17.7	34.7	70.2	144	42	112	77	1.0
TH 88005 RR2X	3618	18.4	32.5	70.1	166	47	116	70	1.0
Torro R2	4053	17.0	34.9	70.0	153	49	110	81	1.7
LSD (0.05)	1047	1.1	1.9	1.4	17.6	6.8	3.5	12.8	NS *
CV (%)	16.0	3.8	3.5	1.2	6.9	9.0	1.9	10.6	36.0

NS = not significant

* = Significant at P < 0.10

Table 3. Agronomics of 2017 WC Soybean Performance Evaluation – Irrigated vs Dry Land Soybean, 2017.

System/Variety	Yield (kg/ha)	% Oil	% Protein	Test weight (kg/hl)	Seed weight (g/1000)	Plants m^2	Maturity (days)	Height (cm)	Lodge (1-5)
Irrigated	4990	16.8	34.2	71.6	165	47	117	92	1.8
Dry Land	4033	17.9	35.0	70.3	157	47	112	74	1.2
LSD (0.05)	NS *	0.6	NS *	0.5	2.5	NS	NS *	17.8	NS *
CV (%)	12.4	3.1	3.1	1.1	5.8	10.3	2.0	8.7	0.6
Variety									
TH 33003 R2Y	***4811***	***17.6***	***34.4***	***71.0***	***164***	***48***	***116***	***93***	***1.7***
22-60 RY	4144	17.4	34.1	70.8	154	47	115	64	1.0
23-60RY	5164	16.2	34.7	71.6	164	50	115	94	1.8
Akras R2	4977	15.8	34.5	73.4	170	49	118	81	1.8
Barron R2X	4305	17.2	35.7	70.8	142	53	113	82	2.2
Bishop R2	4216	17.1	35.0	71.3	152	49	112	89	1.8
CFS17.1.03 R2	3703	16.4	35.5	70.1	151	48	110	76	1.2
CFS17.1.04 R2X	4866	17.7	33.3	70.6	181	48	117	81	1.2
Dario R2X	4869	17.2	36.0	72.4	150	45	114	86	2.0
DKB003-29	5234	17.0	34.5	71.1	192	45	116	88	1.8
DKB008-39	4594	17.5	35.2	71.6	156	48	112	85	1.6
DS0067Z1	4282	16.6	34.0	71.7	177	40	119	90	1.2
Dylano R2X	4251	17.5	35.0	72.0	166	48	118	79	1.1
EXP00418XRN	4730	16.8	34.7	71.5	153	49	115	89	1.3
HS 006RYS24	4180	16.5	33.9	71.9	182	45	118	94	1.5
Kosmo R2	4419	17.7	34.5	70.8	170	50	116	85	1.3
Lono R2	4871	16.8	34.2	73.0	159	42	117	86	1.9
LS 002R24N	4946	16.2	34.4	70.7	186	48	115	92	2.3
LS NorthWester	4424	18.5	34.9	70.9	170	51	116	103	1.9
LS TR17XT	3934	17.2	34.1	72.2	1152	44	113	82	1.2
LS TR19R2Y	4007	18.4	33.8	70.4	145	47	113	76	1.0
Mahony R2	4640	17.8	34.0	70.4	163	46	118	86	1.6
Marduk R2	4413	16.8	32.2	71.2	192	48	114	88	1.5
McLeod R2	4751	16.8	34.6	71.5	183	49	115	90	1.7
NSC Belmont RR2X	4353	17.6	36.0	69.9	171	41	116	92	1.3
NSC Leroy RR2Y	3637	16.7	36.3	70.0	144	41	108	70	1.3
NSC Star City RR2X	4193	17.2	35.6	72.2	136	46	112	75	1.2
NSC Watson RR2Y	4352	18.6	32.9	69.9	161	52	109	72	1.0
P002A63R	5418	17.0	35.5	70.8	158	50	115	89	1.0

P002T04R	4529	18.2	35.1	70.0	144	49	114	82	1.3
P006T46R	5230	18.3	34.3	70.3	169	51	118	90	1.0
P0007A43R	2899	18.0	33.4	67.1	143	43	100	60	1.0
PS 0035 NR2	4772	16.6	34.5	70.7	202	46	115	92	1.6
PS 00095 R2	4490	18.4	34.2	69.5	160	45	111	79	2.0
PV 115001 RR2	4072	17.5	36.2	70.7	166	43	113	76	1.2
S001-B1	4872	17.5	36.5	71.2	177	45	114	88	1.6
S003-L3	4317	19.0	32.9	69.9	174	44	113	76	1.0
S006-W5	5291	17.7	35.6	70.7	141	50	114	80	1.6
S007-Y4	5223	16.4	35.8	71.4	172	44	117	81	1.3
S0009-D6	3847	18.4	33.5	69.5	129	42	110	77	1.0
S0009-M2	4326	19.2	33.4	69.5	146	46	110	73	1.0
SC17-2375R2	5094	16.9	34.0	71.6	145	46	121	86	2.3
TH 32004 R2Y	4831	18.1	34.1	70.8	166	46	117	79	1.9
TH 37004 R2Y	4715	17.8	34.9	71.0	158	49	120	85	1.4
TH 87000 RR2X	4159	16.7	36.2	73.2	132	49	114	81	2.7
TH 87003 RR2X	4581	16.9	35.1	70.9	158	41	115	85	1.8
TH 88005 RR2X	4459	17.5	33.5	70.8	168	46	119	85	1.2
Torro R2	4162	16.4	35.5	71.0	154	45	112	90	2.3
LSD (0.05)	639	0.6	1.2	0.8	10.7	5.4	2.6	8.2	0.6
System x Variety Interaction									
LSD (0.05)	NS *	S	S	S	NS	NS	S	NS	S

S = Significant NS = not significant * = Significant at P < 0.10

Demonstration of Potential Irrigated Crops

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
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- Garry Hnatowich, PAg, Research Director, ICDC

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)

Objectives
This demonstration gave producers the opportunity to view some unfamiliar crops and compare different varieties which will help them decide on incorporating them into their crop rotations.

Research Plan
Four crops were selected for this trial, two varieties of quinoa, 1 variety of niger, 1 variety of borage and a variety of marrowfat peas (table 1). The seeding, date, depth and rate for each crop are described in table 1.

Hand weeding was done throughout the growing season, as there is little or no in crop herbicide options for these crops. The agronomic information for this trial is illustrated in table 1.

Table 1. Crops and Varieties grown and general agronomy for this Demonstration

Crop	Variety	Seeding Date	Harvest Date	Seeding depth	N rate (kg/ha)	P205 (kg/ha)
Quinoa	Norquin NQ94PT	May 31	Sept 27	¾ inch	80	25
Quinoa	Norquin Black	May 31	Sept 27	¾ inch	80	25
Niger	NA	May 31	Sept 27	¾ inch	80	25
Borage	NA	May 31	Sept 27	¾ inch	50	25
Marrowfat Pea	Hitomi	May 31	Sept 20	¾ inch	Inoc	25

This demonstration was seeded with a no-till drill on field 9 at the CSIDC farm. Each treatment consisted of 6 rows with 6x1.5m dimensions with guard rows at the end of the demonstration. The plot plan can be seen in figure 1. The trial was irrigated with a low pressure pivot system in order to keep soil moisture above 60% by weight throughout the growing season. A total of 129 mm (5 inch) of irrigation was applied and 103 mm (4 inch) of rainfall occurred for this trial.

Figure 1: Plot Plan for Demonstration of Potential Irrigated Crops

1.75 m							
	Marrow Fat	Niger	Borage	Quinoa			
	Pea						
		Seed		Quinoa 1	Quinoa 2	Quinoa 1	
Pea	Hitomi	Rate 1	Variety 1	Rainbow	94PT		6 m
Border				ELIMINATED		Border	
1 - 1.5"	1 - 1.5"	1/2"		1/2 - 1"	1/2 - 1"	1/2 - 1"	
Inoc	Inoc	80 kg N	50 kg N	80 kg N	80 kg N	80 kg N	
25 kg P2O5	25 kg P2O5	25 kg P2O5	25 kg P2O5	25 kg P2O5	25 kg P2O5	25 kg P2O5	
			12.25 m				

Results and Discussion

Producers are looking for new types of crops to add in their rotation in order to help control disease and pest issues. New specialty crops are becoming available and markets for them are being, or are already established. There is limited agronomic knowledge for these crops under irrigation. This demonstration will both evaluate the crop's growing potential, and also provide producers with a side-by-side comparison between these different crops. The crops included in this trial will include; niger, coriander, quinoa, marrowfat peas and borage.

Demonstrating these higher value crops falls in line with the first pillar in Saskatchewan's irrigation strategy, which is to enhance the returns from existing irrigation. Increasing acres of these crops under irrigation would provide value added opportunities as well as a higher gross return per irrigated acre.

Figure 1: The 2017 Potential Irrigated Crop Trial on September 6th

The Results of this demonstration are listed in table 2 for this trial.

This is the third year that Quinoa has been grown in this trial at CSIDC. In 2015 both varieties, black and golden, failed to produce any harvestable yield. This was hypothesized to be caused by heat blast sterilization or excess water stress. In 2016, the harvest was successful despite very high precipitation throughout the growing season with the golden variety producing 1498 kg/ha (1336 lb/ac). The 2017 trial produced a very poor amount with the variety golden, which is bred for Saskatchewan conditions producing 471 kg/ha (420 lb/ac) under the irrigated trial (table 2). The plot that contained the variety rainbow was discarded due to poor emergence and no yield was obtained.

Crop	Yield (kg/ha)
quinoa Rainbow	0
quinoa Golden	471
niger	47
borage	676
Hitomi peas	180

Table 2. Results for 2017 Potential Irrigated Crops Trial

Niger produced 47kg/ha (42 lb/ac) which is much far lower than what was achieved in the 2016 trial which yielded 850 kg/ha (758 lb/ac). Borage performed slightly less than 2016's trial yielding 676kg/ha (603 lb/ac). The marrowfat pea variety Hitomi, performed poorly compared to last year's trial producing 180 kg/ha (161 lb/ac) under irrigation.

Conclusion

Quinoa

Quinoa is a crop grown for seed production that is Native to the Andes Mountains of Bolivia, Chile, and Peru, and has been eaten as a grain for well over 5,000 years. It has received a lot of attention in North America recently due to its high nutritional value. Quinoa contains all the essential amino acids that humans require and is a complete plant protein. This makes it a great alternative to meat for vegetarians. It also is gluten free so it can be used as a side dish for people with celiac disease or people following gluten free diets.

Figure 2. Quinoa on August 8th

Production is growing in Western Canada with around 35000 acres contracted in 2017. Currently Northern Quinoa sells all the seed, buys all the grain and does the processing for all Quinoa grown in Saskatchewan. Quinoa yields are highly variable and can range from 300 to 2,000 lbs/ acre. This trial produced on the low end of yield at 471 lbs/acre for the Golden Variety. The Black variety had very poor establishment and was not harvested. If a producer sold this crop for the typical price ($0.60/lb) he would gross $283/acre using the data from this year's trial. The lower yield from his year's trial could have been caused by the hot weather during flowering sterilizing the plant, which is a problem for quinoa. Further investigation of growing quinoa in the Outlook area is necessary due to inconstant yields from year to year. For more information on growing this crop contact Northern Quinoa at (306) 933-9525.

Niger

Niger is a grain crop with most commercial production occurring in Ethiopia. It is a high-water user that requires around 25 inches of water to achieve optimum yields. This crop has been research as a potential by Bill May at the research farm in Indian Head has been testing this crop to be grown for the local bird seed market.

Figure 3. Niger setting seed on August 8th

Yields at Indian head average from 250-500 lbs/acre under dryland conditions. The yield for the irrigated plot in this trial was 42 lbs/ac which would be considered disappointed for this crop. In the 2016 trials there was pollinators brought out which cause it to yield much higher at over 750 lbs/acre. Pollinators were not brought out in 2017 due to logistics issues and the poor yield could have been caused by that.

Borage

Borage is an annual spice crop grown for its gamma linolic Acid content contained in its seed. This crop does not tolerate drought making irrigation necessary to prevent crop loss and achieve optimum yields.

Figure 4. Borage setting seed on August 6th

There are two Canadian borage exporters in Saskatchewan, Bioriginal Food & Science Corp. (Saskatoon) and Northern Nutraceuticals Inc. (Spalding). There are currently around 200 acres grown in Saskatchewan which are marketed by these companies. The yields in this demonstration suggest that further evaluation is required before giving merit for this crop to be grown under irrigation in Saskatchewan. It is possible that this crop suffered due to the lack of pollinators.

Marrowfat Peas

Marrowfat Peas are flat, large-seeded peas used in specialty snack foods markets in Asia and the United Kingdom. These peas contain slightly more fat and sugar than regular field peas and typically yields 10-20% lower. Rudy Agro currently markets this crop and pays a premium for these peas. The yield obtained in this year's results was poor and would not be economical for production.

Figure 5. Marrowfat Peas in full maturity on August 6th

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- Colin Dutcheshen, Northern Quinoa Corp for supplying quinoa seed and agronomic guidance
- Bill May, Agriculture and Agri-Food Canada, who supplied the niger seed
- Bioriginal for supplying the borage seed
- Wes Walker, Rudy Agro, for supplying the marrowfat pea seed

AGRONOMIC TRIALS

Defining Agronomic Practices for Forage Corn Production in Saskatchewan

Funding

Funded by the Agriculture Development Fund (ADF)

Project Leads

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- Co-investigator:
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    - Stephanie Ginter, NARF Melfort
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Organizations

- Prairie Agricultural Machinery Institute
- Western Beef Development Centre
- 5 AgriARM members

Objectives

The objective of this study is to:

(1) To develop and refine seeding and fertility recommendations for corn silage production
(2) To evaluate the cost of production and feed quality of corn silage grown in Saskatchewan

Research Plan

Corn production in Saskatchewan is gaining popularity due to its high feed quality for cattle production. The agronomic recommendations for corn production in Saskatchewan are based on field trials conducted before hybrids were developed for the corn heat units (CHUs) typically experienced in Saskatchewan. Since the input costs for corn production are more than double the input costs for barley or oats (*2015 Crop Production Guide*), more refined recommendations for seeding and fertility rates are required to maximize profitability. In addition, a detailed economic analysis on the cost of production and an analysis of the feed value of the product are required to facilitate management decisions regarding feedstocks and feeding practices.

The silage trial was established in the spring of 2017 at CSIDC. The soil, developed on medium to moderately coarse-textured lacustrine deposits, is classified as Bradwell loam to silty loam.

All seeding operations were conducted using a commercial precision corn planter owned and operated by PAMI. The trial was established in a factorial randomized complete block with three replications, treatments consisted of;

- two corn hybrids with varying corn heat unit maturity ratings,
- three seeding rates – 75,000 (low), 100,000 (mid) and 125,000 (high) plants/ha, and
- three rates of nitrogen (N) fertilizer application such that soil N + fertilizer N = 112 (low), 168 (mid) and 224 (high) kg N/ha (100, 150 and 200 lbs N/ac).

Corn hybrids were Pioneer P7958AM (2300 CHU) and DeKalb 30-07 (2325 CHU). Soil test analysis indicated a level of soil available N to a depth of 0 – 60 cm as 22 kg N/ha (20 lb N/ac) so supplemental N fertilizer, as 46-0-0, was applied in a side banded position at rates of 90, 146 and 202 kg/ha (80, 130 and 180 lb N/ac) to achieve target N levels. The corn was seeded on 76 cm row spacing. Four rows were seeded per treatment plot. Corn plots consisted of four rows and measured 3 m x 6 m.

The trials were seeded on May 23. Fertilizer N was broadcast and incorporated prior to seeding along with 34 kg P_2O_5/ha as 12-51-0 in a pre-seed band application. Weed control consisted of spring pre-plant and a post emergence applications of Roundup (glyphosate) supplemented by hand weeding.

Silage yield was obtained when the milk line of each hybrid from their respective mid-seeding rate and mid-N fertilizer rate reached the mid-point down the kernel. The silage was harvested with a Hege forage harvest combine equipped with a corn silage chopper header, wet field yield was recorded and subsamples of chopped material sampled for processing. Silage corn was harvest September 6.

Growing season rainfall (May through August) and irrigation was 129 mm and 216 mm, respectively. Cumulative Corn Heat Units (CHU) were 2226 for the period May 15 - September 5. Climatic conditions in 2017 were slightly warmer and much drier than historic norms.

Results

Agronomic data collected in the study is tabulated in Table 1 (analysis of variance procedures conducted on entire data set), results of each factorial treatment within the test are summarized in Table 2.

Analysis of variance procedures conducted upon all treatments indicate that treatments were statistically significant differences from one another with respect to dry and wet yield. However factorial analysis of variance procedures indicate that only seeding rate resulted in significant yield differences as shown in Table 2 and Figure 1. Though number of cobs per plot were not recorded the yield gain associated with increasing seeding rate can likely be attributed to the higher plant counts associated with higher plant density per plot. Yield differences between the two hybrids and nitrogen (N) fertilization rates were not statistically different (Figure 1). The lack of yield response to N is surprising, given that the spring soil test analysis indicated a marginal level of available N in the soil. There is a possibility that the lack of a nitrogen fertilizer yield response was due to high levels of available N in the soil at depths below which was sampled for analyses. The previous very wet years at Outlook has resulted in an elevated water table and with the dry, hot growing season of 2017 it's possible the corn roots either grew into these reserves or they moved to roots by upward movement of soil solution by capillary action. It is also possible that a significant amount of the broadcast N applied was lost to plant availability through such mechanisms as volatilization, denitrification, leaching or immobilization.

As indicated in Table 2 the hybrids evaluated differed in plant characteristics. N fertilizer application rates had little dramatic impact on any agronomic measurement captured in 2017. Increased seeding rate did delay days to anthesis and silking.

These results are from the second year of an intended three year study. PAMI will combine this data with the results from another four locations and a complete report prepared at project completion.

Table 1. Defining Agronomic Practices for Forage Corn Production – CSIDC site.

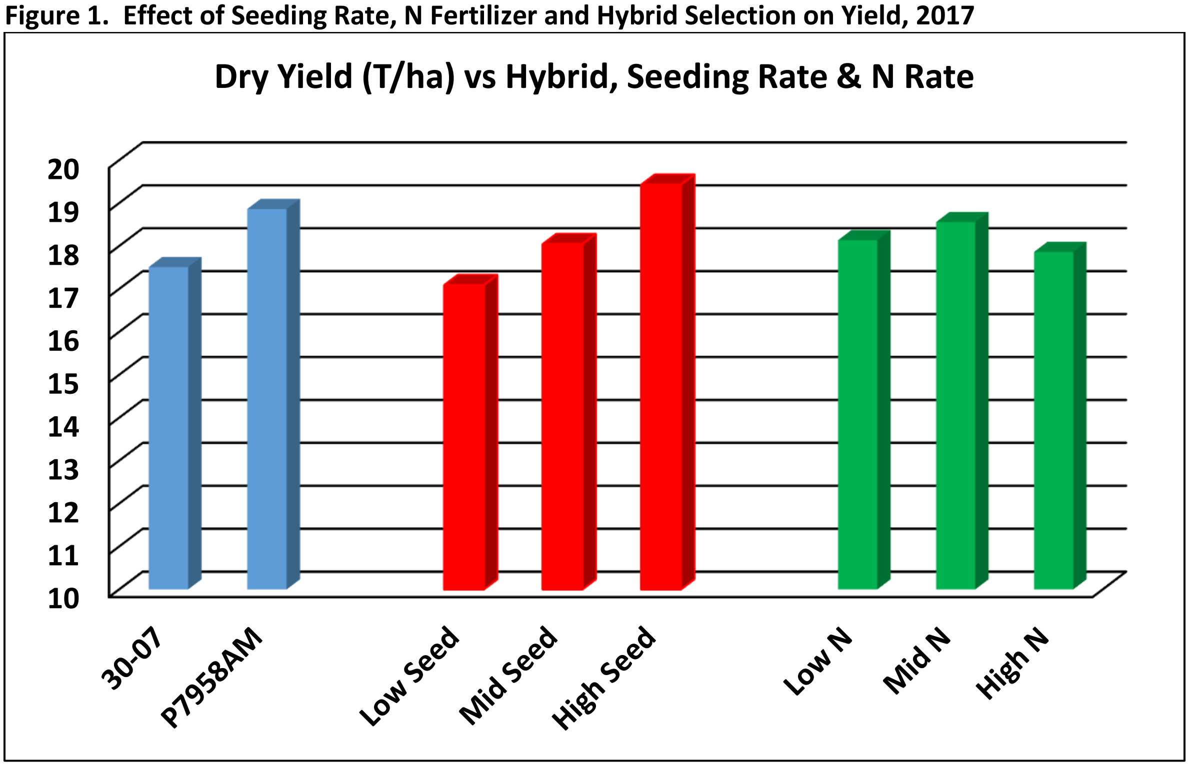
Hybrid	N Rate	Seed Rate	Dry Yield (T/ha)	Wet Yield @65% Moisture (T/ha)	% Moisture	Plant Stand (#/ha)	Days to Anthesis	Days to Silk	Plant Height (cm)
1. P7958AM	Low	Low	18.52	52.91	75.7	78,947	71	73	252
2. P7958AM	Low	Mid	19.20	54.85	76.3	106,360	71	76	253
3. P7958AM	Low	High	20.54	58.70	76.0	129,020	71	75	248
4. P7958AM	Mid	Low	18.09	51.69	75.7	78,216	71	73	243
5. P7958AM	Mid	Mid	19.91	56.88	75.7	104,898	71	75	253
6. P7958AM	Mid	High	19.41	55.45	77.1	130,848	72	77	251
7. P7958AM	High	Low	16.95	48.44	77.3	77,485	72	76	236
8. P7958AM	High	Mid	16.33	46.67	80.2	101,243	71	75	249
9. P7958AM	High	High	20.82	59.49	76.6	115,497	72	76	260
10. 30-07	Low	Low	15.50	44.21	77.1	76,023	70	73	227
11. 30-07	Low	Mid	15.76	45.02	76.7	101,974	70	75	212
12. 30-07	Low	High	19.33	55.24	76.7	128,289	71	75	221
13. 30-07	Mid	Low	17.30	49.43	76.3	75,658	70	73	243
14. 30-07	Mid	Mid	18.35	52.42	77.2	101,974	71	74	244
15. 30-07	Mid	High	18.29	52.27	77.5	125,731	71	75	237
16. 30-07	High	Low	16.19	46.27	78.1	73,465	70	74	240
17. 30-07	High	Mid	18.72	53.50	76.8	91,374	70	74	241
18. 30-07	High	High	18.17	51.90	78.5	116,228	71	76	237
LSD (0.05)			2.44	6.98	2.1	9,897	1.1	1.9	19.5
CV (%)			8.1	8.1	1.6	5.9	0.9	1.5	4.9

Table 2. Factorial Analysis of Variance for Agronomic Parameters of Forage Corn 2017.

Treatment	Dry Yield (T/ha)	Wet Yield @65% Moisture (T/ha)	% H_2O	Plant Stand (#/ha)	Days to Anthesis	Days to Silk	Plant Height (cm)
Hybrid							
P7958AM	18.86	53.90	76.7	102,501	71.4	75.1	249
30-07	17.51	50.03	77.2	98,968	70.5	74.4	233
LSD (0.05)	0.81	2.33	NS	3,299	0.4	0.6	6.5
Seeding Rate							
Low	17.09	48.83	76.7	76,632	70.7	73.8	240
Mid	18.04	51.56	77.1	101,304	70.9	74.8	242
High	19.43	55.51	77.1	124,269	71.4	75.6	242
LSD (0.05)	1.0	2.85	NS	4,040	0.4	0.8	NS
Nitrogen Fertilizer Rate							
Low	18.14	51.82	76.4	103,436	70.8	75	235
Mid	18.56	53.02	76.6	102,887	71.1	75	245
High	17.86	51.04	77.9	95,882	71.1	75	244
LSD (0.05)	NS	NS	0.9	4,040	NS	NS	8.0
CV (%)	8.1	8.1	1.6	5.9	0.9	1.5	4.9

NS = not significant

Figure 1. Effect of Seeding Rate, N Fertilizer and Hybrid Selection on Yield, 2017



Developing Nitrogen Management Recommendations for Soybean Production in Saskatchewan

Funding

Funded by the Saskatchewan Pulse Growers

Project Lead

- Project P.I: Chris Holzapfel (IHARF)
- ICDC Lead: Garry Hnatowich

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Indian Head Research Foundation (IHARF)
- Northeast Agriculture Research Foundation (NARF)
- Saskatchewan Pulse Grower

Objectives

The objective of this study is to investigate soybean responses to and interactions between granular inoculant rates and contrasting N fertilization practices.

Research Plan

The trial was established at the CSIDC Off-station land base (Knapik). The soybean variety 23-60RY was used due to its relative early maturity. All seed was pre-packaged by weight after adjusting for seed weight, % germination and assuming a 90% seedling survival. Target plant population was 556,000 plants/ha. Seed was treated with Acceleron (fluxapyroxad, pyraclostrobin, matalaxyl and imidacloprid) and with Optimize ST liquid soybean inoculant. The trial was established in a factorial randomized complete block plot design with four replications. Plots were seeded on May 23. Granular Cell-Tech soybean inoculant was applied at an application rate of 0, 5.2, 10.4 or 20.8 kg/ha (0, 1x, 2x or 4x recommended application rate) with the seed. Granular urea and ESN were side banded at seeding, UAN was surface dribble banded at R1 growth stage of soybean, all nitrogen fertilizers were applied at a rate of 55 kg N/ha. Plots were maintained weed free by a pre-plant burn-off and post-emergent glyphosate applications. Priaxor DS (fluxapyroxad & pyraclostrobin) and Copper 53W (tribasic copper sulphate) fungicides were applied for foliar disease prevention. Whole plant harvest of a 1 m^2 area occurred at R3 stage (early pod) for N uptake determination. Harvest area was 1.5 x 7.0 m, plots were combined with a Wintersteiger plot combine when the plants were dry enough to thresh and the seed moisture content was <20%. Harvest occurred on October 12. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser.

Total in-season rainfall from May through October was 157.0 mm. Total in-season irrigation at CSIDC Off-station was 192.5 mm.

Soil test results obtained prior to seeding are shown in Table 1.

Table 1. Soil test results, Agvise Labs 2017.

Depth (cm)	NO_3-N	P	K	SO_4-S
	ppm			
0 - 15	6	5	165	15
15 - 60	30			15 (15-30cm)
Organic Matter	1.9%			
pH (0 - 15 cm)	7.3			
pH (15 - 60 cm)	7.8			
Carbonate				
Soluable Salts (0 - 15 cm)	0.32 mmho/cm			
Soluable Salts (15 - 60 cm)	0.34 mmho/cm			

Results

Individual treatment effects on seed and seed quality parameters measured, and RCBD statistical analyses, are outlined in Tables 2 & 3 (tissue and seed N concentrations if available at time of printing). Results presented when data is summarized by factorial analyses is presented in Tables 4 & 5.

Granular inoculation had a statistically significant impact on grain yield. In general, all granular inoculant applications increased soybean seed yield above the absolute control (0 kg/ha granular inoculant, no N fertilizer). The trial was established on ground with no prior history of soybean production and therefore free of the *Bradyrhizobium japonicum* species of bacteria necessary for biological nitrogen fixation to occur in soybean. The 0X granular control treatments did have a seed applied inoculant but it is apparent this single dose application was insufficient to provide optimal seed yields. This finding is in keeping with prior results at ICDC and other Saskatchewan research trials. Though the 4X granular applications tended to have the highest yields suggesting that the soybeans produced at this site, for this growing season, had a high N demand. Yields were high, and the soil test available soil N was relatively low, so the high N demand through either N fixation and/or N fertilization is reasonable. N fertilization also had a significant effect on soybean seed yield. The mean effect of fertilizer N additions, regardless of the N fertilizer source, increased seed yield (Table 4). The interaction between granular inoculation and N fertilizer additions is graphically illustrated in Figure 1 and provides a visual representation of the yield results obtained. N fertilizer additions increased grain yields above the unfertilized treatments across all granular inoculant rates. The highest yield responses occurred where no granular inoculant was applied. Results suggest that in 2017 biological N fixation was incapable of providing optimal N to the plants to produce maximum yields. Yields tended to be higher when the fertilizer was applied at the time of seeding as opposed to a later in-season application. The high responses achieved when fertilizer N is applied without granular inoculant also suggests that fertilizer might be able to be used in an “inoculant failure” situation as a rescue strategy.

Nitrogen fertilizer applications also tended to produce higher plant biomass yields and produce taller plants. Nitrogen fertilizer additions had only little influence on seed oil and protein contents. Analysis for tissue N concentrations performed from the above ground mid-season biomass sampled collected indicated that granular inoculant applications failed to increase tissue N concentrations in the plant, nor did the application of fertilizer as ESN. Both urea and dribble band UAN significantly increased tissue N concentration. Total N uptake in plant biomass (data not shown) was also not influenced by granular inoculation but all fertilizer applications resulted insignificantly more N in the above ground plant material. Unfortunately, seed N concentrations have not as yet been determined at the time of this publication.

This is the third and final year of this trial, results of the past three seasons will be summarized and a final report prepared.

Table 2. Effect of treatments on seed yield and quality.

Entry	Granular Inoculant	N Fertilizer Treatment	Yield (kg/ha)	Yield (bu/ac)	Oil (%)	Protein (%)	Test weight (kg/hl)	1000 Seed weight (mg)
1	no granular inoculant	0 Nitrogen	2983	44.4	16.3	33.8	72.3	157
2	4.5 kg/ha	0 Nitrogen	3779	56.2	16.2	33.9	72.2	146
3	9.0 kg/ha	0 Nitrogen	3425	50.9	16.2	34.1	71.4	151
4	18.0 kg/ha	0 Nitrogen	3810	56.7	15.8	34.3	72.2	148
5	no granular inoculant	Urea Side Band	4538	67.5	15.8	34.3	72.6	153
6	4.5 kg/ha	Urea Side Band	4002	59.5	15.7	34.4	72.0	145
7	9.0 kg/ha	Urea Side Band	4190	62.3	15.7	34.5	71.9	149
8	18.0 kg/ha	Urea Side Band	4426	65.8	15.7	34.4	72.2	153
9	no granular inoculant	ESN Side Band	4196	62.4	16.0	33.9	73.0	145
10	4.5 kg/ha	ESN Side Band	4343	64.6	16.0	33.7	71.9	146
11	9.0 kg/ha	ESN Side Band	3942	58.6	16.2	33.4	72.1	150
12	18.0 kg/ha	ESN Side Band	4667	69.4	15.8	34.4	72.1	147
13	no granular inoculant	UAN Dribble Band	4018	59.7	15.7	34.4	72.0	148
14	4.5 kg/ha	UAN Dribble Band	4071	60.5	16.0	33.9	72.1	146
15	9.0 kg/ha	UAN Dribble Band	3589	63.4	16.1	34.1	72.4	147
16	18.0 kg/ha	UAN Dribble Band	4499	66.9	15.8	34.5	72.4	151
		LSD (0.05)	689	10.2	NS *	NS	NS	NS
		CV	12.0	12.0	2.1	1.5	1.1	4.1

NS = not significant

* = Significant at P < 0.10

Table 3. Effect of treatments on field observations and N concentration.

Entry	Granular Inoculant	N Fertilizer Treatment	Plant Population (plants/ha)	Height (cm)	Dry Plant Biomass (g/m^2)	Biomass N (%)	Seed N (%)
1	no granular inoculant	0 Nitrogen	441,250	54	197	1.94	
2	4.5 kg/ha	0 Nitrogen	476,563	58	220	2.07	
3	9.0 kg/ha	0 Nitrogen	418,750	55	218	2.30	
4	18.0 kg/ha	0 Nitrogen	472,188	55	227	2.40	
5	no granular inoculant	Urea Side Band	477,500	70	327	2.53	
6	4.5 kg/ha	Urea Side Band	445,625	65	319	2.47	
7	9.0 kg/ha	Urea Side Band	474,063	67	371	2.18	
8	18.0 kg/ha	Urea Side Band	462,188	66	313	2.47	
9	no granular inoculant	ESN Side Band	468,125	69	347	2.13	
10	4.5 kg/ha	ESN Side Band	457,183	68	372	2.00	
11	9.0 kg/ha	ESN Side Band	461,250	63	276	2.11	
12	18.0 kg/ha	ESN Side Band	457,500	69	343	2.28	
13	no granular inoculant	UAN Dribble Band	436,250	61	309	3.03	
14	4.5 kg/ha	UAN Dribble Band	451,563	62	267	2.58	
15	9.0 kg/ha	UAN Dribble Band	465,938	52	271	2.67	
16	18.0 kg/ha	UAN Dribble Band	491,250	64	341	2.80	
		LSD (0.05)	NS	9.8	94	0.49	
		CV	9.2	11.0	22.3	14.4	

NS = not significant

Table 4. Effect of treatments on seed yield and quality, Factorial Analyses

Treatment	Yield (kg/ha)	Yield (bu/ac)	Oil (%)	Protein (%)	Test weight (kg/hl)	1000 Seed weight (mg)
Granular Inoculant Rate						
no granular inoculant	3934	58.5	15.9	34.1	72.5	151
4.5 kg/ha	4049	60.2	16.0	34.0	72.0	146
9.0 kg/ha	3786	56.3	16.0	34.0	71.9	149
18.0 kg/ha	4351	64.7	15.8	34.4	72.2	149
LSD (0.05)	345	5.1	NS	NS*	NS	NS
CV	12.0	12.0	2.1	1.5	1.1	4.1
Nitrogen Source & Placement						
0 Nitrogen	3499	52.0	16.1	34.0	72.0	150
Urea Side Band	4289	63.8	15.7	34.4	72.2	150
ESN Side Band	4287	63.7	16.0	33.9	72.3	147
UAN Dribble Band	4044	60.1	15.9	34.2	72.2	148
LSD (0.05)	345	5.1	0.2	NS*	NS	NS
Granular Inoculant Rate x Nitrogen Source & Placement						
LSD (0.05	NS	NS	NS	NS	NS	NS

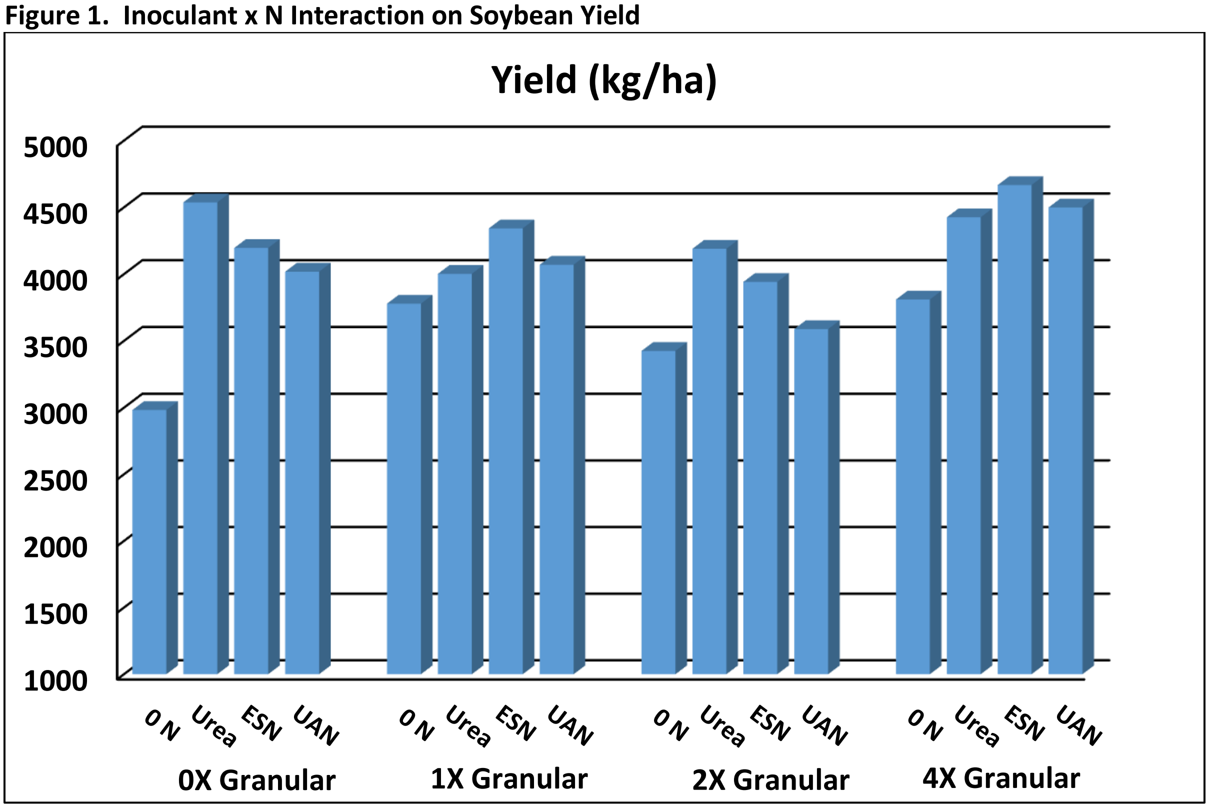
NS = not significant
* = Significant at P < 0.10

Table 5. Effect of treatments on field observations and N concentration, Factorial Analyses.

Treatment	Plant Population (plants/ha)	Height (cm)	Dry Plant Biomass (g/m^2)	Biomass N (%)	Seed N (%)
Granular Inoculant Rate					
no granular inoculant	455,781	64	302	2.41	
4.5 kg/ha	457,891	63	294	2.28	
9.0 kg/ha	455,000	59	284	2.31	
18.0 kg/ha	470,781	64	306	2.49	
LSD (0.05)	NS	NS	NS	NS	
CV	9.2	11.0	22.3	14.4	
Nitrogen Source & Placement					
0 Nitrogen	452,188	55	223	2.18	
Urea Side Band	464,844	67	333	2.41	
ESN Side Band	461,172	67	334	2.13	
UAN Dribble Band	461,250	60	297	2.77	
LSD (0.05)	NS	5	47	0.24	
Granular Inoculant Rate x Nitrogen Source & Placement					
LSD (0.05	NS	NS	NS	NS	

NS = not significant

Figure 1. Inoculant x N Interaction on Soybean Yield



Developing Phosphorus Management Recommendations for Soybean Production in Saskatchewan

Funding

Funded by the Saskatchewan Pulse Growers

Project Lead

- Project P.I: Chris Holzapfel (IHARF)
- ICDC Lead: Garry Hnatowich

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Indian Head Research Foundation (IHARF)
- Northeast Agriculture Research Foundation (NARF)
- Western Applied Research Corporation (WARC)
- Saskatchewan Pulse Growers

Objectives

The objective of this study is to improve P management recommendations for soybeans in Saskatchewan by investigating crop response to monoammonium phosphate (MAP; 11-52-0) rates and placement methods.

Research Plan

The trial was established at the CSIDC Off-station land base (Knapik). The soybean variety 23-60RY was used due to its relative early maturity. All seed was pre-packaged by weight after adjusting for seed weight, % germination and assuming a 90% seedling survival. Target plant population was 556,000 plants/ha. Seed was treated with Acceleron (fluxapyroxad, pyraclostrobin, matalaxyl and imidacloprid) and with Optimize ST liquid soybean inoculant. The trial was established in a factorial randomized complete block plot design with four replications. Plots were seeded on May 24. Phosphorus fertilizer was applied as either a seed-placed, side-band or broadcast and incorporated application. At each method of application phosphorus fertilizer was applied at rates of 20, 40 and 80 kg P_2O_5/ha as monoammonium phosphate (11-52-0). Broadcast phosphorus was applied prior to seeding and incorporated with the seeding operation. Granular Cell-Tech soybean inoculant was applied at an application rate of 10 kg/ha with the seed. Plots were maintained weed free by a pre-plant burn-off and post-emergent glyphosate applications. Priaxor DS (fluxapyroxad & pyraclostrobin) and Copper 53W (tribasic copper sulphate) fungicides were applied for foliar disease prevention. Whole plant harvest of a 1 m^2 area occurred at R3 stage (early pod) for P uptake determination. Harvest area was 1.5 x 7.0 m, plots were combined with a Wintersteiger plot combine when the plants were dry enough to thresh and the seed moisture content was <20% and occurred on October 12. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser.

Total in-season rainfall from May through October was 157.0 mm. Total in-season irrigation at CSIDC Off-station was 192.5 mm.

Soil test results obtained prior to seeding or fertilizer application are shown in Table 1.

Table 1. Soil Test Results 2017 – Agvise Laboratories

Depth (cm)	NO_3-N	P	K	SO_4-S
	ppm			
0 - 15	6	5	165	15
15 - 60	30			15 (15-30cm)
Organic Matter	1.9%			
pH (0 - 15 cm)	7.3			
pH (15 - 60 cm)	7.8			
Carbonate				
Soluable Salts (0 - 15 cm)	0.32 mmho/cm			
Soluable Salts (15 - 60 cm)	0.34 mmho/cm			

Results

Seed and seed quality parameters measured are outlined in Table 2. Field observations and phosphorus tissue concentration (if available at the time of printing) are shown in Table 3.

Phosphorus (P) fertilizer applications had a statistically significant effect on seed yield of soybean. The site was chosen on the basis of a soil test report submitted in early-May to Agvise Labs, the soil available P level determined in this soil test was 5 ppm and deemed deficient. Individual treatment yield results are illustrated in Figure 1, the mean influence of both P fertilizer rate and placement is shown in Figure 2. In general, as fertilizer P increased soybean seed yield increased. Given the low available soil P levels a response may have been unsurprising, however, the magnitude of the response was dramatic. The mean impact of an application of 80 kg P_2O_5/ha (methods of placement combined) provided an additional 957 kg/ha (14.2 bu/ac) seed yield increase over the unfertilized control treatment. The mean influence of method of P fertilizer application was less influential than fertilizer rate as shown in Figure 2. It is interesting that the broadcast P applications were generally as effective as the other placement methods. Due to the chemical nature of P fertilizers broadcast applications are deemed ineffective when compared to other methods of placement for most field crops other than perennial forages. However, soybeans are known to be effective scavengers of soil P, which could explain the effectiveness of this method of application in this trial year.

Neither the method nor rate of P fertilizer application had a significant effect on any other seed quality measurement as shown in Table 2. Plant populations were influenced by both method and rate of P fertilization. In general, the application of P fertilizer resulted in a higher plant establishment, likely due to stronger, healthier plants which resulted in an increased seedling survival rate as compared to the unfertilized control. Plant population was reduced by seed placed applications at all fertilizer rates compared to side band or broadcast applications indicating seed sensitivity to the fertilizer as illustrated in Figure 3. Tissue P analyses for above ground mid-season biomass samples did indicate some interesting observations. In general, the 20 P_2O_5/ha application rate, regardless of method of placement, failed to significantly elevate tissue P concentration. At the 40 & 80 P_2O_5/ha application rates tissue P concentrations were higher indicating that the fertilizer P was being acquired. Interesting the 80 P_2O_5/ha application was the lowest P concentration of the higher P fertilizer rate treatments and may reflect a degree of plant sensitivity to the higher rates. Also interesting is that the highest P plant tissue concentrations were obtained with the 80 P_2O_5/ha broadcast application indicating the scavenging ability of the plant to obtain shallow placed P fertilizer. In terms of total P uptake in biomass statistical analyses indicated there were no differences between treatments (data not shown) as was the case with respect to plant biomass yield.

Unfortunately, seed P concentrations have not as yet been determined at the time of this publication.

This is the third and final year of this trial, results of the past three seasons will be summarized and a final report prepared.

Table 2. Effect of treatments on seed yield and quality, 2017.

Entry	P_2O_5 Rate	P_2O_5 Placement	Yield (kg/ha)	Yield (bu/ac)	Oil (%)	Protein (%)	Test weight (kg/hl)	1000 Seed weight (mg)
1	Control (0 P_2O_5)	N/A	3042	45.3	16.0	34.1	71.9	148
2	20 P_2O_5 kg/ha	Seed-Placed	3704	55.1	15.9	34.4	71.7	150
3	20 P_2O_5 kg/ha	Side-Banded	3439	51.2	15.8	34.5	71.8	147
4	20 P_2O_5 kg/ha	Broadcast	3368	50.1	15.9	34.3	71.6	147
5	40 P_2O_5 kg/ha	Seed-Placed	3788	56.3	15.7	34.8	72.0	147
6	40 P_2O_5 kg/ha	Side-Banded	3677	54.7	15.8	34.6	72.1	151
7	40 P_2O_5 kg/ha	Broadcast	3747	55.7	15.7	34.3	69.2	143
8	80 P_2O_5 kg/ha	Seed-Placed	3871	57.6	16.1	34.1	72.1	147
9	80 P_2O_5 kg/ha	Side-Banded	4115	61.2	15.6	34.9	70.5	153
10	80 P_2O_5 kg/ha	Broadcast	4010	59.6	15.5	34.8	71.9	149
		LSD (0.05)	558	8.3	NS	NS	NS *	NS
		CV	10.5	10.5	2.08	1.6	1.8	2.8

NS = not significant
* = Significant at $P < 0.10$

Table 3. Effect of treatments on field observations and P concentration, 2017.

Entry	P_2O_5 Rate	P_2O_5 Placement	Plant Population (plants/ha)	Plant Height (cm)	Dry Plant Biomass (g/m^2)	Biomass P (%)	Seed P (%)
1	Control (0 P_2O_5)	N/A	446,562	50	181	0.28	
2	20 P_2O_5 kg/ha	Seed-Placed	460,625	55	204	0.29	
3	20 P_2O_5 kg/ha	Side-Banded	493,750	53	209	0.29	
4	20 P_2O_5 kg/ha	Broadcast	495,625	56	225	0.28	
5	40 P_2O_5 kg/ha	Seed-Placed	456,562	60	248	0.31	
6	40 P_2O_5 kg/ha	Side-Banded	465,625	58	218	0.30	
7	40 P_2O_5 kg/ha	Broadcast	509,375	59	242	0.30	
8	80 P_2O_5 kg/ha	Seed-Placed	432,187	59	249	0.30	
9	80 P_2O_5 kg/ha	Side-Banded	507,187	59	241	0.33	
10	80 P_2O_5 kg/ha	Broadcast	529,375	55	232	0.34	
		LSD (0.05)	56,231	NS	NS	0.03	
		CV	8.1	9.2	26.6	7.7	

NS = not significant

Figure 1. Effect of Phosphorus Fertilizer Application on Soybean Yield, 2017

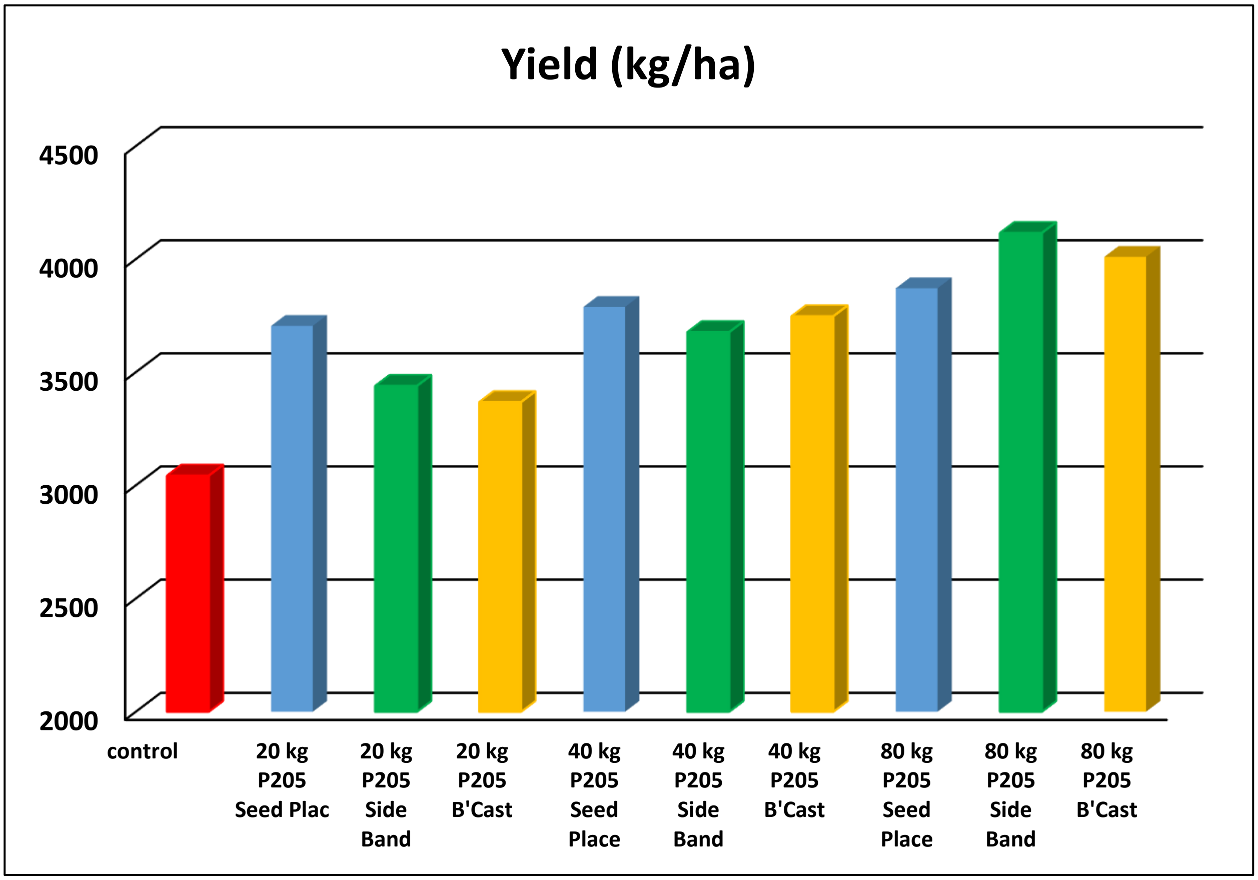


Figure 2. Effect of Phosphorus Fertilizer Rate & Placement on Soybean Yield, 2017

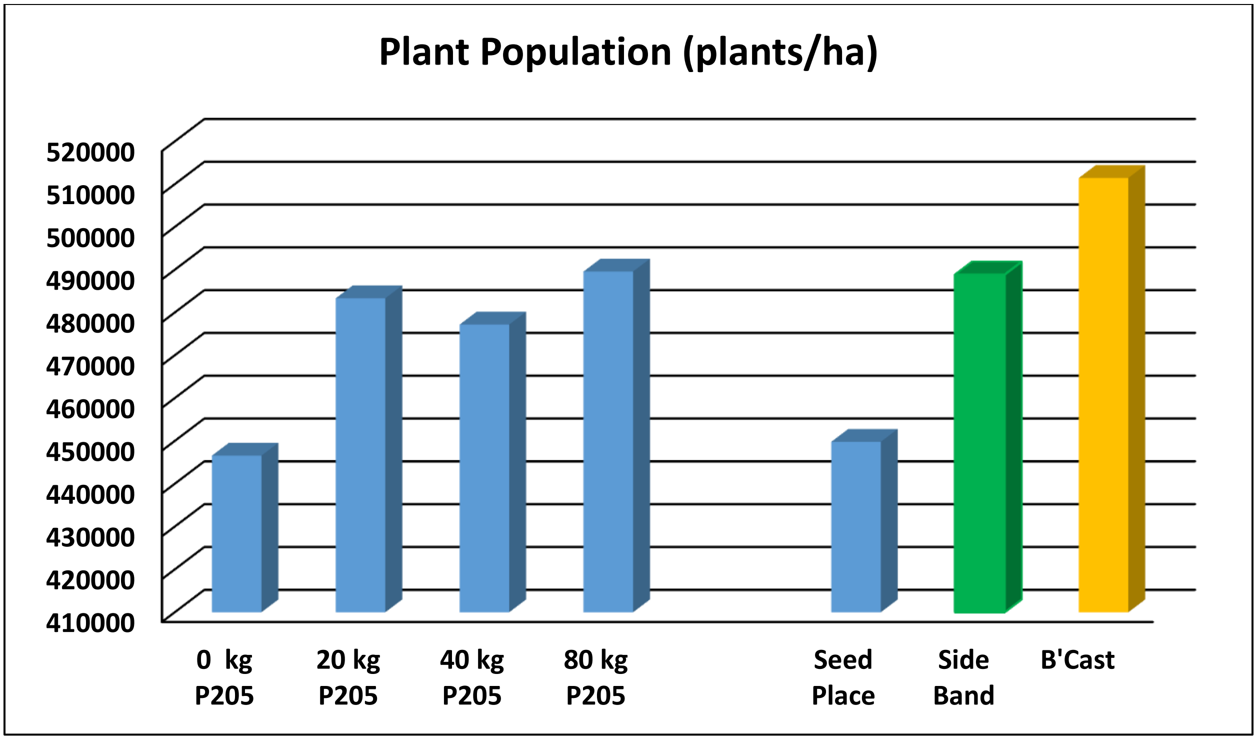
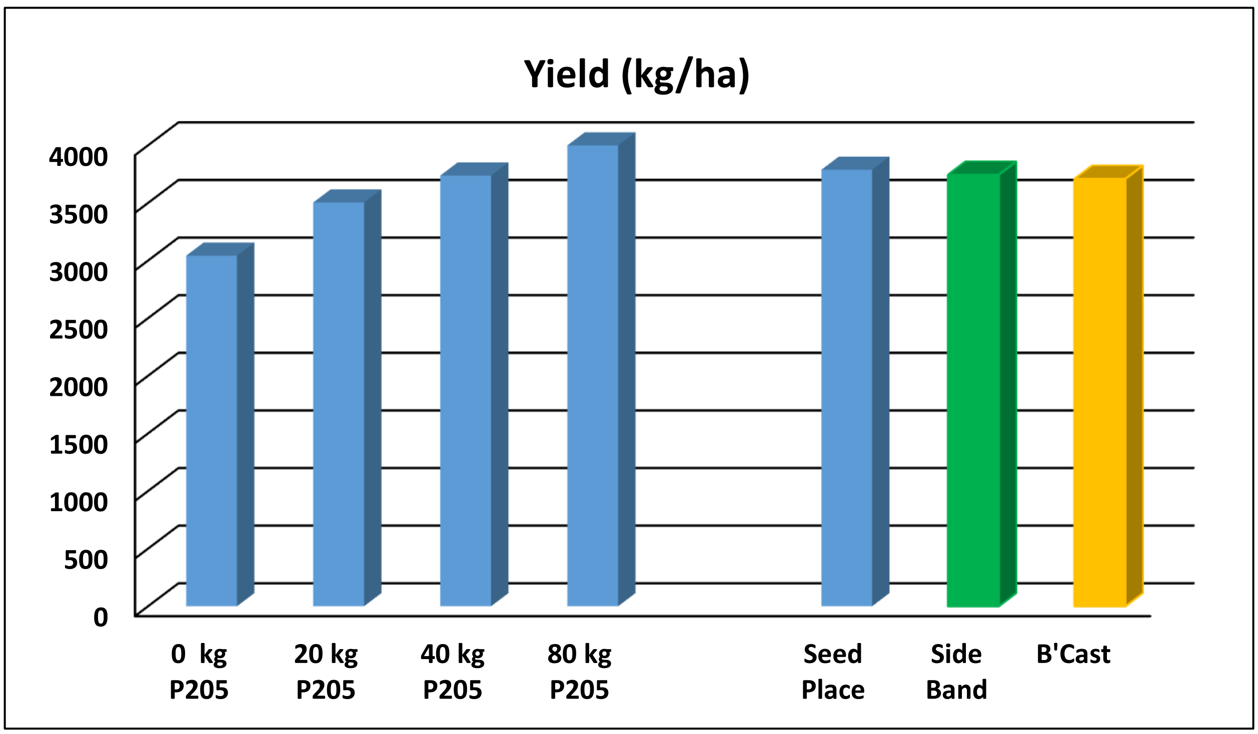


Figure 3. Effect of Phosphorus Fertilizer Rate & Placement on Soybean Plant Population, 2017



Faba Bean Plant Population Evaluation

Funding
Funded by the Saskatchewan Pulse Growers

Project Lead
- Project P.I: Steve Shirtliffe (U of S)
- ICDC Lead: Garry Hnatowich

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- University of Saskatchewan
- Indian Head Research Foundation (IHARF)
- Northeast Agriculture Research Foundation (NARF)
- Western Applied Research Corporation (WARC)
- East Central Research Foundation (ECRF)
- Wheatland Conservation Area Inc.
- Southeast Agricultural Research Foundation
- Saskatchewan Pulse Growers

Objectives
Faba beans are a reasonably well adapted pulse crop for large areas of the Canadian Prairies; however, acreage for this crop has traditionally been small and agronomic recommendations along producer experience for faba beans are limited. It has traditionally been recommended to target faba bean populations of 45 plants/m^2 but seedling mortality can be variable and difficult to estimate depending on spring soil moisture and temperatures. Higher faba bean seeding rates could have the advantages of accelerating maturity and increasing yields but may also have implications for disease.

The objectives of this study are to investigate the effects of faba bean seeding rate on the agronomic growth and seed yield.

Research Plan
The trial was established at CSIDC, in a randomized complete block design (RCBD) with four replications. Snowdrop faba bean was established at potential seeding rates of 5, 10, 20, 40, and 60 plants/m^2. Seeding rate was established by pre-weighed seed per treatment accounting for individual seed weight, 90% germination and assuming 85% plant establishment. The trial was seeded on May 10. Plot size was 1.5 m x 8 m. All plots received 30 kg P_2O_5/ha as 12-51-0 as a side banded application and TagTeam granular inoculant at a rate of 7.4 kg/ha as a seed place application during the seeding operation. Weed control consisted of a spring pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergence application tank mix of Odyssey (imazamox + imazethapyr). Supplemental hand weeding was conducted. An application of Matador (lambda-cyhalothrin) was applied August 25 for control of observed aphid activity. Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and the seed moisture content was <20%. Harvest occurred on September 28.

Total in-season precipitation at CSIDC from May through September 27 was 136.8 mm. Total in-season irrigation at CSIDC consisted of 100 mm.

Results

Agronomic observations collected are outlined in Table 1.

Table 1. Impact of Seeding Rate on Seed Quality & Agronomics of Faba Bean, 2017

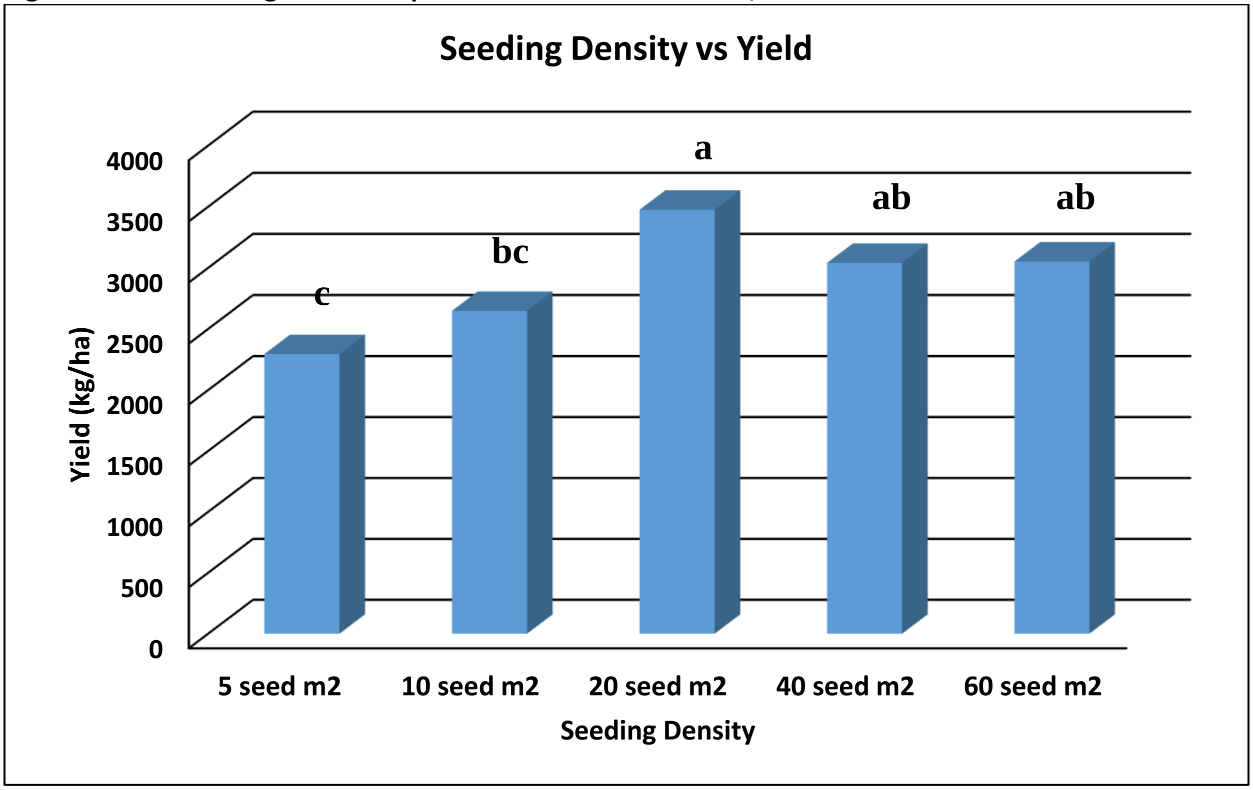
Seeding Rate (plants/m^2)	Yield (kg/ha)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Plant Population (plants/m^2)	Maturity (days)	Height (cm)	Lodging (1-5)
5	2295	25.8	81.6	230	10	114	107	1.0
10	2648	26.0	80.8	244	18	111	116	1.0
20	3475	25.8	81.4	246	32	113	127	1.3
40	3041	26.6	79.9	275	52	113	130	1.0
60	3052	26.8	80.3	287	72	113	127	1.0
LSD (0.05)	623	0.9	1.0	26	3.8	1.2	8	NS
CV	13.9	2.2	0.8	6.6	6.7	0.7	4.4	21.3

Faba bean seed yield was very low, the highest yield obtained was 53% of the highest yield obtained in 2016 and 59% obtained in 2015. Significant flower abortion was apparent throughout the flowering duration and individual plants had very few pods formed. As a cool season pulse the faba beans did not respond favourably to the heat and intense sun exposure through June and July. This is believed to be the cause of the low grain yields obtained.

Highest yield was obtained at the seeding rate that provided 20 plants/m^2, this yield was not statistically different from the 40 and 60 plants/m^2 rates but was compared to the 5 and 10 plants/m^2 rates. Effect of plant density on yield is graphically illustrated in Figure 1. In previous years trials highest yields were typically occurring at the 40 plants/m^2 population. The higher yield of the 20 plants/m^2 is possibly a reflection of the low rainfall, despite irrigation, and high light intensity of the season. Target plant populations were attempted using seed germination % and an estimated seedling survival of 85%. Established populations were proportionally higher at the two lowest target populations. Higher populations were likely reduced due to plant to plant competition within a seed row. Protein in general increased as seeding rate increased. Test weight was not strongly influenced by planting density in 2017. Seed weight increased as seed rate increased, plant height increased until the 20 plants/m^2 planting density. Days to plant maturity and plant lodging were not greatly influenced by planting density.

This is the third and final year of the trial. A final report will be prepared and results released at a later time.

Figure 1. Effect of Target Plant Population on Faba Bean Yield, 2017



Faba Bean Fungicide Evaluation

Funding

Funded by the Saskatchewan Pulse Growers

Project Lead

- Project P.I: Steve Shirtliffe (U of S)
- ICDC Lead: Garry Hnatowich (ICDC)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- University of Saskatchewan
- Indian Head Research Foundation (IHARF)
- Northeast Agriculture Research Foundation (NARF)
- Western Applied Research Corporation (WARC)
- East Central Research Foundation (ECRF)
- Wheatland Conservation Area Inc.
- Southeast Agricultural Research Foundation
- Saskatchewan Pulse Growers

Objectives

The objectives of this study are to investigate the merits of foliar fungicide applications on faba bean in western Canada for the control of chocolate spot.

Research Plan

The trial was established at CSIDC, in a randomized complete block design (RCBD) with four replications. Snowdrop faba bean was established at a target seeding rates of 50 plants/m^2. Seeding rate was established by pre-weighed seed per treatment accounting for individual seed weight, % germination and assuming 85% plant establishment. The trial was seeded on May 10. Plot size was 1.5 m x 8 m. All plots received 30 kg P_2O_5/ha as 12-51-0 as a side banded application and TagTeam granular inoculant at a rate of 7.4 kg/ha (2X recommended rate) as a seed place application during the seeding operation. Weed control consisted of a spring pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergence application of Odyssey (imazamox + imazethapyr). Supplemental hand weeding was conducted.

Fungicide applications were applied at early and mid-flowering using a high-clearance small plot sprayer. Early or 10% flower is considered to occur when the majority of plants have at least 1 flower open at the first node. Mid or 50% flower is considered to occur when the majority of plants have at least 1 flower open at the fourth node. Application for the 10% flower occurred on June 30 and 50% flower on July 6, 2017. Fungicides applied were Bravo 500 (chlorothalonil), Priaxor DS (fluxapyroxad + pyraclostobin), Propulse (prothioconazole + fluopyram) and Vertisan (penthiopyrad). An application of Matador (lambda-cyhalothrin) was applied August 25 for control of observed aphid activity.

Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and the seed moisture content was <20%. Harvest occurred on September 29.

Total in-season precipitation at CSIDC from May through September 27 was 136.8 mm. Total in-season irrigation at CSIDC consisted of 100 mm.

Results

Faba bean agronomic observations and seed quality are shown in Table 1. Statistically, neither fungicide formulation nor time of application had an effect on faba bean seed yield. Significant flower abortion was apparent throughout the flowering duration and individual plants had very few pods formed. As a cool season pulse the faba beans did not respond favourably to the heat and intense sun exposure through June and July. This is believed to be the cause of the low grain yields obtained and may have limited or masked potential yield responses to fungicide treatment.

Fungicide treatment had no impact on any other seed quality or plant characteristics measured in Table 1.

The disease rating scale utilized in this study are shown in Table 2 and the dates and ratings obtained are shown in Table 3. In general, disease severity incidence was very low and not unexpected given the field season was dry and very windy. These environmental conditions were not conducive to disease pressure.

This is the third and final year of the trial. A final report will be prepared and results released at a later time.

Table 1. Agronomics & Seed Quality of Faba Bean, 2017

Entry	Fungicide	Application Timing	Yield (kg/ha)	Protein (%)	Test weight (kg/hl)	1000 Seed weight (mg)	Height (cm)	Plant Population (plants/m^2)
1	Control	N/A	2564	26.1	80.2	287	123	60
2	Priaxor DS	10% Flowering	2822	26.8	80.4	279	121	62
3	Propulse	10% Flowering	2653	26.1	79.8	275	119	60
4	Vertisan	10% Flowering	2725	26.3	80.3	286	122	66
5	Bravo	10% Flowering	2843	26.5	79.7	282	122	62
6	Priaxor DS	50% Flowering	2811	25.9	80.6	257	116	58
7	Propulse	50% Flowering	2724	26.5	80.3	288	122	59
8	Vertisan	50% Flowering	2757	26.4	80.8	275	119	63
9	Bravo	50% Flowering	2911	26.4	80.2	296	122	66
		LSD (0.05)	NS	NS	NS	NS	NS	NS
		CV	10.5	2.0	0.8	7.4	5.0	10.5

NS = not significant

Table 2. Disease Rating System

Score	0	1	2	3	4	5	6	7	8	9	10
% Disease	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100

Table 3. Disease Ratings Until Beginning of Senescence.

Entry	Fungicide	Application Timing	Disease Rating					
			June 21	**July 5**	**July 14**	**July 28**	**Aug 15**	**Aug 29**
1	Control	N/A	0.45	1.0	1.0	2.0	3.2	5.0
2	Priaxor DS	10% Flowering	0.50	1.0	1.0	2.0	3.1	5.0
3	Propulse	10% Flowering	0.35	1.0	1.0	2.0	3.1	5.0
4	Vertisan	10% Flowering	0.45	1.0	1.0	2.0	3.1	5.0
5	Bravo	10% Flowering	0.60	1.0	1.0	2.0	3.1	5.0
6	Priaxor DS	50% Flowering	0.40	1.0	1.0	2.0	3.1	5.0
7	Propulse	50% Flowering	0.40	1.0	1.0	2.0	3.1	5.0
8	Vertisan	50% Flowering	0.60	1.0	1.0	2.0	3.0	5.0
9	Bravo	50% Flowering	0.40	1.0	1.0	2.0	3.1	5.0
		LSD (0.05)	NS	NS	NS	NS	NS	NS
		CV	31.0	1.0	1.0	1.0	3.3	1.0

NA = not applicable

Evaluating Inoculant Options for Faba beans

Funding

Funded by the Saskatchewan Pulse Growers

Project Lead

- Project P.I.: Garry Hnatowich, Research Director (ICDC)

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Indian Head Research Foundation (IHARF)
- Northeast Agriculture Research Foundation (NARF)
- Western Applied Research Corporation (WARC)
- East Central Research Foundation (ECRF)
- Wheatland Conservation Area Inc.
- Southeast Agricultural Research Foundation (SERF)
- Saskatchewan Pulse Growers

Objectives

The objective of this trial is to determine the effects of two inoculants at different rates and in combination on faba bean grown in various soil/climatic zones of Saskatchewan.

Research Plan

Field trials will be conducted at six locations (Outlook, Scott, Indian Head, Swift Current, Redvers, and Yorkon, SK) from 2015-2017. Two inoculants (Nodulator peat for faba bean and TagTeam granular for faba bean) in different combination on two Faba bean varieties (Snowbird and SSNS-1) were arranged factorial randomized complete block design with four replicates (16 treatments).

A consistent treatment protocol was observed and followed at all participating trial locations. Inoculants as indicated, their formulation and method of application was consistent across all sites. What did differ between locations was such practical aspects of date of seeding, method of seeding (direct vs worked), plot size, harvest date, etc., variables that would be expected to differ among a multi-organizational study such as this.

Trial Design and Treatments

This study was established in a factorial randomized complete block design with four replications. Treatments are shown in Table 1.

A seeding population of 43-54 plants/m^2 (4-5 plants/ft^2) was targeted after accounting for seed size, % germination and assuming 90% emergence. The thousand kernel weight (TKW) for Snowdrop was 343.3 g with a germ % of 90, CDC SSNS-1 had a TKW of 299.0 g and a germ % of 90. All seed was treated with Apron Maxx RTA (fludioxonil and metalaxyl-M and S-isomer) for various seed rots, damping off and seedling blights and with and Stress Shield 600 (imidacloprid) for wireworm control. The CSIDC trial was seeded on May 11.

Table 1. Varieties and Inoculation Formulation and Rate of Application.

Treatments	Faba bean Variety	Inoculants
1	Snowdrop	Un-inoculated check
2	Snowdrop	Nodulator peat for Faba Beans
3	Snowdrop	0.5x rate TagTeam Granular for Faba bean
4	Snowdrop	1x rate TagTeam Granular for Faba bean
5	Snowdrop	2x rate TagTeam Granular for Faba bean
6	Snowdrop	Nodulator peat for Faba Beans + TagTeam granular for Faba Beans at 0.5x
7	Snowdrop	Nodulator peat for Faba Beans + TagTeam granular for Faba Beans at 1x
8	Snowdrop	Nodulator peat for Faba Beans + TagTeam granular for Faba Beans at 2x
9	CDC SSNS-1	Un-inoculated check
10	CDC SSNS-1	Nodulator peat for Faba Beans
11	CDC SSNS-1	0.5x rate TagTeam Granular for Faba bean
12	CDC SSNS-1	1x rate TagTeam Granular for Faba bean
13	CDC SSNS-1	2x rate TagTeam Granular for Faba bean
14	CDC SSNS-1	Nodulator peat for Faba Beans + TagTeam granular for Faba Beans at 0.5x
15	CDC SSNS-1	Nodulator peat for Faba Beans + TagTeam granular for Faba Beans at 1x
16	CDC SSNS-1	Nodulator peat for Faba Beans + TagTeam granular for Faba Beans at 2x

Supplemental fertilizer as 11-52-0 was applied at all locations at rates of 20 – 30 kg P_2O_5/ha and either side-banded or seed-placed depending upon location. Two inoculants Nodulator peat seed treatment (BASF) and TagTeam (Monsanto BioAg) a granular inoculant were utilized in the study. Nodulator was applied to the seed at a recommended rate of 1.22 gm per kg of seed. All sites applied the Nodulator peat inoculant to the seed by damp inoculation method of applying 2.0 ml water to a kg of seed, adding 1.22 gm inoculant, and mixing well in either a large plastic bag or plastic container. Seed-placed peat inoculant was applied to seed immediately prior to seeding. TagTeam granular inoculant was metered through seeded boxes or pre-weighed and applied through a cone on the seeder. TagTeam granular inoculant was seed-placed at the recommended rate of application for the row spacing used at each testing site.

At all sites plots were maintained weed free by herbicide burn-off prior to seeding, post herbicide applications and in many cases significant hand weeding. Most sites received an in-season fungicide application for disease prevention, at the Swift Current location weather conditions were such that fungicide application was not deemed as needed.

Harvest at all locations was accomplished with a small plot combine in a straight cut operation and/or by hand harvesting procedures. At some locations Reglone was applied in a desiccation application, at other locations natural dry down occurred.

The trial at CSIDC was also sprayed with Matador (lambda-cyhalothrin) on August 25 for control of observed aphid activity. The trial at this location was harvested on September 2.

Total in-season precipitation at CSIDC from May through September 27 was 136.8 mm. Total in-season irrigation at CSIDC consisted of 162.5 mm.

Results

Spring soil test analysis for the trial is shown in Table 2.

Table 2. Agvise Soil Test Results, Sampled Spring 2017

Depth (cm)	NO_3-N	P	K	SO_4-S
	ppm			
0 - 15	6	14	166	22
15 - 30	8			41
30 -- 60	18			
Organic Matter	2.6%			
pH (0 - 15 cm)	8.2			
pH (15 - 60 cm)	8.3			
E.C. (0 - 15 cm)	0.38 mS/cm			
E.C. (15 - 30 cm)	0.51 mS/cm			

ICDC 2017 Trial

Seed quality and agronomic plant characteristics collected are tabulated in Table 3. Factorial statistical analysis is given in Table 4.

Overall yields were very low for irrigated faba bean production. Significant flower abortion was apparent throughout the flowering duration and individual plants had very few pods formed. As a cool season pulse the faba beans did not respond favourably to the heat and intense sun exposure through June and July.

Inoculation had no statistically significant response on grain yield of either variety. Soil test available nitrogen (N) was considered deficient so a positive response to inoculation might have been expected. Lack of response is speculative but a couple of possibilities are worth considering. Biological N-fixation in Faba bean occurs with the infection of *Rhizobium leguminosarum* which is both native to prairie soils but can also persist in soil from previous commercial inoculation applications. This field, the entire CSIDC Research Station, has a long and frequent history of pulse production and it might be that a "background" indigenous population of *R. leguminosarum* mitigated fresh commercial inoculant applications. Roots of the uninoculated control plots did have nodules formed on the root system although in fewer numbers than inoculated treatments. Commercial inoculants utilized in the trial were stored in refrigerated conditions prior to use so inoculant damage or reduced titre is not considered a contributing issue. Without measurable evidence the utilization of indigenous rhizobia is a speculative hypotheses but the research literature indicates it can occur. It is also possible that given the low yields obtained due to environmental conditions that this also masked or limited an expression of an inoculation response. The effect of inoculation on faba bean yield is illustrated in Figure 1.

Inoculation had no impact on either protein content, test weight, seed size, mid-season biomass or established plant population. Inoculation did tend to result in taller plants. Varieties did differ in most of the above mentioned observations other than mid-season biomass.

Results from this year will be combined with results from trial sites located at Indian Head, Swift Current, Scott, Melfort, Yorkton, Indian Head and Redvers to complete a full report for 2017.

Table 3. Impact of Inoculant on Seed Quality & Agronomics of Faba Bean, CSIDC 2017

Entry	Variety	Inoculant	Yield (kg/ha)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Biomass (T/ha)	Height (cm)	Plant Population (plants/m^2)
1	Snowdrop	Check	3572	27.3	80.4	313	8750	92	55
2	Snowdrop	Nod peat	3634	26.6	80.9	287	10300	102	55
3	Snowdrop	0.5X TT	3799	26.8	80.3	290	8600	98	54
4	Snowdrop	1.0X TT	3574	26.8	80.4	273	7500	100	56
5	Snowdrop	2.0X TT	3540	27.1	80.1	314	7030	102	57
6	Snowdrop	Nod + 0.5X TT	3419	26.9	80.4	291	9590	95	54
7	Snowdrop	Nod + 1.0X TT	3577	27.2	80.9	310	9070	99	56
8	Snowdrop	Nod + 2.0X TT	3539	27.2	80.7	320	8460	92	53
9	CDC SSNS-1	Check	3841	30.5	83.9	286	9470	99	38
10	CDC SSNS-1	Nod peat	3679	30.5	84.1	279	8570	111	36
11	CDC SSNS-1	0.5X TT	3591	30.6	84.3	298	7860	100	35
12	CDC SSNS-1	1.0X TT	3777	31.0	83.8	277	11030	109	38
13	CDC SSNS-1	2.0X TT	3405	30.7	83.8	278	8280	103	36
14	CDC SSNS-1	Nod + 0.5X TT	3698	30.0	83.6	276	8360	111	37
15	CDC SSNS-1	Nod + 1.0X TT	3623	30.9	84.0	283	8790	99	37
16	CDC SSNS-1	Nod + 2.0X TT	3646	31.4	83.9	288	9320	102	36
		LSD (0.05)	NS	0.9	0.7	NS	NS	10	3.9
		CV	10.6	2.3	0.6	9.8	22.5	7.1	5.9

NS = Not significant

Figure 1. Effect of Inoculation on Faba Bean Grain Yield, ICDC 2017.

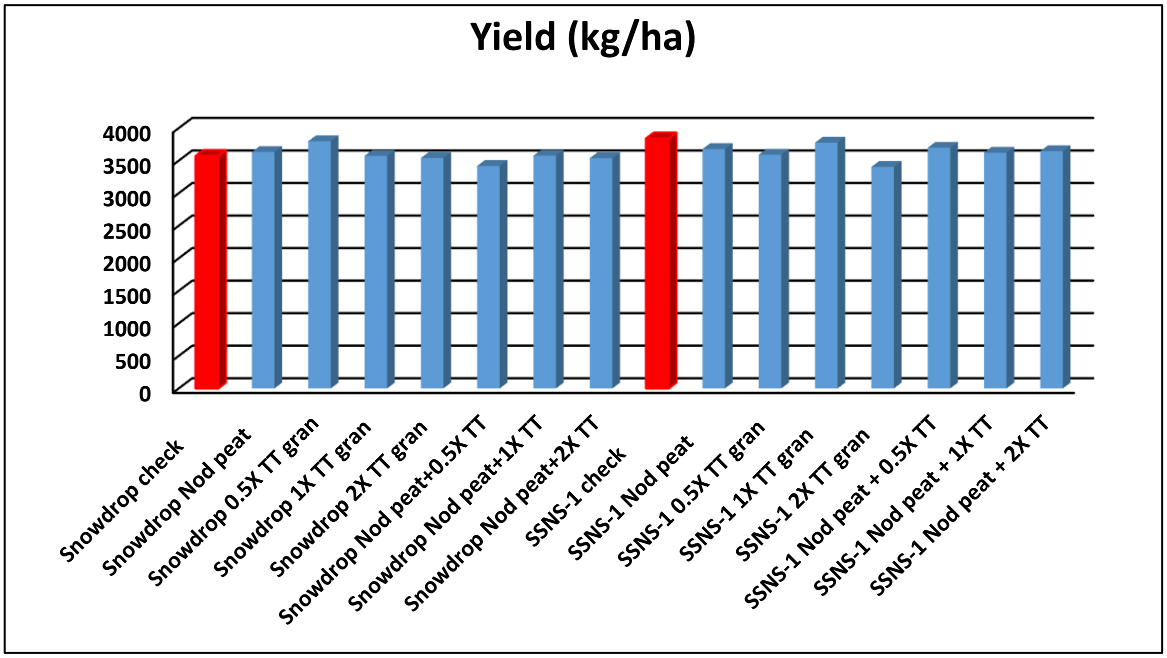


Table 4. Factorial Analysis of Varieties and Inoculation on Seed Quality & Agronomics of Faba Bean, 2017.

Treatment	Yield (kg/ha)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Biomass (T/ha)	Height (cm)	Plant Population (plants/m^2
Variety							
Snowdrop	3582	27.0	80.5	300	8663	98	55
CDC SSNS-1	3657	30.7	83.9	283	8960	104	37
LSD (0.05)	NS	0.3	0.3	14	NS	3.6	1.4
CV	10.6	2.3	0.6	9.8	22.5	7.1	5.9
Inoculant							
Check	3706	28.9	82.2	299	9110	95	46
Nod peat	3656	28.5	82.5	283	9435	107	46
0.5X TT	3695	28.7	82.3	294	8230	99	44
1.0X TT	3676	28.9	82.1	275	9265	105	47
2.0X TT	3472	28.9	82.0	296	7655	103	47
Nod + 0.5X TT	3559	28.4	82.0	284	8975	103	46
Nod + 1.0X TT	3600	29.1	82.4	297	8930	99	46
Nod + 2.0X TT	3593	29.3	82.3	304	8890	97	45
LSD (0.05)	NS	NS	NS	NS	NS	11	NS
Variety x Inoculant							
LSD (0.05	NS	NS	NS	NS	NS	NS	NS

NS = Not significant

Improving Fusarium Head Blight Management in Durum Wheat in Saskatchewan

Funding

Funded by the Agriculture Development Fund (ADF) and Western Grains Research Foundation

Project Lead

- Project P.I: Randy Kutcher (U of S)
- ICDC Lead: Garry Hnatowich (ICDC)

Objectives

The objective of this trial is to improve fungicide timing in durum wheat for the control of fusarium head blight (FHB) in Saskatchewan.

Research Plan

The trial was seeded on May 18, the durum variety was CDC Desire. Plot size was 1.5 m x 6.0 m. Two seeding rates were evaluated, seed was packaged to achieve a seeding density of 75 plants/m^2 designated low seeding rate and 400 plants/m^2 designated as high seeding rate. CDC Desire seed was packaged to account for a germination of 96% and assuming a seedling survival of 90%. Nitrogen fertilizer was applied at a rate of 110 kg N/ha as 46-0-0 as a sideband application and 20 kg P_2O_5/ha as 12-51-0 seed placed. Weed control consisted of a post-emergence applications of Simplicity (pyroxsulam) and Badge II (bromoxynil +MCPA ester).

The chemical fungicide used in the study was Caramba (metconazole) applied at the following phenological growth stages or timings;

- BBCH 59 – end of heading, spikes fully emerged from the boot
- BBCH 61 – beginning of flowering
- BBCH 65 – full flowering, 50% anthers mature
- BBCH 69 – end of flowering
- BBCH 73 – early milk
- BBCH 61 for first fungicide application followed by a second at BBCH 73
- Unsprayed control
- Sprayed control – plots received a fungicide application at each growth stage/timing.

Data collected for the study included emergence counts per square meter of each plot at the seedling stage, days to beginning and end of flowering, number of spikes at fungicide application times, and the number of spikes per square meter at the soft dough stage. Further data collection will include FHB index, grain yield, thousand kernel weight, test weight, protein content, FDK, and DON content.

Reglone (diquat) desiccant was applied September 8 and plots were harvested on September 15. Yields were estimated by direct cutting the entire plot with a small plot combine when the plants were dry enough to thresh and seed moisture content was <20%.

Total in-season rainfall from May through September was 136.8 mm. Total in-season irrigation at CSIDC was 75 mm.

Results

Trial results will be made available once tabulated with the results of additional trials being conducted at Saskatoon, Scott and Indian Head. This project is part of a graduate degree program and ICDC will only release results at a time mutually agreed to by both ICDC and the University of Saskatchewan.

2017 Irrigated Flax Fungicide Demonstration

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Organizations
Irrigation Crop Diversification Corporation (ICDC)

Objectives
The objective of this project will be to demonstrate the yield benefit of applying foliar fungicide on flax to control Pasmo on an irrigated field. This project evaluated two different fungicide on flax in the Lake Diefenbaker Development Area and compared them to an untreated control.

Research Plan
Two fungicides, Headline and Priaxor, were applied on an irrigated flax field in the South Saskatchewan River Irrigation District. The producer applied the fungicide on two portions of the field and left a strip as an untreated control. The crop was monitored for disease development throughout the season. The yield was taking at harvest from the treatments and the control to determine the results of this project. Prairie Thunder Flax was seeded on NE10-22-7 W3M. This site has a Fox Valley soil association and is a loam. The quarter section is irrigated with a low pressure pivot system. See table 1 for the agronomic and irrigation management for this site.

Table 1. Agronomic Management of Flax Fungicide Demonstration

Fertilizer	N	P	K
Banded	80 lb /ac	30 lb/ac	30 lb/ac
Fertigated	15 lbs/ac		
Seeding Rate	46bs/ac		
Fungicide Application	beginning of flowering		
Priaxor Rate	160 ml/acre		
Headline Rate	180 ml/acre		
Rainfall	6 mm (0.25)		
Irrigation	NA		
Harvest Date	September 29th		

Results and Discussion

Flax is an irrigated crop in Saskatchewan, taking up 3.2% of the irrigated acres in the Lake Diefenbaker Development Area in 2017. Pasmo is a major disease in flax that can reduce yield by up to 30% in severely infected fields according to the Flax Council of Canada. The Flax Council has also stated that all surveyed flax fields in Western Canada have had traces of Pasmo. Enhancing returns from existing irrigation is a part of Saskatchewan irrigation strategy and effective disease management is a proven way to flax increase yield.

This project compared the benefits of two different fungicides, Headline (group 7) and Priaxor (group 7, 11). This will help give producers a comparison of these two products in order to help them choose which would fit best on their operation. Under irrigated conditions, crops are more susceptible to disease due to higher amounts of moisture compared to dryland. The benefit of this project will be to promote the efficacy of foliar fungicide application to control disease and promote health in high yielding flax under irrigation. This project will demonstrate the economic and yield benefits of this practice.

Yield was measured with a weigh wagon on September 28th. The results of this demonstration showed a large response to the fungicide application. The yield results are shown in Table 1 and show a slight yield decrease to Priaxor and a 5.9 bu/acre response to Headline. Visual symptoms of disease were very low this year mostly likely due to the hot, dry growing season. Weed pressure from volunteer canola and kochia was a large problem for this crop which caused a delay in harvest.

Table 2. Yield Results of Flax Fungicide Demonstration

Treatment	Sample Size (ac)	Yield (lb/ac)	Yield (bu/ac)
Control	1.00	2672	47.7
Priaxor	1.32	2244	40.1
Headline	1.00	3002	53.6

Conclusion

This project was implemented to give a year of data after the success of the 2016 flax fungicide trial conducted by ICDC. This project was conducted during a very dry year only .025 inch of rainfall during the growing season. Headline gave a 5.9 bushel yield response although priaxor had no positive effect on yield. There were no visual symptoms of Pasmo incidence even in the untreated portions of the field. The little benefit seen by the fungicide in this trial may have been due to the hot, dry conditions keeping the crop canopy dry even though irrigation water was applied. An approximate cost of applying fungicide on flax is $28 an acre including the cost of running the machinery. A yield response of 3.5 bu/acre is needed in order to break even if the price of flax is at $8/bu.

Demonstration of Narrow vs. Wide Row Dry Bean Production

Funding

Funded by ADOPT

Project Lead

- Jeff Ewen, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Garry Hnatowich, PAg, Research Agronomist, ICDC
- Co-investigators: Dr. Kirstin Bett, Crop Development Centre

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Crop Development Centre

Objectives

The objective of this project will be to demonstrate the effect narrow row spacing of 20 – 30 cm (8 – 12") has versus traditional wide row spacing of 60 cm (24") in irrigated dry bean production.

Research Plan

Trials were established at the Canada-Saskatchewan Irrigation Centre (CSIDC) in Outlook and at Riverhurst, SK. The trial at CSIDC was established and maintained by ICDC, the Riverhurst by the CDC. Trials were established in a randomized split plot design with four replications, main plots were row spacing's and subplots were varieties.

The CSIDC solid or narrow row plots were on 20 cm (8") row spacing's of four rows, the wide row on 60 cm (24") spacing's of two rows. At Riverhurst narrow rows were on 30 cm (12") spacing's of three rows and wide row on 60 cm (24") of two rows. Three market class dry beans, with two varieties each, were included in each test. Pinto market class varieties were AC Island and CDC WM-2, Black market class were CDC Blackstrap and CDC Jet and the Navy market class dry bean varieties were Envoy and Portage. At each site varieties were planted to establish a target plant population of 35 plants/m^2 for narrow row production and 25 plants/m^2 for wide row production. Planting rates for each system were adjusted for variety seed size and % germination. All seed was treated with Apron Maxx RTA (fludioxonil and metalaxyl-M and S-isomer) for various seed rots, damping off and seedling blights and with and Stress Shield 600 (imidacloprid) for wireworm control. The Riverhurst site was seeded May 19th and the CSIDC site May 29th.

At CSIDC weed control consisted of a pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergent application of Basagran (bentazon) + Assure II (quizalofop-P-ethyl) supplemented by one in-season cultivation, for wide row trials, and periodic in-row hand weeding. The trial received a tank-mix application of Priaxor DS (fluxapyroxad & pyraclostrobin) and Copper 53W (tribasic copper sulphate) fungicide at flowering for white mold, anthracnose and bacterial blight control.

At Riverhurst weed control consisted of a pre-plant soil incorporated application of granular Edge (ethalfluralin) and a post-emergent application of Basagran (bentazon) + Solo (imazimox) on June 20th, supplemented by one in-season cultivation, for wide row trials on July 2 by ICDC staff, and periodic in-row hand weeding. The trail received a fungicide application of Lance WG (boscalid) and Kocide (copper hydroxide) July 20th. A second fungicide application of Allegro (fluazinam) on July 31st was applied for white mold, anthracnose, and bacterial blight control.

All plots were undercut to facilitate harvest at CSIDC on Sept.7th. At Riverhurst narrow row plots were swathed by CDC staff on August 31st and wide row plots were undercut by ICDC staff on September 1st to facilitate harvest.

Plots were harvested September 26th at both CSIDC and Riverhurst.

In-season irrigation at CSIDC resulted in 192mm (7.6 inches) and natural precipitation at CSIDC was 142mm (5.6 inches).

In-season irrigation at Riverhurst resulted in 145mm (5.7 inches) and natural precipitation at Riverhurst was 96mm (3.8 inches).

Results

Complete results are recorded below in Tables 1 & 2. Yield results from both sites found a substantial yield increase for solid seeded that is statically significant. All varieties performed excellent under both wide row and narrow production in 2017. Statistics for agronomic attributes were evaluated at the Outlook site and no perimeters were found to be statically significant.

Table 1. Dry Bean Yield as Influenced by Row Spacing and Variety.

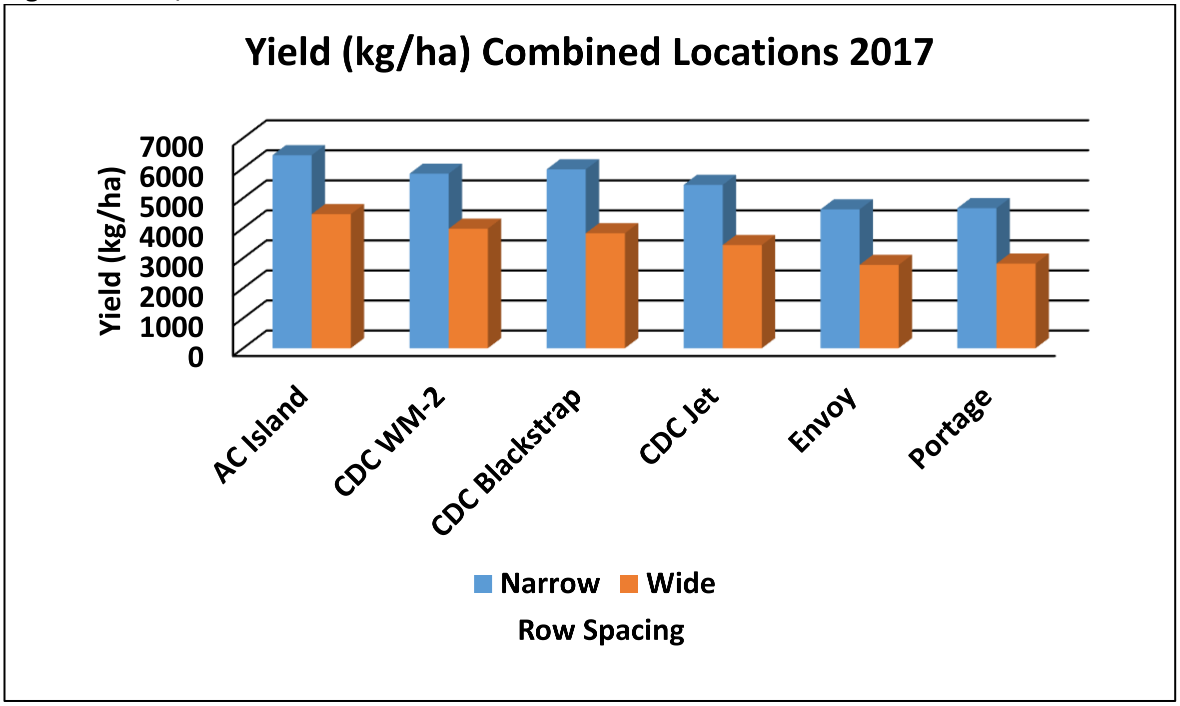
Treatment	**CSIDC**		**Riverhurst**	
	Yield		**Yield**	
	kg/ha	**lb/ac**	**kg/ha**	**lb/ac**
Row Spacing				
Solid	5950	5307	5025	4482
Wide	3330	2970	3772	3364
Row Spacing LSD (0.05)	668	596	1239	1105
CV	9.6	9.6	17.1	17.1
Variety				
Pinto				
AC Island	6046	5392	4846	4322
CDC WM-2	5256	4688	4537	4047
Black				
CDC Blackstrap	4992	4452	4795	4277
CDC Jet	4814	4293	4064	3624
Navy				
Envoy	3164	2822	4236	3778
Portage	3571	3185	3912	3489
Variety LSD (0.05)	456	407	768*	685*
Row Spacing x Variety				
LSD (0.05)	NS	NS	NS	NS

Table 2. Dry Bean Agronomic Characteristics Observed at CSIDC

Treatment	Test weight (kg/hl)	Seed weight (mg)	Flower (days)	Maturity (days)	Lodge rating 1=upright 5=flat	Pod clearance (%)	Height (cm)	Plant Stand (plants /m^2)
Row Spacing								
Solid	79.2	267	51	94.9	1.5	83	49	34
Wide	79.3	266	51	96.3	1.6	79	49	22
Row Spacing LSD (0.05)	NS	NS	NS	1.2	NS	2.9	NS	5
CV	0.7	3.2	1.7	0.9	31.1	6.7	8.0	8.4
Variety								
Pinto								
AC Island	79.2	396	50	96	2.5	71	48	28
CDC WM-2	77.6	404	49	94	1.9	80	46	25
Black								
CDC Blackstrap	77.6	237	50	95	1.1	87	47	26
CDC Jet	78.4	193	56	97	1.3	86	56	30
Navy								
Envoy	82.1	191	51	95	1.8	81	44	30
Portage	80.7	177	53	97	1.0	81	52	29
Variety LSD (0.05)	0.5	8.8	0.9	0.9	0.5	5.5	4.0	2.4
Row Spacing x Variety								
LSD (0.05)	S	S	NS	NS	NS	NS	NS	NS

S = Significant
NS = Not Significant

Figure 1. Yield, Combined CSIDC & Riverhurst 2017



Final Discussion

Irrigated dry bean production in Saskatchewan has primarily been done using wide row production to facilitate inter-row cultivation and undercutting. Wide row production has been proven to be successful in the production of dry beans, but the exponential cost of owning specialized row crop equipment such as planters, inter-row cultivators, and under-cutters, creates a barrier for producers to include dry beans in their rotation.

Narrow row production is common in other parts of Western Canada for growing dry beans primarily on dryland fields in Southern Manitoba. Narrow row production allows for producers to use common dryland farming equipment such as air seeders and swathers. The use of common dryland farm equipment results in lower production costs.

The results from this demonstration showed that narrow-row production is equivalent or even more productive than the traditional wide row production in all different classes and varieties. ICDC was able to replicate similar results obtained in 2016 using the identical protocol (ADOPT 20150114).
ICDC intends to continue evaluating wide-row vs. narrow row dry bean production in 2018. The goal will be to move to field scale demonstration and hopefully in the future submit a proposal to agriculture development fund (ADF) for machinery evaluation.

Acknowledgements

The project lead would like to acknowledge the co-operation with the CDC and the technicians and summer staff that helped with the project.

Field Scale Demonstration of Narrow vs. Wide Row Irrigated Dry Bean Production

Funding
Funded by the Saskatchewan Pulse Growers (SPG)

Project Title
Narrow row vs. wide row irrigated dry bean production

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Introduction
Dry Bean production in Saskatchewan has remained relatively constant and predominately under irrigation on a small amount of acres. Wide row production has created a barrier for most farmers to adopt production of dry beans because of the need for specialized equipment. A narrow row (solid seeded) production system would allow for farmers to adopt dry bean production with their conventional farming equipment. Solid seeding may also allow for further expansion of dry bean on to dryland acres with adequate rainfall as another pulse crop option.

Dry bean is the most widely produced and consumed pulse in the world and has many market opportunities. Traditional dry bean growing areas in the Northern United States and Southern Manitoba are decreasing acres annually with pressure from soybeans and unfavorable growing conditions. Current dry bean markets are very strong, which presents an opportunity for Saskatchewan farmers.

Objectives
The objective of this project is to show that narrow row dry bean production is equal or superior to wide row production. To show narrow row is equal or superior to wide row production an 80 acre center pivot will be split in half for a side by side comparison of a traditional wide row production system, vacuum planted on 22 inch rows compared to air seeded on 10 inch rows in a solid seeded situation. Expected results are that narrow rows will result in equal or greater yield with a less intensive production system.

Material and Methods
This trial was established on an irrigated parcel within the Riverhurst Irrigation District (RID) in RM#224. A side by side comparison was demonstrated between wide row planted (22”) and narrow row air seeded (10”) dry beans. CDC Blackstrap black beans were chosen to use in this demonstration for their early maturity, high pod clearance, and high yield potential in Saskatchewan growing conditions. CDC Blackstrap seed came pre-treated with Apron Maxx RT® seed treatment, germination of 98%, and seed moisture of 15%.

Field preparation for the wide row portion of the field began April 12th by tandem disking to bury cereal residue from the prior year and blacken the soil. Granular Edge® herbicide was then applied across the entire field with a heavy harrow on April 13th. The wide row portion of the field was banded on April 20th with 136 lbs/ac of 46-0-0, 125 lbs/ac of 9-36-16, and 23 lbs of 12-51-0 equivalent to 76.25 lbs/ac of nitrogen, 56.75 lbs/ac of phosphate, and 20 lbs/ac of potassium. Pre-plant cultivation on the wide row portion of the field took place May 24th to leave a level and mellow planting surface. The entire field received a pre-plant application of a half-litre of glyphosate mixed with Permit® on May 28th. The wide row portion of the field was planted with a John Deere MaxEmerge™ vacuum planter on 22 inch row spacing on May 29th with a target plant population of 115,000 plants/acre or 56 lbs/ac seeding rate. (Image 2 section14)

Seeding of the narrow row portion of the field took place May 29th using a Bourgault 3320 Paralink™ hoe drill and Bourgault 6700™ seed tank with auger metering. (Image 3 section 14) The exact same fertilizer blends were applied as on the wide row portion of the field. Application of the nitrogen and the potassium blends were applied through the midrow banders and the phosphate with the seed. Target plant population for the narrow row spacing was 125,000 plants/acre or 61.4 lbs/ac seeding rate. Seeding took place at 3.8 mph at a seeding depth of 1" into warm moist soil. Air seeder fans were set to 5500 rpm on the mid row banders and 3000 rpm to the seed row. Seed row fans were set just high enough to avoid plugging and as low as possible to reduce seed damage. Land rolling took place immediately following seeding to flatten dirt lumps and rocks to facilitate swathing and direct harvest.

Inter-row cultivation in the wide row spacing portion of the field took place on July 1st and a second cultivation on July 13th. Inter-row cultivation is used for weed control as well as keeping the soil loose to facilitate undercutting prior to harvest in wide row production. An in-crop herbicide application of Viper ADV® and a top up of Basagran® took place July 3rd across both the wide and narrow rows. A single fungicide application of Contegra® applied at 20 gal/acre was applied July 20th at the early pin bean stage of development across the entire field for control of white mold.

Through the course of the growing season 11 separate applications of irrigation were applied for a total of 7.5 inches (190.5mm). (Figure 1 section 14) Irrigation application rate ranged from 0.5 inch (12.7mm) to 0.75 inch (19.05mm) per application. A total of 3.78 inches (96.1mm) of natural precipitation accumulated through the growing season. The vast majority of rainfall came in a single rain event in late May and another single rain event in late August.

Undercutting of the wide row area of the field took place September 1st at buckskin stage of development with a Pickett One Step™. (Image 7 section 14) It was decided to include a swathed versus direct harvest comparison in the narrow row spacing, so approximately half the area of the narrow row dry beans was desiccated with Reglone® at 20 gal/acre on Sept 4th at the buckskin stage of development to facilitate direct harvest. The remaining area of the narrow row portion of the field was swathed September 5th at the buckskin stage of development. Harvest look place September 12th with the wide row undercut and the narrow row swathed portion of the field being harvested with a Pickett Twin Master™ bean combine. (Image 9 section 14) The remaining standing area of the field was direct harvested with a Case IH 8230™ rotary combine with a MacDon FD75™ flex draper header. (Image 11 section 14) The three separate areas of the field were weighed on a calibrated truck scale to evaluate yield differences. A sample of each area was retained to evaluate moisture, damage, and dockage.

Results & Discussion

CDC Blackstrap black beans were developed at the University of Saskatchewan and are well suited to Saskatchewan growing conditions. (Image 1 section 14) CDC Blackstrap black beans are early maturing indeterminate short vine (type II) dry bean. The certified seed used in this demonstration was 98% germ and 15% moisture. Seed moisture above 12% is preferred to reduce the amount of seed damage through handling and seeding. The addition of seed treatment is a preferred practice to protect the seed from various seedling diseases. Seeding typically does not take place until late May when soil temperatures are above 10°C. It is important to seed into moist warm soil to allow the large seeded dry bean to imbibe warm moisture and get it out of the ground as quick as possible. The seeding date for this demonstration was May 29th into warm moist soil resulted in quick germination and seedlings breaking ground in 7 days. (Image 4 section 14)

Fertility requirements for dry bean production in Saskatchewan are still being evaluated. Current recommendations are for 80 to 90 lbs. of available nitrogen and 50 to 60 lbs. of available phosphate. Addition of potassium and zinc may be required in cases where soils test low in these nutrients. A dry bean specific inoculant can be used to help fix nitrogen, but dry bean is a poorer nitrogen fixer than most other pulses. Inoculant specific to dry beans is difficult to find in Saskatchewan. Current producers often receive seed pre-treated with inoculant or fertilize to not account for nitrogen fixation. 136 lbs/ac of 46-0-0, 125 lbs/ac of 9-36-16, and 23 lbs of 12-51-0 equivalent to 76.25 lbs/ac of nitrogen, 56.75 lbs/ac of phosphate, and 20 lbs/ac of potassium were applied in this demonstration resulted in maximum yield. No inoculant was used in this demonstration.

Plant counts were taken on June 19th based on an average of ten counting sites. The wide row area averaged 142,600 plants/acre or 20% higher than target. Planter seeding rate was set based on manufacturer manual settings and resulted in a higher seeding rate than expected. The narrow row area averaged 98,000 plants/acre or 22% lower than target. (Image 5 section 14). It is believed more seed damage resulted through the air seeder than observed at the time of seeding.

Herbicide options for dry bean production are limited. Herbicides that are registered are effective, but specific attention to crop rotation and re-cropping restrictions need to be considered. It is important to choose fields with lower weed populations as dry beans are poor competitors with weeds. The herbicide application of glyphosate and Permit® pre-plant and Viper ADV® and Basagran® provided excellent weed control in this demonstration.

Typically white mold is the most devastating disease in dry bean production and often two applications of fungicide are warranted. Bacterial blight can also be a problem and once visual symptoms are present a copper based fungicide should be applied for control. The climatic conditions in 2017 made for low disease pressure. Between irrigation management and a single application of Contegra® disease infection was minimal in this demonstration.

Due to the indeterminate nature of most dry beans some form of pre-harvest preparation is required whether it be undercutting, swathing, or desiccation. The wide row production system is based around tillage to facilitate undercutting prior to harvest. Undercutting takes place when pods are at the buckskin stage and are not prone to shattering. (Image 6 section 14) The undercutter cuts the plant off below ground and lays the crop into windrows to dry down. Swathing is a common practice in solid seeded dry bean production to allow cutting to occur at the buckskin stage of development before pods are prone to shattering. (Image 8 section 14) It is important to cut the plants as low as possible to avoid damaging or missing lower hanging pods. Swathing with a rigid header can be difficult on fields that are not relatively level. The down side to undercutting and swathing is windrows are left exposed to wind and rain. Windrows can potentially be moved by high winds and if windrows are rained on it takes substantially more time to dry down than standing crop. Desiccation is the final option and is most commonly used in solid seeded production. Reglone® is the best suited desiccation production for quick dry down. Glyphosate can also be used in cases of heavy weed infestation. Desiccation should take place no earlier than buckskin stage of development to allow seeds to fully mature. The dry bean crop is then left to mature standing and is direct harvested with a straight cut header. In this demonstration all three methods of pre-harvest were experimented. Both undercutting and swathing resulted in little or no seed losses from this practice. Undercut windrows were left 12 days and the swathed windrows were left 7 days before harvesting. A notable observation, due to the higher plant population, the wide row area of the field matured approximately 5 days faster than the narrow row. Both undercut and swathed were ready to harvest in approximately 5 days following the operation, but due to logistics of harvesting they were left until the entire field was ready to harvest. The desiccated portion of the field was ready for harvest 7 days after application. All methods worked well in these circumstances.

Dry beans are known to be a very delicate seed and this requires specific attention when it comes to harvesting. Dry beans should be harvested below 16% moisture, but ideally between 14 and 16% moisture to avoid seed damage. A Pickett Twin Master™ dry bean combine is specifically designed to harvest dry beans. The gentle pickup feeds material into two large cylinders that separate seed from plant material. Fans blow away light material to leave a clean sample that is elevated to a hopper using a bucket elevator. Once the hopper is full it is hoisted and dumped directly into trucks. (Image 10 section 14) The alternative is using conventional or rotary combines. Many modifications can be made to current conventional and rotary combines to reduce seed damage such as specific threshing kits and conveyor unloaders. With specific attention to settings, no major alterations need to be made to conventional or rotary combines. In this demonstration the undercut and swathed portions of the field were harvested using a Pickett Twin Master™ dry bean combine. The Pickett Twin Master™ did an excellent job resulting in minimal seed damage and minimal harvest losses. A Case IH 8230™ rotary combine with a MacDon FD75™ flex draper header was used to direct harvest the desiccated portion of the field. No modifications were made to the combine or header. The combine was set to factory default setting for black beans which has the concave set wide open, rotor speed on low, and fan set high. The header was tilted forward to allow for the lowest possible cutting. The reel was slowed down and reel tines tilted back to allow for the knife to be cleared and the material to be pulled onto the canvas. The majority of losses were happening on the cutter bar of the header. It was found that in areas with less plant material resulted in more losses due to poor feeding. In area with more plant material a constant feed resulted in fewer losses. The rotary combine did a good job of separating seed, but the use of augers throughout the combine resulted in some seed damage. The auguring from hopper to truck seemed to be the most damaging.

Dry bean production in Saskatchewan is almost entirely under irrigation and planted in wide rows. Typical target dry bean yields in Saskatchewan under irrigation are 3000 lbs/acre. Average dry bean yield under irrigation in Saskatchewan are 2500lbs/acre. There is some variability of yield potential depending on variety and market class. Dryland dry bean production in Southern Manitoba results in average yields of 1800 to 2000lbs/acre again with variability depending on variety and market class. In Southern Manitoba the vast majority of dry bean production is on dryland and much of the navy and black bean production is narrow row seeded and either swathed or direct harvested. Specialty beans such as kidney and cranberry are grown in wide rows and undercut prior to harvest. This demonstration was to find out if there was any advantage to row spacing as well as specific production practices around the row spacing production systems. The wide row system resulted in the highest yield of 3735.3 lbs/acre. The sample was very clean with minimal damage and seed moisture of 10.7%. The narrow row swathed portion of the field resulted in the 2nd highest yield of 3515.5 lbs/acre. The sample was also very clean with minimal damage and seed moisture of 11.7%. The narrow row straight harvest portion of the field yielded the lowest at 3226 lbs/acre. The sample had more damaged seed and slightly more dockage. The seed moisture of the straight harvested portion was 11.7%. All seed moisture was lower than ideal due to the hot dry conditions surrounding harvest. The differences in damage and dockage was strictly the difference in harvest machinery between the Pickett Twin Master™ dry bean combine and the Case IH 8230™ rotary combine. The Pickett Twin Master™ is far superior by design on threshing, cleaning, and handling. The difference in yield mainly has to do with the plant population difference. The wide row portion of the field had over 20% more plants than was targeted. The narrow row side of the field had 22% less plants than targeted. The narrow row portion of the field seemed to compensate well for the lower plant population by producing larger plants with more branches. The slight yield advantage to the swathed over the straight harvested narrow row portions was mostly due to harvest losses of the straight cut system.

Economics and Practical Implications for Growers

Below is an economic analysis that takes into consideration machinery and input cost for this demonstration. The economic analysis does not take into account land, insurance, or overhead costs.

Narrow Row – Straight Cut

Equipment	$/ac	Input	$/ac	
Harrow	$ 5.40	Edge	$ 22.48	
Burnoff	$ 1.95	Glyph/Permit	$ 20.80	
Seed/Fertilizer	$ 14.49	Seed/N/P/K	$ 98.20	
Rolling	$ 6.77			
Herbicide	$ 1.95	Viper	$ 16.75	
Fungicide	$ 1.95	Contegra	$ 28.80	
Desiccate	$ 1.95	Reglone	$ 13.90	
Combine	$ 21.93			
Irrigation	$ 39.31	Water/Power	$ 70.00	
Total	$ 95.70		$ 270.93	**$ 366.63**

Yield: Lbs./acre	Price: $/lb	Returns:	
3226	0.33	$ 1,064.58	Gross
		$ 697.95	**Net**

Narrow Row – Swathed

Equipment	$/ac	Input	$/ac	
Harrow	$ 5.40	Edge	$ 22.48	
Burnoff	$ 1.95	Glyph/Permit	$ 20.80	
Seed/Fertilizer	$ 14.49	Seed/N/P/K	$ 98.20	
Rolling	$ 6.77			
Herbicide	$ 1.95	Viper	$ 16.75	
Fungicide	$ 1.95	Contegra	$ 28.80	
Swath	$ 5.94			
Combine (Custom)	$ 34.00			
Irrigation	$ 39.31	Water/Power	$ 70.00	
Total	$ 111.76		$ 257.03	**$ 368.79**

Yield: Lbs./acre	Price: $/lb	Returns:	
3515.5	0.33	$ 1,160.10	Gross
		$ 791.31	**Net**

Wide Row - Custom

Equipment	$/ac	Input	$/ac				
Disk	$ 17.26						
Harrow	$ 5.40	Edge	$ 22.48				
Burnoff	$ 1.95	Glyph/Permit	$ 20.80				
Fertilizer	$ 14.49	N/P/K	$ 36.80	Yield:	Price:		
Cultivate	$ 8.61			Lbs./acre	$/lb	Returns:	
Plant (Custom)	$ 19.00	Seed	$ 56.00	**3735.3**	$ 0.33	$ 1,232.63	Gross
Cultivate (Custom)	$ 12.00					**$ 793.08**	**Net**
Herbicide	$ 1.95	Viper	$ 16.75				
Hilling (Custom)	$ 12.00						
Fungicide	$ 1.95	Contegra	$ 28.80				
Undercut (Custom)	$ 20.00						
Combine (Custom)	$ 34.00						
Irrigation	$ 39.31	Water/Power	$ 70.00				
Total	$ 187.92		$ 251.63		**$ 439.55**		

Conclusion and Recommendations

Irrigated dry bean production in Saskatchewan has primarily been done using wide row production to facilitate inter-row cultivation and undercutting. Wide row production has been proven to be successful in the production of dry beans, but the exponential cost of owning specialized row crop equipment such as planters, inter-row cultivators, and under-cutters, creates a barrier for producers to include dry beans in their rotation. Narrow row production is common in other parts of Western Canada for growing dry beans primarily on dryland fields in Southern Manitoba. Narrow row production allows for producers to use common dryland farming equipment such as air seeders and swathers.

The results from this demonstration showed no major advantages to one system over another with net returns being less than $100/acre different from one another. The wide row production system would require substantially more capital cost to own and operate all the specialized equipment. The wide row production system is also a more time consuming intensive production system. The economics do show that if the increased productivity remains at higher levels over narrow row production, that investment in the machinery may be sustainable. The narrow row system proved to be economical and with some tweaking to achieve target plant population there is potential to meet or exceed returns of the wide row production system. Both systems were extremely successful in producing high yields and high quality dry beans.

A number of positive conclusions have been shown as a result of this demonstration. Going forward continued research and demonstration needs to be done to evaluate and improve the narrow row dry bean production system.

Future Research
There will need to be continued research towards improving the dry bean production system. Future research on fertility requirements and the benefits of inoculant will be important. The narrow row production system needs more focus on machinery specific modifications and settings for the air seeder and direct harvesting equipment. Seed polymers should be tested for the ability to protect seed from damage through the air delivery system of today's seeding equipment. The observation of the high plant population reducing days to maturity might be worth consideration of investigating recommended seeding rates.

Technology Transfer Activities
Results from this project will be published in ICDC's *Annual Research and Demonstration Report* as well as presented at the Annual SIPA/ICDC Irrigation Conference. Results may also be published in articles included in *AgriView* and *The Irrigator*. The site was also included in a late summer Dry Bean Field Day. This demonstration will help create some baselines for a potential ADF proposal in the future.

Acknowledgements
The project lead would like to acknowledge the funding contribution from Saskatchewan Pulse Growers (SPG) and co-operation with Prairie Agricultural Machinery Institute (PAMI).

Appendices

Figure 1- Irrigation

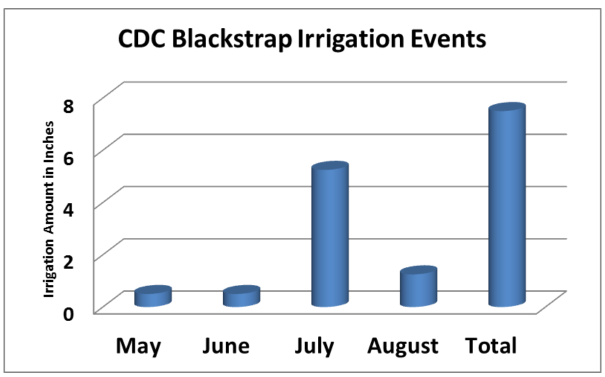


Image 1 – CDC Blackstrap Black Beans

Image 2 - John Deere MaxEmerge™ vacuum planter on 22 inch row spacing

Image 3 - Bourgault 3320 Paralink™ Hoe Drill and Bourgault 6700™ Seed Tank

Image 4 – CDC Blackstrap Seedlings 7 Days after Planting

Image 5 – Narrow Row Plant Counts - 98,000 plants/acre

Image 6 – Buckskin Stage of Development

Image 7- Pickett One Step™ Undercutter

Image 8 – MacDon M155™ Swather- 35' Rigid Header

Image 9 - Pickett Twin Master™ Bean Combine

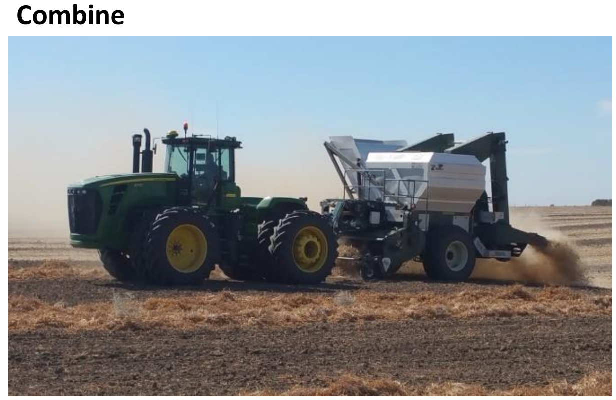


Image 10 - **Pickett Twin Master™ Bean Combine unloading**

Image 11 - **Case IH 8230™ Rotary Combine with a MacDon FD75™ Flex Draper Header**

Lentil Input Study

Funding

Funded by the Agriculture Development Fund (ADF)

Project Lead

- Project P.I: Jessica Weber (WARC)
- ICDC Lead: Garry Hnatowich

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Western Applied Research Corporation (WARC)
- Indian Head Research Foundation (IHARF)
- East Central Research Foundation (ECRF)
- Wheatland Conservation Area Inc. (WCA)

Objectives

The objective of the study is to:

(1) Determine which combination of common agronomic practices (seeding rate, herbicides and fungicides) produce the greatest lentil yield and

(2) Determine which agronomic practices provide the best economic return to producers.

Research Plan

The trial was established at CSIDC, in a 3 x 3 x 2 way factorial combination of three seeding rates (130, 190 and 260 seeds/m^2), three fungicide treatments (no application, single application, two applications) and two herbicide management practices (pre-seed burn off + pre-emergent + in-crop and pre-seed burn off + in-crop) for a total of 18 treatments with four replications. Pre-seed burn off was with a glyphosate application at a rate of 0.67 L/ac as Roundup Transorb HC by itself or in combination with Focus (pyroxasulfone + carfentrazone) at 280 ml/ha om May 23, and in-crop applications of Ares (imazamox + imazapyr) at 244 ml/c + Merge at 0.5L/100L on June 20 followed by Centurion (clethodim) at 75 ml/ac + Amigo at 0.5L/100L on June 23. Fungicidal application was either a single application of Priaxor (fluxapyroxad + pyraclostobin) at 180 ml/ac on July 10 with selected treatments receiving an additional application of Lance WDG (boscalid) at 170 g/ac on July 17. All plots received a foliar application of Matador (lambda-cyhalothrin) on August 2 for control of observed aphid feeding activity. The trial was desiccated with Reglone (diquat) at 0.83 L /ac on August 29 and plots were harvested by direct cutting the entire plot with a small plot combine on September 5.

Total in-season rainfall from May through end of August was 136.8 mm. Total in-season irrigation at CSIDC was 62.5 mm.

A treatment description is provided in Table 1.

Table 1. Seeding Rate, Herbicide and Fungicide Treatments

Treatment	Seeding Rate (seed/m^2)	Fungicide	Herbicide	
			Pre	Post
1	130	None	Glyphosate + Focus	Ares + Centurion
2	130	None	Glyphosate	Ares + Centurion
3	130	Priaxor	Glyphosate + Focus	Ares + Centurion
4	130	Priaxor	Glyphosate	Ares + Centurion
5	130	Priaxor + Lance WDG	Glyphosate + Focus	Ares + Centurion
6	130	Priaxor + Lance WDG	Glyphosate	Ares + Centurion
7	190	None	Glyphosate + Focus	Ares + Centurion
8	190	None	Glyphosate	Ares + Centurion
9	190	Priaxor	Glyphosate + Focus	Ares + Centurion
10	190	Priaxor	Glyphosate	Ares + Centurion
11	190	Priaxor + Lance WDG	Glyphosate + Focus	Ares + Centurion
12	190	Priaxor + Lance WDG	Glyphosate	Ares + Centurion
13	260	None	Glyphosate + Focus	Ares + Centurion
14	260	None	Glyphosate	Ares + Centurion
15	260	Priaxor	Glyphosate + Focus	Ares + Centurion
16	260	Priaxor	Glyphosate	Ares + Centurion
17	260	Priaxor + Lance WDG	Glyphosate + Focus	Ares + Centurion
18	260	Priaxor + Lance WDG	Glyphosate	Ares + Centurion

Results

Seed quality and agronomic plant characteristics collected from each treatment are tabulated in Tables 2 & 3. Factorial statistical analysis is given in Table 4.

Results as tabulated in Tables 2 & 3 will not be discussed and are presented for data preservation purposes. The discussion will be based upon results as tabulated and analysed in Table 4.

Lentil seed yield was significantly reduced as plant populations exceeded 190 plants/m^2. Given that rainfall was well below historic normal and that irrigation was applied only to alleviate plant stress it is not unexpected that yields would begin to decline at high seeding rates. Neither herbicide nor fungicide applications statistically influenced lentil seed yield. As indicated with the dry growing season, accompanied with intense sunshine and continues winds neither weeds nor disease were in present to a degree to play any significant part in influencing lentil yield. Increased seeding rates increased the established plant stand and had a modest effect on plant maturity. No other effects of treatments were observed in 2017. Disease ratings (data not shown) were taken throughout July and August weekly but no significant disease was apparent through the growing season.

This is the first year of a three year trial and will be repeated in 2018.

Table 2. Impact of Treatments on Seed Yield and Seed Characteristics

Trt	Seed Rate (seed/m^2)	Fungicide Application	Pre-seed Herbicide Application	Yield (kg/ha)	Test weight (kg/hl)	Seed weight (mg)
1	130	None	Glyphosate + Focus	1975	80.1	28.8
2	130	None	Glyphosate	1745	80.3	29.1
3	130	Single	Glyphosate + Focus	2113	80.5	30.0
4	130	Single	Glyphosate	1952	80.3	28.1
5	130	Dual	Glyphosate + Focus	2350	80.5	29.5
6	130	Dual	Glyphosate	2364	80.5	29.2
7	190	None	Glyphosate + Focus	1966	80.3	29.2
8	190	None	Glyphosate	2243	80.3	28.8
9	190	Single	Glyphosate + Focus	2055	80.4	28.2
10	190	Single	Glyphosate	2114	80.5	29.3
11	190	Dual	Glyphosate + Focus	2153	80.2	29.1
12	190	Dual	Glyphosate	2132	80.6	29.6
13	260	None	Glyphosate + Focus	1556	80.4	18.9
14	260	None	Glyphosate	1451	80.4	28.4
15	260	Single	Glyphosate + Focus	1900	80.1	29.1
16	260	Single	Glyphosate	1686	80.4	29.2
17	260	Dual	Glyphosate + Focus	1805	80.7	28.3
18	260	Dual	Glyphosate	1526	80.3	27.0
LSD (0.05)				371	NS	*NS
CV				13.4	0.4	3.6

NS = Not significant

* = Significant at P < 0.10

Table 3. Impact of Treatments on Seed Yield and Seed Characteristics

Trt	Seed Rate (seed/m^2)	Fungicide Application	Pre-seed Herbicide Application	Days to Flower	Days to Mature	Plant Stand (plant/m^2)	Dry Mid-Season Biomass (kg/ha)
1	130	None	Glyphosate + Focus	43	95	127	8250
2	130	None	Glyphosate	43	95	114	7135
3	130	Single	Glyphosate + Focus	43	95	125	8585
4	130	Single	Glyphosate	43	95	118	7660
5	130	Dual	Glyphosate + Focus	43	95	121	7730
6	130	Dual	Glyphosate	43	95	126	8165
7	190	None	Glyphosate + Focus	43	95	177	7905
8	190	None	Glyphosate	43	95	171	7140
9	190	Single	Glyphosate + Focus	43	95	159	8070
10	190	Single	Glyphosate	43	95	149	8350
11	190	Dual	Glyphosate + Focus	43	95	169	8520
12	190	Dual	Glyphosate	43	95	156	8915
13	260	None	Glyphosate + Focus	43	95	217	8295
14	260	None	Glyphosate	43	95	208	7855
15	260	Single	Glyphosate + Focus	43	94	205	8255
16	260	Single	Glyphosate	43	94	216	8165
17	260	Dual	Glyphosate + Focus	43	95	213	7930
18	260	Dual	Glyphosate	43	93	216	8540
LSD (0.05)				NS	0.8	26	NS
CV				0	0.6	11.0	12.5

Table 4. Factorial Analysis of Seeding Rate, Herbicide and Fungicide Application on Seed Quality & Agronomics of Lentil, 2017.

Treatment	Yield (kg/ha)	Test weight (kg/hl)	Seed weight (mg)	Days to Flower	Days to Mature	Plant Stand (plant/m^2)	Dry Mid-Season Biomass (kg/ha)
Seeding Rate (seeds/m^2)							
130	2084	80.4	29.1	43	95	122	7921
190	2111	80.4	29.0	43	95	163	8150
260	1654	80.4	28.5	43	94	212	8173
LSD (0.05)	151	NS	NS	NS	0.3	11	NS
Pre-Seed Herbicide Application							
Glyphosate	1986	80.3	29.0	43	95	168	8171
Glyphosate + Focus	1913	80.4	28.7	43	95	164	7992
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS
Fungicide Application							
None	1823	80.3	28.8	43	95	169	7763
Priaxor	1970	80.4	29.0	43	95	162	8181
Priaxor + Lance WDG	2055	80.4	28.8	43	95	167	8300
LSD (0.05)	151	NS	NS	NS	NS	NS	NS
CV (%)	13.4	0.4	3.6	0	0.6	11.0	12.5

4R Nitrogen Fertilizer Canola Study

Funding

Funded by the Agricultural Demonstration of Practices and Technologies Fund (ADOPT) and Fertilizer Canada

Project Lead

- ICDC Lead: Garry Hnatowich

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Western Applied Research Corporation (WARC)
- Indian Head Research Foundation (IHARF)
- East Central Research Foundation (ECRF)
- Wheatland Conservation Area Inc. (WCA)
- Conservation Learning Centre (CLC)
- South East Research Farm (SERF)

Objectives

Nitrogen is the most commonly limiting nutrient in annual crop production and often accounts for one of the most expensive crop nutrients, particularly for crops with high N requirements like wheat and canola. Most inorganic N fertilizers contain NH4-N but some (i.e. UAN) also contain NO3-N. Since the advent of no-till and innovations in direct seeding equipment, side- or mid-row band applications and single pass seeding / fertilization quickly became the standard and most commonly recommended BMP for nitrogen. Side-or mid-row banding is effective with the major forms of N including anhydrous ammonia (82-0-0), urea (46-0-0) and urea ammonium-nitrate (28-0-0) and the combination of concentrating fertilizer (safely away from the seed row) and placing it beneath the soil surface dramatically reduced the potential for environmental losses while maintaining seed safety. Fall applications have always been popular, at least on a regional basis, in that fertilizer prices are usually lower and applying N in a separate pass can take logistic pressure off during seeding when labour and time are limited. It is primarily for these logistic reasons that many growers are again considering two pass seeding / fertilization strategies as a means of spreading out their workload and managing logistic challenges associated with handling large product volumes during the narrow seeding window. While the timing and/or placement associated with two pass systems are usually not ideal, enhanced efficiency formulations such as polymer coats (ESN), volatilization inhibitors (i.e. Agrotain) and volatilization / nitrification inhibitors (Super Urea) can reduce the potential risks associated with applying N well ahead of peak crop uptake (i.e. fall applications) or sub-optimal placement methods (i.e. surface broadcast, which seems to be increasing in popularity for irrigated production). Enhanced efficiency N products are more expensive than their more traditional counterparts; however, this higher cost may be justified by the potential improvements in efficacy and logistic advantages of alternative fertilization practices.

This project is relevant to producers because, for many, there has been a movement back to two pass seeding fertilization systems for logistic reasons. The availability of high speed floater applicators is increasing within major irrigation districts. While we do not necessarily want to encourage growers to revert to two pass seeding / fertilization systems, it is important for them to have a certain amount of flexibility with respect to how they manage N on their farms. By demonstrating different N fertilization strategies according to the 4R principles and providing data on their efficacy relative to benchmark

BMPs we can help them to make informed decisions while taking into consideration both the advantages and potential disadvantages of the various options. Canola is a good candidate for this project since it is highly responsive to N fertilizer applications.

The objective of this trial is to demonstrate canola's response to varying rates of Nitrogen (N) along with different combinations of formulations, timing and placement methods relative to side-banded, untreated urea as a control. The proposed field trial design encompasses all four considerations (source, rate, time and place) for 4R nutrient management.

Research Plan

The trial was established at the Canada-Saskatchewan Irrigation Diversification Center (CSIDC). The trial was established in a randomized complete block design (RCBD) with four replications. Pre-seed fertilizer applications were conducted May 17, 2017 and canola was seeded into wheat stubble the same day. The Liberty tolerant hybrid L252 was seeded at a rate of 5.6 kg/ha.

Pre-seed fertilizer applications were incorporated by the seeding operation. Fertilizer treatments are shown in Table 1. Soil analyses from spring 2017 sampling of the trial area is shown in Table 2. On the basis of soil test analyses the 1X rate of N fertilizer was identified as 100 kg N/ha (89 lb N/ac). All treatments received 25 kg P_2O_5/ha seed placed monoammonium phosphate (12-51-0) at seeding. Split applications were surface broadcast/dribble applied at the 6-leaf stage of canola development. Weed control involved a tank mix application of Muster Toss-N-Go (ethametsulfuron) and Poast Ultra (sethoxydim) + Merge adjuvant on June 16, periodic hand weeding was required. No foliar fungicides nor insecticides were applied as neither foliar leaf diseases nor detrimental insect pressure was observed. Plots were swathed on August 31 and combined on September 15, 2017.

Total in-season precipitation was 128.7 mm. An additional 37.5 mm was applied by irrigation in June, 100 mm in July and 25 mm in August for a total irrigation amount of 162.5 mm through the growing season.

Table 1. 4R Nitrogen Canola Study Treatments

Treatment	Fertilizer Rate, Placement & Source
1	Un-inoculated check
2	0.5X sideband Urea
3	1.0X sideband Urea
4	1.5x sideband Urea
5	1.0x pre-seed broadcast Urea
6	1.0x pre-seed dribble UAN
7	1.0x pre-seed broadcast Agrotain
8	1.0x pre-seed broadcast Super U
9	1.0x split broadcast Urea
10	1.0x split dribble UAN
11	1.0x split broadcast Agrotain
12	1.0x split broadcast Super U

Table 2. Soil Testing Report, Agvise Labs, Sampled Spring 2017

Depth (cm)	NO_3-N	P	K	SO_4-S
	ppm			
0 - 15	6	14	166	22
15 - 30	8			41
30 - 60	9			
Organic Matter	2.6%			
pH (0 - 15 cm)	8.2			
pH (15 - 60 cm)	8.3			
Carbonate	0.4%			
Soluble Salts (0 - 15 cm)	0.38 mmho/cm			
Soluble Salts (15 - 60 cm)	0.51 mmho/cm			

Seasonal and 30 year historic precipitation and growing degree days at CSIDC are outlined in Tables 3 & 4. Seasonal precipitation was well below "normal" at seasons end. Seasonal Cumulative Growing Degree Days was close to historic norms.

Table 3. 2016 Growing Season Precipitation vs Long-Term Average, CSIDC

	Year		
Month	**2016 mm (inches)**	**30 Year Average mm (inches)**	**% of Long-Term**
May	32.0 (1.3)	45.0 (1.8)	71
June	29.0 (1.2)	63.0 (2.5)	46
July	60.4 (2.4)	55.0 (2.2)	110
August	7.3 (0.3)	42.0 (1.7)	17
Total	128.7 (5.2)	205 (8.2)	**63**

Table 4. Cumulative Growing Degree Days (Base 0°C) vs Long-Term Average, CSIDC

	Year		
Month	**2016**	**30 Year Average**	**% of Long-Term**
May	208	224	93
June	690	708	97
July	1300	1290	101
August	1890	1844	102

Results

Results obtained for the 4R Nitrogen Principals in Canola are shown in Table 5.

Yields in 2017 were lower than traditionally achieved for small plot testing at this location and are attributed to the hot temperatures and extreme sunlight intensity experienced throughout flowering.

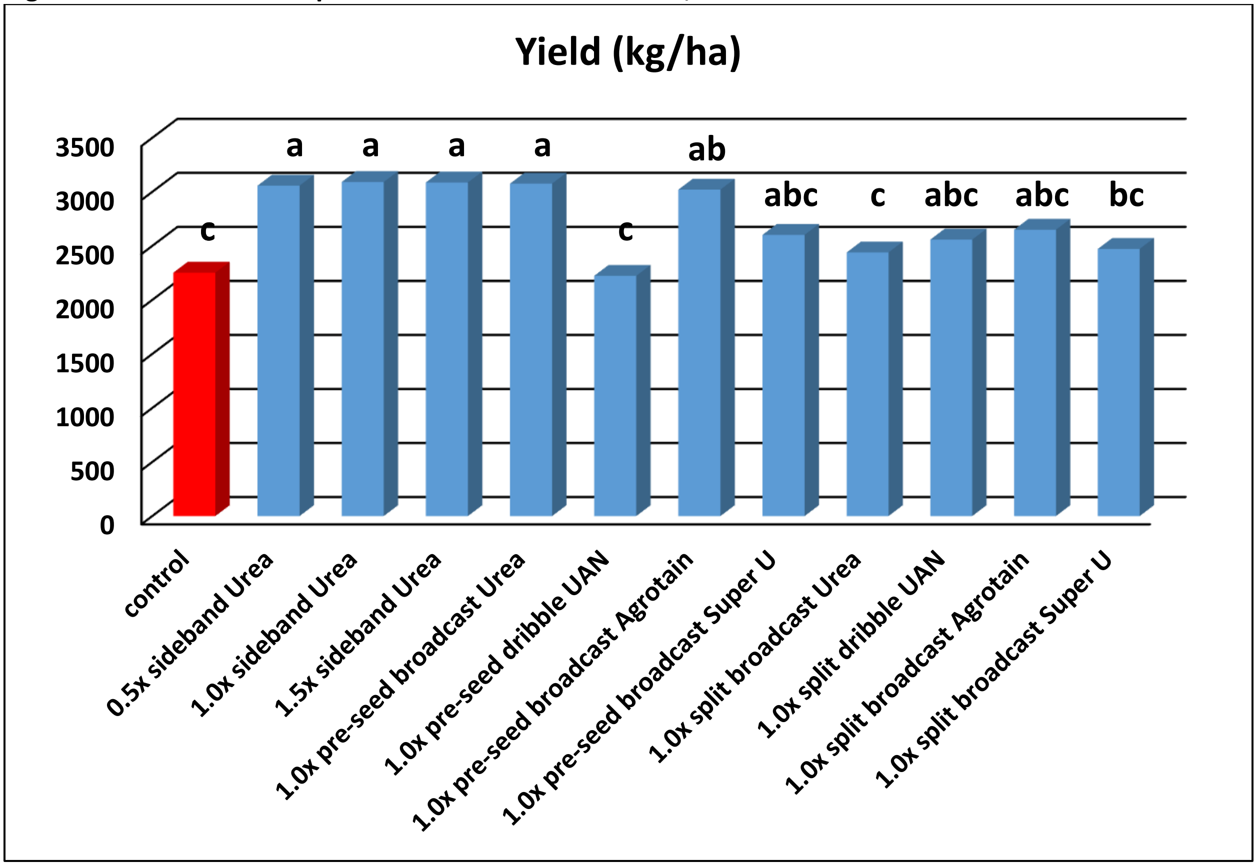
Flower abortion was noted in all plots. Disease and insects were not an issue in 2017. The highest yielding treatment occurred with the conventional 1.0X urea sideband at the time of seeding, however this treatment did not statistically differ from any other urea application other than the split broadcast applications. The unfertilized control and the pre-seed surface dribble band UAN were the lowest yielding treatments. It can be speculated that significant N losses occurred with the pre-seed dribble band application. Neither of the efficiency products Agrotain or Super U appeared warranted with respect to conventional urea. Highest yields were obtained when the recommended rate of fertilizer N was applied at seeding, later season split-applications did not provide optimal yields. Yield response to treatments are graphically illustrated in Figure 1.

Table 5. 4R Nitrogen Canola Study Results, 2017

Treatment	Yield (kg/ha)	Yield (bu/ac)	Oil (%)	Test weight (kg/hl)	Seed weight (gm)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
1. Un-inoculated check	2252	40.2	49.5	64.4	3.7	97	110	1.3
2. 0.5X sideband Urea	3057	54.5	49.1	64.6	3.7	97	118	1.5
3. 1.0X sideband Urea	3091	55.1	48.8	64.4	3.7	97	117	1.3
4. 1.5x sideband Urea	3087	55.1	48.8	64.5	3.7	97	115	1.5
5. 1.0x pre-seed broadcast Urea	3076	54.9	48.5	64.7	3.7	97	120	1.5
6. 1.0x pre-seed dribble UAN	2223	39.7	49.2	64.4	3.7	97	118	1.3
7. 1.0x pre-seed broadcast Agrotain	3021	53.9	49.4	64.2	3.7	97	113	1.5
8. 1.0x pre-seed broadcast Super U	2602	46.4	48.8	64.8	3.6	97	119	1.8
9. 1.0x split broadcast Urea	2439	43.5	50.0	64.5	3.7	97	114	1.5
10. 1.0x split dribble UAN	2558	45.6	49.6	64.4	3.7	97	117	1.5
11. 1.0x split broadcast Agrotain	2649	47.3	50.1	64.3	3.7	97	113	1.5
12. 1.0x split broadcast Super U	2472	44.1	50.0	64.0	3.6	97	117	1.3
LSD (0.05)	578	10.3	NS	NS	NS	NS	NS	NS
CV (%)	14.8	14.8	2.3	0.6	3.4	0	4.7	39.3

NS = not significant

Figure 1. Canola Yield Response to N Fertilizer Additions, 2017



Neither N fertilizer rate, source, time nor method of application influenced canola oil content, test weight, seed weight, maturity, plant height or lodging.

4R Phosphorus Fertilizer Canola Study

Funding

Funded by the Agricultural Demonstration of Practices and Technologies Fund (ADOPT)

Project Lead

- ICDC Lead: Garry Hnatowich

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Western Applied Research Corporation (WARC)
- Indian Head Research Foundation (IHARF)
- East Central Research Foundation (ECRF)
- Wheatland Conservation Area Inc. (WCA)

Objectives

Canola is known to be a large user of phosphorus (P) and it is well documented that high rates of seed-placed P fertilizer can reduce seedling survival and establishment in canola. While P fertilizer will typically result in higher canola seed yields when residual levels of this nutrient are low, often the response is most evident early in the season when more vigorous growth is frequently observed with P fertilization. This is sometimes referred to as a 'pop-up' effect and is usually attributed specifically to seed-placed P fertilizer; however, yields do not typically differ between commonly recommended placement methods when using safe rates. The dominant form of P is mono-ammonium phosphate (11-52-0); however, other forms are available and effective, albeit generally more expensive. As for rates, relatively low rates of starter P can often be sufficient to optimize yield and, due to limited mobility and availability in cool, spring soils, may be beneficial even when residual nutrient levels are relatively high. Appropriate rates of P fertilizer generally depend on whether the objective is to draw down, maintain or build long-term soil P levels. Due to the large P requirements of canola and limits to how much fertilizer can be safely placed in the seed-row, growers who seed-place P are often forced to choose between applying less than the required amount of P for maintenance purposes or seed-placing rates that will potentially result in crop injury. Alternatively, growers have the option of side-banding P fertilizer and most research has shown that this is an effective practice, despite concerns of reduced availability early in the season relative to seed-placement. Broadcast P is not recommended because it can quickly become insoluble and unavailable when applied in this manner, particularly in high pH, calcareous soils.

The project is relevant for several reasons. Phosphorus is the second most commonly limiting nutrient throughout most of Saskatchewan and, in many cases, residual P levels are declining over the long-term as a result of continuous cropping, recent high yields and inadequate application rates. A 2015 survey of soil testing lab results by the International Plant Nutrition Institute showed that 81% of Saskatchewan soil tests fall below the critical levels for P. In addition, many growers and agronomists prefer in-furrow placement of P fertilizer versus side-band and, with mid-row band configurations, at least some of the P must typically be seed-placed to prevent yield loss due to early season deficiencies. The project is intended to illustrate the potential risks and benefits.

Developing best management practices (BMPs) for nutrient applications has long been focussed on the 4R principles which refer to using the: 1) right formulation, 2) right rate, 3) right placement and 4) right timing. These factors are not necessarily independent of each other. For example, depending on the formulation, application timings or placement options that would normally be considered high risk can become viable.

The purpose of this trial is to demonstrate 4R principles for phosphorus in canola with a focus on using the right rate, right placement and right timing of application. Formulations will not be a part of this demonstration because our drills are not equipped for liquid products and the granular alternatives are either not widely utilized or contain multiple nutrients.

Research Plan

The trial was established at the Canada-Saskatchewan Irrigation Diversification Center (CSIDC). The trial was established in a randomized complete block design (RCBD) with four replications. Pre-seed phosphorus (P) broadcast fertilizer applications were conducted May 17, 2017 and canola was seeded into wheat stubble the same day. The Liberty tolerant hybrid L252 was seeded at a rate of 5.6 kg/ha. Pre-seed fertilizer applications were incorporated by the seeding operation. Fertilizer treatments are shown in Table 1. Soil analyses from spring 2017 sampling of the trial area is shown in Table 2. All treatments received 100 kg N/ha side-band urea (46-0-0) at seeding. Weed control involved a tank mix application of Muster Toss-N-Go (ethametsulfuron) and Poast Ultra (sethoxydim) + Merge adjuvant on June 16, perriodic hand weeding was required. No foliar fungicides nor insecticides were applied as neither foliar leaf diseases nor detrimental insect pressure was observed. Plots were swathed on August 31 and combined on September 15, 2017.

Total in-season precipitation was 128.7 mm. An additional 37.5 mm was applied by irrigation in June, 100 mm in July and 25 mm in August for a total irrigation amount of 162.5 mm through the growing season.

Table 1. 4R Phosphorus Canola Study Treatments

Treatment	Fertilizer Rate, Placement & Source
1	Un-inoculated check
2	25 kg P_2O_5/ha broadcast
3	55 kg P_2O_5/ha broadcast
4	25 kg P_2O_5/ha seed-placed
5	55 kg P_2O_5/ha seed-placed
6	25 kg P_2O_5/ha side-band
7	55 kg P_2O_5/ha side-band

Table 2. Soil Testing Report, Agvise Labs, Sampled Spring 2017

Depth (cm)	NO_3-N	P	K	SO_4-S
	ppm			
0 - 15	6	14	166	22
15 - 30	8			41
30 - 60	9			
Organic Matter	2.6%			
pH (0 - 15 cm)	8.2			
pH (15 - 60 cm)	8.3			
Carbonate	0.4%			
Soluble Salts (0 - 15 cm)	0.38 mmho/cm			
Soluble Salts (15 - 60 cm)	0.51 mmho/cm			

Seasonal and 30 year historic precipitation and growing degree days at CSIDC are outlined in Tables 3 & 4. Seasonal precipitation was well below "normal" at seasons end. Seasonal Cumulative Growing Degree Days was close to historic norms.

Table 3. 2016 Growing Season Precipitation vs Long-Term Average, CSIDC

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June	29.0 (1.2)	63.0 (2.5)	46
July	60.4 (2.4)	55.0 (2.2)	110
August	7.3 (0.3)	42.0 (1.7)	17
Total	128.7 (5.2)	205 (8.2)	**63**

Table 4. Cumulative Growing Degree Days (Base 0°C) vs Long-Term Average, CSIDC

	Year		
Month	**2016**	**30 Year Average**	**% of Long-Term**
May	208	224	93
June	690	708	97
July	1300	1290	101
August	1890	1844	102

Results

Results obtained for the 4R Phosphorus Principals in Canola are shown in Table 5.

Yields in 2017 were lower than traditionally achieved for small plot testing at this location and are attributed to the hot temperatures and extreme sunlight intensity experienced throughout flowering. Flower abortion was noted in all plots. Disease and insects were not an issue in 2017.

Neither P application rate nor method of placement influenced canola seed yield. The fertilizer P recommendation from Agvise was to broadcast apply 48 P_2O_5 lb/ac (43 kg P_2O_5/ha). Therefore, it might have reasonably been expected to have measured a seed yield response. The lack of a yield response to P fertilization may have been restricted or prevented due to flower abortion noted during the progress of canola development. Seed yield influence to P additions and placement are graphically illustrated in Figure 1. It does appear that the higher application of 55 kg P_2O_5/ha, in general, provided a numerical seed yield boost (Figure 2.)

Seed-placed 55 kg P_2O_5/ha reduced the oil content of seed in comparison to the unfertilized control. The 25 kg P_2O_5/ha seed-placed and 55 side-band applications reduced days to maturity in comparison to the unfertilized control. Phosphorus fertilization had no influence in this trial on test weight, seed weight, plant height or plant lodging.

Table 5. 4R Phosphorus Canola Study Results, 2017

Treatment	Yield (kg/ha)	Yield (bu/ac)	Oil (%)	Test weight (kg/hl)	Seed weight (gm)	Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Un-inoculated check	2524	45.0	50.5	63.8	3.53	97.8	91	1.3
25 kg P_2O_5/ha broadcast	2482	44.3	50.1	63.9	3.70	97.5	106	1.5
55 kg P_2O_5/ha broadcast	2911	52.0	49.9	64.3	3.68	97.5	105	1.3
25 kg P_2O_5/ha seed-placed	2469	44.1	50.3	64.0	3.70	96.3	109	1.3
55 kg P_2O_5/ha seed- placed	2685	47.9	49.3	64.2	3.63	97.5	112	1.3
25 kg P_2O_5/ha side-band	2528	45.1	50.5	64.0	3.58	97.0	112	1.5
55 kg P_2O_5/ha side-band	2950	52.6	51.1	64.5	3.53	96.8	110	1.0
LSD (0.05)	NS	NS	0.8	NS	0.14	0.8	NS	NS
CV (%)	12.5	12.5	1.1	0.5	2.6	0.6	11.5	38.6

NS = not significant

Figure 1. Canola Yield Response to P Fertilizer Additions, 2017

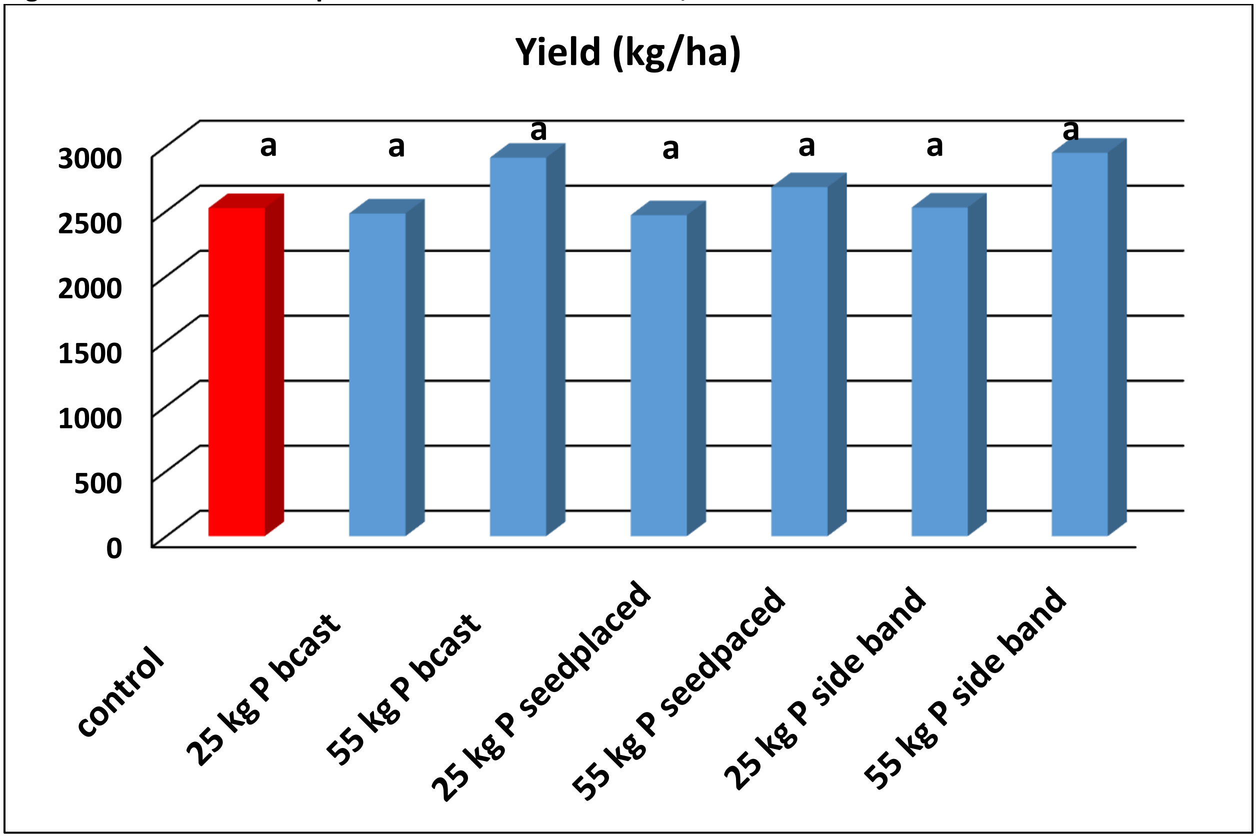
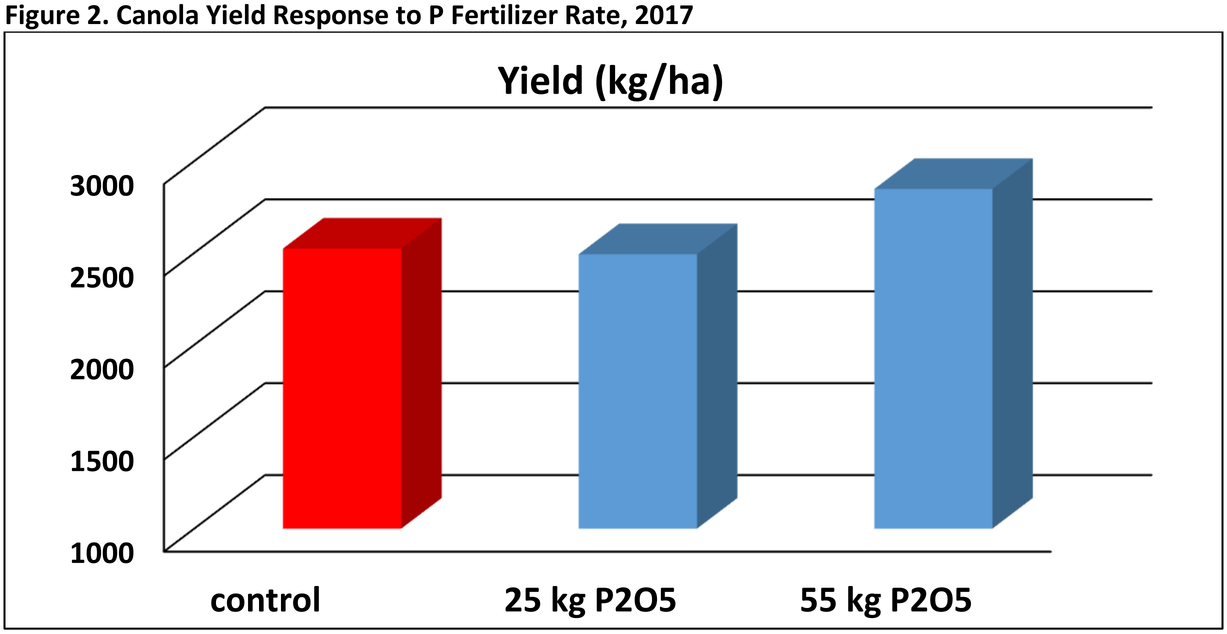


Figure 2. Canola Yield Response to P Fertilizer Rate, 2017



Specialized N Efficiency Products for Irrigated Cropping Systems

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Ministry of Agriculture
- Garry Hnatowich, PAg, ICDC Research Manager, Irrigation Crop Diversification Corporation

Co-operators

- Barry Vestre, CSIDC Field Manager
- Damian Lee, ICDC Field Research Technician

Project Objective

This project will demonstrate aspects of the 4R concept of fertilizer stewardship. The project will compare three enhanced nitrogen fertilizer products to untreated urea at two rates in two crops, spring wheat and canola under dryland and irrigated conditions.

Demonstration Plan

The project used single strips of each treatment laid out in a rational sequence to allow easier visual assessment of fertilizer treatment effects on crop growth. Treatments included:

1) Check with no supplemental fertilizer N,
2) Untreated urea@70% of soil test recommendation,
3) Untreated urea @ 100% of soil test recommendation,
4) Agrotain urea @ 70% of soil test recommendation,
5) Agrotain urea @ 100% of soil test recommendation,
6) Super U @ 70% of soil test recommendation,
7) Super U @ 100% of soil test recommendation,
8) ESN @ 70% of soil test recommendation,
9) ESN @ 100% of soil test recommendation.

Research Plan

The project was located at the CSIDC Research Center on Field #1 located on SW15-29-8-W3. The soil is classified as Bradwell very fine sandy loam. The site was soil sampled in spring 2017 to confirm uniformity at the plot site and determine appropriate fertilization rates for the site. The nitrogen fertilizer treatments were applied to two crops, spring wheat and canola, under irrigated and dryland management. The fertilizer was applied at the time of seeding in a side band using the plot drill. Nitrogen products were applied as indicated in the treatment listing. Phosphorus was applied as 11-52-0 at a rate of 30 P205 lb/ac. The soil tests confirmed the adequacy of potassium, sulphur and zinc at the site. The same rate of nitrogen and phosphorus was applied to dryland and irrigated treatments using the soil test as the basis.

The project used single strips of each treatment laid out in a rational sequence to allow for more accurate visual assessment of fertilizer treatment effects on crop growth. Each plot was 20m long x 1.5 m wide with 9.25m harvested for dry matter yield and 9.25m harvested for grain. Spring weed control was accomplished with a glyphosate burnoff using 1 liter/ac equivalent of Roundup Transorb. Carberry wheat was seeded on May 29, 2017 at 120 lb/ac. Liberty L252 canola was sown on May 29, 2017 at 6 lb/ac. Both crops were fertilized with 30 lb P205 as 11-52-0 placed in a sideband for both crops. In-crop weed control for the wheat was accomplished with 500 ml/ac of Badge II at 5 leaf stage of the wheat on July 6, 2017. The canola was sprayed with Muster TNG at 12 g/ac tankmixed with 0.45 l/ac of Poast Ultra on July 6 as well. The plots were seeded with the ICDC Fabro disk plot drill with 10" row spacing. Spring wheat was seeded at 1-1.5 inch depth and canola was seeded at 0.5 – 1.0 inch depth into a fairly dry seedbed. The plot area was watered with 0.5 inch irrigation following seeding to aid in seed germination and emergence. Soil analyses of the four quadrants of the demonstration are reported in Table 1. The pH of the site is quite high and may reflect the activity of land leveling to establish gravity irrigation. The organic matter content is typical for a cultivated Dark Brown Chernozemic soil. All irrigation at the site is currently applied by high efficiency overhead sprinklers.

Table 1: Soil analysis of research site for 2017 ADOPT Specialized N Efficiency Products Demonstration

Site	Depth	pH	OM (%)	N lb/ac	Olsen P ppm	K ppm	S lb/ac	Zn ppm
Dryland West	0-6	8.3	2.5	9	16	291	20	0.77
Dryland West	6-24	8.4		45			132	
Dryland East	0-6	8.4	2.6	9	11	179	120+	0.96
Dryland East	6-24	8.3		42			360+	
Irrigated West	0-6	8.2	2.4	5	14	323	24	0.97
Irrigated West	6-24	8.4		27			168	
Irrigated East	0-6	8.4	2.8	10	14	207	20	1.09
Irrigated East	6-24	8.3		39			120	

Whole plant tissue samples were collected from each treatment of the canola at early bloom stage on June 28, 2017 and each treatment of the spring wheat at the flag leaf stage on July 6, 2017. Samples were submitted to A&L Laboratories. These samples were used to evaluate the fertility status of the plots. The results of these analyses are presented in Table 2. All nutrients except for boron in both crops are present in adequate concentrations. No corrective measures were taken because of this analysis. Follow-up work with boron on the site to investigate this possibility would be desirable. Yields for 2017 are reasonable for both wheat and canola but investigating this possible weak link is desired. Organic matter levels are not low at the site which is usually a factor contributing to a limiting boron supply for crops. The pH of the site is very high, however, and may contribute to some tie-up of soluble boron making the boron supply not sufficient.

Table 2. Plant analysis of wheat and canola from specialized N efficiency product demonstration (July 2017)

Canola - Irrigated

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Check	6.45	0.50	5.24	1.36	2.69	0.81	9	106	73	47	28
Bare Urea 70%	6.84	0.49	5.06	0.39	2.98	0.85	8	94	87	46	25
Bare Urea 100%	7.36	0.55	5.07	1.11	2.44	0.73	8	118	75	50	22
Agrotain 70%	7.43	0.62	5.59	1.19	2.56	0.79	9	117	80	54	23
Agrotain 100%	7.66	0.61	5.55	1.15	2.52	0.73	8	109	73	50	20
Super U 70%	7.69	0.55	5.76	1.07	2.64	0.69	6	95	70	41	20

Super U 100%	7.58	0.56	5.62	1.16	2.93	0.75	7	105	77	51	21
ESN 70%	7.26	0.56	5.39	1.22	2.93	0.75	8	121	81	47	22
ESN 100%	7.05	0.56	5.60	1.23	2.95	0.75	7	108	73	47	19
Average	7.26	0.56	5.43	1.10	2.74	0.76	7.8	108	77	48	22
Threshold	**3.0**	**0.25**	**2.00**	**0.40**	**0.50**	**0.20**	**4.5**	**40**	**20**	**15**	**30**

Canola - Dryland

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Check	6.36	0.48	4.56	1.11	2.09	0.80	6	96	73	41	19
Bare Urea 70%	7.39	0.57	5.06	1.14	2.38	0.78	7	106	93	48	19
Bare Urea 100%	6.91	0.58	4.97	1.32	2.45	0.84	8	110	97	53	23
Agrotain 70%	7.35	0.59	5.26	1.54	2.69	0.83	8	100	90	56	22
Agrotain 100%	7.13	0.51	4.89	1.50	2.79	0.80	7	106	87	46	19
Super U 70%	7.40	0.55	5.00	1.68	2.99	0.82	8	112	79	52	21
Super U 100%	7.18	0.41	4.59	1.41	2.66	0.71	6	94	75	44	19
ESN 70%	7.16	0.50	4.99	1.82	2.81	0.76	8	103	81	52	20
ESN 100%	6.59	0.49	5.09	2.54	3.04	0.89	9	107	81	63	23
Average	7.05	0.52	4.93	1.56	2.66	0.80	7.4	104	84	51	21
Threshold	**3.0**	**0.25**	**2.00**	**0.40**	**0.50**	**0.20**	**4.5**	**40**	**20**	**15**	**30**

Wheat - Irrigated

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Check	4.00	0.42	4.77	0.32	0.30	0.23	8	140	43	36	3
Bare Urea 70%	4.23	0.45	5.01	0.37	0.40	0.26	8	126	45	40	4
Bare Urea 100%	4.34	0.38	4.43	0.33	0.36	0.24	7	102	42	32	3
Agrotain 70%	4.61	0.44	5.30	0.34	0.29	0.23	6	111	45	39	3
Agrotain 100%	4.37	0.48	5.50	0.36	0.38	0.24	8	116	43	41	3
Super U 70%	4.25	0.44	4.88	0.34	0.30	0.21	8	112	45	41	3
Super U 100%	4.45	0.47	4.91	0.39	0.38	0.23	10	122	54	44	4
ESN 70%	4.21	0.43	5.20	0.33	0.32	0.22	8	146	45	38	3
ESN 100%	4.68	0.48	5.21	0.36	0.37	0.23	9	146	44	41	3
Average	4.35	0.44	5.43	0.35	0.34	0.23	8.0	125	45	39	3.2
Threshold	**3.0**	**0.25**	**2.0**	**0.15**	**0.2**	**0.15**	**4.5**	**20**	**20**	**15**	**5**

Wheat - Dryland

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Check	5.51	0.38	3.5	0.45	0.37	0.26	8	152	46	25	7
Bare Urea 70%	5.27	0.47	4.2	0.48	0.50	0.34	9	160	64	29	6
Bare Urea 100%	4.58	0.45	4.3	0.44	0.50	0.31	9	199	62	28	7
Agrotain 70%	5.03	0.45	4.3	0.47	0.57	0.32	10	165	68	27	6
Agrotain 100%	4.63	0.45	4.6	0.39	0.50	0.25	8	187	57	36	4
Super U 70%	4.65	0.46	4.7	0.39	0.53	0.27	9	146	61	37	5
Super U 100%	4.28	0.40	4.5	0.31	0.35	0.22	8	125	50	34	3
ESN 70%	4.41	0.40	4.2	0.33	0.38	0.22	7	112	53	36	3
ESN 100%	4.42	0.44	4.9	0.36	0.38	0.25	8	126	53	40	3
Average	4.75	0.43	4.4	0.40	0.45	0.27	8.4	152	57	32	4.9
Threshold	**3.0**	**0.25**	**2.0**	**0.15**	**0.2**	**0.15**	**4.5**	**20**	**20**	**15**	**5**

Dry matter yields were determined by two approaches. The wheat and canola plots were cut in half at the 10 m mark using the Haldrop forage harvester. One half of the entire plot was weighed for wheat dry matter yield with the Haldrop forage harvester with the remaining standing wheat harvested with the Hege combine to determine grain yield. Because the canola was allowed to ripen before cutting for dry matter yield, it was too brittle to feed through the throat of the harvester. Instead of weighing the entire plot for dry matter yield, one meter of one row of canola from each treatment was cut by hand, weighed moist, dried and weighed dry to estimate dry matter yield in the plots. Dry matter yields are reported in Table 3.

The canola plots which were harvested for seed yield were swathed and threshed when dry. The spring wheat was threshed by straight combining on September 8, 2017. The canola was harvested on September 15, 2017. The yields and grain quality are reported in Table 3.

Table 3: Yield and grain quality of wheat and canola harvested from Field 1(2017)

Canola - Irrigated	Dry Matter Yield (kg/ha)	Seed Yield (bu/ac)	Test Weight (kg/hl)	TKW (g/1000 seeds)	Seed Oil %	Analysis of % N in Seed
Check	5555	46.7	63.7	3.69	49.9	3.48
Bare Urea 70%	6370	44.3	64.2	3.54	49.6	3.54
Bare Urea 100%	8288	46.6	64.1	3.69	50.3	3.43
Agrotain 70%	4713	52.6	63.8	3.69	49.6	3.50
Agrotain 100%	5135	44.0	63.7	3.59	49.3	3.54
Super U 70%	6500	49.9	64.1	3.5	49.7	3.53
Super U 100%	8808	45.6	64.5	3.61	49.3	3.54
ESN 70%	8613	43.1	64.1	3.55	50.0	3.65
ESN 100%	8158	29.6	63.1	3.67	45.9	3.88
Average	**6904**	**44.7**	**63.9**	**3.61**	**49.3**	**3.57**

Canola - Dryland	Dry Matter Yield (kg/ha)	Seed Yield (bu/ac)	Test Weight (kg/hl)	TKW (g/1000 seeds)	Seed Oil %	Analysis of % N in Seed
Check	5460	28.8	64.6	3.66	47.9	3.63
Bare Urea 70%	3673	38.1	64.3	3.56	48.5	3.61
Bare Urea 100%	6435	28.3	64.5	3.5	48.3	3.66
Agrotain 70%	3933	35.8	64.7	3.46	50.3	3.53
Agrotain 100%	3608	36.0	64.9	3.7	48.9	3.54
Super U 70%	3153	33.2	64.7	3.55	49.3	3.58
Super U 100%	3478	33.9	64.0	3.26	48.3	3.65
ESN 70%	2828	30.3	64.6	3.5	49.0	3.69
ESN 100%	N/D	25.5	65.0	3.61	48.1	3.71
Average	**4071**	**32.2**	**64.6**	**3.53**	**48.7**	**3.62**

Wheat - Irrigated	Dry Matter Yield (kg/ha)	Seed Yield (bu/ac)	Test Weight (kg/hl)	TKW (g/1000 seeds)	Grain Protein (%)	Analysis of % N in Seed
Check	5732	59.2	82.9	35.7	15.2	2.97
Bare Urea 70%	5363	59.6	82.2	35.9	15.4	2.99
Bare Urea 100%	8112	56.6	82.0	34.4	15.6	3.00
Agrotain 70%	6309	59.7	82.1	37.0	15.4	2.91
Agrotain 100%	6189	54.5	82.5	37.9	16.0	3.05
Super U 70%	5595	54.3	81.2	37.3	15.8	2.92
Super U 100%	5234	57.5	82.5	37.3	15.3	2.88
ESN 70%	5640	54.3	82.0	37.1	15.4	2.92
ESN 100%	6058	64.6	82.5	37.5	15.3	2.87
Average	**6026**	**57.7**	**82.2**	**36.7**	**15.5**	**2.95**

Wheat - Dryland	Dry Matter Yield (kg/ha)	Seed Yield (bu/ac)	Test Weight (kg/hl)	TKW (g/1000 seeds)	Grain Protein (%)	Analysis of % N in Seed
Check	3869	68.0	82.7	36.2	15.4	2.98
Bare Urea 70%	4361	66.9	82.6	37.0	15.7	2.92
Bare Urea 100%	5098	60.4	83.0	37.8	15.8	3.05
Agrotain 70%	5947	61.7	82.6	37.5	16.0	3.04
Agrotain 100%	5461	56.5	82.2	38.6	16.3	3.05
Super U 70%	5098	54.1	82.3	37.9	16.1	3.12
Super U 100%	6241	58.7	82.4	37.9	15.8	3.00
ESN 70%	5168	58.3	82.4	38.3	15.8	2.94
ESN 100%	5597	63.8	82.9	36.8	15.4	3.00
Average	**5205**	**60.9**	**82.6**	**37.6**	**15.8**	**3.01**

Yields of spring wheat and canola at the site are respectable but need to increase a notch to pay for the added infrastructure costs that growers are being challenged with. The seeding date for the project is toward the end of the seeding window for the Outlook region. Perhaps some of the yield potential loss can be attributed to the date of seeding. On the basis of this project, the improved efficiency nitrogen fertilizers do not assist with this challenge. The check yield for spring wheat is the highest yield in the project. Obviously, the soil has tremendous potential to mineralize available nitrogen. Alternately, the canola check yield was exceeded by three of the four EEF products but required the application of 100 lb N/ac of fertilizer N.

Table 4: Project seed yields at Outlook as affected by enhanced efficiency fertilizers in 2017

Treatment	**Spring Wheat**	**Canola**	**Dryland**	**Irrigated**
	Grain Yield (bu/ac)	Seed Yield (bu/ac)	Seed Yield (bu/ac)	Seed Yield (bu/ac)
Check	63.6	37.8	48.4	53.0
Bare Urea	60.9	39.3	48.4	51.8
Agrotain	58.1	42.1	47.5	52.7
Super U	56.2	40.7	45.0	51.8
ESN	60.3	32.1	44.5	47.9
Average	**59.3**	**38.6**	**46.6**	**51.2**
70% of soil test	58.6	40.9	47.3	52.2
100% of soil test	59.0	36.2	45.4	49.8

Yields of spring wheat and canola at the site were respectable, but need to increase a notch to fund the added infrastructure costs that growers are being challenged with. On the basis of this project, the improved efficiency nitrogen fertilizers do not provide an easy answer for this challenge.

The check yield for spring wheat has the highest spring wheat yield in the project. The canola check yield is bettered by three of the four EEF products but required application of 100 lb N/ac.
None of the three EEF products consistently produced seed with higher nitrogen content in this demonstration compared to application of bare urea.

Table 5: Nitrogen content of seed produced in enhanced efficiency fertilizer demonstration.

Treatment	Spring Wheat	Canola	Dryland	Irrigated
	Seed N (%)	Seed N (%)	Seed N (%)	Seed N (%)
Check	2.98	3.56	3.31	3.23
Bare Urea	2.99	3.56	3.31	3.24
Agrotain	3.01	3.53	3.29	3.25
Super U	2.98	3.58	3.34	3.22
ESN	2.93	3.73	3.34	3.33
Average	**2.98**	**3.60**	**3.32**	**3.26**
70% of soil test	**2.97**	**3.58**	**3.58**	**3.32**
100% of soil test	**2.99**	**3.62**	**3.62**	**3.26**

Residual nitrate in 0-24" depth was determined by soil analysis of samples collected October 11-12, 2017. These results are summarized in Table 6. Residual nitrate in the soil profile on dryland soils was nearly twice the level found in irrigated soils. Sampling to a greater depth should be conducted to properly monitor the residual nitrate on irrigated sites.

Yield response to irrigation was higher with canola than with spring wheat. The dryland spring wheat yields were higher than the irrigated spring wheat yields in this demonstration. Does this indicate that the irrigation scheduling for the spring wheat did not meet the water needs of the crop? Is residual N fertility in the soil or high N mineralization during the growing season interfering with the uniformity of the research area? The project has led to a number of unanswered questions which new work will hopefully build on.

Table 6: Post harvest soil test nitrate levels to 24" depth

Treatment	Dryland Wheat (lb N/ac)	Dryland Canola (lb N/ac)	Irrigated Wheat (lb N/ac)	Irrigated Canola (lb N/ac)
Check	44	52	20	32
Bare Urea	72	90	30	52
Agrotain	58	54	36	40
Super U	86	62	28	30
ESN	70	70	52	34
70%	65	61	33	34
100%	68	77	44	44
Average (9 Treatments)	68	67	35	38

Table 7: Precipitation and Irrigation at Field 1, PFRA, Outlook, SK for 2017

Month	Rainfall (mm)	Irrigation (mm)	Total (mm)
April	16.9	Nil	16.9
May	32.9	Nil	32.9
June	27.9	32.5	60.4
July	67.7	95.0	162.7
August	7.0	12.5	19.5
September	6.4	Nil	6.4
2017 Growing Season	158.8	140.0	298.8

Final Discussion

Use of enhanced efficiency sources of nitrogen for annual crop production did not provide an easy solution to increase crop yields and quality and solve the environmental challenges of nitrogen in the ecosystem. The impact on yield of the fertilizers under dryland and irrigation was similar for the products included in this demonstration.

Residual nitrogen in the soil was higher on dryland than on the irrigated site.

The potential impact of low soil available boron on crop growth on these high pH soils needs to be investigated further. An application of boron to the soil or foliage of the crops to look for a yield response should be investigated.

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Yield Response of Marrowfat Pea to Foliar Boron Mixed with Herbicide and Fungicide Applications

Project Leads

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Co-operator

- Michelle Walker, Grower, South Saskatchewan River Irrigation District, Broderick, SK
- Glen Erlandson, Grower, Broderick, SK
- Nico deWaal, Saskatchewan representative, ATP Nutrition

Project Objective

This project will demonstrate the impact of split application of foliar boron fertilizer to a field of marrowfat field pea grown on dryland.

Demonstration Plan

The yield response of boron fertilizer applied as a foliar spray with herbicide and fungicide applied to marrowfat field pea was demonstrated.

Demonstration Site

The project was located in the South Saskatchewan River Irrigation District on a quarter not yet developed for irrigation. Irrigated production of marrowfat peas had disappeared from the irrigation projects after 2016 because production during the previous wet years has not been able to generate profitable yields. Yields of field pea under irrigation have struggled in recent years due to injury during seedling growth from the root rot, aphanomyces. The disease is soil borne and requires several years without pea or lentil in the rotation to become free of contamination. Because an irrigated site could not be identified for this 2017 project, it was located on a dryland site north of Broderick at NW27-30-7-W3.

Project Methods and Observations

The site was sown to Hitomi marrowfat peas on May 8 with a Flexi coil vibrashank cultivator. No fertilizer was applied at the time of seeding. Plant tissue samples were collected June 3 at the 6 node stage by sampling pairs of fully developed leaflets from the third node from the top of the plant. The marrowfat peas were sprayed with Odyssey tank mixed with liquid boron (ATP Kinetic B) applied at 0.5 litre/ac. Another 0.5 litre/ac of ATP Kinetic B was applied to the marrowfat peas tank mixed with Headline on June 29. Two weeks later, a second application of fungicide as Priaxor was applied to the field. The field was swathed Aug 7 and threshed August 12.

The plant tissue analysis indicated that the boron content in the field pea tissue sample was 16 ppm, which is less than the threshold of 18 ppm. The harvest sample showed that the two applications of boron to the marrowfat pea, one with the herbicide and a second with the first fungicide provided a yield increase of 1.5 bu/ac. As of January 25, marrowfat peas were trading at $9 per bu. The boron fertilizer retails at $7 per litre. The double application of a half litre boron liquid would yield $14 return for an investment of $7 per acre.

Table 1: Plant tissue analysis of marrowfat pea plants grown on a non-irrigated field at Broderick NW27-30-7-W3.

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Hitomi Marrowfat Pea	7.0	0.66	4.1	0.52	0.9	0.36	11	159	32	65	16
Threshold	***3.5***	***0.25***	***1.5***	***0.20***	***0.35***	***0.25***	***5***	***50***	***20***	***20***	***18***

Table 2: Marrowfat pea grain yield

Treatment	Marrowfat Pea Yield (bu/ac)
Broderick site	
Control	41.65
Boron tank mixed with both herbicide and fungicide @0.5 l/ac	43.10

Final Discussion

Addition of 0.5 litre liquid boron with both the herbicide and first fungicide application of non-irrigated marrowfat peas generated a 1.5 bu marrowfat pea/ac yield increase. The yield increase provided approximately 90% return on a $7/ac investment in boron liquid fertilizer.

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Nico deWaal with ATP Nutrition provided the Kinetic B product for this demonstration in the Broderick area.

- Michele Walker helped coordinate the project with cooperator Glen Erlandson

Yield Response of Canola with Foliar Boron Applied at Early Bolting Stage

Project Leads

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- Joel Peru, Irrigation Agrologist, Saskatchewan Ministry of Agriculture

Co-operator

- Riverhurst Irrigation District - NE23-22-7-W3 – Mark Gravelle
- Grainland Irrigation District - WH8-23-4-W3 – Nigel Oram
- Nico de Waal – ATP Nutrition Regional Representative, Saskatchewan

Project Objective

This project will demonstrate the impact of the application of foliar boron fertilizer to an irrigated field of canola at early bolting stage when tankmixed with the first fungicide application.

Demonstration Plan

The yield response of boron fertilizer applied as a foliar spray with fungicide applied at about 20% bloom to canola foliage will be demonstrated.

Demonstration Site

The project was conducted at two locations for 2017. One was located in the southern portion of Riverhurst Irrigation District on NW23-22-7-W3 on Fox Valley loam developed on calcareous silty glaciolacustrine parent material. The second was located on WH8-23-4-W3 in Grainland Irrigation District on Hatton sandy loam developed on coarse textured moderately calcareous sandy glaciolacustrine deposits. The plant tissue analysis for two of the replications is reported in Table 1. The project is relying on plant tissue analysis to guide selection of potential responsive sites because the effectiveness of a soil test has been inconsistent for predicting yield response of canola to boron.

Project Methods and Observations

This project evaluated the yield response of foliar boron applied at 10 - 20% bloom stage tank mixed with the first fungicide application to control sclerotinia in irrigated canola. The product applied to the Grainland Irrigation District and South Riverhurst Irrigation District sites was ATP Nutrition 8% boron. At 1.0 litre/ac, 1.26 lb B was sprayed on the canola foliage.

Plant tissue samples were collected from the Grainland and South Riverhurst District sites at the rosette stage and their analyses are reported in Table 2. For 2017, the Grainland site had 20 ppm in the plant tissue sample. The Riverhurst site had higher levels of 27 ppm. No visual differences were noticed at the sites at any time during the growing season. NDVI imagery obtained from Farmer's Edge in Outlook for the two Riverhurst Irrigation District sites also did not show any hints of differences in plant growth as they had in 2016. This year's B tissue levels in this year's projects were not as successful in predicting yield response. The high tissue B sample field responded as well to the foliar B treatment as the lower B tissue site. Stubble type was also ineffective in predicting the likelihood of a B response for canola.

Table 2. Plant tissue analysis of canola samples collected at the rosette stage prior to the application of foliar B fertilizer applied with fungicide at the 20% bloom stage of canola

Treatment (Fertilizer/ac)	**N** (%)	**P** (%)	**K** (%)	**S** (%)	**Ca** (%)	**Mg** (%)	**Cu** ug/g	**Fe** ug/g	**Mn** ug/g	**Zn** ug/g	**B** ug/g
Canola											
Riverhurst Irrigation District Site	6.2	0.50	3.2	0.92	2.7	0.42	5.4	126	177	49	27
Grainland Irrigation District Site	6.3	0.41	4.2	0.76	2.2	0.31	1.3	96	111	30	20
Target	**4.0**	**0.25**	**2.0**	**0.30**	**0.5**	**0.20**	**4.5**	**40**	**20**	**15**	**30**

The canola yields for the three sites are summarized in Table 3. Yield response to the boron application at the Riverhurst Irrigation District site and Grainland Irrigation District site was 2-3 bu/ac, about half as large as in 2016. Higher use of irrigation water in the production of canola may have contributed to a smaller canola yield response to B in 2017. Higher rainfall in 2016 is also associated with an increase in soil pH which would reduce the availability of boron. Previous water analysis showed that each acre-inch of Lake Diefenbaker water contains 0.005 lb boron. Usual amounts of irrigation water applied to canola fields are 8-12 inches of water. The lower amounts of growing season rainfall during 2017 lead to higher quantities of boron supplied to crops through irrigation.

Table 3: Canola grain yield

Treatment	**Canola Yield (bu/ac)**
Riverhurst District Site	Lentil stubble
Control	70.4
Boron foliar 1.0 l/ac	72.9
BioForge Gold	74.9
Grainland Irrigation District Site	Durum stubble
Control	61.7
Boron foliar 1.0 l/ac	64.2
Grainland Irrigation District Site	Lentil stubble
Control	72.4
Boron foliar 1.0 l/ac	72.2

Final Discussion

Foliar boron applied at 20% bloom stage of irrigated canola increased seed yield at two of three sites in 2017. NDVI imagery was not successful for identifying the boron responsive areas of the field in 2017. Plant tissue levels below 20 ppm boron was suggested as a potential threshold for successful application of foliar boron at early flowering with the first fungicide application to irrigated canola in 2016. The projects completed in 2017 did not support the 2016 conclusion but the level may still provide a guideline to assist in making this judgement as one of the responsive sites had a plant tissue test level of 20 ppm. Other work has showed that the soil test has not been effective in predicting the potential for a boron yield response with foliar application.

Acknowledgements

Growers in Grainland Irrigation District (Nigel Oram) and Riverhurst Irrigation District (Mark Gravelle) provided the sites for the boron fungicide applications. Farmer's Edge provided NDVI images for evaluating the boron application to the fields. ATP Nutrition (Nico deWaal) supplied the liquid fertilizer B for application to the canola demonstrations.

Contans Control of Sclerotinia for Irrigated Lentil and Dry Bean

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Ministry of Agriculture
- Dale Ziprick, Product Manager, United Agri Products, Winnipeg, MB
- David Jessiman, Territory Manager, United Agri Products, Lucky Lake, SK
- Jon Weinmaster, Product Manager, BayerCropScience, Guelph, Ontario

Co-operator

- Marc Gravelle, Irrigator, Riverhurst, SK

Project Objective

This project will compare the control of sclerotinia using a biological control product with a foliar fungicide.

Demonstration Plan

Many of the profitable cropping options open to irrigated producers are susceptible to sclerotinia. Close to 60% of the crops seeded on irrigated land were hosts for sclerotinia in 2016. Crop rotation research has shown that crop rotation is only marginally successful in controlling this disease. In the push to pay the costs of irrigation development and operation as well as to maximize profits, sclerotinia susceptible crops are commonly grown on irrigated land without an intervening cereal break crop. The current best management practice for biological control of sclerotinia in susceptible crops is to apply Contans in fall prior to freeze-up. The fungal organism, Coniothyrium minitans, is most effective when applied in fall - the earlier the better. Rain following the application improves the survival of the organism as fungus seeks out sclerotia bodies in the soil to infect. The project will be conducted from spring 2016 until fall 2018 to demonstrate the advantage of multi-year disease management using both biological and foliar fungicide treatments. Another advantage with Contans for sclerotinia control is the minimum rate of 0.2 kg/ha can be applied annually for control once the background collection of sclerotia bodies is controlled by the annual application of the bio-control fungus. The cost of the 0.2 kg/ac application is currently $7/ac.

Demonstration Site

The project was located at NE14-22-7-W3 on canola and NW24-22-7-W3 on wheat for 2016. The wheat stubble was treated with 0.6 lb/ac of Contans in spring 2016 as well to demonstrate advantages of a multi-year approach to control of sclerotinia on irrigated soils. In 2017, dry beans were grown on NE14-22-7-W3 on canola stubble, and red lentil was sown on NW22-22-7-W3 on wheat stubble.

Project Methods and Observations

The initial Contans application was applied in spring 2016 by spraying the control organism on the soil surface on durum stubble and incorporated with a light harrowing. The initial product rate of Contans was 0.8 kg/ac for NE14-22-7-W3 on ground seeded to canola and 0.6 kg/ac for NW24-22-7-W3 for ground seeded to wheat. For 2017, Maxim lentil was seeded on the canola stubble and pinto beans were seeded on the canola stubble. The lentils were irrigated with 3.5" of water over the growing season while the pinto beans were irrigated with 8" of water in addition to the 2.5" of growing season precipitation.

Table 1: 2017 Yield of Red Lentil as Affected by Fungicide Treatment at Contans Site

Treatment (Fertilizer/ac)	**Lb/ac**
Contans	2693
Normal (No fungicide)	2568

Table 2: 2017 Yield of Dry Beans as Affected by Fungicide Treatment at Contans Site

Treatment (Fertilizer/ac)	**Lb/ac**
Contans + Contegra	2887
Contegra only	2697

In 2017, a dry year with limited visible sclerotinia infection on irrigated production fields, use of Contans for sclerotinia control on lentil showed over 100 lb/ac advantage for the biological control strategy. This was surprising because it was not possible to find sclerotinia infection in lentil fields. On the dry bean field, sclerotinia infection was relatively easy to find, but the yield advantage for the Contans treatment was limited to 190 lb/ac.

The application of Contans to the project field showed up in NDVI images compliments of Farmer's Edge in 2016. In the drier year, 2017, the treatment was not visible with NDVI imagery. Thanks to Kris Ewen for his assistance in providing NDVI imagery from the project fields.

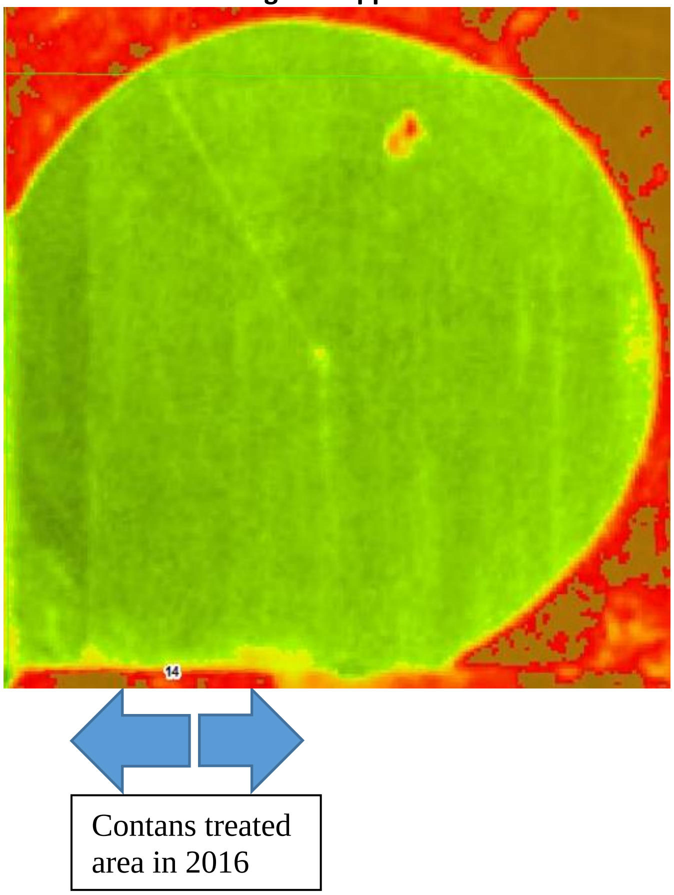
Final Discussion

Profitable control of sclerotinia is crucial for irrigated crop production. For any given year, about 60% of the irrigated area is sown to sclerotinia sensitive crops. Contans shows promise as a control option for these conditions. The first year of the threeyear project attempted to demonstrate that control efficacy and simplicity are both provided by including a biological control mechanism in the control program for sclerotinia. The second year of this project has measured small yet economical yield responses using the biological control organism. Contans also confers an advantage for the irrigation producer by reducing labor constraints during the summer irrigation season by reducing at least one fungicide application. Irrigation can also be a tool to apply and incorporate Contans in the fall when applied early enough to use water from the irrigation system prior to system shutdown in the fall. This practice is not currently registered for Contans, but the company, Bayercropscience is working towards registration of fall chemigation application of Contans.

Acknowledgements

United Agri Products and Bayercropscience have both contributed Contans product for this project. Thanks to Dale Ziprick with UAP for his support. Thanks to David Jessiman, Territory Manager with United Agri Products, for his efforts to coordinate product delivery for the demonstration. Marc Gravelle has graciously contributed the labour, land and equipment to implement the project on two of his fields for a three-year period. Thanks to Jon Weinmaster with Bayercropscience for his interest in pivot application of fungicide for control of sclerotinina.

Figure 1: 2016 Aerial image of canola at Gravelle site with Contans and fungicide applications



2017 Demonstration of Fall Rye as an Irrigated Crop

Funding

Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead

- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Garry Hnatowich, PAg, Research Director, ICDC
- Co-investigators: Jamie Larson AAFC Lethbridge Research Centre

Organizations

- Irrigation Crop Diversification Corporation (ICDC)

- Canada-Saskatchewan Irrigation Diversification Centre (CSDIC)

Project Objective

This demonstration is intended to provide local producers a yield and visual comparison of fall rye production under irrigated and dryland conditions in central Saskatchewan. Producers will have a chance to compare how new hybrid varieties perform compared to conventional varieties.

Project Background

Producers are looking for new types of crops to add in their rotation in order to help control disease and pest issues. New hybrid varieties are making rye a higher yielding crop that could be a fit for irrigation. There is limited agronomic knowledge for this crop under irrigation. This demonstration will both evaluate the crop's growing potential, and also provide producers with a side-by-side comparison between dryland and irrigated production. This demonstration will also show the increase in performance of a hybrid rye compared to conventional rye varieties when water and nutrients are not limiting factors. A similar trial harvested in 2016 successfully demonstrated how the new hybrid varieties could outperform conventional varieties. This project will build off the 2016 results and will give another year of data to help producers choose if they want to adopt this crop in their rotation. The 2016 dryland trial results were not significant due to a high critical value so this trial will help compensate for that.

This demonstration gave producers the opportunity to view and compare different varieties of fall rye under irrigation in order to will help them decide on incorporating them into their crop rotations. Having a fall seeded crop in your crop rotation can help time management for producers because in the difference in seeding and harvest date compared to spring seeded crops. Recent trends have shown that irrigated farmers in the Lake Development Area are slowly adopting new crops but the majority of acres are still seeded to wheat and canola.

This demonstration is also intended to show the variance in the different varieties of fall rye that are available in Saskatchewan. It is important for producers to know what varieties are available to them and how they perform in their area in order to help them make informed decisions on crop choice. It will also demonstrate growing these crops under irrigation as opposed to dryland.

Demonstration Plan

Seed of the nine varieties used in this trial was acquired from Jamie Larson, Research Scientist with AAFC Lethbridge. The fall rye varieties were direct seeded into canola stubble at the CSIDC research farm on

September 22th 2016. At seeding, each trial received 80 kg N/Ha as urea side banded and 25 kg P2O5/ha seed placed monoammonium nitrate. In spring the irrigated trial was top dressed with another 40 kg N/ha. Fall rye varieties were established in a small plot randomized trial design replicated 3 times. Yields were estimated by direct cutting the plot with a small plot combine once the fall rye reached maturity. For ease of harvest with small plot seeders, the plots were desiccated on August 4th with Desica and Agral 90 (note this product is not registered for cereal crops). The varieties used in this trial are listed in Table 1.

Table 1. Varieties and Information of Fall Rye Seed

Variety	Type
Brasetto	Hybrid
Guttino	Hybrid
Bono	Hybrid
Helltop	Hybrid
Prima	Open Pollinated
AC Rifle	Open Pollinated
Danko	Open Pollinated
Hazzlet	Open Pollinated
Brandie	Open Pollinated

Results

Results obtained for the irrigated trial are shown in Table 2 and the dry land trial is shown in Table 3.

Irrigated Trial

The hybrid variety Bono yielded the highest under irrigation (Table 2), and the conventional variety AC Rifle the lowest. Yields of the 9 varieties ranged from 7224 kg/ha to 12193 kg/ha (115-194 bu/ac) with the median being 9436 kg/ha (150 bu/ac). The hybrid varieties excluding Brasatto (Guttino, Helltop and Bono) yielded significantly higher than the conventional varieties under irrigation. Grain protein was as low as 11.2% (Bono) to a high of 13.1% (Danko). Median test weight and seed weights for all evaluated varieties was 71.7 kg/hl and 32.6 gm respectively. Maturity was spread over a period of 7 days among the varieties with AC Rifle being the earliest and Brasatto, Guttino and Bono tied as the latest. Lodging was not a major factor on this trial with Hazlet having the highest rating.

Dry Land Trial

The hybrid variety Bono yielded the highest under dryland (Table 3), and the conventional variety AC Brandie the lowest. Yields of the 9 varieties ranged from 6523kg/ha to 11742 kg/ha (104-187 bu/ac) with the median being 8676 kg/ha (138 bu/ac). The hybrid varieties (Brasatto, Guttino, Helltop and Bono) yielded higher than the conventional varieties under dryland conditions. Grain protein was as low as 11.6% (Bono and Guttino) to a high of 13.5% (Brandie). Median test weight and seed weights for all evaluated varieties was 70.8 kg/hl and 33.9 gm respectively. Maturity was spread over a period of 6 days among the varieties with AC Rifle and Prima tied for the earliest and Brasatto being the latest. Lodging was not a major factor on this trial with Brasatto having the highest rating.

Irrigated vs Dry Land

The irrigated trial gave an average yield increase of 11.1 bu/acre (8%) compared to the dryland trial (table 4). Irrigation gave a slight increase to test weight and decrease to seed weight compared to the dryland trial. The irrigated trial had a slightly larger lodging rating although it was still not a major factor in either trial.

Table 2. Fall Rye Variety Evaluation, Irrigation Site, 2017.

Variety	Yield (kg/ha)	Yield (bu/ac)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Days to Flower (days)	Days to Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Brasetto	8486	135.2	11.7	70.1	36.1	June 5	July 30	116	2.7
Guttino	11144	177.5	11.4	71.2	32.4	June 5	July 30	121	2.7
Bono	12193	194.2	11.2	71.7	32.6	June 6	July 30	119	2.7
Prima	7734	123.2	12.6	71.4	30.2	June 4	July 25	148	3.0
AC Rifle	7224	115.0	13.0	69.7	27.4	June 6	July 24	116	1.0
Danko	9436	150.3	13.1	72.5	31.6	June 3	July 27	129	2.0
Hazlet	9594	152.8	12.3	71.8	37.0	June 5	July 29	137	3.7
Helltop	10173	162.0	12.2	72.5	36.0	June 6	July 29	134	1.0
Brandie	7960	126.8	12.9	73.5	33.2	June 4	July 28	139	3.0
LSD (0.05)	1647	26.2	0.4	1.0	4.2	1.8 days	1.7 days	11.0	NS
CV (%)	10.2	10.2	1.7	0.8	7.4	0.7	0.5	5.0	42.0

Table 3. Fall Rye Variety Evaluation, Dry Land Site, 2017.

Variety	Yield (kg/ha)	Yield (bu/ac)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Days to Flower (days)	Days to Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
Brasetto	8772	139.7	12.0	69.7	36.8	June 6	July 30	111	3.0
Guttino	10200	162.5	11.6	70.1	33.7	June 5	July 29	112	2.3
Bono	11742	187.0	11.6	70.8	30.0	June 6	July 29	113	2.3
Prima	7692	122.5	12.5	70.7	29.9	June 3	July 23	133	2.0
AC Rifle	6548	104.3	12.8	68.6	26.6	June 5	July 23	112	1.0
Danko	8676	138.2	12.6	71.6	34.8	June 3	July 25	120	1.7
Hazlet	8169	130.1	12.2	71.9	36.1	June 4	July 27	125	2.7
Helltop	9373	149.3	12.3	71.6	33.9	June 7	July 28	121	1.7
Brandie	6523	103.9	13.5	73.0	38.5	June 4	July 27	128	2.7
LSD (0.05)	1753	27.9	0.4	0.8	2.9	NS	0.9 days	10.2	1.0
CV (%)	11.7	11.7	1.7	0.6	5.0	1.1	0.3	5.0	26.7

Table 4. Fall Rye Variety Evaluation, Combined Site, 2017

System / Variety	Yield (kg/ha)	Yield (bu/ac)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)	Days to Flower (days)	Days to Maturity (days)	Height (cm)	Lodging 1=erect; 9=flat
System									
Irrigated	9327	148.6	12.3	71.6	32.9	June 5	July 28	128	2.4
Dry Land	8633	137.5	12.3	70.9	33.4	June 5	July 27	119	2.1
LSD (0.05)	NS	NS	NS	0.2	NS	NS	NS	NS	NS
CV (%)	10.9	10.9	1.7	0.7	6.3	0.9	0.4	5.0	36.1

Conclusion

This ADOPT demonstration displayed the merit growing fall rye under irrigation in Saskatchewan. The top performing variety, Bono, demonstrated a 7.2 bu/acre yield advantage to its dryland counterpart. This is much less significant than what was seen in a similar 2016 trial. This project also demonstrated the yield advantage that new hybrid varieties of fall rye can offer. Three of the hybrid varieties in this project, Helltop, Guttino and Bono all yielded significantly more under irrigation than the top performing conventional variety, Hazlet. Brasetto yielded close to the median in this trial despite it being the top performing hybrid in the 2016 trial. 2017 experienced a dry spring and summer making the smaller response to irrigation puzzling. Perhaps the dryland trial had sufficient sub soil moisture to almost reach its yield potential without the addition of irrigation.

This project showed irrigators in Saskatchewan that fall rye can be a high yielding crop that could be added into their rotation. The different timing of operations for fall seeded crops compared to spring seeded can help a producer manage time and resources. Further demonstration of this crop under irrigation and extension of this year's results will help provide awareness to Saskatchewan irrigators.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- CSIDC and ICDC staff who assisted with the field and irrigation operations for this project
- Jamie Larson AAFC Lethbridge Research Centre, who organized and sourced seed fort his project

Intercropping marrowfat pea and mustard

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Ministry of Agriculture
- Garry Hnatowich, PAg, ICDC Research Director

Co-operator

- Damian Lee, Field Research Technician, ICDC
- Barry Vestre, Farm Manager, CSIDC

Project Objective

This project will demonstrate the benefit of growing mustard as an intercrop with marrowfat pea to reduce lodging of the marrowfat pea. By holding the plants off the ground, the mustard will minimize disease in the stand and increase the yield potential of marrowfat pea.

Demonstration Plan

Marrowfat pea and mustard will be sown as an intercrop and sole crop to determine the potential for using this technique to reduce disease within the pea stand.

Demonstration Site

The project was located on Field 1 at the Canada-Saskatchewan Irrigation Diversification Center.

Project Methods and Observations

The intercropping demonstration consisted of three treatments:

1) AC Pennant yellow mustard seeded at 5 lb/ac
2) Hitomi marrowfat pea seeded at 180 lb/ac and
3) a yellow mustard-marrowfat pea intercrop (3.5 lb/ac yellow mustard and 120 lb/ac marrowfat pea).

Each plot consisted of four passes with the research plot drill. The site was sown May 31, 2017. Height measurements were taken July 6. All crops looked healthy and were standing well. On August 4, aphids invaded the stand requiring Matador @ 33.2 ml/ac to be applied. The plots were desiccated September 8 with Reglone @ 0.83 l/ac. The mustard was harvested by straight cutting on September 15. The sole crop marrowfat peas and intercrops were straight cut September 27.

Table 1: Crop measurements collected from intercropping site @ Field 1

Crop	Seeding Rate (lb/ac)	Crop Height (cm) (as of July 6)	Yield (Bu/ac)	Revenue ($/ac)
Marrowfat	180	46	23.5	$78
Yellow mustard	5	78	56.7	$964
Intercrop	3.5 120	89	49.5 bu/ac yellow mustard 2.0 bu/ac marrowfat pea	$849

Figure 1: Intercropping plot showing competitive advantage of yellow mustard relative to marrowfat pea on July 6, 2017.

Final Discussion

The yellow mustard grew vigorously on Field 1 at CSIDC and overpowered the marrowfat pea on the site. Growth of the marrowfat pea was average in the sole crop but certainly not as vigorous as anticipated in either the sole crop or the intercrop. Growers who commercially grow the intercrop on dryland do not experience yellow mustard strongly out competing the marrowfat pea. The moist conditions under irrigation and high nitrogen status of irrigated soil may contribute to the vigorous growth of the yellow mustard under irrigated conditions. A lower seeding rate for mustard in the intercrop may improve the performance of the intercrop. The disappearance of field pea in the stand was not expected. Another crop such as shatter resistant canola may be better suited to irrigated production.

Acknowledgements

Marrowfat seed was supplied by Rudy Agro at Broderick. AC Pennant mustard seed was provided by Russ Harris on reference from Landis Coop Agronomist Gary Graham.

Irrigated Soybean Fungicide Demonstration

Funding

Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead

- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Organizations

- Irrigation Crop Diversification Corporation (ICDC)

Objectives

This project evaluated two different fungicides on soybean in the Lake Diefenbaker Development Area and compared them to an untreated control.

Demonstration Plan

Site 1:

Pioneer 00 soybeans were seeded on May 25th on the North Half of 9-24-7 W3M, Luck Lake Irrigation District, SK with an air drill. This site is has a Haverhill association and is a Loam. The quarter section is irrigated with a low pressure pivot system. See table 1 for the agronomic and irrigation management for this site.

Site 2:

Low CHU requiring soybeans were seeded on May 28th on the NW-20-24-7 W3M, Luck Lake Irrigation District, SK with an air drill. 85 percent of this quarter is has a Haverhill association and is a Loam and the northern 15% is a Weyburn association which is also a loam. The quarter section is irrigated with a low pressure pivot system. See table 2 for the agronomic and irrigation management for this site.

Table 1. Site 1 Agronomic Management of Soybean Fungicide Demonstration

Fertilizer	K	11-50-2
Banded	30lbs/ac	40 lb/ac
Inoculant	granular, 7lbs/acre	
Seeding Rate	190lbs/ac	
Row Spacing	12 inch	
Fungicide Application	July 18th (R2 stage)	
Rainfall	35mm (1.4 inch)	
Irrigation	229 (14 inch)	
Harvest Date	October 27th	

Table 2. Site 2 Agronomic Management of Soybean Fungicide Demonstration

Fertilizer	K	P
Banded	NA	NA
Inoculant	Granular	
Seeding Rate	68 lb	
Row Spacing	12 ic	
Fungicide Application	July 24th	
Rainfall	51 mm (2 inch)	
Irrigation	NA	
Harvest Date	October 11th	

Results and Discussion

Soybean acres in Western Canada have increased as improved varieties for our growing conditions are emerging and producers are looking for different crops that could maximise profits. There have been between 400 and 500 acres of soybeans seeded under irrigation in the Lake Diefenbaker Development Area in 2014 and 2015 and increased to 650 in 2016. Acres expanded in 2017 to 2600 in the Lake Diefenbaker Development Area.

Soybeans are a relatively new cop for irrigated producers in Saskatchewan therefore the benefits of foliar fungicide applications have not been sufficiently demonstrated locally. Under irrigated conditions, crops are more susceptible to disease due to higher amounts of moisture compared to dryland. This project demonstrated the efficacy of foliar fungicide application to control disease and promote health in high yielding soybeans under irrigation. This project also evaluated the economic and yield benefits of this practice.

Yields were measured for this project with a weigh wagon at both sites 1 and 2. Representative strips were selected by the producer for the trial and were harvested with a 33 foot header combine at site 1 and a 30 foot header at site 2. Table 3 and 4 show the sample size and yields for of the treatments in both sites in this trial. There were no visual signs of disease in either of the sites in 2017.

Table 3. Site 1
Yield Results of Soybean Fungicide Demonstration

Treatment	Sample Size (ac)	Yield (lb/ac)	Yield (bu/ac)
Control	7.36	1760	29.3
Delaro	7.36	1705	28.4
Priaxor	7.36	1659	27.6

Table 4. Site 2
Yield Results of Soybean Fungicide Demonstration

Treatment	Sample Size (ac)	Yield (lb/ac)	Yield (bu/ac)
Control	0.97	2059	34.3
Delaro	0.76	2009	33.5
Priaxor	0.92	2082	34.7

Conclusion

This project was implemented due the increasing interest in soybean production in Saskatchewan and the high disease risk associated with irrigated crop production. This project was conducted during a very dry year with 1-2 inches of rainfall during the growing season at both sites. There were no visual symptoms of white mold incidence even in the untreated portions of the field. The control at both sites had very consistent yield with the treated plots which showed no yield response to the fungicides. Sufficient water was applied to both sites to acquire a normal yield and it was thought that this would also induce disease.

The hypothesis for why disease was not present, even under irrigation, is that the crop canopy was able to dry out fast enough due to the hot, dry, windy weather. The fungicide did not delay harvest for this crop and all treatments including the control were fairly uniform in maturity. This project demonstrated that applying fungicide on soybeans may not be economical during dry years even under irrigation. The cost of applying fungicide for a both products is about $28 per acre including equipment use so a producer would need to see a 2.5 bushel increase to break assuming the price of soybean in $11/bu.

Figure 1. Soybean trial not showing an obvious visual response on September 5

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The project lead would like to acknowledge the following contributors:

- Kelvin Bagshaw (Cooperator), Producer
- Kees De Winter (Cooperator), Producer

Phosphate, Potassium & Zinc Demo at Lodge Creek

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Ministry of Agriculture
- Andre Bonneau, P.Ag., Regional Forage Specialist, Saskatchewan Ministry of Agriculture
- Trevor Lennox, PAg., Regional Forage Specialist, Saskatchewan Ministry of Agriculture

Co-operator

- Mike Leismeister, Producer, Consul, SK
- Randy Stokke, Producer, Consul, SK
- Kevin Eremenko, Richardson Pioneer, Maple Creek, SK

Project Objective

This project will demonstrate potential for improved forage production with increased fertilizer inputs at gravity irrigated alfalfa fields in Southwest Saskatchewan.

Project Background

A local producer noticed a distinct line between two sides of his flood irrigated field at Lodge Creek Irrigation District. Soil samples were collected from both sides of the flood irrigated site to compare differences in soil quality and nutrient status between the two areas. Forage producers on irrigated hay plots in southwest Saskatchewan often use minimal fertilizer on their hay fields. The hypothesis for the project was that land leveling had introduced a nutrient deficiency to the field. The project investigated this assumption.

Demonstration Plan

Targeted blends of fertilizer nutrients were broadcast on border dykes to measure the impact of different fertilization strategies on forage production on the flood irrigated project. The forage yield of the entire area of pairs of border dykes was weighed in 2016 to determine the forage yield. The bales needed to be removed in 2017 prior to being weighed. For the 2017 yields, the bales were counted and four representative bales were weighed to determine an average weight per bale to estimate the forage yield.

Demonstration Site

The project is located on Plot #17 on SE12-2-30-W3 on Kindersley clay within Lodge Creek Irrigation District. This soil association has pockets of sodium affected soil present over the landscape, but the surface soil is nonsaline. The site has been in forage since the irrigation dykes were constructed. Soil fertility analysis for the two areas is reported in Table 1. The irrigation district is sown entirely to forage, mainly alfalfa and grass. The proportion of grass in the stand on Plot #17 was higher than originally thought. It was suspected that the visual line observed in the stand was due to soil fertility effects introduced when the site was leveled for irrigation. Further investigation at the site indicated that the observed growth difference at the site was due to a difference in grass species. A relatively small difference in soil fertility and soil quality was noted for the two areas, but the change in grass species, smooth bromegrass versus meadow bromegrass, is the main cause for the visual effect.

Table 1: Soil analysis of two areas with differential productivity at Lodge Creek Irrigation District.

Site	Depth	pH	OM (%)	N	P	K	S	Cu	Fe	Mn	Zn	B
				-----------------------				ppm	-------------------------			
Poor	0-6	7.5	3.1	1	2	217	11	1.3	16	4.9	0.6	1.1
Poor	6-12	8.3		1			24					
Better	0-6	7.4	4.3	6	3	300+	8	1.1	13	5.0	0.6	1.7
Better	6-12	8.0		1			11					

Project Methods and Observations

Fertilizer recommended for alfalfa hay based on a comparative soil test shown in Table 1 was essentially equal consisting of 40 lb P2O5/ac and 4 lb Zn with 15 lbK20 /ac and 10 lb S/ac considered discretionary. The side with better growth (meadow bromegrass) had slightly higher organic matter levels, slightly higher extractable potassium, but lower extractable sodium, all consistent with the observed differences in growth. Available sulphur was slightly higher for the poorer growth area. Differences in available micronutrients were small even though the site would have been land leveled at the time of border dyke construction. Land leveling has been known to reduce zinc fertility where a thinner layer of topsoil was deposited.

Fertilizer was broadcast with a spin spreader on November 2, 2015 to dry ground on a beautiful sunny day with temperature about 10C. The fertilization plan is outlined in Table 2 below. It was not possible to calibrate the spreader prior to applying the fertilizers so judgement with the equipment chart was used to approximate the settings for the spreader using the bulk density of the fertilizer products.

Table 2: Fertilizer applications to Field 17, Lodge Creek Irrigation District

Treatment	Fertilizer Applied (lb nutrient)	Bulk Density (lb/ft^3)	Rate of Blend (lb product/ac)
Control	None	N/A	None
Phosphorus	50 lb P_2O_5	65 lb/ft^3	115 lb 11-51-0 /ac
Potassium	80 lb K_2O	70 lb/ft^3	128 lb 0-0-60 / ac
Phosphorus/Potassium	50 lb P_2O_5 + 80 lb K_2O	67.6 lb/ft^3	243 lb 5-22-35-0 /ac
Phosphorus/Potassium/ Zinc/Sulphur	50 lb P_2O_5 + 80 lb K_2O +4 lb Zn + 4 lb S	67 lb/ft^3	243 lb 5-22-35-0 / ac + 16 lb Zn product / ac

The plan was to apply each blend to three border dykes. The spreader was driven down the center of each of two border dykes and emptied out while doubling back on the first border dyke of each treatment as shown in Figure 1. Each treatment consisted of two border dykes. Melting snow moved the fertilizer into the root zone. See Figure 1 below.

Irrigation

Water for irrigation was supplied by gravity flow from an irrigation canal fed from nearby Altawan Reservoir in early May. The site was irrigated on May 9, 2016. The hay fields saturated with water fairly quickly in 2016 compared to other springs. The water provided from the reservoir was excellent irrigation water. The water sample collected in early May had an electrical conductivity of 793 uS/cm, and an SAR of 1.74. This water has excellent quality for irrigation. Lake Diefenbaker reservoir water has similar electrical conductivity and an SAR of about half, but Altawan reservoir water is still excellent quality for irrigation. Irrigation for 2017 occurred later in spring toward the end of May.

The precipitation recorded at the Environment Canada weather station at Altawan Reservoir for 2016 totaled 287 mm for the growing season. Data for 2017 was collected from the Willow Creek station. Rainfall during the 2017 growing season was about half that which fell during 2016. Both precipitation summaries are recorded in Table 2.

Figure 1: Project layout at Field 17, Lodge Creek Irrigation District

Table 3:

Month	2016 Rainfall (mm)	2017 Rainfall (mm)
April	51	28
May	61	29
June	56	48
July	50	4
August	28	9
September	25	14
October	16	8
Total	**287**	**140**

Precipitation recorded at Altawan Reservoir on SE12-2-30-W3 during 2016
(Data courtesy Dan Selinger and , Environment Canada, Regina, SK)

The hay was cut and baled in early July both years. Each border dyke was baled separately. The bales were left on the field until they were weighed with the ICDC Bale scale during the last week of July in 2016. Two core samples were collected from each bale and composited for each border dyke. Each border dyke sample was analyzed for feed quality. The average feed quality for each treatment is reported in Table 4.

The forage yields for the fertilizer treatments in 2016 and 2017 are reported in Table 3. The forage yield increased with each fertilizer nutrient blend applied to the site in 2016. The largest individual yield response occurred for the nutrient potassium that season, but an increase in yield occurred with each supplementary nutrient addition. When phosphorus, potassium, and zinc were all applied, the largest yield response of close to 0.5 ton/ac occurred. The hypothesis when the project was initiated was that the largest yield increase would occur with phosphorus application. Phosphorus improved the yield, but potassium provided the greatest individual nutrient yield increase in 2016. Because no fertilizer had been applied to the site prior to the project, the harvesting of the forage at the site represents a continual removal of nutrients from the field. Fertilizer application increased not only yield but also crude protein in the forage. Fertilizer increased the crude protein content between 0.5 and 1 percent. There was limited impact on other forage quality parameters measured.

The project was designed with the assumption that alfalfa represented the majority of the species in the stand. Since grass represents likely 80 - 85% of the forage stand, nitrogen would most likely provide a better boost for the forage yield. Much of the yield response observed is likely due to the nitrogen supplied from the ammonium phosphate fertilizer. Some or even potentially all of the yield boost observed for zinc fertilizer is possibly attributable to sulphur included with the zinc fertilizer. Yet the strongest response in this demonstration was to potassium. Putting this field on an annual program of 50 lb P205, 50 lb K20, and 10 lb S/ac until soil test levels rise above the minimal levels would improve the yield and quality of the forage. The cost of this level of fertilization would be near $50 per acre. The benefit of this type of fertilization program would be improved productivity and quality of hay produced from the irrigated flats. Micronutrient content of the forage is changed little in the demonstration likely because of the clay soil texture. The health of the beef herd would be improved once the microelement content of the forage began to improve. Longevity of the stand would be improved if the K status increased. The persistence of alfalfa in the stand would be improved once this occurred.

Table 3: Forage yield response from fertilization at Field 17, Lodge Creek Irrigation District

Treatment	2016 Hay Yield (t/ac)	2016 Increase in Yield Above Control (t/ac)	2017 Hay Yield (t/ac)	2017 Increase in Yield Above Control (t/ac)	Fertilizer cost/ac (2016)	Cost/ton forage increase	Amortization
P+K+Zn(+S)	2.39	0.45	1.02	0.24	41.79	60.56	3 yr PK, 10 yr Zn
Control	1.94		0.78		Nil	Nil	None
Phosphorus (+N)	2.06	0.12	0.99	0.21	18.24	18.42	3 yr
Potassium (+N)	2.17	0.23	0.91	0.13	12.94	33.18	3 yr
P+K(+N)	2.19	0.25	0.85	0.07	31.18	97.44	3 yr

A meeting to report these results to the irrigators was held February 3, 2017 in conjunction with the South of the Divide Conservation Action Program at Consul.

Table 4: Feed analysis of hay from fertilizer treatments applied to border dykes at Lodge Creek Irrigation District

	Control	Phosphorus	Potassium	P + K	P + K + Zn
Moisture (%)	5.87	4.23	5.36	5.42	5.45
Dry Matter (%)	94.1	95.8	94.6	94.6	94.5
Crude Protein (%)[1]	9.0	9.9	9.8	10.3	9.5
Calcium (%)[1]	0.60	0.73	0.69	0.74	0.64
Phosphorus (%)[1]	0.17	0.18	0.18	0.20	0.20
Magnesium (%)[1]	0.17	0.19	0.18	0.20	0.17
Potassium (%)[1]	1.76	1.85	1.92	1.98	1.93
Copper (mg/kg)[1]	6.1	4.9	5.4	7.6	5.0
Sodium (%)[1]	0.05	0.06	0.06	0.06	0.04
Zinc (mg/kg)[1]	64	21	28	25	21
Manganese (mg/kg)[1]	34	33	33	34	32
Iron (mg/kg)[1]	84	61	61	65	54
Acid detergent fiber (%)[1]	37	37	39	37	37
Neutral detergent fiber (%)[1]	57	57	57	57	59
Non fiber carbohydrate (%)[1]	24	22	22	22	22
Total digestible nutrients (%)[1]	60	60	58	59	60
Relative feed value (%)[1]	99	98	96	98	97

[1] DM basis

For 2017, alfalfa plant tissue samples were collected from each of the treatments of the top 6 inches of growth at early bloom on May 29, 2017. From the samples collected, only potassium was below the recognized critical level for some of the treatments. The data reported in Table 5 indicates that residual phosphorus or potassium fertilization without the other reduced nitrogen fixation, phosphorus, potassium, sulphur, iron, and zinc content in the forage, but only potassium concentrations were below recommended critical concentrations for most of the treatments. This observation is due to dilution of nutrient concentration as growth was encouraged by the fertilizer. Nutrient uptake by the roots was unable to compensate for the increase in growth of the forage. If the potassium status of the alfalfa could be improved, root growth may increase and assist with micronutrient uptake.

Table 5: Plant tissue analysis of alfalfa samples collected from treatments at early bud stage in June, 2017.

Treatment (Fertilizer/ac)	**N (%)**	**P (%)**	**K (%)**	**S (%)**	**Ca (%)**	**Mg (%)**	**Cu ug/g**	**Fe ug/g**	**Mn ug/g**	**Zn ug/g**	**B ug/g**
Control 1	5.2	0.42	2.2	0.53	1.7	0.36	10	92	33	43	31
Control 2	5.1	0.40	1.7	0.50	2.2	0.36	13	112	38	39	35
P	4.8	0.37	1.6	0.41	1.9	0.35	10	71	33	33	34
K	4.8	0.34	1.7	0.44	2.4	0.41	10	74	37	33	37
PK	5.0	0.34	1.6	0.40	1.8	0.34	11	79	30	36	34
PKZn	5.1	0.38	1.7	0.41	1.7	0.34	11	72	27	38	33
Threshold	***4.5***	***0.25***	***2.0***	***0.30***	***0.5***	***0.25***	***8***	***50***	***20***	***20***	***30***

Final Discussion

The continual removal of forage on hayland draws heavily on the nutrient reserves of the soil. The industry is fortunate soil reserves at this site are derived from chernozemic grassland soils which have a large nutrient storehouse. The clay soil present at the site supplies generous quantities of nutrients for the perennial forage. Nutrients which are present in higher concentrations in the harvested portion are depleted faster from the soil. The low to marginal levels of potassium in the alfalfa tissue samples is an example of this concept. Potassium application is likely the most critical nutrient for this site second to nitrogen for the grass component on this site.

Acknowledgements

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Mike and Tony Leismeister for hosting the demonstration on Field 17 at Lodge Creek Irrigation District.

Randy Stokke for providing emergency boosting service to staff stranded at the site.

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Trevor Lennox of Sask Ministry of Agriculture for site visits to evaluate the health of the forage stand.

Reclamation of Sodium-Affected Soil

Project Lead

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Co-operator

- Andre and Patrick Perrault, Ponteix, SK Ponteix Irrigation District
- Greg Oldhaver, Cabri, SK Miry Creek Irrigation District

Objective

The project was initiated to demonstrate three alternatives for replacement of sodium with calcium on the soil exchange complex of heavy textured irrigated soils.

Demonstration Plan

Sodium, a monovalent cation, does not effectively neutralize the negative charge associated with soil colloids because of its large hydrated radius. When this occurs, the clay particles repel each other which interrupts the continuity of pores for water infiltration and soil moves into the soil profile at a much reduced rate. Calcium, with its smaller diameter hydrated radius, is able to displace sodium from the cation exchange sites in the soil. After the sodium is flushed from the soil profile, calcium on the cation exchange is able to restore healthy soil structure and adequate water infiltration. Three calcium products - calcium chloride, calcium nitrate, and calcium sulphate - differ in ionic size and solubility. Each was broadcast on the surface of sodium-affected soils to evaluate their impact on crop yield. The application rate selected for the sites was 100 lb calcium per acre, which is substantially less than the rate predicted by the theoretical gypsum requirement calculations. This was attempted to determine whether lower rates of application would be effective. A total of four applications were made to the site after three years.

Demonstration Site

Two sites were selected for the demonstration. The Ponteix site is situated on Alluvium soils along the edge of Notekeu Creek. Plot 22 in Ponteix Irrigation District is clay textured and has been irrigated with high SAR water from Gouveneur Reservoir in the past. The poor water infiltration was created by man-made interference using the high SAR water for irrigation.

The Miry Creek site is located on orthic Willows-Sceptre lacustrine soils which show reduced water infiltration (ponding following irrigation) compared to the adjacent area. Plot 13 in Miry Creek Irrigation District is near the bay north of Cabri at the edge of the South Saskatchewan River. The soil is heavy textured and suffers waterlogging in a low lying area during irrigation.

Prior to application of the calcium amendments, soil samples were collected in spring, 2014 from each of the two replicates at three depths: 0–12”, 12–24”, and 24–36”. Detailed salinity analysis was conducted on each sample to determine the soil chemical properties at the locations. These soil results are reported in Table 1.

Table 1 a. Soil properties determined for the sodium-affected soils from the Ponteix site sampled in spring 2014

Parameter	Ponteix Plot 22 - South Plot			Ponteix Plot 22 - North Plot		
	0-12"	12-24"	24-36"	0-12"	12-24"	24-36"
pH	7.26	7.59	8.05	7.29	7.82	8.34
Conductivity (dS/m)	2.25	1.42	5.17	2.74	1.10	1.40
% Saturation	81.70	84.90	113.00	81.60	83.80	75.50
Calcium (mg/L)	53.20	17.50	138.00	58.60	11.20	9.80
Magnesium (mg/L)	31.90	8.80	84.00	37.70	4.90	5.70
Potassium (mg/L)	21.20	6.20	23.00	47.40	4.35	3.10
Sodium (mg/L)	361.00	257.00	1280.00	416.00	190.00	222.00
Sulphate (mg/L)	245.00	264.00	2740.00	252.00	128.00	204.00
Chloride(mg/L)	79.20	29.10	29.00	114.00	27.70	20.20
SAR	***10.70***	***13.60***	***19.90***	***11.50***	***13.00***	***16.00***
TGR(sodic) (t/ha)	3.44	5.99	14.20	4.14	5.42	7.01

Table 1 b. Soil properties determined for the sodium-affected soils from the Miry Creek site sampled in spring 2014

Parameter	Miry Creek Plot 13 -Southside			Miry Creek Plot 13 - Northside		
	0-12"	12-24"	24-36"	0-12"	12-24"	24-36"
pH	7.79	8.13	8.11	7.79	8.30	8.17
Conductivity (dS/m)	1.04	3.05	11.10	1.12	1.98	7.37
% Saturation	80.50	99.20	97.40	80.80	98.30	98.70
Calcium (mg/L)	49.30	66.10	509.00	63.90	26.50	221.00
Magnesium (mg/L)	27.40	67.70	479.00	28.50	22.90	258.00
Potassium (mg/L)	3.57	5.30	<19.00	3.69	2.90	<20.00
Sodium (mg/L)	112.00	619.00	2100.00	110.00	410.00	1450.00
Sulphate (mg/L)	91.00	1060.00	6510.00	218.00	491.00	3950.00
Chloride(mg/L)	24.50	157.00	286.00	16.60	63.30	152.00
SAR	***3.50***	***12.80***	***16.20***	***3.20***	***14.20***	***15.90***
TGR(sodic) (t/ha)	<0.10	6.30	9.22	<0.10	7.49	9.01

The Ponteix site has grown barley in 2014, field pea in 2015, barley in 2016 and lentil in 2017. The Miry Creek site was sown to alfalfa for 2014 to 2016, but rotates to annual crops when the productivity of the alfalfa stand tapers off and as the stand ages. The alfafa stand was terminated at the end of the 2016 season and was sown to oats for greenfeed in 2017.

Project Methods and Observations

The amendments were applied to two replicates at each site on May 20 and November 8, 2014, November 13, 2015 and November 3, 2016. The rate of calcium applied was 100 lb/acre for each application. The application rate was based on gypsum rates applied to cultivated potato fields to improve harvest conditions for potato. The calcium in the amendment improves floculation of the clay reducing soil lumps in the field and the quanity of soil collected during potato harvest operation. The approach also attempts to improve water infiltration at a lower cost than the rapid remediation practiced on brine contaminated oilfield sites. The rate in this demonstration is less than 10% of the calculated theoretical gypsum requirement determined from the detailed salinity analysis.

The calcium nitrate and calcium sulphate amendments also supply plant nutrients. For 2014 and 2015, 70 lbs/ac of nitrogen was applied to the calcium chloride and calcium sulphate treatments to compensate for the nitrogen applied with the calcium nitrate treatment. Unfortunately, no N was applied to the control area in 2014 and 2015. This shortcoming was corrected in fall, 2016.

The results of the first two years were reported in the 2014 and 2015 ICDC Research and Demonstration report available on the ICDC website. No yield data was collected in 2016.

In 2017, the Ponteix site was sown to Maxim lentil while the Miry Creek site was sown to greenfeed oats. The Ponteix site was seeded April 25 with 60 lb of granular 8-21-23-4 seed-placed and topped up with 3 US gallons of 6-22-2 in the seed furrow. The weed control program consisted of Solo and Assure II. Nitrogen application to the site appears to have encouraged growth of kochia in the lentil stand. The crop received limited rainfall during the 2017 growing season. Hand harvested samples were collected on July 28. The samples were dried, threshed and weighed at CSIDC.

The Cabri site was sown to greenfeed oats in early June. Greenfeed oat forage was harvested on August 30. Note the two stages of growth in the greenfeed oats. It appears that irrigation stimulated the oats to ratoon so that two stages of growth occurred in the stand. The second growth was about ten inches taller than the initial stand of oats. The mixture of ripening oats together with the just headed oats should provide an unintended advantage for the greenfeed. Elevated levels of nitrate in the greenfeed is a potential risk for this feedstuff. See Figure 2.

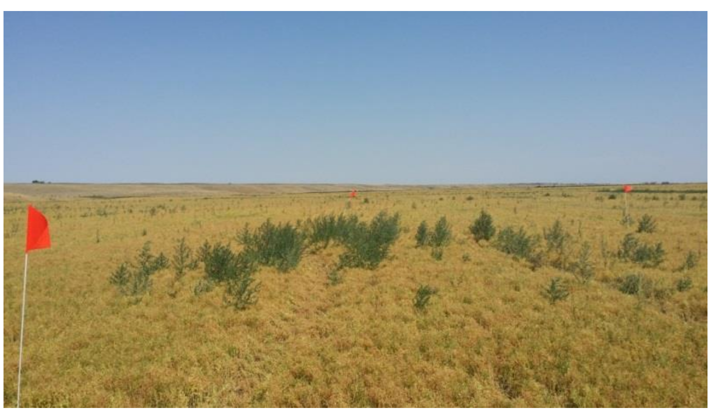

Figure 1

Field strips receiving calcium application at Ponteix in 2017. Plots are 10 feet wide by 50 ft long. The picture (Figure 1) shows calcium chloride, calcium nitrate, and calcium sulphate treatments from left to right. Note how the urea nitrogen enhanced the emergence of kochia within the lentil. The field received only 0.4 inches of rain during the growing season.

Table 2: 2017 Yields on Calcium Amended soils

Treatment	Lentil Seed Yield at Ponteix (lb/ac)	Greenfeed Oats Yield at Miry Creek (t/ac)	Product cost ($/ac/yr)	Quantity of Reclamation Product (lb/ac/yr)
Calcium Chloride	860	2.01	$167	271
Calcium Nitrate	1370	2.26	$261	400
Calcium Sulphate	1430	1.99	$172	420
Control	1050	2.15	Nil	0

The calcium products used for the demonstration are prohibitively costly. If an agronomic benefit can be demonstrated with the lower rate of calcium application, less expensive product sources would need to be sourced for the practice to be practical.

Figure 2

Two stages of growth in the greenfeed oats developed in the field due to the dry summer and lack of moisture in early spring. The lack of uniformity for water application from the wheel line irrigation system was evident in the two stages of oat growth at the site. Irrigation is not possible at Miry Creek until spring recharge on Lake Diefenbaker raises the water level to allow pumping from the intake in the middle of the river .

Final Discussion

The calcium applications provided mininal yield improvements at both sites. The yield effects were not consistent enough to recommend one product over another. Yield measurements in 2017 continued to show limited improvement in yield for the crops grown at the sites. The cost of the treatments using current products are too expensive to justify continuing the demonstration. Going forward, the site will been mapped using GPS mediated EM38 technology with a goal to developing a reclamation strategy using calcium products in conjunction with installed tile drainage.

FRUIT AND VEGETABLE CROPS

Use of Photoselective Netting To Improve Productivity of Dwarf Sour Cherry, Haskap, and Saskatoon Berry

Funding

Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead

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- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Fruit Growers Association (SFGA)

Objective

The primary objective of this project was to display use of photo-selective netting to enhance orchard productivity, increase growth rate, reduce disease and insect pressure, and improve fruit quality of Saskatchewan fruit crops.

The quality of light modified underneath photo-selective netting can invoke various beneficial plant physiological responses. So; in some cases plants grow more vigorously and productively, but in other cases plants may display more disease resistance and inhibition of growth may occur. In addition; photo-selective netting has been shown to reduce pest pressure (through exclusion and reduced dispersal), and protects plants from the drying effects of winds, hail, et cetera. It has a shading effect (which can be ordered at different levels; for example 30% or 40%) which reduces evapotranspiration, and moderates soil dynamics.

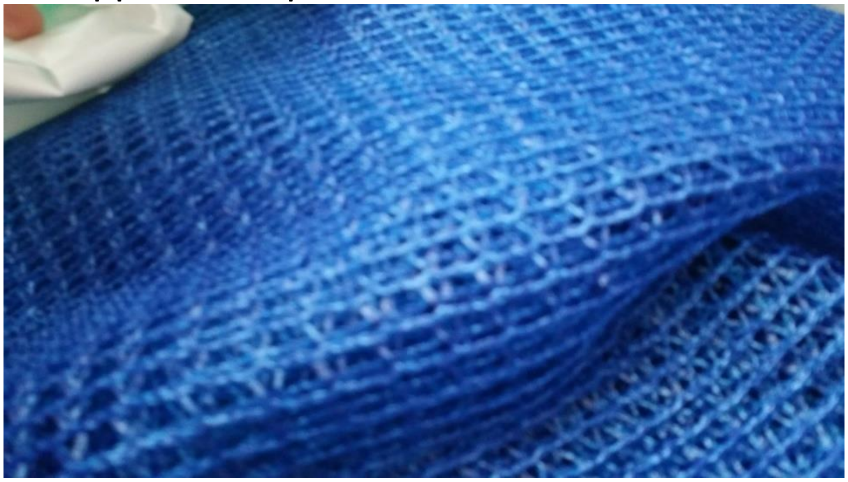
Project Plan

The demonstration showcased the use of Blue, Red, and Pearl (appears white) photo-selective netting on dwarf sour cherry, Haskap and Saskatoon berry. The net was purchased through ACW Supply and is sourced from Green tek shading solutions based in California.

Four rows of Saskatoon berry, four rows of Haskap, and three rows of dwarf sour cherry were used in this project. Saskatoon berry rows included two cultivars Smokey and Thiessen.
Haskap rows include University of Saskatchewan varieties Tundra, Borealis, Honey Bee; as well as Berry Blue, (a variety from One Green World nursery, Oregon).

Dwarf sour cherry rows included University of Saskatchewan cultivars Cupid, Valentine, and Romeo.
In Saskatoon berry and dwarf sour cherry treatment plots were 6 meters of row length (since the plants sucker the number of plants per plot was not prescribed). Haskap plots included 3 plants per plot (plot length is roughly 6 meters).

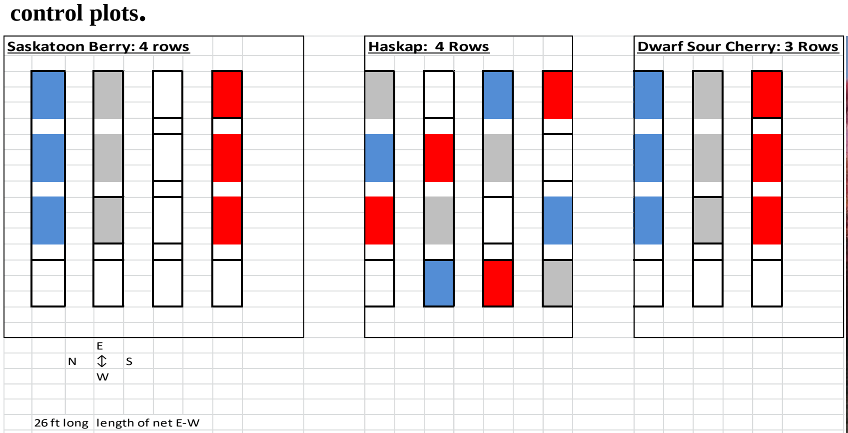
Close-up photo of blue photo selective net



The spectrum of net colours was chosen according to project objectives, lack of availability of other colours, and budget constraints. The diversity of colour and amount of net was limited, but the highest priority colours were obtained in sufficient quantity by early August 2016. Net shade level was ordered at 30% for all net colours.

Each net type was strung above an equal length of orchard row and colours were randomized in Haskap, but not in Saskatoon berry and dwarf sour cherry due to infrastructure and logistical difficulties. Colour arrangements are outlined in the following image.

Blue boxes in the map represent blue netting; red boxes, red net; grey represents pearl; and white boxes are control plots.



The net was supported above ground with 2” galvanized pipe and 3/32”galvanized aircraft cable. Major fertilizer application was applied according to soil sample (N-P-K-S at 100-60-40-5 lbs/acre was needed), and applications were made at rates based upon fertilizer product nutrient percentages to ensure 110-60-40-5 lbs was applied. Fertilizer application occurred on May 10th in 2016 and 2017.

Since the fruit species in this project do not have predetermined crop nutrient testing standardization; the fertility measurements for the leaf samples were evaluated according to apple standards.

In regard to yield; representative branches were selected for harvest in order to minimize the effect of pre-existing plot variability, and fruit was hand harvested. Leaf samples were analyzed by ALS Labs for nutrient content, and fruit was harvested from Haskap on June 20th, Saskatoons on July 14th (2017), and from dwarf sour cherry on August 14th

Dwarf sour cherry and Saskatoon berry fruit Brix (rough equivalent to sugar content) was measured using an optical refractometer.

Casoron herbicide was applied to all fruit species in late fall (October 13, 2016), this broad spectrum herbicide helped control most weeds in the plots.

Results

In regard to 2017 climate conditions and the impact on fruit development; general conditions started similar to 2016 in that Spring and early/mid summer conditions were warm and dry. However; 2016 was roughly one week earlier in crop development for early harvestable crops like Haskap and Saskatoons. Late summer and early fall conditions were warm and dry in 2017 (as opposed to wet and cool in late summer/fall in 2016) this affected cherry fruit development to be roughly two weeks delayed in 2017 compared to 2016.

Saskatoons

In 2016 and 2017; Saskatoon berry did not receive precipitation through the bloom period, this led to low entomosporium and fire-blight disease pressure, and warm subsequent conditions led to good fruit set, rapid development, and good fruit quality.

In 2016, Saskatoon juniper rust was evident on many Saskatoon berries, but this disease was not detected on Saskatoons grown under photoselective net in 2017. In addition; a significant population of Hawthorn lace bugs were present in the entire Saskatoon orchard in 2016, and although they were evident in control plots in 2017, they were almost non-existent in all net-covered plants in 2017.

Leaf samples were collected at fruit harvest (July 14), and samples were submitted to ALS labs in Saskatoon for nutrient analysis. Nutrient data was converted (see following tables) into a percentage in which: 0 to 25% indicates nutrient deficiency, 25 to 50% indicates marginal nutrient content, 50 to 75% indicates adequate nutrition, and 75 to 100% indicates optimum nutrient content. Standards utilized to determine leaf sample nutrient status were based upon recommendation standards for apples. In regard to genetics, Saskatoon berries are “pommes” (members of the apple family), so apple comparisons hold a high degree of validity for Saskatoon berry.

In regard to leaf nutrient assessments; availability was sufficient to create bountiful crops in 2016 and 2017 and the plants did not display symptomology consistent with nutrient deficiencies in either year. Nonetheless a few plots were noted to be deficient in potassium (K) in **2016.**

Saskatoon Berry:											
cv.Smokey	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
SR2T1	52	70	85	30	54	85	48	33	75	32	60
SR2T2	50	54	27	30	70	85	50	48	74	27	63
SR2T3	47	54	25	30	60	85	50	50	85	27	63
SR2T4	52	70	73	27	42	85	40	65	65	50	55
SR2T5	50	52	24	30	54	85	50	65	85	27	58
SR2T6	47	72	50	27	57	85	48	50	73	30	68

And consistently low in Zinc in **2017**

Saskatoon Berry:											
	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
Blue	50	70	46	27	70	87	46	65	87	25	67
Pearl	52	70	46	27	68	87	46	65	87	25	67
Red	52	70	46	27	68	87	46	65	87	25	67
Control	52	70	46	27	68	87	46	65	87	25	67
Control	52	70	46	27	68	87	46	65	87	25	67
Control	52	70	46	27	68	87	46	65	87	25	67

The blue netting appeared to use slightly more nitrogen; but lower content may have been caused by inaccurate fertilizer or irrigation applications, or possibly from positioning at the outside facing row.

Zinc deficiency did not appear to be a serious physiological problem for the plants, so the leaf assessment may be inaccurate for Saskatoon berry (since leaves were assessed according to apple reference standards).

Orchard in year 2017 left and 2017 right not showing any nutrient defiency

In regard to fruit quality characteristics: the weight of Smokey and Thiessen Saskatoon berries was within normal size ranges averaging roughly 1 g per fruit in 2016. In 2017 the fruit was significantly larger averaging 1.2 grams per berry in control plots, and 1.5 grams per berry on all photo-selective netted plots. In regard to sugar content, average brix readings averaged extremely high in 2016 at 16.7 between control and netted plots. Saskatoon berries are high in fibre, so brix readings may have provided a somewhat false sugar reading; however the sugar content was definitely above the normal range in both 2016 and 2017. Net colour did not appear to influence fruit quality or yield, but the marketable fruit yield was higher in netted plots compared to control with average of 16.4 % higher marketable yield. Some reasons for the higher yield are: higher disease incidence in controls, bird foraging loss, possible wind losses (higher ground fall) and perhaps slightly less uniform ripening in control plots.

Total yield weights were not measured per plot; but losses were assessed according to fruit bunch numbers, and the number of marketable fruit per bunch. Averages were extrapolated from those assessments.

In regard to plant growth; average length of new growth in Saskatoons grown under Blue net was 19.0 cm, under Pearl net it was 18.5 cm, under Red net it was 20cm, and within Control plots it averaged roughly 15 cm.

Haskap

In regard to Haskap; the plants bloomed early in 2016 and 2017 but there was no frost through the bloom period, so blossom retention was strong. Warm conditions above 10^{o}C during the bloom period allowed ample bee pollination activity and fruit set was excellent in both 2016 and 2017.

It isn't unusual for robins and cedar waxwings to rob fruit from Haskap orchards, but they don't often forage so early in the ripening process (by early June 2016). It is suspected the early warm and dry conditions pressured birds to seek food sources at a stage outside their normal preference range. Photoselective netting eliminated bird foraging underneath the nets (in 2017) and the birds did not forage early in 2017. Nonetheless; control plots were entirely robbed the day before plots were harvested (when sugar content had reached near optimums).

In regard to yield; comparison between controls and netted plots in 2017 are unfair because typically the control harvested fruit was small somewhat unripe fruit that the birds didn't detect. Given this limitation; the average weight of control fruit was less than .5 grams per fruit, whereas the average weight of fruit grown under photo-selective net was 1 gram. There was no significant variation in individual fruit weight when comparing between net colours (the blue, red, and pearl nets all averaged roughly 1 gram per fruit). There appeared to be a significant difference in total yield with blue net averaging highest at roughly 300 grams per plant, pearl net averaging slightly lower at 255 grams per plant, and red averaging lowest at roughly 183 grams per plant. The control plot averages were very low (since fruit had been robbed) and that data was not collected since it did not reflect what the actual yield had been. In any event; control plot yields appeared to be close to the red netted plots (prior to bird foraging) at roughly 180 grams per plot.

Control plot prior to bird foraging 2017

Blue net plot prior to harvest June 19, 2017

Given nutrient and irrigation deficiencies highlighted below, the yield potential of all of the treatments is likely significantly below the productivity the plants should be able to achieve at their maturity level (given better nutrient and irrigation application as is highlighted below in nutrient assessment). There had also been some fruit-fall (to the ground) and that fruit weight was not included since it was not marketable and in most cases had lost turgor.

In regard to brix; there was no significant variation between the net colours. All plots averaged at 14 % brix. This brix level was very similar to the brix of the Saskatoon berries despite having a shorter season to develop higher sugar content. It is possible that the Haskap could have remained on the plants longer to allow for increased sugar content. Harvesting was initiated June 20, 2017 because bird foraging loss caused the staff to become worried that the birds would find a way to steal the netted crops too, and fruit-fall had already started.

In regard to leaf nutrient assessment; various deficiencies were reported in 2016, including lack of nitrogen, potassium, and zinc.

Symptomology of nutrient deficiency was greatly reduced over the years prior to 2016, but deficiencies continued to be evident. It's unlikely that zinc deficiency was as significant as the assessment indicates (rather it is more likely to be reflective of inappropriate use of an apple standard to measure Haskap). Higher amounts of fertilizer were applied in 2017 to better optimize apparent need for more nutrients. Unfortunately Nitrogen and Potassium remained at deficient levels, and photo-selective netting colour had no impact on leaf nutrient content in 2017.

2016:

Haskap:	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
HR2T1	25	85	20	70	85	85	53	36	27	23	85
HR2T2	27	85	13	68	85	85	52	28	28	23	85
HR2T3	26	72	10	67	85	85	48	35	32	20	85
HR2T4	25	72	10	68	85	85	48	35	32	20	85
HR2T5	25	85	10	67	85	85	47	25	27	20	85
HR2T6	25	85	10	67	85	85	35	27	28	18	85

2017:

Haskap:	N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
Blue	25	75	12	65	87	87	27	65	35	25	87
Pearl	25	75	12	65	87	87	27	65	35	25	87
Red	25	75	12	65	87	87	27	65	35	25	87
Control	25	75	12	65	87	87	27	65	35	25	87
Control	25	75	12	65	87	87	27	65	35	25	87
Control	25	75	12	65	87	87	27	65	35	25	87

In regard to plant growth response under photo-selective netting; average new growth under Blue net was roughly 17 cm, under Pearl net it was 16 cm, under Red net it was 18 cm, and in Control plots it was roughly 13 cm.

Dwarf Sour Cherry

In regard to dwarf sour cherry; early to mid-summer warm and dry conditions in 2017 resulted in strong fruit set and low disease pressure, but 2017 was roughly 2 weeks behind 2016 in the speed of fruit development resulting in slightly larger fruit. Furthermore; unlike 2016, the heat and relatively dry conditions continued into late summer and early Fall resulting in higher quality fruit and considerably less splitting than the 2016 crop.

Cherries become larger if conditions favour a slow early development process. The heat in the first half of the crop cycle in 2016 resulted in fruit development that outstripped the plant's ability to size the fruit. Although 2017 was slightly cooler in early Spring and fruit development was therefore slightly more gradual, fruit size in 2017 was insignificantly greater than 2016 (on average 0.1 - 0.2 gram larger). There was a marginally significant size difference between the Net treated plots and the Control plots in 2017 (again roughly 0.1 gram greater under net than Control), and this may be attributed to less evapotranspiration under netting leading to greater water availability. Wet cool conditions at the mid to later stages of 2016, led to poor sugar accumulation

In regard to fruit size, it was below average with average Cupid fruit weight of 5.2 grams per cherry in 2016 compared to 5.3 grams in 2017, Valentine weight of 3.8 grams per cherry in 2016 and 3.9 in 2017, and average Romeo sized at 4.3 grams in 2016 and 2017. Average sugar content was exceptionally low with; Cupid at 15.4 % in 2016 vs 20 % in 2017, Valentine was 13.1 % in 2016 vs. 18 % in 2017, and Romeo was 15.9 % Brix in 2016 compared to 22% in 2017. Brix/sugar content did not vary based upon control versus photoselective netting. Late July and early August rain caused widespread splitting and disease spread in 2016. Fruit was harvested relatively soon after rain in 2016 and the concentration of sugars may therefore have been diluted by the intake of water.

Sour cherry Weight and Brix, 2016

ADOPT Sour Cherry 2017

	Average g	Brix	Cultivar
Blue Net	5.3	20	Cupid
B control	5.3	20	Cupid
White Net	4	18	Valentine
W control	3.8	18	Valentine
Red Net	4.3	22	Romeo
R control	4.2	22	Romeo

Cherry	Treatment	# of Cherries	Weight g	Avg Wt g	Brix %
Cupid cv.					
R1	T1	9	48	5.3	14.2
R1	T2	9	45	5	14.2
R1	T3	12	56	4.7	16
R1	T4	9	54	6	15
R1	T5	12	59.5	5	16
R1	T6	14	73.7	5.3	16.8
Valentine cv.					
R2	T1	11	42.5	3.9	12.2
R2	T2	13	51	3.9	13.2
R2	T3	14	48.2	3.5	14
R2	T4	8	31.2	3.9	12.2
R2	T5	15	56.7	3.8	13.2
R2	T6	19	73.7	3.9	14
Romeo cv.					
R3	T1	16	62.4	3.9	16.4
R3	T2	14	62.4	4.5	15.2
R3	T3	18	73.7	4.1	17
R3	T4	22	93.6	4.3	14.4
R3	T5	20	93.6	4.7	16
R3	T6	19	79.4	4.2	16.4

Diseases like american brown rot (*Monilinia*)are spread when precipitation spreads spores from fruit to fruit. Although disease inoculum was low early in 2016 and 2017, it increased and spread in August following rain events and fruit ripening (in part taking advantage of juice dripping from split fruit in 2016).

In 2017 there were a few rains in July and August that spread Brown rot inoculum from fruit to fruit in Control plots. Plots covered with Photo-selective netting had significantly less disease presence (likely due to less precipitation splashing as a result of net protection from wind and rain). In addition the fruit yield was greater under nets than in control plots, this may be attributed to bird foraging, greater "june drops" due to more plant stress, and perhaps via the negative impact of disease infections.

Copper deficiency in 2016 and 2017 (although somewhat surprising) is likely valid. Iron deficiency was more significant in 2016 than 2017; but does not display typical chlorosis symptomology seen in crops like Saskatoon berry under similar nutrient levels. In part, those deficiencies reflect the late season harvest when cooler wetter conditions prevailed in 2016. Under cool wet conditions, plants develop iron chlorosis as the plant available form of iron becomes less prevalent. Calcium deficiencies in cherry are also known to play a role in the likelihood that the fruit will split. Calcium levels were measured to be significantly lower in 2016 than they were in 2017, and fruit splitting was also significantly more prevalent in 2016 than it was in 2017. Phosphorus deficiency in 2017 (that wasn't significant in 2016) may have inhibited plant growth, but typical purple leaf margin symptomology was not detected. In general, marketable fruit yield in Cupid cherries (the Blue net row) were higher than the Valentine and Romeo cherry rows. This may be partially explained by the differences in P uptake detected in the Blue row versus the other rows that were measured to be deficient. Blue and Pearl net covered plots averaged 15.5 cm of new growth in 2017. Red net new growth averaged significantly longer than the blue and Pearl plots at 20 cm in 2017. It should be noted that there are cultivar differences that may also influence the rate of growth, so these results should not be understood to indicate that red net promotes growth as significantly as it seems to over the other net types (via this data). In any event; average new growth in Romeo control plots was only 13 cm, so it appears red net did have a significant influence on plant growth despite Phosphorus deficiency detected in leaf nutrient analysis.

Conclusions and Recommendations

Photo-selective netting appears to have many beneficial effects on Saskatchewan grown fruit crops. Fruit quality, marketable yield, plant growth, and reduction in pest incidence was found to be improved under all net types, compared to control plots. Net Colour induced different physiological responses from various Saskatchewan fruit cultivars. Overall blue net appeared to provide the most beneficial growth environment under 2017 growing conditions, but red net induced the most growth, and pearl may be more comparable to blue if irrigation and nutrient conditions are better adapted for it.

It is recommended that testing of this netting be continued in Haskap (as per ADOPT application submitted for 2018). Sour cherry and Saskatoon berry economics may not provide as strong a rationale for growers to employ this technology in those crops. However; the impact of photo-selective netting on Haskap production is far more likely to justify the expenditure for this type of net. Determining optimum recommendations for nutrient and irrigation usage under photo-selective netting will better enable that component of the Saskatchewan fruit industry to expand into larger markets with consistent supply of high quality fruit.

Growers have expressed interest in this project at field days held July 14 2016, and July 13 2017. A presentation regarding 2016 results from this project was made at the "Green Trade Conference" November 2016, and final results will be presented at the Saskatchewan Fruit Growers Annual Conference January 13, 2018.

Acknowledgements

- Forrest Scharf, Provincial Fruit Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Strawberry and Raspberry Water and Fertilizer Management Demonstration

Funding

Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead

- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Fruit Growers Association (SFGA)

Project Objective

The primary objective of this project was to demonstrate differences between standard cultivars and newer genotypes of strawberry and raspberry grown under Saskatchewan conditions, and to demonstrate water and fertilizer management using tensiometers and fertigation tools in strawberry and raspberry. Proper water and fertilizer application serves to maximize growth, yield, fruit quality, profitability, and efficient use of resources to make Saskatchewan strawberry and raspberry production more sustainable. The project demonstrated differences between standard cultivars and newer genotypes under Saskatchewan growing conditions, better enabling growers to experiment with new cultivars that may offer advantage over traditional varieties and increase profitability of their operations. Growers will also benefit from data generated from this project for everything from accessing markets, securing loans, to perhaps making crop production insurance programs more feasible.

Project Plan

Four rows of raspberry and five rows of strawberry were planted in May/June 2016 parallel and north of the Saskatoon berry orchard within the fruit orchard area established at CSIDC in Outlook. Three varieties of June-bearing strawberries were selected: the standard variety Kent (a mid-season, medium fruit size cultivar, released from AAFC Kentville in 1981); and two newer cultivars, Sapphire (a mid-season, large fruited cultivar, released from University of Guelph in 2002), and Serenity (a late season, large fruited cultivar, released from University of Guelph in 2003). Two day-neutral strawberries were also selected: the industry standard Seascape (a large fruited, high yielding, day-neutral, released from U of California Davis in 1991) and Albion (a high fruit quality, medium yield variety, released from, the U of C Davis in 2006). Another strawberry variety was unavailable when project approval was obtained in 2016, but was obtained and planted in May 2017. The variety AC Wendy (an early season, large fruiting, high yielding June-bearing variety, released from AAFC Kentville in 2006) was assessed for growth characteristics in 2017 and will be assessed for fruit yield, quality, and growth characteristics in 2018.

Major fertilizer application was initially applied according to soil sample (N-P-K-S at 100-60-40-50lbs./acre), and applications were made at rates based upon fertilizer product nutrient percentages to ensure 110-60-40-5 lbs was applied. Fertilizer application occurred on May 10th in 2016 and 2017. Subsequent fertilizer applications were made using a water soluble Plant Prod 20-20-20 mix and a

Dosatron injector. In 2017, some foliar applications of iron chelate were used on Seascape and Albion day-neutral strawberry cultivars because they suffered from iron chlorosis in 2016 and were continuing to suffer in early 2017.

All strawberries were planted into 1m wide black plastic mulch with ½ inch drip line running underneath (in the middle of the mulch width). Daughter plants were hand planted between May 30 and June 2, and plants were organized according to the following plot plan (with 1 m alleys separating rows). Strawberry plots 1,3,6,8 were monitored using Irrometer sensors (tensiometers) at 6 and 18 inch depths, all attached to a single Watermark data-logger**.** Plots 13, 15, 18, and 20 were attached to a separate data logger and the tensiometers were also set at 6, and 18 inch depths. Raspberries were purchased from sources utilizing two different propagation techniques. 50 “SK Red Bounty” (CV. released from the U of SK in 1999,very hardy, high yield, large & high quality fruit) and 50 “SK Red Mammoth” (CV. Released from U of SK in 1999, large high quality fruit, good mid to late season yields) were purchased from Prairie Tech Propagation and these plants were propagated via tissue culture technique. An additional 50 plants each of the cultivars “Nova” (a standard cultivar released in 1981 from Nova Scotia, moderately hardy, average early season yield, good quality fruit) and “Prelude” (a newer cultivar released from New York in 1998, first crop very early, and second crop late season, excellent quality, with high yield) were purchased from Strawberry Tyme located in Simcoe Ontario. Those canes were propagated via cuttings, and the roots (referred to as “bare root”) were quite voluminous. The tissue culture plantlets were generally significantly smaller and their root systems developed in a “plug container” which is quite compact. The smaller plants are easier to plant successfully, but they are slower growing in the first year than the bare root counterparts. Raspberries were planted in June 2016 immediately north and parallel to the Saskatoon berries, but south of the strawberries. Rows were spaced 3 meters apart, and canes within a plot were spaced 24 inches apart. The rows are 100 feet long, with 4 different cultivars randomized within the row according to the following plot arrangement.

Drip line was laid down the raspberry row and was held down with ground staples. Tensiometers were placed within the rows in plots 1, 3, 5, 6, 10, 12, 14, 15; at 6 and 18 inch depths. Plots 1,3,5,6 were hooked into one data-logger, and plots 10, 12, 14, and 15 were attached to another data-logger (due to limitations of the number of inputs per data-logger). Casoron herbicide was applied to raspberries in mid-October, and straw was used to cover the strawberries at roughly the same time.

Results

Please see the ADOPT final report for a detailed review of the results.

Four cultivars of raspberry and six varieties of strawberry were planted north of the CSIDC orchard in Outlook, SK. Plots were randomized and drip irrigation was laid with supporting fertigation infrastructure and water monitoring sensors, to provide a good characterization of conditions plants were exposed to. Growth differences were noted between tissue culture propagated and bare root raspberry canes. Bare root plants were significantly larger than tissue culture plants in 2016. In addition production differences were evident between varieties. Raspberry yield was highest in Prelude, followed by Nova in 2016. The tissue culture propagated raspberry varieties SK Red Bounty and SK Red Mammoth, did not produce fruit in 2016, but provided comparable yield to Nova in 2017. Day-neutral strawberries were the most productive in 2016, followed by June-bearer Kent, then Sapphire and Serenity. Day-neutral varieties display much greater sensitivity to high pH soil, evidenced by iron chlorosis symptomology. June bearing strawberries provided greater yields than the day-neutral varieties in 2017. Serenity had the highest yields followed by Kent, then Sapphire and the day-neutral varieties. Irrigation data is provided, but in general irrigation requirement was minimal through mid to later stages of the 2016 growth cycle and in the spring and early summer of 2017 due to consistent precipitation events and cool conditions that also induced iron chlorosis symptomology in strawberries. Foliar application of iron chelates on strawberries reduced the negative impact on growth that this minor fertilizer deficiency caused, and the plants were productive in the fall of 2017.

Acknowledgements

- Forrest Scharf, Provincial Fruit Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Demonstration of shelling peas for mechanical harvest

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to provide a season long supply of fresh shelling pea for fresh and processing markets. It was also intended to encourage producer and buyer uptake by providing an opportunity for them to see this crop grown in the field. Lastly, this demonstration compared cultivars for their suitability in Saskatchewan in terms of weather conditions and market potential.

Garden peas are, grown in Saskatchewan by market gardeners and home gardeners alike. In Saskatchewan, they are most currently hand-picked in the same patch multiple times. There is currently large scale commercial production of peas in Alberta for the processing market. These fields are harvested mechanically and require cultivars of peas that mature uniformly, as the mechanical harvest is destructive. This project will raise awareness of Saskatchewan producers regarding the opportunity to grow green peas for the processing market.

The Saskatchewan vegetable industry has been working collaboratively with Federated Coop to increase the supply of Saskatchewan grown produce for retail. Because of the high cost of labor to hand pick, fresh peas are not grown for retail market in Saskatchewan, however, the industry is presently evaluating some processing opportunities that might increase acreage to making mechanization an option.

Project Plan
The demonstration consisted of 4 rows, 3-meter-long of 6 varieties suitable for mechanical harvest. Seeding occurred in early spring and again one month later. The center rows, treatment rows were harvested at maturity by hand as a commercial harvester was not available.

The plot size for each of the six varieties of peas was 8′ x 10′. Each variety had four rows, with two feet between rows. The outer two rows were kept as a guard rows and middle rows were used as the treatment rows. The produce was harvested and measured from treatment rows only. Allocation of the varieties in the plot was randomized.

This demonstration was designed for two sequential harvests to occur; therefore, the first planting was done on May 11 with a subsequent planting roughly one month later, on June 9. All the seeding was done with a single row hand planter (Fig. 1).

Fig 1 Peas are being drilled by a summer student.

Fig 2 First crop germinated and reached 4th node stage.

To demonstrate the comparison in the adoptability and production efficiency of different varieties of peas in the prevailing conditions of Saskatchewan, seeds of six varieties of peas: Premium, Jumbo, Sabre, Knight, Legacy and Spring, sourced from Stokes Seeds: (http://www.stokeseeds.com/home.aspx). The trial was direct seeded through a single row earthway hand planter (Fig 1) on May 11, 2017 on the south half of the fields #2 between the wheels tracks of tower 1 and 2, at CSIDC research station in Outlook. The entire plot measured 16 x 72 feet divided in two plots of the of 8 x 72 feet. Each 8 x 72 foot plot was sub-divided in six plots measuring 8 x 10 feet. Each sub plot was allotted and seeded with one of the six varieties of peas. Each sub plot had a row spacing of two feet between rows (Fig 2).

Results

The average time taken for the second planting of the six varieties to reach maturity was 57 days. That's 8 days less than the first planting (65 days). The growing degree days for the corresponding period ranged from 566 to 835 for crop 1 and from 660 to 845 (Fig 4.) for crop 2 (Fig 4.). Crop 1 yielded more in comparison to crop 2 (Fig 3). As expected, some varieties matured earlier than the others. As shown in (Fig 5), Premium, and Spring matured earlier than the other four varieties in crop-1, while in crop 2, Premium, Spring and Sabre all matured early. The variety Jumbo matured latest in both plantings. The yield of Jumbo was the highest in both the plantings, while varieties Premium, Legacy and Spring yielded the same in both plantings (Fig 3).

Fig 3. The blue line shows the yield of crop-1 and brown line shows the yield of crop-2

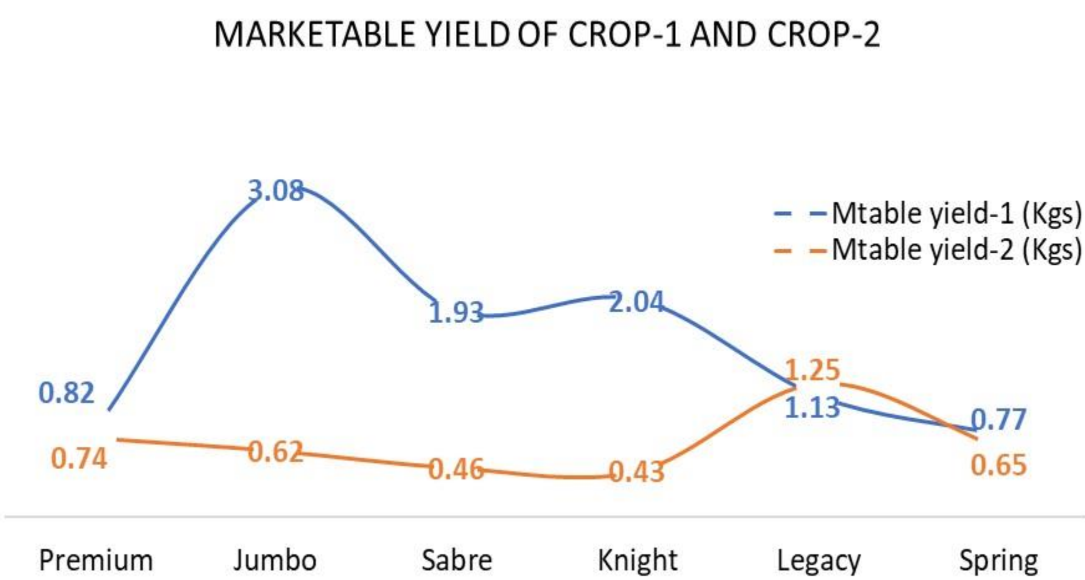
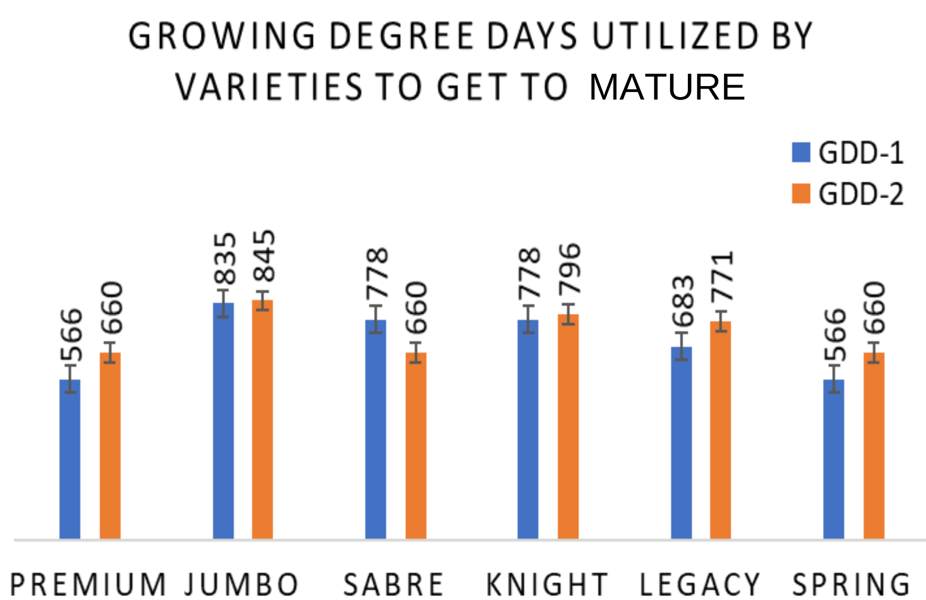
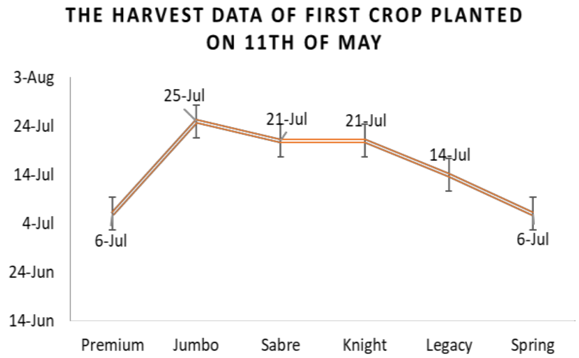


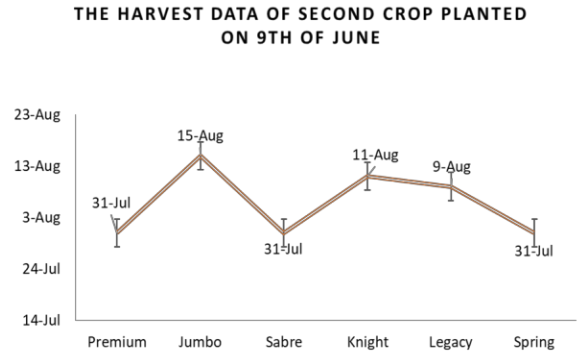
Fig 4. The blue bars show the GDD available to crop-1 and brown bars represent the GDD available to crop-2



On July 6th, almost 65 days after planting, the first varieties in planting number 1 were harvested. The first crop in planting-2, which was seeded on June 9th, was harvested on July 31st after 57 days (Fig 6). The first crop took a little longer to reach maturity in comparison to the second probably due to the GDD which was higher, later in the season (Fig 5).

Fig 5. Showing days to maturity taken by each variety of Peas in both seeding dates.





After each harvest, the total number of plants harvested for each variety were counted. All the pods were collected from the harvested plants of each variety. The collected pods were counted and weighed to calculate the yield per variety. Unfilled Pods were counted as not marketable and discounted from the total number of marketable (filled) pods. The details are illustrated in Table 1 and Table 2.

Table 1. harvest data of all varieties of plantation-1

Variety	Total Plants Count	Total Yield (Kgs)	Total No. Pods	No. Unfilled Pods	Marketable weight (Kgs)		Peas Per 25 pods	Ave. Peas/Pod
					Pod + Pea	Pea		
Premium	58	0.82	203	29	0.82	0.3	149	5.96
Jumbo	53	2.19	533	225	308	1.71	184	7.36
Sabre	68	2.02	383	43	1.93	1.01	86	3.44
Knight	65	2.38	658	229	2.04	0.93	79	3.16
Legacy	81	1.61	445	220	1.13	0.48	85	3.4
Spring	60	0.77	163		0.77	0.3	155	3.4
Totals	**385**	**9.79**	**2385**	**746**	**314.69**	**4.73**	**738**	**26.72**

Table 2. harvest data of all varieties of plantation-2

Variety	Total Plants Count	Total Yield (Kgs)	Total No. Pods	No. Unfilled Pods	Marketable weight (Kgs)		Peas Per 25 pods	Ave. Peas/Pod
					Pod + Pea	Pea		
Premium	51	0.85	195	20	0.74	0.39	147	5.88
Jumbo	42	0.69	104	29	0.62	0.15	189	7.56
Sabre	68	0.85	315	150	0.46	0.18	164	6.56
Knight	68	0.5	218	75	0.43	0.21	174	6.96
Legacy	69	1.35	300	81	1.25	0.54	200	8.00
Spring	61	0.68	184	14	0.65	0.36	111	4.44
Totals	**359**	**4.92**	**1316**	**369**	**4.15**	**1.83**	**985**	**39.4**

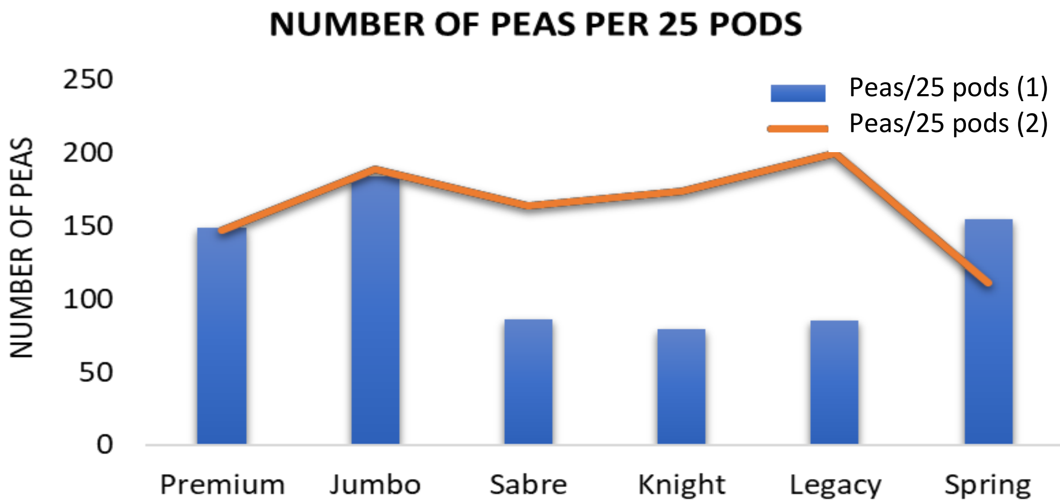


Fig 6. This bar graph shows the number of peas per 25 pods collected from each variety at each harvest. Blue bars show the number of peas in 25 pods in crop 1 and brown line show the number of peas in 25 pods harvested from crop2.

Conclusions and Recommendations

This demonstration of two sequential plantings of shelling peas under irrigation in Outlook, Saskatchewan was conducted in the summer of 2017 in order to assess the economic feasibility of growing peas on a commercial level for both the fresh market and the processing industries. Six varieties (Premium; Jumbo; Sabre; Knight; Legacy and Spring), were evaluated for yield potential and general agronomic performance. All of the six varieties took the same amount of time to achieve over 95% germination. The varieties, Sabre, Legacy and Jumbo germinated faster than the others. The varieties Premium and Spring, in crop 1, matured early while Jumbo, was matured very late. In crop 2, Premium, Sabre and Spring matured early and again Jumbo matured latest. We also calculated Growing Degree Days (GDD) taken by the peas to achieve maturity. Our results did not show much difference in GDD utilized by varieties of peas the varieties Premium, Legacy and Spring utilized less GDDs than other varieties due to faster maturation. It was also noticed that the same varieties utilized different amount of GDD in planting 1 and planting 2. Most varieties in planting 1 utilized less GDD than the varieties in planting 2. Sabre was the only exception. It utilized more GDD in crop 1 than in the second planting, with the difference of 118°C. In terms of yield all varieties in crop 1 had higher yields than crop 2. Cultivar Knight in crop 1 and Legacy in crop 2 gave the highest yields.

Cultivars Premium; Legacy and Spring yielded similar in both the seeding dates Fig 7, shows that the pods (25) collected from each variety in the first planting had a lower number of peas except spring. These results are little bit surprising because if we look at the overall yield, it is higher in crop 1. This could be due to the higher number of GDDs for crop 2, which may have increased the number of pods in each variety in comparison to the first planting.

Table 3: Economic analysis of both planting of shelling peas. Yields are based on a 40 square foot plot size and returns are based on a market value of $3.75/lbs.

Variety	Crop 1 Yield (lbs/acre)	Crop 2 Yield (lbs/acre)	Crop 1 Gross Return ($/acre)	Crop 2 Gross Return ($/acre)
Premium	1971	2036	7392	7637
Jumbo	5260	1655	19725	6207
Sabre	4846	2036	18173	7637
Knight	5717	1198	21440	4492
Legacy	3866	3267	14497	12251
Spring	1851	1634	6942	6126

Acknowledgements

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- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Demonstration of Broccoli for season long supply

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to provide a season long supply of fresh broccoli for market. It also compared direct seeding versus transplanting with different cultivars for production efficiency. The demonstration provided the opportunity for producers and buyers to see the crops being grown locally.

Broccoli is grown commercially across Canada and producers in Saskatchewan already grow broccoli on large scale for farmers market and retail sales. Currently most of the broccoli grown is transplanted to allow for earlier harvests although this makes them more susceptible to pests such as cabbage maggot, flea beetles and thrips early in the season and also requires more time and labour at planting. The direct seeded broccoli is later and requires thinning and more weed control since the plants remain in the field longer. Broccoli is a cool season crop and some varieties tend to bolt in the summer heat.

This project compared the maturity and quality of crops transplanted and direct seeded to assist producers in developing program to provide a high-quality season long supply of broccoli for the fresh market. Retail market opportunities are increasing and some opportunities for processing are currently being assessed by producers.

Project Plan
The direct seeded demonstration consisted 4 rows 3 meters in length of 6 varieties seeded beginning in early spring and seeded every two weeks until mid-July. The center 2 rows were harvested at maturity as the treatment.

The transplanted demonstration also consisted 4 rows, 3 meters long of the same six varieties. With transplants being started in the greenhouse about 4 weeks prior to transplanting, dates on the same day as the direct seeding. The varieties in this demonstration include: 1) Castle Dome; 2) Gypsy (SBC8411); 3) Emerald Jewel (SBC7540); 4) Green Magic (hybrid); 5) Greenbelt (hybrid); 6) Emerald Crown, sourced from, Stokes Seeds: http://www.stokeseeds.com/home.aspx. The first crop was started in the greenhouse and transplanted by hand (Fig 1) four weeks later. The transplanting and direct seeded through a single row hand planter occurred on same day for crop 1 on May 23, 2017. The subsequent trials of both the methods (transplant and direct seed) followed roughly with the interval of two weeks

Fig 1. Broccoli, transplanted by summer students

Fig 2. The plot measured 110 x 72 feet for 6 plantings of Broccoli. This photo was taken after the completion of the second planting.

or 6 plantings.

The plot measured 110.4' x 72' (Fig 2) and was divided into six plots. Each sub plots had 4 rows at the distance of two feet with the two rows in the centre being treatment and were harvested to obtain results. The outer 2 rows served as guard rows. The distance between central rows in the plots meant for transplantation was 3'2".

Results

The first planting of broccoli was transplanted on May 23 and harvested after 63 days on July 26. The direct seeding occurred on the same day on and was harvested after 78 days on August 9. The transplants were harvested early because they were seeded 4 weeks prior in greenhouse. After each harvest the heads were assessed for the quality by measuring the size of heads, size of the stalk, compactness, coarseness and interleafing (Fig 3). All the harvested material from each variety was weighed separately to get the data for the results.

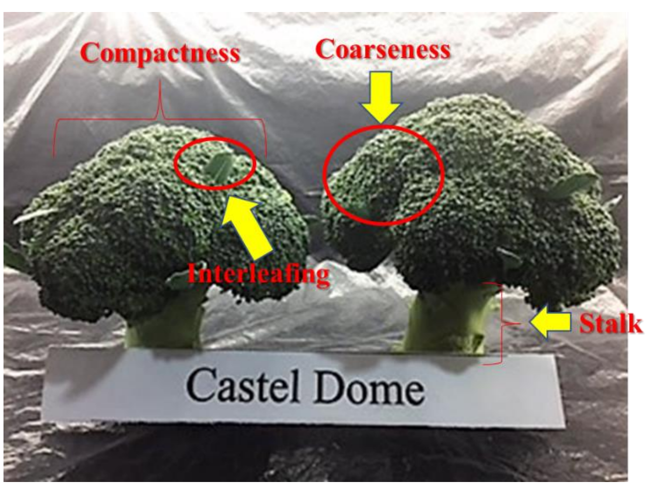

Fig 3. Each head of each variety of Broccoli was assessed by considering above mentioned features, pointed out with arrows, brackets and circles.

The combo chart (Fig 4) shows the yield per variety in crop 1. All the transplanted varieties in crop 1 had high yield in comparison to the direct seeded crop. The yield in the direct seeded crop was almost half of the crop transplanted. It was also noticed that all the varieties in crop 1 had different levels of uniformity in maturity. The maturity of the broccoli in the transplanted crops was staggered which made multiple harvests necessary. The harvest of heads in the direct seeded crop for each variety started from August 9 and lasted until September 22. The yield of each variety in transplanted crop-1 was almost the same excluding the variety ***Emerald Crown*** which was the highest yielder. Similarly, the yield of all varieties in direct seeded crop was the nearly same except the varieties, ***Green Magic*** and ***Emerald Jewel***, which were the lowest.

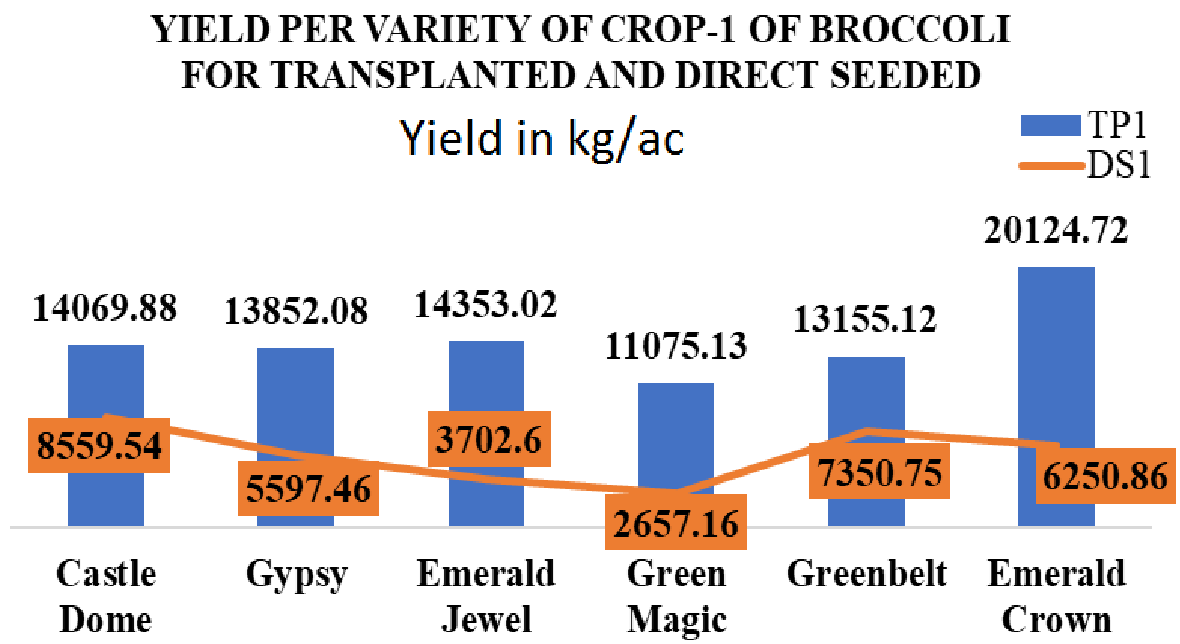

Fig 4. Yield (kg/ac) per variety in first plantation, blue bars show yield of each variety in transplanted crop, brown line shows yield of each variety in direct seeded crop

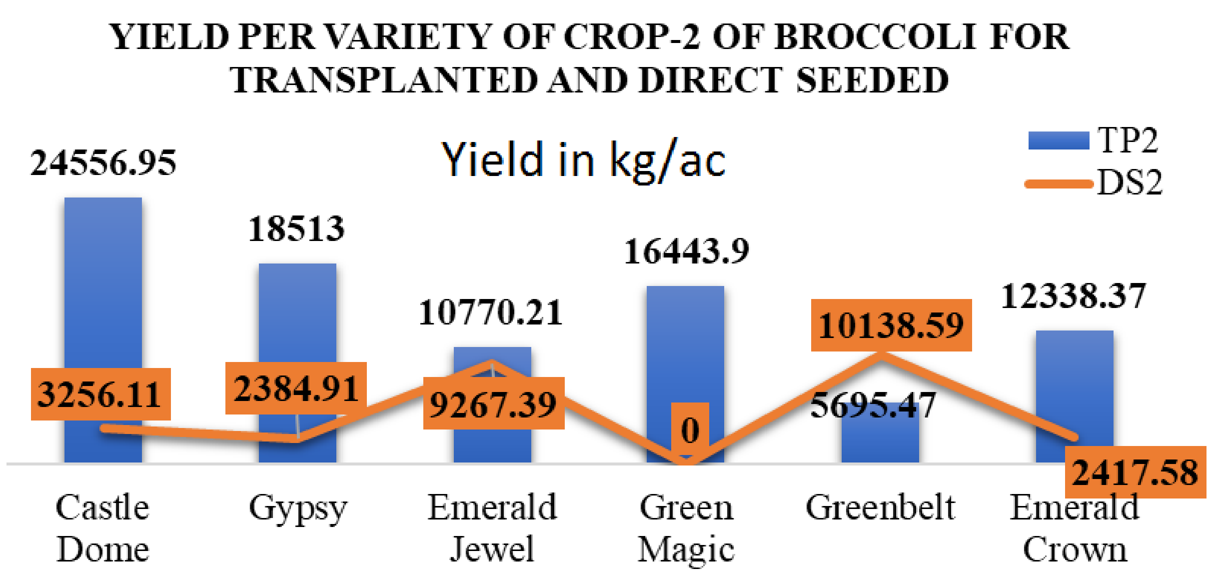

Fig 5. Yield (kg/ac) per variety in second plantation, blue bars show yield of each variety in transplanted crop, brown line shows yield of each variety in direct seeded crop.

In crop 2 the yield of most of the varieties transplanted was higher than the varieties which were direct seeded, except for the variety *Greenbelt*. Combo chart (Fig 6), shows the yield of each variety in second plantation for both the methods.

The maturity of varieties in the transplanted crop was more uniform than the crop direct seeded. The directed seeded crop in second plantation showed a steady increase in the number of heads harvested starting from August 16, ending at September 22.

The third crop was similar to the second crop, where the transplanted crop yielded higher than the varieties in direct seeded crop (Fig 6.).

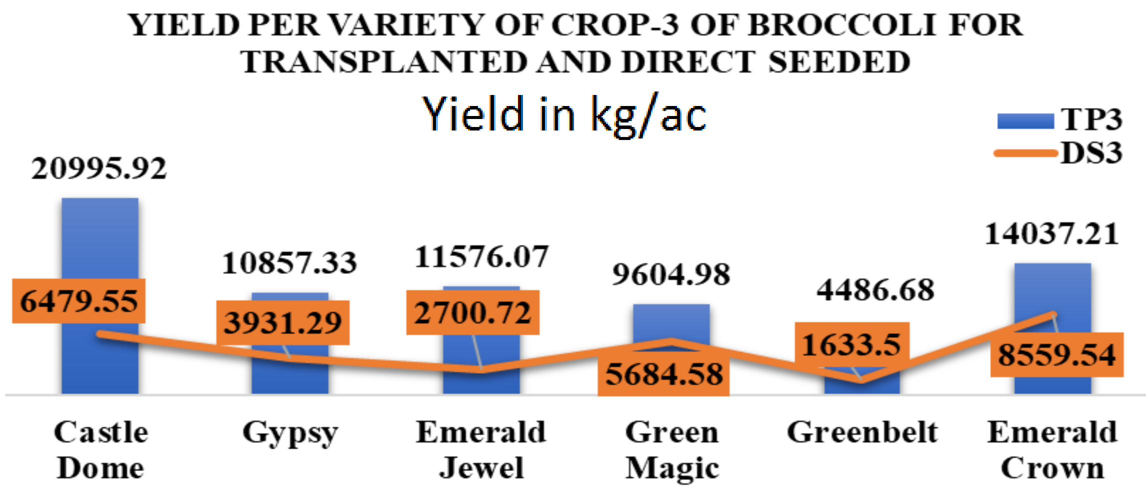

Fig 6. Yield (kg/ac) per variety in third plantation, blue bars show yield of each variety in transplanted crop, brown line shows yield of each variety in direct seeded crop.

The scattered plots for the harvest in crop 3 didn't show any pattern in both transplanted and direct seeded crops. This may be because the maturity in both transplanted and direct seeded crops had uniform maturity. In the fourth planting only Castle Dome performed well in the direct seeded trial. The other varieties reached only about half the yield of the transplanted varieties. The yield in all transplanted varieties in crop 4, except Castle Dome, was very similar. Also, the yield in all the direct seeded varieties was similar except for ***Castle Dome*** which had higher yields and the variety, ***Emerald Jewel,*** which yielded low (Fig 7).

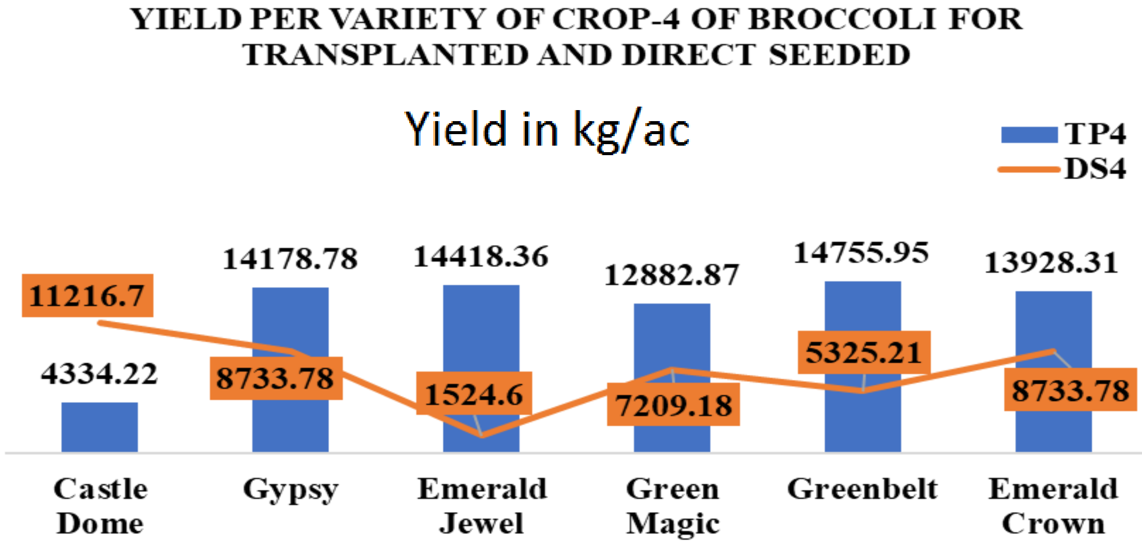

Fig 7. Yield (kg/ac) per variety in fourth planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop.

Harvests occurred from August 22 to September 21 in transplanted crop and from September 20 to October 23 in crop direct seeded.

Crop 5 was planted in July and all transplanted varieties produced marketable heads. In the direct seeded crop none of the varieties produced marketable head except the variety ***Castle Dome***.

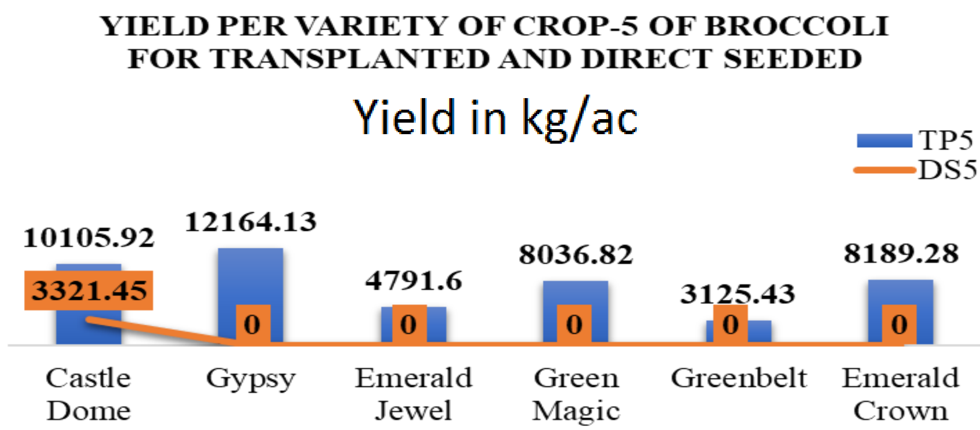

Fig 8. Yield per variety (kg/ac) in fourth planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop.

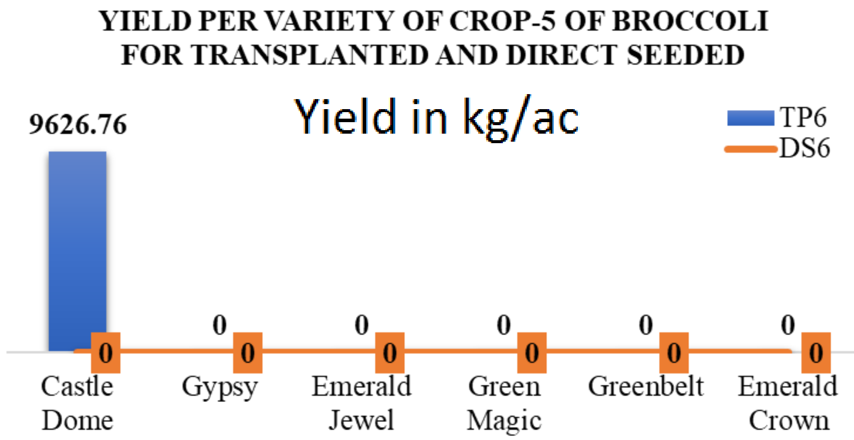

Fig 9. Yield (kg/ac) per variety in fourth planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop.

Crop 6 was planted on July 28, 2017 and neither the transplanted nor the direct seeded crops produced marketable heads.

In order to compare yield between the two methods of planting, the yield of each cultivar was added separately to get the final figure for total yield. The total yield per crop, for both the planting methods is shown in Figures 10 & 11.

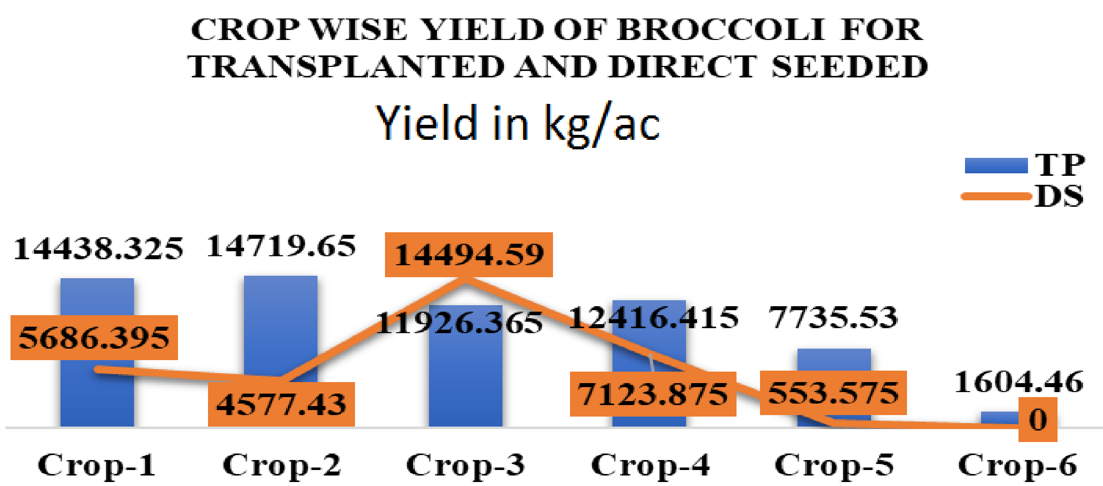

Fig 10. Yield (kg/ac) per crop, blue bars show yield of each crop (planting) in transplanted crop, brown row shows yield of each crop (plantation) in direct seeded crop.

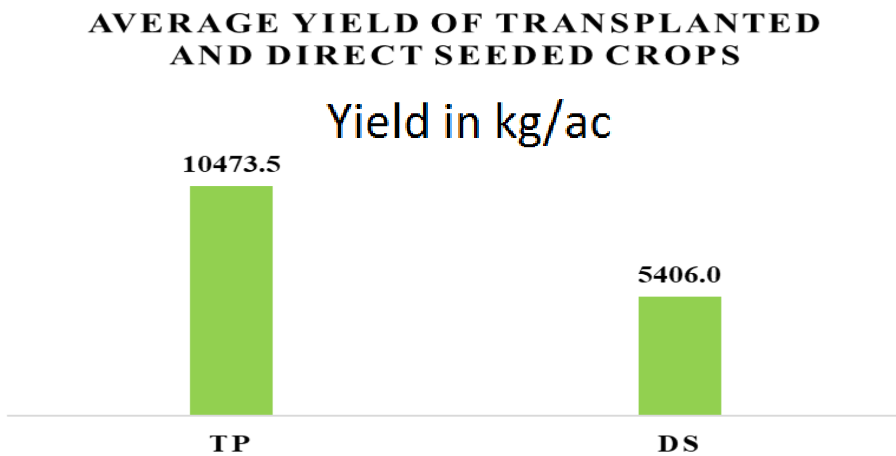

Fig 11. Shows the average yield (kg/ac) obtained from all cultivars through transplanted and direct seeded method.

Conclusions and Recommendations

This demonstration of sequential plantings of broccoli under irrigation was conducted in Outlook, Saskatchewan during the summer of 2017. It compared the maturity and quality of produce harvested in both transplanted and direct seeded cropping systems to assist producers in providing a high-quality season long supply of broccoli for the fresh market. The main purpose of this demonstration was to see if there is any difference in the method of planting (transplanting and direct seeding) in terms of production and quality of the crop among different varieties. Another goal was to assess the economics and feasibility of growing broccoli at commercial level for both.

Six varieties (Castle Dome; Gypsy; Emerald Jewel; Green Magic; Greenbelt; Emerald Crown), were evaluated in this demonstration in both cropping systems. The results suggest that there is not much difference in the quality and production of broccoli in the method of planting, however, some visible differences in terms of maturity were observed. The maturity of heads in the transplanted crop was more uniform, when planted between May 23 and June 16. However, the crop planted on June 29 did not show any difference in the maturity between transplanted and direct seeded crops. In the crop planted in mid-July, only the transplanted varieties produced marketable heads. None of the varieties in the direct seeded crop produced marketable heads other than the variety, ***Castle Dome*****.** For the crop planted on July the 28th ¸ none of the varieties produced marketable heads neither in transplantation or direct seeding except the transplanted Castle Dome. It can be assumed that broccoli can produce if seeded between May 20 and June 30 under Growing Degree Days (GDD) ranging between 650-750 degree centigrade. The yield of all the varieties was very similar. The Growing Degree Days (GDD) for first; second; third; fourth and fifth direct seeded crops were 717.95; 668.05; 710.5; 768.55 and 627.25 respectively. It was noticed that the color of head, harvested in the beginning was dark green and later in the season the heads of the same varieties showed a purple tinge. The majority of the heads produced by these varieties in September were attractive and larger than the others. This demonstration also suggests that it would be likely that the direct seeded crops could perform well in terms of yield and quality if seeded in the month of June and preferably from beginning to mid-June with the interval of one week.

The average yield for transplanted crop was 10473.5 kg/acre, while direct seeded crop only reached 5406 kg/acre (Fig 11). Staff had difficulty keeping up with the thinning of direct seeded crops, therefore some of the yield loss was probably due to crowding. The variability among the seeding dates among the varieties suggests that the no single variety can be deemed the best from this 1 year demonstration. A survey of producers estimated the average direct selling price of broccoli at $4/kg. Based on this project, the gross income from the transplanted crop would be $41,894 and from the direct seeded crop would be $21,624. This shows that broccoli has a potential to be grown economically in Saskatchewan if transplanted before August.

The trial was not replicated; therefore, we are not able to make definitive statements, however, based on this study, a combination of varieties would maximize returns to the producer. Emerald Crown performed best early in the season when temperatures were cooler. Castle Dome, performed best mid-season while Green Belt & Emerald Jewel performed better later in the season, although yields were down across the board late in the season . From this demonstration alone, the recommend variety would be Castle Dome despite one planting where the transplants performed very poorly.
Even with the reduced yields later in the season – it is worthwhile growing broccoli for season long supply.

Acknowledgements

- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Demonstration of Cauliflower for season long supply

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to provide a season long supply of fresh cauliflower for market. It compared sequential plantings of direct seeding versus transplanting for production efficiency. This project provided opportunities for producers and buyers to see the different cultivars being compared for suitability in Saskatchewan's conditions.

Cauliflower is grown commercially across Canada and Saskatchewan producers already grow cauliflower on large scale for farmers market and retail sales. Currently, small producers transplant, while large producers direct seed most of their crop. Large producers transplant only the first plantings, to get earlier product. Transplants are more susceptible to pests such as cabbage maggot and flea beetles. Seeded cauliflower is later and requires thinning and more weed control as the plants stay in the field longer.

This project compared the maturity and quality of sequential seeding of cauliflower using both transplanting and direct seeding methods. This will assist producers in making agronomic decisions when growing this high value crop for the fresh market.

Project Plan
The direct seeded demonstration consisted of 4, 3-meter-long rows each of 6 varieties seeded beginning in early spring and every two weeks until mid-July. The center rows were considered the treatment rows and were harvested at maturity and evaluated based on Canadian grade standards.

The transplanted demonstration consisted 4 rows, 3 meters long, of the same six varieties. Transplants were started in the greenhouse about 4 weeks prior to transplanting. Transplanting occurred on the same day as the direct seeding. The center rows, treatment rows, were harvested at maturity by hand. Total and marketable yield was measured and the crops graded according to the Canadian grade standards.

Fig. 1 Transplants are getting established

Fig 2. Cauliflower is being assessed

The first batch of six varieties of Cauliflower: 1) Apex, 2) Casper, 3) Snow Crown (early), 4) Minuteman (hybrid), 5) Freedom CMS, 6) and Symphony, were all sourced from Stokes Seeds: (http://www.stokeseeds.com/home.aspx). The transplanted trial was grown in greenhouse and planted by hand after 4 weeks of growth. The direct seeded trial was planted through a single row hand planter on f May 23, 2017, the same day the transplanting was done. There were 6 sequential plantings done on both trials with the interval of 15 days. The entire cauliflower demonstration plot measured 110.4′ x 72′ feet. It was divided into six plots of the of 18′.4″ x 72′ feet. Each plot of 18′.4″ x 72′ feet was again divided. Each sub plot had 4 rows at the distance of two feet, two rows in the center were considered treatment rows and were harvested to measure the production of each method of plantation. The outer rows served as guard rows.

Results

The first planting of cauliflower was transplanted on June 1 and was harvested after 55 days on July 26. The direct seeded trial was planted on the same day and was harvested after 82 days on August 22. Both the crops, transplanted and direct seeded took almost the same time to get to maturity with the 4 weeks of greenhouse seedling development for the transplants factored in.

After each harvest the heads were assessed for the quality by measuring the size of heads, compactness and color (Fig 2), based on the Canadian grade standards.

All the heads harvested from each variety were weighed separately to get the yield per variety. The chart (Fig 3) shows the yield of each variety of cauliflower in the first planting for both methods. The results show that the yield per variety in transplanted crop was higher than the crop direct seeded, except the variety Apex. The scattered plots in Fig 5 and 6, show the dates and the quantity harvested. The concentration of the harvests in the first transplanted crop doesn't show any pattern. The direct seeded crop harvest was concentrated between September 22 and October 2, where the highest yield was achieved.

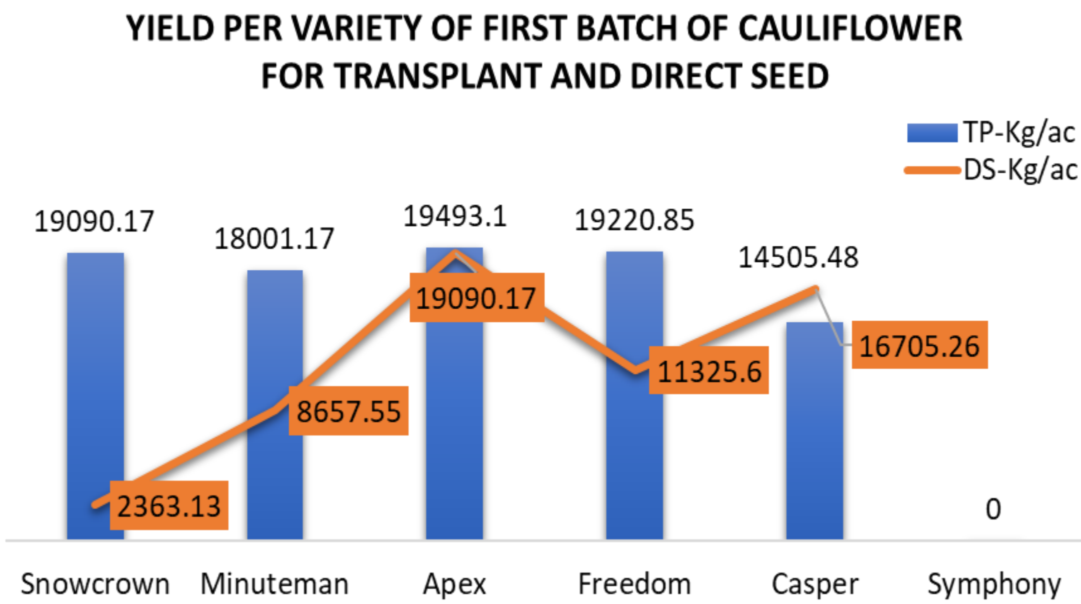

Fig 3. Yield per variety in first planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop

The combo chart (Fig 4), shows the yield of each variety in the second planting for both direct seeding and transplanting. Snow Crown was the only variety where direct seeding out yielded the transplanted treatments.

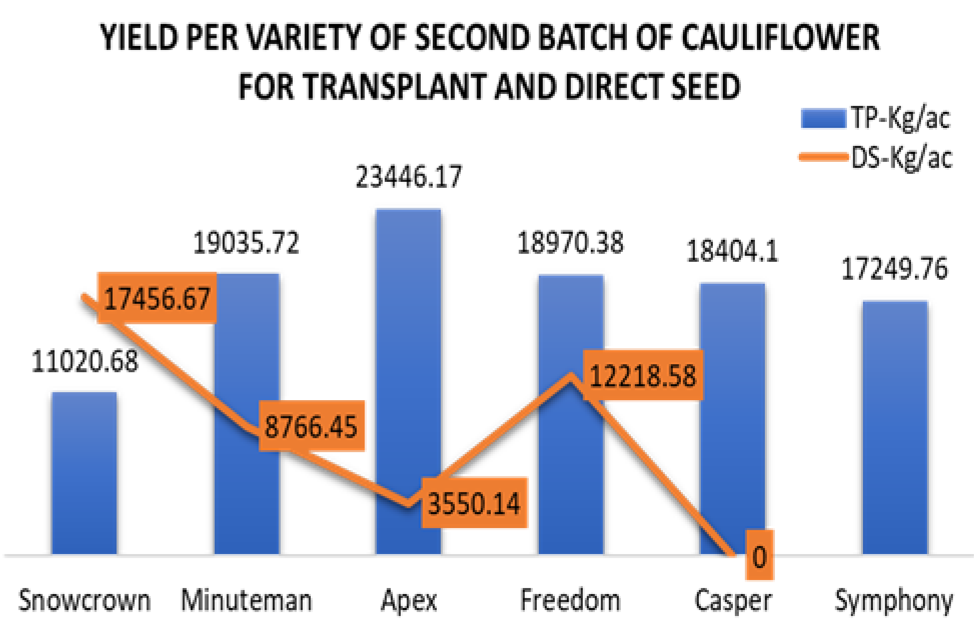

Fig 4. Yield per variety in second planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop.

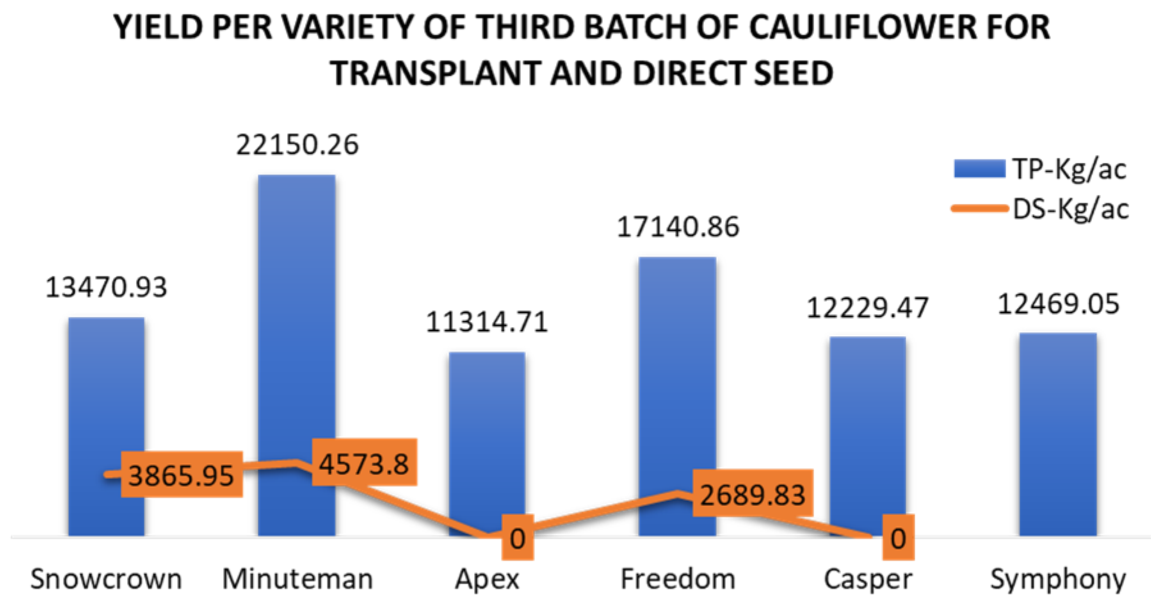

Fig 5. Yield per variety in third planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop.

In the fourth planting only the transplanted crop produced marketable heads. The direct seeded crops did not reach to the maturity (Fig 6). None of the plantings in crops five and six produced any marketable heads. Harvests on the previous plantings occurred until mid-October and the total yields were recorded. The total yield per planting, for both methods is shown in Fig 7.

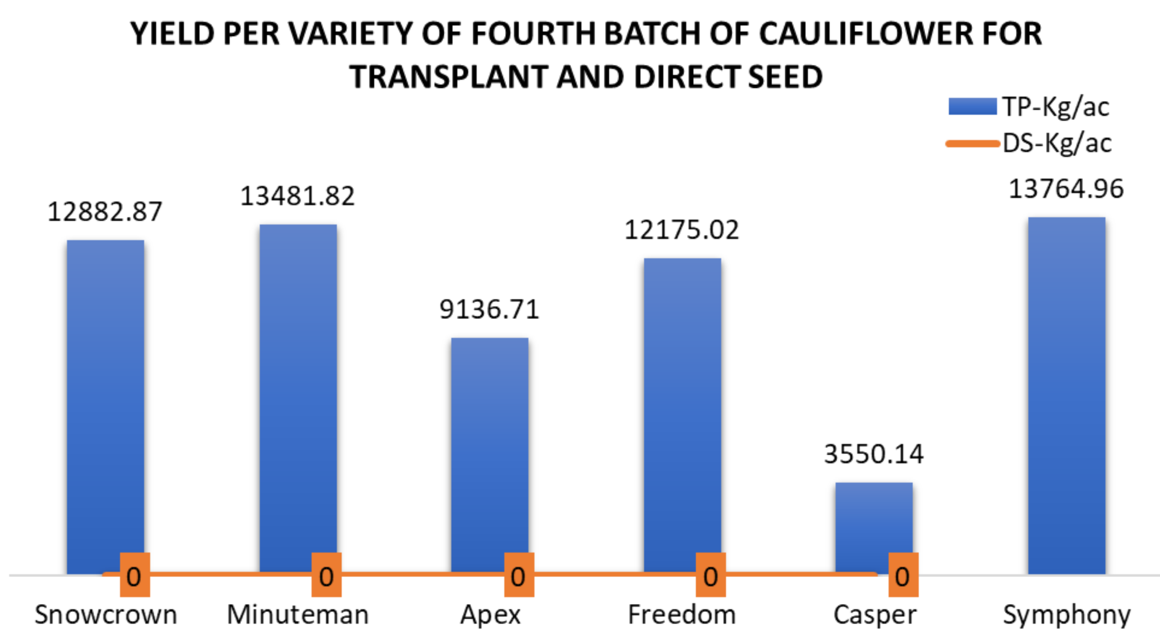

Fig 6. Yield per variety in fourth planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop.

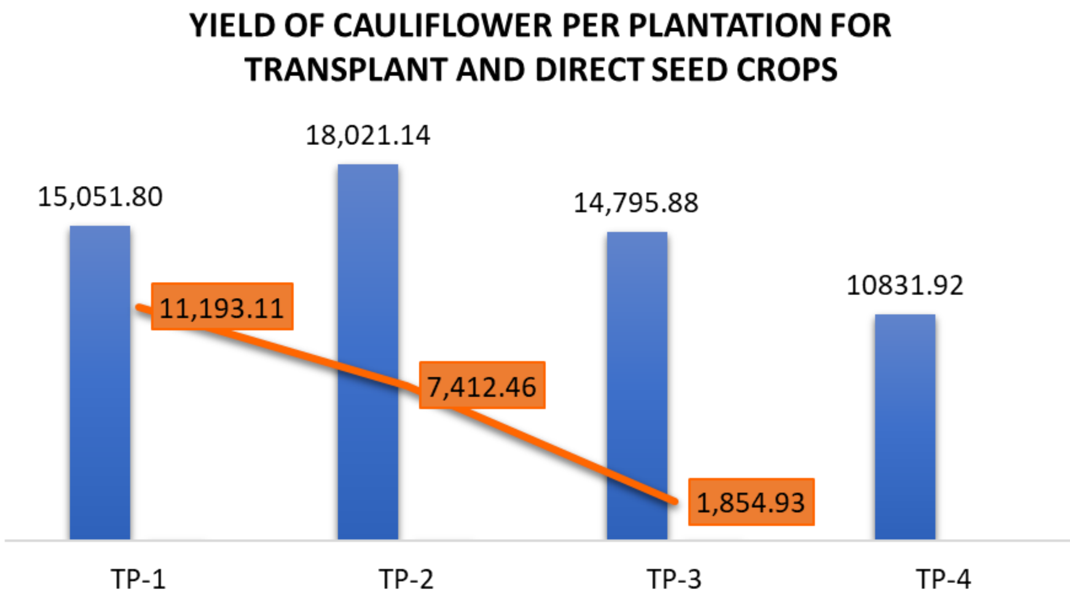

Fig 7. Yield per variety (kg/acre) in fourth planting, blue bars show yield of each variety in transplanted crop, brown row shows yield of each variety in direct seeded crop

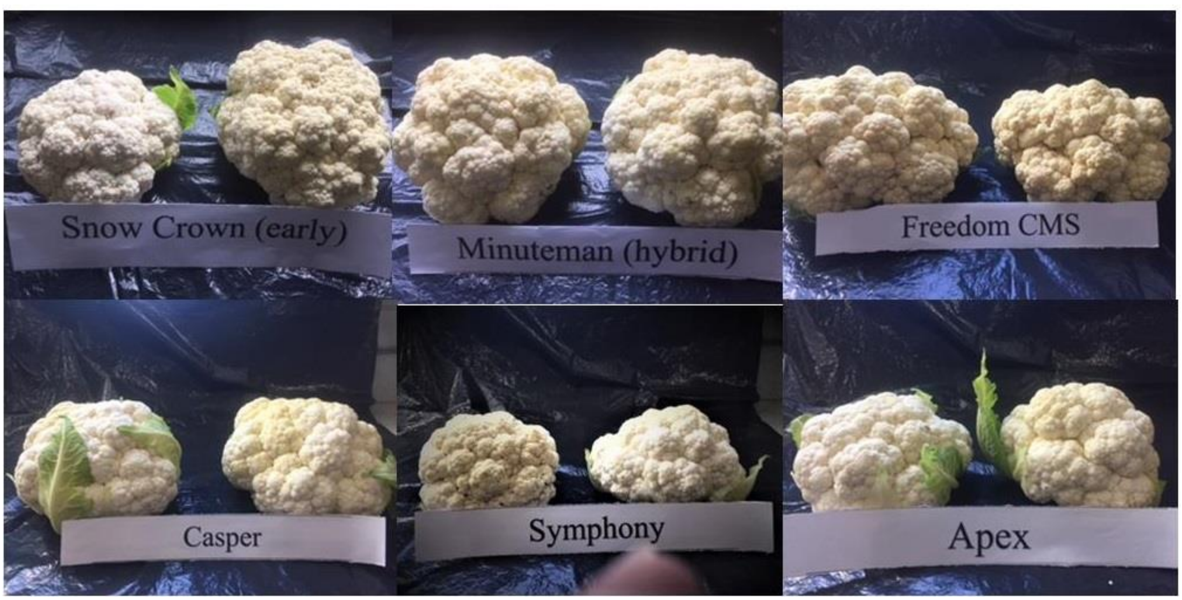

Figure 8: visual comparison of cauliflower varieties from this trial

Conclusions

The demonstration of sequential plantings of cauliflower under irrigation in Outlook, Saskatchewan was conducted in the summer of 2017. This demonstration compared the maturity and quality of produce harvested in transplanted and direct seeded cropping systems to assist producers in deciding on practices on their own farms. The main purpose of this demonstration was to see if there is any difference in planting method (transplanting and direct seeding) in terms of production and quality of the crop. Another goal was to assess the economics and feasibility of growing cauliflower at commercial level for both. Six varieties (Snow crown; Minuteman; Apex; Freedom; Casper and Symphony), were both direct seeded and transplanted and evaluated in this demonstration. Our results suggest that there is not much difference in the quality of cauliflower based on method of planting. However, some visible differences were seen between varieties, that the variety, Snow crown; Minuteman and Freedom were early irrespective of planting method. In terms of yield, all the varieties tested looked similar except Casper, which continuously yielded less than the other varieties in both the planting methods. The Growing Degree Days (GDD) for first; second and third direct seeded crops were 831.25; 841.95 and 793.5 respectively. It was noticed that the color of heads, harvested in the beginning were creamy white but later in the season, the heads of the same varieties appeared whiter. As such, the majority of the heads produced by these varieties after July were more attractive, whiter and larger in comparison to the earlier harvests. This demonstration also suggests that it would be likely that the direct seeded crops could perform well in terms of yield and quality if seeded in the month of June. The last 3 plantings in this trial produced little or nothing, therefore, late plantings are not feasible in our climate.

The results of demonstration of cauliflower were encouraging. The average yield for the transplanted crop was 14,675.18 kg/acre, while the direct seeded crop yielded 6,820.17 kg/acre. Yields of the direct seeded crop might have been higher, but staff did have problems thinning the plot in a timely manner. The value of transplanted and direct seeded crops, was calculated with the retail rate of cauliflower at $4/kg. The transplanted crop would have a gross value of $85,700.72 and the gross value of the direct seeded crop would be $ 27,280.86

Acknowledgements

- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
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Demonstration of Bok Choy for season long supply

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to provide a season long supply of bok choy for fresh markets. It was also intended to encourage producer and buyer uptake by providing an opportunity for them to see this crop grown in the field. Lastly, this demonstration compared cultivars for their suitability in Saskatchewan in terms of weather conditions and market potential.

Bok Choy is grown commercially in Ontario, Prince Edward Island, and British Columbia in Canada, but has not been grown for retail in Saskatchewan. In 2015, the SVGA conducted a trial (ADOPT 20140361) on many Asian vegetables. Bok Choy was one of the crops successfully produced but only two cultivars and one crop was produced. Further demonstration of available varieties will help producers decide which variety or combination of varieties to grow for season long supply.

The Saskatchewan vegetable industry has been working collaboratively with Federated Co-op to increase the supply of Saskatchewan grown produce into retail. Currently, the standard vegetables consumed by most Saskatchewan residents are being grown and sold to the Co-op, but there is a growing demand for ethnic vegetables for a growing Asian population in Canada. Canada imports over $400M worth of ethnic vegetables annually. Bok choy is a cool season crop and should do well in spring and fall, but varieties that don’t bolt in Saskatchewan’s hot summer will prove more challenging. Due to little production in Western Canada,, many market opportunities would be available if suitable varieties are found. This project will also show producers the practice of sequential plantings which allows more harvests spread out over a longer period of time.

Project Plan
This demonstration was carried out to compare the adoptability and production efficiency of different varieties of Bok Choy, under irrigated production in Saskatchewan. The first batch of six varieties of Bok Choy, viz: 1) Bopak (hybrid); 2) Mei Qing Choi (hybrid); 3) Joi Choi; 4) Green Fortune; 5) White Bok (PW1307); 6) Big Choi F1 (FGj278) were seeded through a single row hand planter on May 16, 2017 on the south half of the field #2 between the wheels tracks of tower 1 and 2, at CSIDC research station in Outlook, while subsequent trials followed roughly with the interval of two weeks.

Fig 1. Bok Choy seeded by single row hand planter

Fig 2. First crop seeded May 16, 2017

The plot measuring 48′ x 72′ feet (Fig 1), was sub-divided into six 8′ x 10′ plots., Separate varieties of Bok Choy were allotted to each sub plot. Each sub plot had 4 rows at the distance of two feet, two rows in the centre were considered as treatment rows and were harvested to measure the production of each cultivar. The outer rows served as guard rows (Fig 2).

Results

The first planting of ***Bok Choy*** was direct seeded on May 16 and was harvested after 51 days on July 6. All the Bok Choy plants harvested from each variety were weighed separately to get yield per variety. The chart (Fig 3) shows the yield per variety in crop 1 except the varieties ***Green Fortune***, ***White Bok***, and ***Big Choy*** which bolted prior to forming heads. The bolting in three Bok choy varieties in crop 1, may have been caused by extended phases of hot days during corresponding growing period (Fig 4). The temperature of 36 out of 51 days, remained higher than the 20 degrees Celsius and the temperature of three days went above 30 degrees Celsius (Fig 4). The variety, ***Bo Pak***, produced 19 chards which was 5% less than normal.

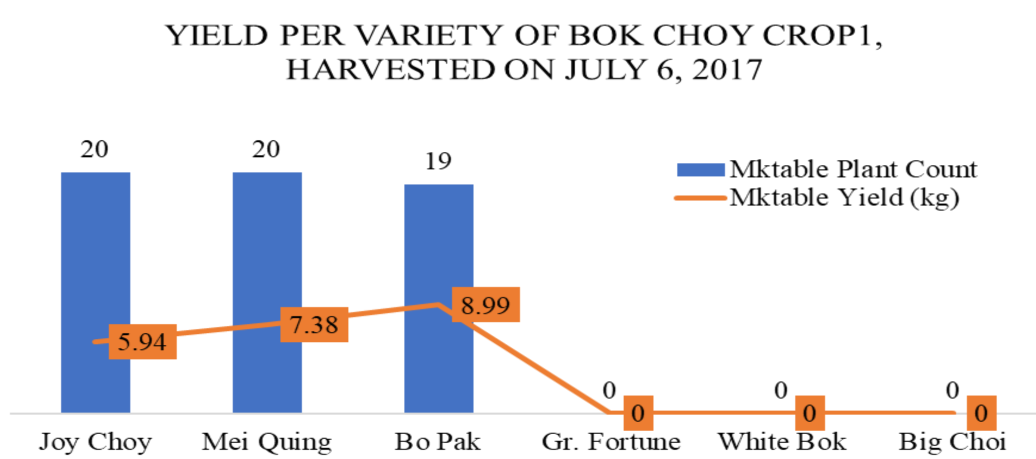

Fig 3. Combo chart showing the yield per variety in first plantation of Bok Choy, blue bars show the count of marketable plants in each variety, brown row shows the yield in each variety in kg/variety.

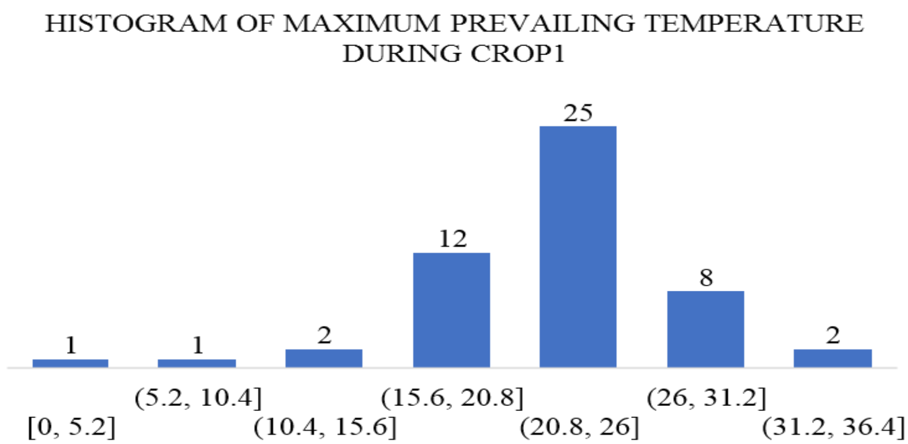

Fig 4. Histogram show the maximum temperature for growing period of crop1. Blue bars show total number of days with the range of temperature at the base.

The yield of the three varieties that did not bolt ranged between 5.94 and 8.99kgs (Fig 3). The high temperature may have had a role in the variation of yield between these varieties. This trial suggests that the varieties of Bok Choy behaved differently, under same temperature during crop 1 as we saw that three varieties out six bolted.

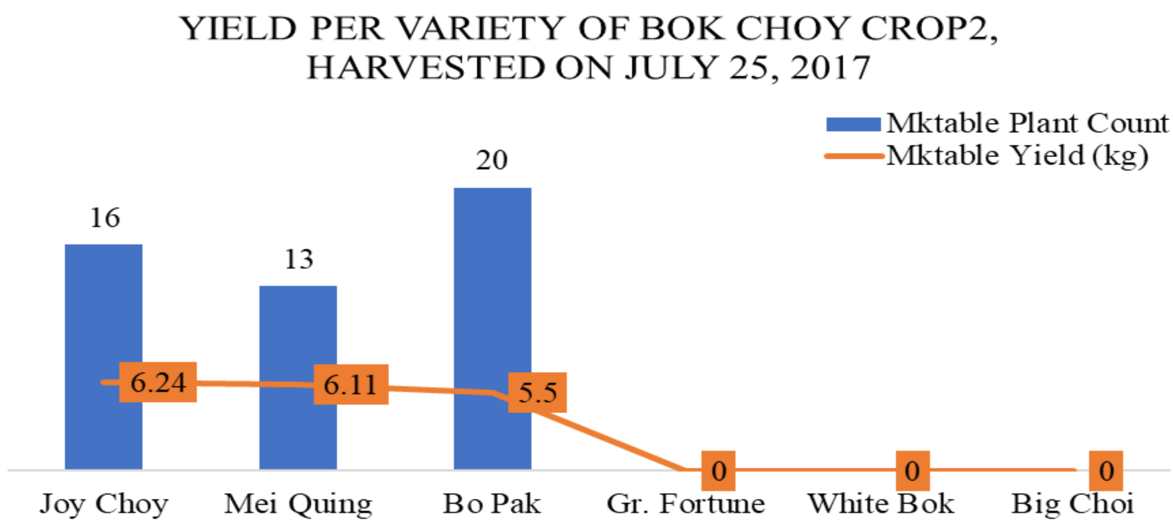

Fig 5. Combo chart showing the yield per variety in second plantation of Bok Choy, blue bars show the count of marketable plants (chards) in each variety, brown row shows the yield in each variety in kg/variety.

The second crop was seeded on June 8 and harvested after 47 days, on July 25. The situation was similar to crop 1 and only three varieties***, Joy Choy, Mei Quing*** and ***Bo Pak*** produced marketable heads, while the three verities***, Green Fortune*** (Gr. Fortune), ***White Choy*** and ***Big Choy*** bolted and did not produced any marketable heads (Fig 5).

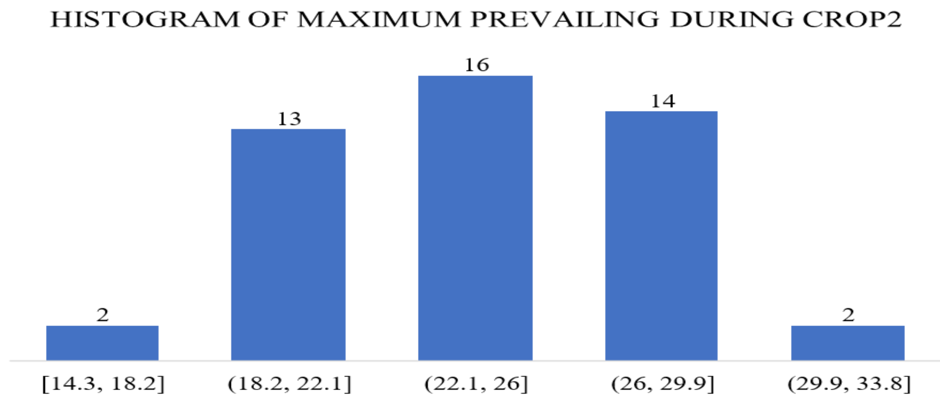

Fig 6. Histogram show the maximum temperature for growing period of crop2. Blue bars show the days with the range of temperature at the base.

In crop 2, the same varieties grew faster and matured earlier than in crop1. Crop2 had slightly higher GDD at 12.5 than the average GDD of crop1 which was at 10.3 (Fig 12), however, the same varieties yielded higher in crop 1 than in crop 2 (Fig 13). The varieties, ***Joy Choy*** and ***Mei Quing***, produced 16 and 13 marketable heads respectively, 20% and 35% less than normal.
The results of third plantation are different than the first and second plantings. This crop was seeded on June 28 and harvested after 43 days on August 10, 2017. This crop took less time to mature in comparison to crop 2 and all except the variety, ***While Bok***, produced marketable heads (Fig 7).

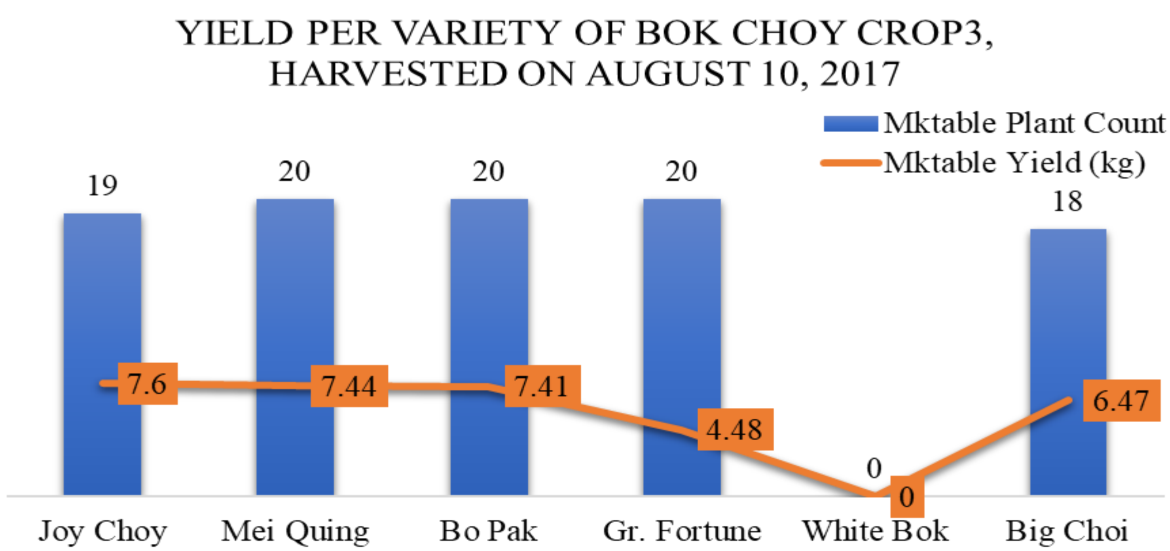

Fig 7. Combo chart showing the yield per variety in third plantation of Bok Choy, blue bars show the count of marketable plants (chards) in each variety, brown row shows the yield in each variety in kg/variety.

The maximum temperature of 39 days out of 43 days in crop3, remained higher than the 20 degrees Celsius, almost eight days were at 30 degrees Celsius, while five of those days even hit 32 degrees Celsius. According to the above results, it could be assumed that the varieties, ***Green Fortune*** and ***Big Choi*** may need warmer weather than the other three varieties. The variety***, White Bok*** remained the same under warmer temperature. This was just a one season demonstration, as such; the observed

results are not confirmed but can provide a baseline to do some in depth investigation.
The growing degree days accumulated during the period of this crop was 589 degrees Celsius. The average GDD was at 13.7, which is almost one degree higher than the average GDD during crop2. Varieties, ***Green Fortune*** and ***Big Choi*** in crop3 produced 20 and 18 chards respectively (Fig 7). The varieties, ***Joy Choy*** and ***Big Choi***, produced 5% and 10% less chards than the normal expected amount.
The fourth crop seeded on July 19, harvested after 51 days on September 8. This crop took the same time as the first crop to mature. Unlike crop1 and crop2, four varieties, ***Joy Choy***, ***Mei Quing***, ***Bo Pak*** and ***Green Fortune*** produced marketable chards, while White Choy and Big Choy bolted and did not produced any marketable chard (Fig 8). The variety, ***Green Fortune*** in crop 4 only produced 2 marketable chards which almost 80% less than the normal. The accumulation of GDD in the period of crop 4 was 646 degrees Celsius, the highest among all the cropping periods (Fig 9). But the average GDD was 12.7, just 0.2 degree higher than crop2 (Fig 10). The maximum temperature of 48 days out of 51 days in crop 4, remained higher than the 20 degrees Celsius, while, six days even went above 30 degrees Celsius. According to the above results, it could be assumed that the varieties, ***Green Fortune*** and ***Big Choi*** may have needed warmer than the other three varieties. The variety, ***White Bok*** remained the same under even warmer temperature.

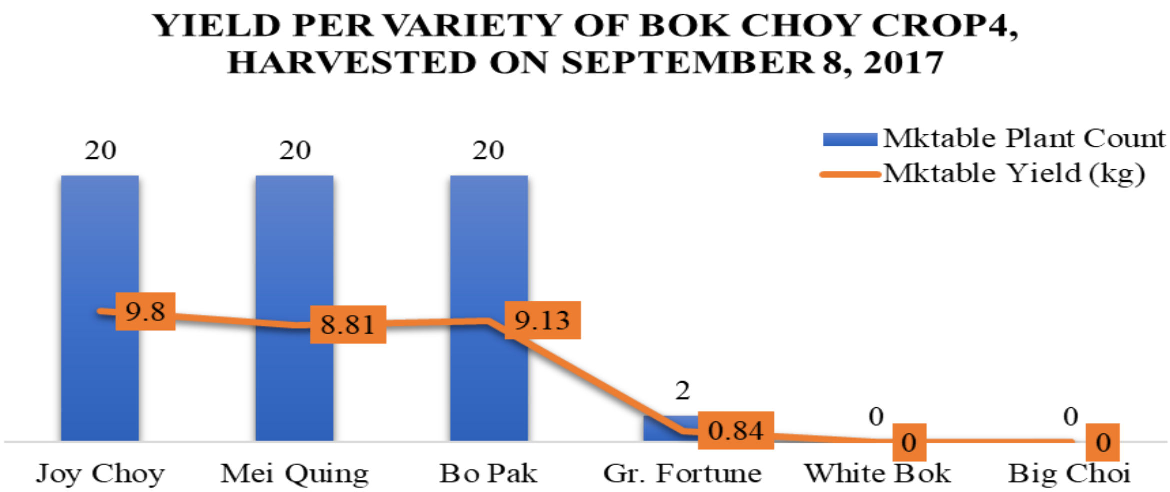

Fig 8. Combo chart showing the yield per variety in fourth plantation of Bok Choy, blue bars show the count of marketable plants (chards) in each variety, brown row shows the yield in each variety in kg/variety.

The plantation of crop 5, which was done on August 9, and plantation of crop 6, which done on August 30, germinated very poorly and could not grow further. The GDD for crop 5 and crop 6 were 493.8 and 265.2 respectively (Fig 11).

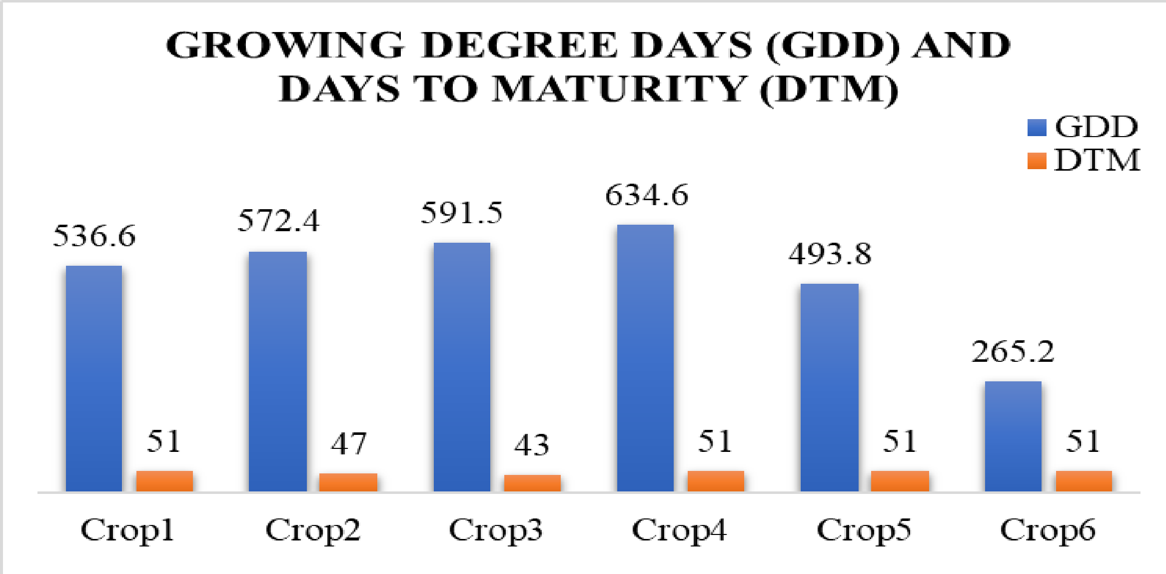

Fig 9. The above bar graph shows Growing Degree Days (GDD) and days to maturity. Blue bars represent days to maturity and brown bars represent the GDD. To calculate the GDD for crop5 and crop6 the DTM were assumed to be (51)

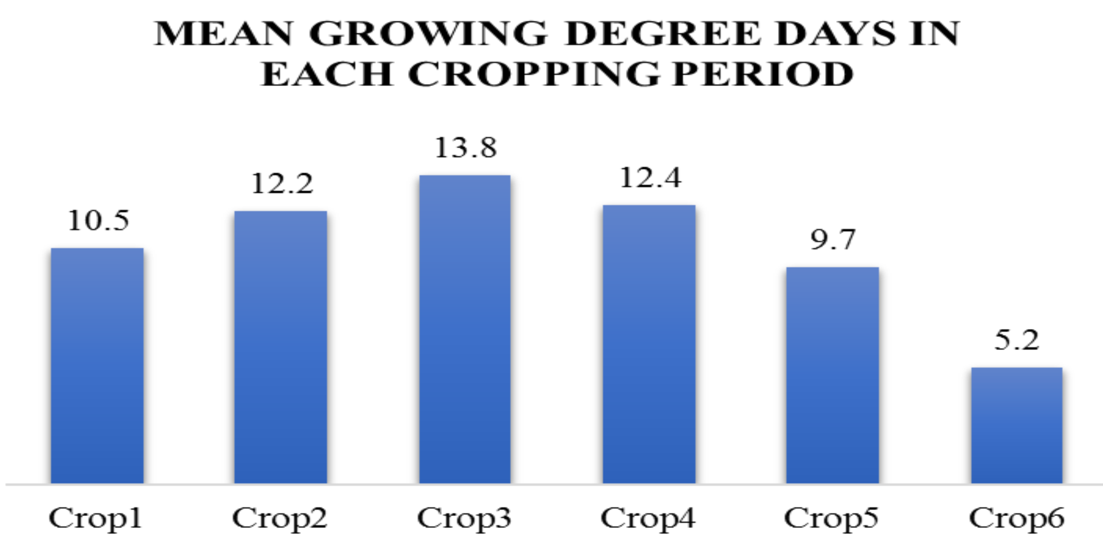

Fig 10. Average number of accumulation of GDD for the period of crops

In order to compare yield between all plantings all data was added separately to get the final figure for total yield for each of the cultivars (Fig 11).

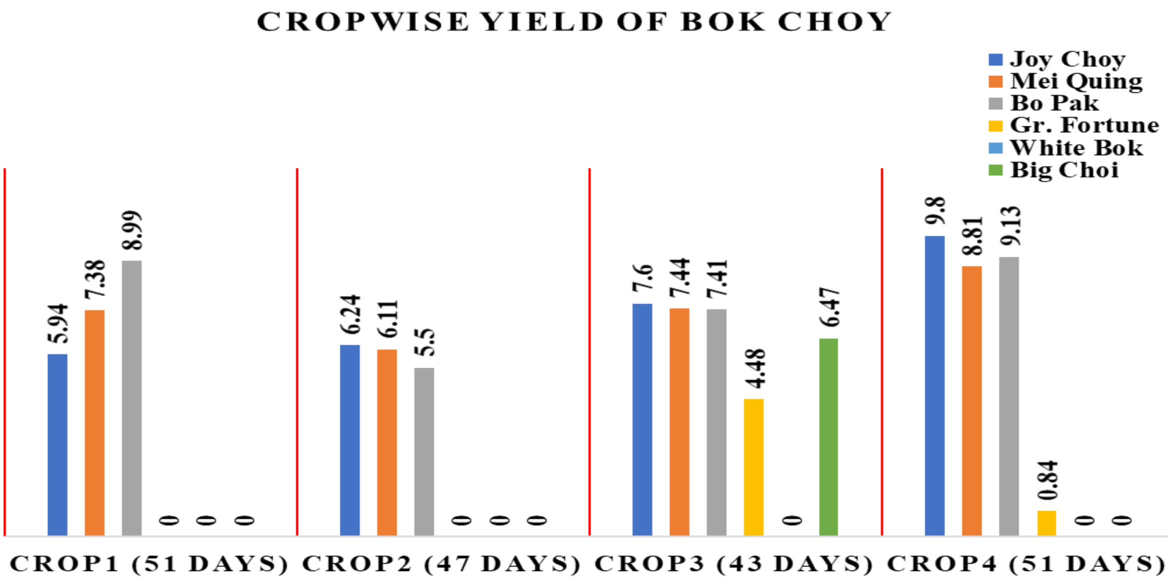

Fig 11. Yield (kg) of each variety of Bok Choy per crop.

Conclusion

The demonstration of sequential plantings of Bok Choy under irrigation in Outlook, Saskatchewan was conducted in the summer of 2017. The purpose was to compare the maturity and quality of marketable produce of direct seeded crops to assist producers in developing a program to provide a high-quality season long supply of Bok Choy for the fresh market. This demonstration also showed a difference in varieties in terms of production and quality of the crop. Another goal was to reveal the economics and feasibility of growing Bok Choy at commercial level for both.

Six varieties of Bok Choy: Bopak; Mei Qing; Joi Choi; Green Fortune; White Bok; Big Choi, were evaluated in this demonstration. Our results suggest that all the six varieties evaluated in this demonstration interacted differently in the same weather conditions. Some varieties produced quality marketable plants, while others bolted under the same conditions. It was also observed that some varieties produced marketable heads when the temperature was little higher than the temperature of previous cropping periods. The speed of growth was also affected, because it was observed that cropping period was varied between 43-51 days. For example, three varieties, Joy Choy, Mei Quing and Bo Pak produced marketable heads in the range of 536 to 634 GDD with mean daily temperature ranging between 10.5-12.5, in average of 48 days. The cultivars, Joy Choy, Mei Quing and Bo Pak Green Fortune and Big Choi produced marketable heads in only 43 days at GDD 591.5 with a mean daily temperature at 13.8. Some visible differences in terms of maturity and production of marketable heads were observed at different GDDs and mean daily temperatures, between varieties and crops. The maturity and marketable production of five cultivars in crop3 was achieved in 43 days, when planted on June 28 at GDD 591.5 with a mean daily temperature at 13.8, the optimum GDD and mean daily temperature, best suited to the crop like Bok Choy. However, the variety, White Bok, failed to produce any marketable heads in this cropping period. None of the varieties of Bok Choy, planted on August 9 and 28 produced any marketable heads. In terms of yield, all the varieties tested, looked similar. The leaves of some plants burned at the tips. The first harvests were light green and attractive but some of them got bigger became pale. This demonstration also suggests that it would be likely that the direct seeded crops could perform well in terms of yield if seeded from early to mid of the June.

The results of demonstration of Bok Choy were encouraging. The average yield for the top performing variety, Bo Pak (converted into kg/acre) was equal to 8450kg/acre for each planting.
This was just a one season demonstration, as such; the observed results are not confirmed but can provide a baseline to do further in-depth investigations.

Acknowledgements

- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Demonstration of Sui Choy for season long supply

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to provide season long supply of fresh Sui Choy for retail market of Saskatchewan. It demonstrated the opportunity for producers and buyers to see different cultivars of this crop being grown in Saskatchewan under irrigation.

Sui Choy is commonly known as, Chinese cabbage, Napa cabbage, Peking cabbage, Celery cabbage. The botanical name of Sui choy is Brassica rapa var. pekinensis (Šamec, D. et al. 2011). Sui Choy is grown commercially in Ontario, Prince Edward Island, and British Columbia in Canada, but has not been grown for retail in Saskatchewan. In 2015, the SVGA conducted a trial (ADOPT 20140361) on many Asian vegetables. Sui Choy was one of the crops successfully produced but only two cultivars and one crop was produced. Further demonstration of varieties available, will help producers decide which varieties to grow for season long supply.

The Saskatchewan vegetable industry has been working collaboratively with Federated Coop to increase the supply of Saskatchewan grown produce into retail. Currently, most standard vegetables consumed by most of Saskatchewan residents are being grown and sold to retail, but there is a growing demand for ethnic vegetables for a growing Asian population in Canada. Canada imports over $400M worth of ethnic vegetables annually. Sui Choy is a cool season crop so should do well in spring and fall, but varieties that don't bolt in Saskatchewan's hot summer will prove more challenging. If successful in finding good varieties, Saskatchewan producers could have the opportunity to produce Sui Choy for in large volumes.

Project Plan
This demonstration consisted of 4 rows, 3 meters in length of 6 varieties of Sui Choy seeded every two weeks beginning in early spring and until mid-July. The center rows, the treatment rows, were harvested at maturity (roughly 51 days). Total and marketable yield was measured, and the crop was graded according to the US No.1 standard.

This demonstration was carried out to demonstrate sequential cropping of different varieties of Sui Choy in Saskatchewan. The first batch of six varieties of Sui Choy, viz: 1) Yuki; 2) Jazz; 3) Emiko; 4) China Gold; 5) Blues and 6) Autumn Express, sourced from, Stokes Seeds: http://www.stokeseeds.com/home.aspx. The first crop was seeded through a single row hand planter on May 16, 2017 on the south half of the field #2 between the wheels tracks of tower 1 and 2, at the CSIDC research station in Outlook. The other 5 seedlings took place in intervals of two weeks.

Fig 1. Sui Choy seeded by single row hand planter on at the CSIDC research station in Outlook

The plot measured 48′ x 72′ feet (Fig 1) and was sub-divided into six plots of 8′ x 10′. A separate variety of Sui Choy was allotted to each sub plot. Each sub plot had 4 rows with 2 feet spacing. The two centre rows were considered as treatment rows and the outer rows served as guard rows.

Results

The first plantation of Sui Choy was direct seeded on May 16 and harvested after 51 days on July 6th. All the heads of the crop was harvested from each variety and weighed separately to get the yield per variety. The combo chart (Fig 2) shows the yield per variety in crop1 where all varieties produced marketable heads of Sui Choy (Fig 2). Three varieties; Emiko, China Gold, Blues and Autumn Express, produced higher number of heads and greater yield than other three varieties at (15) 6.86kg, (16) 8.67kg and (14) 5.84kg respectively.

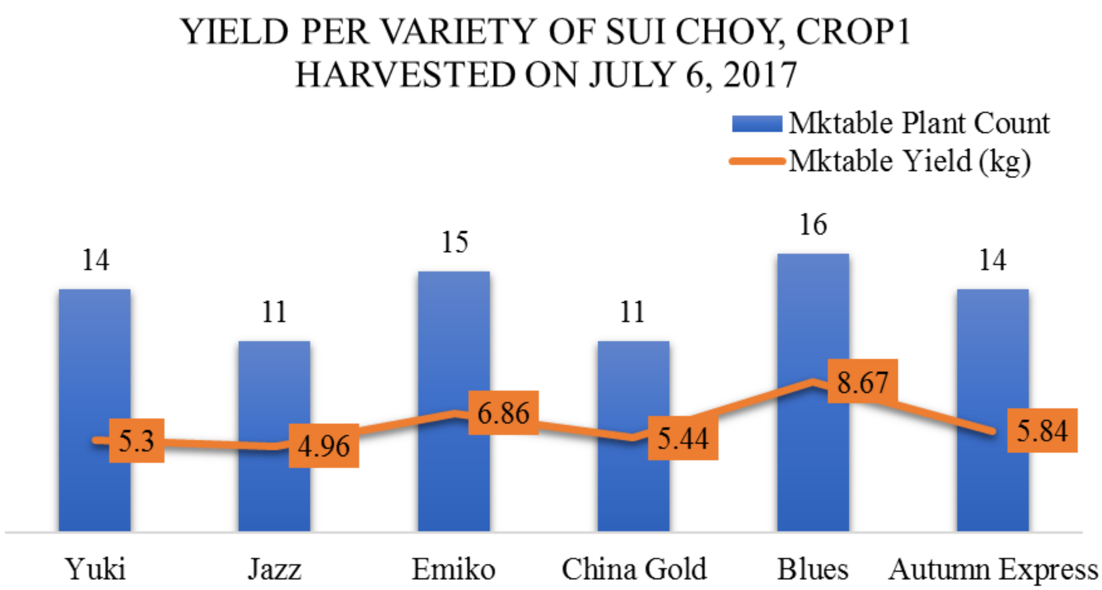

Fig 2. Combo chart showing the yield per variety in first planting of Sui Choy, blue bars show the count of marketable plants in each variety, brown line shows the yield in each variety in kg/variety.

The average weight of the heads was highest in the variety Blues at 0.54kg per head. The temperature of 36 out of 51 day growing period remained higher than the 20 degrees Celsius. The temperature for three days even hit above 30 degrees Celsius (Fig 3). The variety, Blues, produced 16 heads which was 20% less than expected. This could have been caused by the high temperatures this time of year.

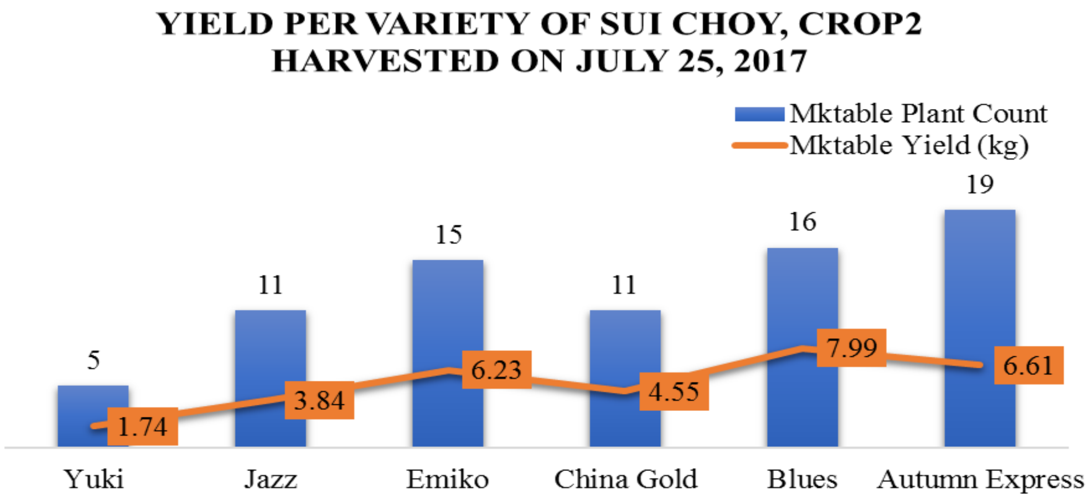

Fig 3. Combo chart showing the yield per variety in second planting of Sui Choy, blue bars show the count of marketable plants (heads) in each variety, brown row shows the yield in each variety in kg/variety.

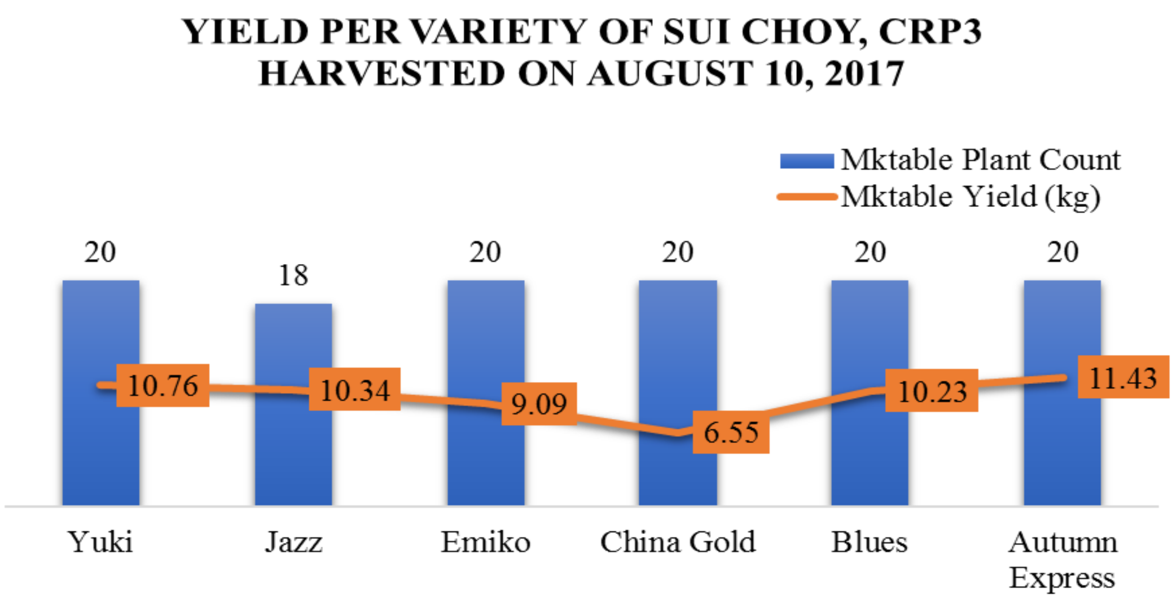

Fig 4. Combo chart showing the yield per variety in third plantation of Sui Choy, blue bars show the count of marketable plants (heads) in each variety, brown row shows the yield in each variety in kg/variety.

The second crop was seeded on June 8 and harvested after 47 days on July 25. The situation in crop 2 was similar to the crop 1 where the three varieties; Emiko, Blues and Autumn Express were the top yielders. The Variety; Yuki produced only five heads which weighed 1.74 Kgs (Fig 3). The yield in crop 2 was ranging between 1.74 and 7.99kgs (Fig 3).

The same varieties grew faster and matured early in the period of crop 2 than of the period of crop 1, mostly likely due to 40 days out of 47 days remained higher than the 20 degrees Celsius and almost ten days were even hit 30 degrees Celsius (Fig 5). The accumulation of GDD was also higher at 572.4. The number of heads and yield of same varieties was slightly higher in crop1 than the crop2 (Fig 11).
The third plantation was seeded on June 28, harvested after 43 days on August 10, 2017. The results were different than the first and second plantations and took even less time to mature in comparison. All varieties, except for Jaxx, produced 100% marketable heads (Fig 4).

The maximum temperature of 39 days out of 43 days in crop3, remained higher than the 20 degrees Celsius and for eight days they were at 30 degrees Celsius. Based on the above results, all the varieties of Sui choy performed well during the period of crop3. The GDD during this time was 591.45 with the average of 13.75 Degree Celsius (Fig 6,7). Only the variety Jazz had 20% less yield than expected (Fig 4).

The fourth crop was seeded on July 19 and harvested after 51 days on September 8. This crop took the same time as crop 1 to mature. Unlike crop 1 and crop 2, all varieties produced a good number of marketable heads, while the variety Jazz produced 12 heads which was 40% less than expected (Fig 4). The accumulation of GDD in the period of crop4 was 634.6 degrees Celsius, the highest among all the cropping periods . But the average GDD was 12.4, just 1.3 Degrees lower than crop3 (Fig 6). The maximum temperature of 48 days out of 51 days in crop 4 remained higher than the 20 degrees Celsius and six days went above 30 degrees Celsius. Based on the above results, it could be assumed that all the varieties performed well but not quite as well as in crop 3.

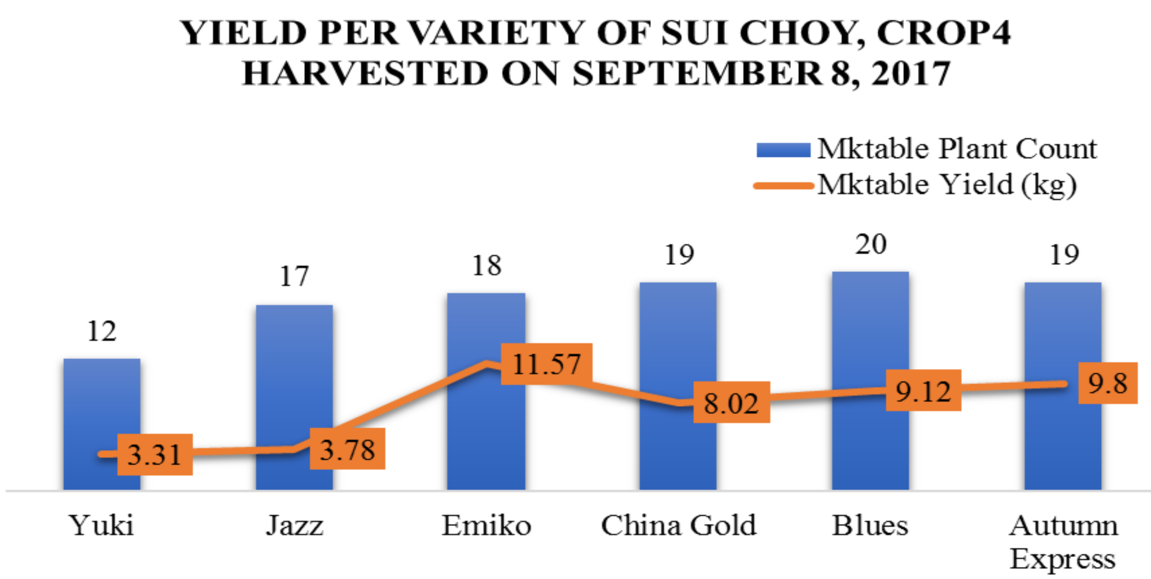

Fig 5. Combo chart showing the yield per variety in third planting of Sui Choy, blue bars show the count of marketable plants (heads) in each variety, brown row shows the yield in each variety in kg/variety.

Crop 5, planted on August 9, and crop 6, planted on August 30, germinated very poorly and did not grow to maturity. The GDD for crop 5 and crop 6 were 493.8 and 265.2 respectively (Fig 6).

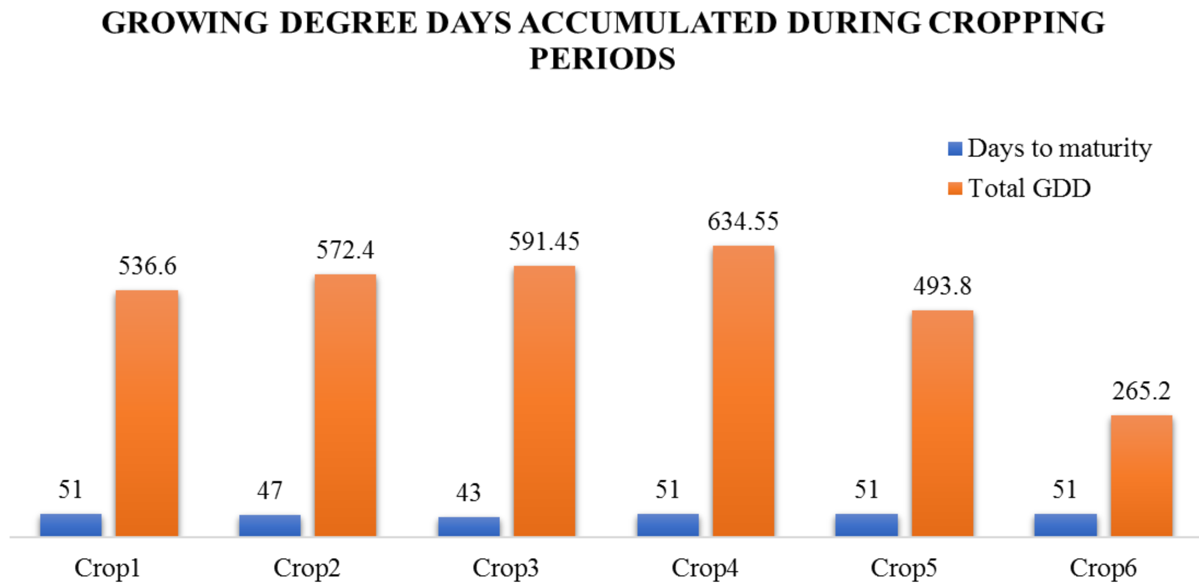

Fig 6. The above bar graph shows Growing Degree Days (GDD) and days to maturity. Blue bars represent days to maturity and brown bars represent the GDD. To calculate the GDD for crop 5 and crop6 the DTM were assumed to be (51).

In order to compare yield between all plantings, the yield of each cultivar at each harvest was recorded and added separately to get the final figure for total yield. Each head in each planting was re-harvested, counted, assessed, and weighed to calculate the marketable yield of each variety per crop per harvest.

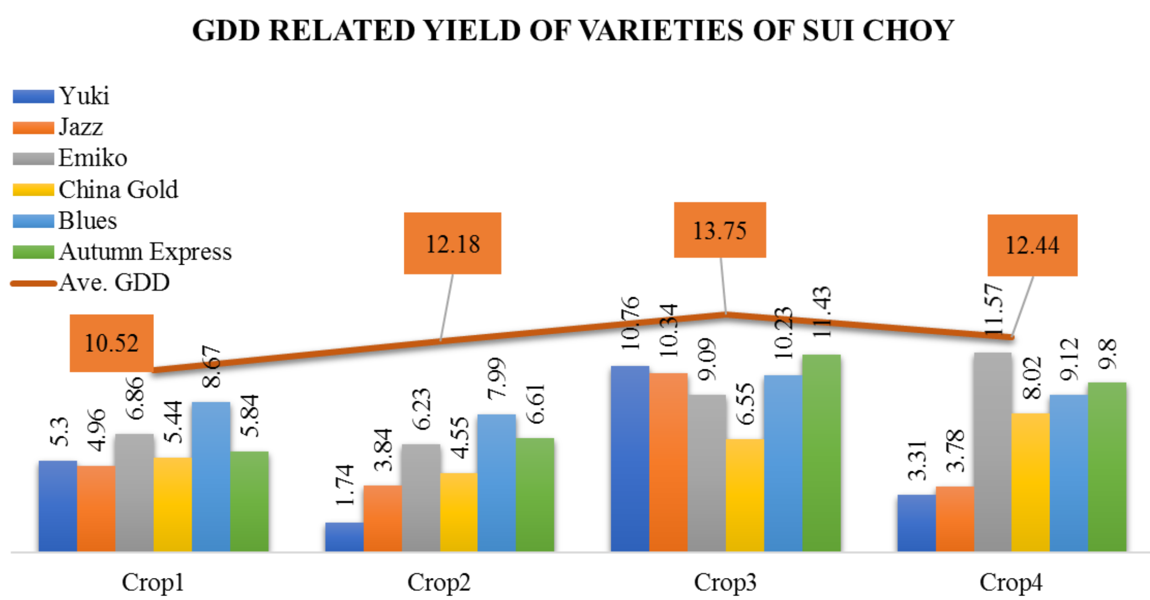

Fig 7. Yield of each variety of Sui Choy per crop under accumulation of average number of GDD in each crop.

Conclusions

This demonstration included six sequential plantings of Sui Choy under irrigation in Outlook, Saskatchewan in the summer of 2017. It compared the maturity and quality of marketable produce of direct seeded Sui Choy to assist producers in making decisions on growing this high value crop. The main purpose of this demonstration was to see if there is any difference in varieties in terms of production and crop quality during the growing season. Another goal was to reveal the economics and feasibility of growing Sui Choy at the commercial.

Six varieties of Sui Choy: Yuki; Jazz; Emiko; China Gold; Blues and Autumn Express, were direct seeded. Our results suggest that all the six varieties evaluated in this demonstration interacted differently in the same weather conditions. Some varieties produced quality marketable plants (heads) in almost each cropping period. Others were able to produce marketable heads at higher temperatures, as the season progressed. The temperature also affected the speed of growth of plants, it was observed that the cropping period varied between 43-51 days. The results of current demonstration suggest that it would be likely that the required range of GDD to grow Sui Choy in Outlook, SK would be between 591.45 and 634.5, with mean daily GDD at 13.7 Degree Celsius. It looks like that this was the optimum GDD and mean daily temperature, best suited to Sui Choy. None of the varieties of Sui Choy that were planted on August 9 and 28 produced any marketable heads. In terms of yield, all the varieties tested, looked similar. It was noticed that the leaves of some plants burned at the tips due to excess heat. The early harvested heads were light green and attractive but as the harvests got later, the heads became bigger and had a shade of paleness. This could be because of very long photoperiods which were nearly 18 hours. This also negatively impacted the marketable yield although this will depend on the year.

The results of this demonstration of Sui Choy were encouraging, as the average yield per crop (converted into kg/acre) was equal to 46835.2kg/acre. As this demonstration occurred for only one year at one location the conclusions are not definitive. The results however, provide a baseline for further in depth investigations.

Acknowledgements

- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Demonstration of Late Blight Resistant Tomato in high tunnel for season long supply

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead
- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations
- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to produce late blight resistant tomatoes commercially using high tunnels in Saskatchewan. This project provided opportunities for producers and buyers to see this crop being grown and compared resistant varieties to a non-resistant check. The demand for local tomato is not being met in most markets across Saskatchewan and this demand is increasing faster than local producers have anticipated. Productions of tomatoes are well suited for high tunnel production. A comparative study on yields and quality of greenhouse and field tomato varieties was carried out under, ADOPT 20150497, to help producers select of suitable varieties of tomatoes for their operations and to bring awareness of this opportunity. Our results show that the field tomatoes out yielded greenhouse tomatoes when grown in high tunnel. The field tomatoes performed well with minimal splitting, however late blight infected three of the varieties. The fourth variety, Defiant is marketed as a late blight resistant variety however, it's fruit is smaller than the market prefers. In other jurisdictions, where late blight occurs almost annually, late blight resistant varieties of tomatoes are becoming the norm. In Prince Edward Island in 2016, AAFC supplied free seed of late blight resistant tomatoes to home gardeners and garden clubs in order to help protect the potato industry in that province. The US 23 strain of late blight is more aggressive to tomatoes, but will attack potatoes as well, therefore promoting resistant varieties in SK will help protect Saskatchewan's potato industry.

A demonstration and comparison of late blight resistant varieties of tomatoes will help commercial producers choose varieties of tomatoes with the characteristics that the market prefers. It will also provide them with a longer growing season and less time spent applying fungicides. Home gardeners introduced to the new varieties will not harbor late blight in their gardens, thereby protecting the potato industry in SK.

Project Plan
This demonstration took place in one 96 feet long high tunnel by the north gate of CSIDC research farm. This demonstration consisted of 4 rows of mulch with trickle irrigation installed underneath (Fig 4). There were 5 varieties demonstrated which were replicated 4 times and randomized in each row. Each replication consisted of 11 plants of each variety. The tomato varieties: Defiant Organic (LB resistant), Plum regal (LB resistant), Mount Merit (LB resistant), Premio (LB resistant) and celebrity (Susceptible to

LB) all sourced from Vesey's seed company, were seeded into pots in a greenhouse on April 20th (Figure 1). On May 30th, once the seedlings were mature enough in the greenhouse, they were transplanted into the high tunnels into plastic mulch (figure 2).

Fig 1. Seeded into pots in a greenhouse on April 20 2017

Fig 2. Seedling transplanted into high tunnel on May 30 2017

This project was located in the orchard area at the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC). The plants were seeded in a greenhouse in plastic trays in order to develop seedlings. The seedlings were planted into rows at the high tunnel and covered with plastic mulch to control weeds and reduce evaporation.

Fig 3. Tomato plants are supported with Iron stakes pegged in ground through mulch.

Fig 4. Tunnel is being prepared for planting

The drip line irrigation for this project was equipped with fertilizer injectors which allowed fertigation of this crop with soluble 20-20-20 throughout the growing season. These plots were irrigated on a daily basis which provided sufficient water for the crops to reach yield potential. Iron stakes were pegged in the ground through plastic mulch at the short distance in the middle along each row in order to support the weight of the crop.

Results

There were total of 12 harvests, spanning from August 23rd to October 3rd. The results of the cumulative harvests for the 4 reps of each variety are shown in Table 2. The total count of tomatoes of all 4 replicates of each variety show the variety, **Premio** produced the greatest number of tomatoes at 5767. The variety**, Mountain Merit** produced lowest number of tomatoes with 2030 (Fig 5).

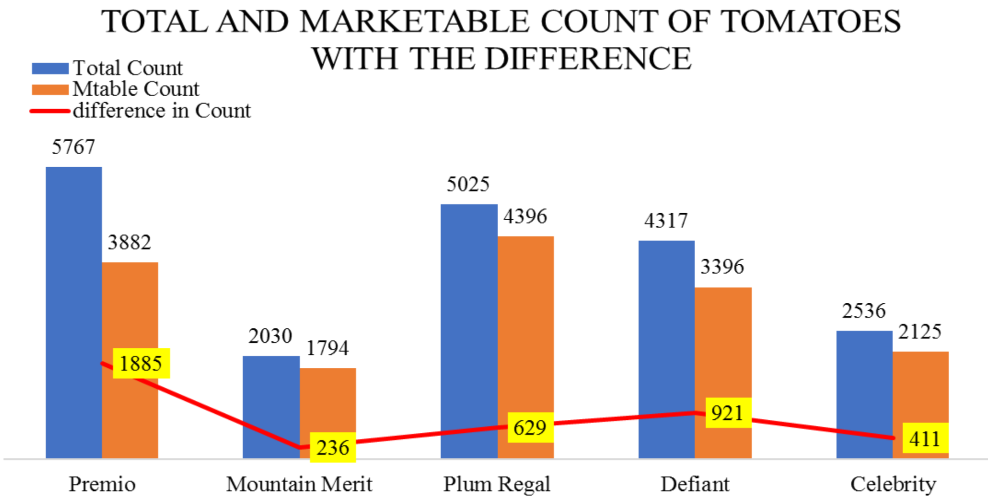

Fig 5. Blue bars in combo chart show the total count and brown bars show the marketable count while red line with yellow labels show the difference between total and marketable count obtained in the current demonstration

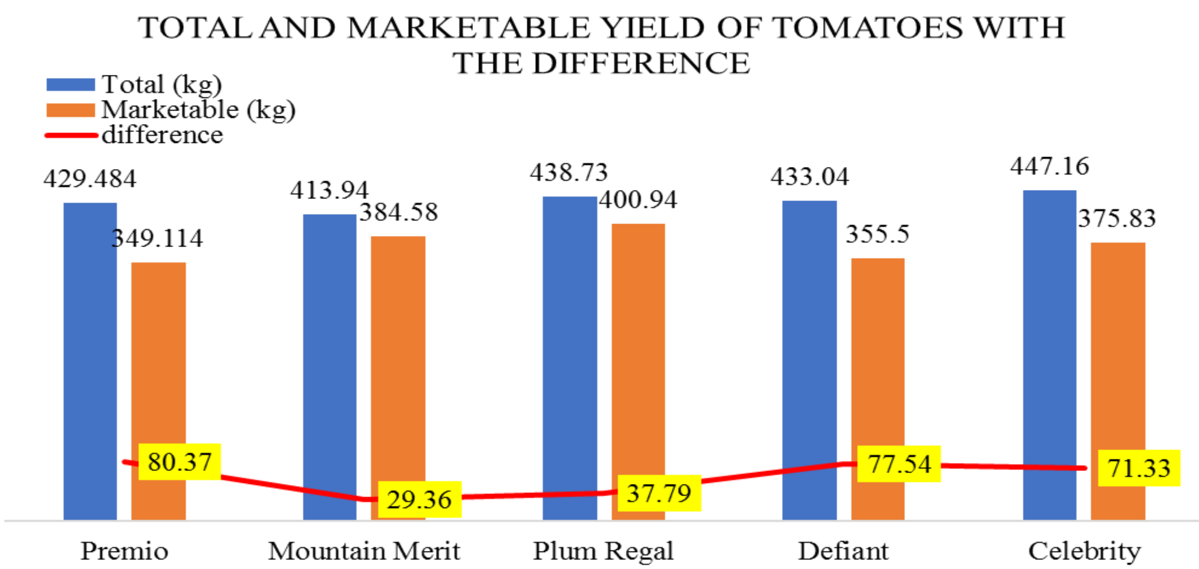

Fig 6. Blue bars show the total yield and brown bars show the marketable yield while red line with yellow labels show the difference between total and marketable yield obtained in the current demonstration.

The red line running through bars in (Fig 5) shows that difference between the marketable and non-marketable yield. The difference was highest in Premio and lowest in Mount Merit. Yields in weight were very similar amongst all varieties despite the variable size of fruit (fig.6).

The difference between total and marketable yield is important to look at for fresh market, as culls generate waste. If no processing markets exist, the culls become a cost. In the varieties, Premio, Defiant and Celebrity the difference was approximately 80kgs, per variety. While the varieties Mountain Merit and Plum Regal had lower differences at around 30Kgs per variety (Fig 6).

Table 1. Results of Tomato Harvest

Variety	Plant Count	Total Count	Total Yield (kg)	Mtable Count	Mtable Yield (kg)	Count Per Plant	Yield Per Plant (kg)	Mtable Count Per Plant	Mtable Yield Per Plant (kg)	Average Tomato Weight (grams)
Premio	44	5089	459.03	3423	301.21	115.66	10.43	77.80	6.85	9.02
Mountain Merit	44	1647	411.95	1459	315.33	37.43	9.36	33.16	7.17	25.01
Plum Regal	44	4327	473.04	3785	346.60	98.34	10.75	86.02	7.88	10.93
Defiant	44	3386	417.79	2747	292.10	76.95	9.50	62.43	6.64	12.34
Celebrity	44	2062	432.77	1761	309.90	46.86	9.84	40.02	7.04	20.99

Premio and Plum Regal are Roma type tomatoes. Both were on the large size for Romas, and had excellent quality characteristics. Both varieties produced more tomatoes than any of the other varieties both in number and weight. Mountain Merit produced the largest tomatoes, larger than Celebrity the late blight susceptible standard variety, Defiant fruit size was not much larger than the Roma types and would therefore not be desirable in the market place.

An economic analysis was done to show producers the potential of his crop to generate revenue. The yield per variety measured in kilograms has been converted from kg/variety into kg/acre to give producers a clear picture of what kind of gross retail value these crops could generate (Fig 7). The marketable yield of variety, Plum regal was the highest among all the variety.

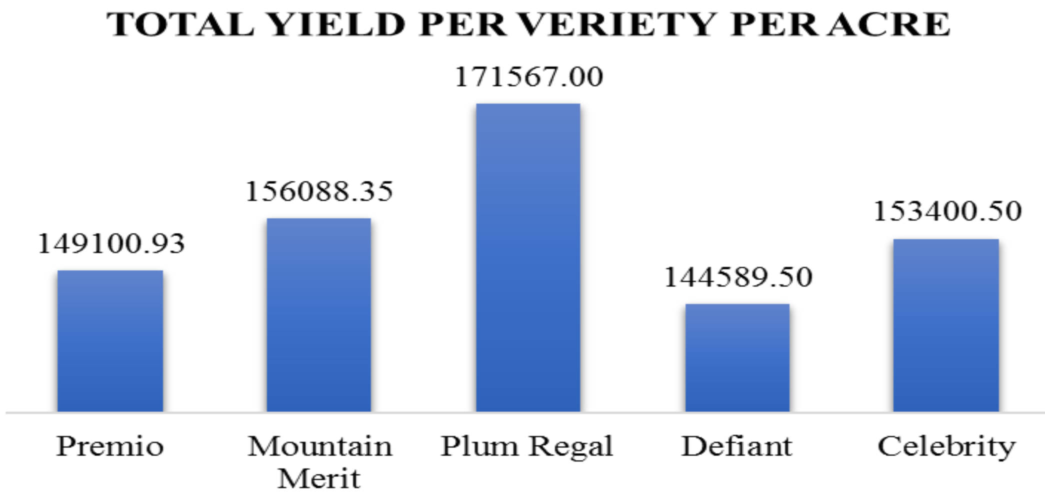

Fig 7. The bar graph shows the marketable yield per variety (kg) obtained in the current demonstration as if grown on one acre of land.

An economic analysis (Table 2) was done in order to determine the gross retail value per acre this crop can generate. The price used for this economic analysis was $3.30/kg although this can vary greatly depending on the supply and demand during the season The prices shown in Table 2 would be a gross value if direct marketed to the consumer (at farmers market, etcetera). The results of this trial suggest that growing the available varieties of late blight resistant tomatoes in high tunnel can be profitable.

Table 2. Gross Economic Analysis of high tunnel tomato Production

Variety	Marketable Number	Total No. per high tunnel	Gross $/ high tunnel (retail value)
Mountain Merit	1459	7296	$10,942.50
Defiant ($2.31/5)	2747	13735	$6345.57
Celebrity	1761	8805	$12,150.90
Premio	6.8	1496	$4936.80
Plum Regal	7.9	1738	$5735.40

Assumptions:

- Mountain Merit & Celebrity are sold as large tomatoes at $1.38 each
- Defiant is too small to be sold as large, therefore would most likely be sold as 5 pack.
- High tunnel size: 96ft x 20ft

Conclusions

This demonstration was conducted in order to determine the potential to produce late blight resistant varieties of tomato, commercially in high tunnels in Saskatchewan. Another reason was to provide opportunities for Saskatchewan producers and buyers to see the crops being grown and learn about the economic opportunity. This demonstration also compared the performance of late blight resistant cultivars to a non-resistant check.

The 2016 trial did not show any signs of late blight in any varieties, including the susceptible variety, Celebrity. The results suggest that all the varieties performed well in terms of total yield. Some varieties produced a large number of tomatoes per plant but a smaller size of tomato which equalized the total weight of the yield (Fig 6). The count of total tomatoes was low in Mountain Merit and Celebrity but yield of both varieties was considerable due to the large fruit size (Fig 5, 6). The variety, Plum Regal gave the highest marketable yield in current demonstration (Fig 7).

The results of economic analysis showed a high potential value in growing the large varieties of tomatoes in high tunnels in Saskatchewan. Although Celebrity showed higher returns than the variety Mountain Merit, input costs would be higher as regular fungicide would be required on the traditional varieties. Roma tomato production would be less profitable in high tunnels.

Acknowledgements

- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Demonstration of Sweet La Rouge Type Red Peppers

Funding
Agriculture Demonstration of Practices and Technologies (ADOPT)

Project Lead

- Joel Peru, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Wali Soomro, ICDC Seasonal Agronomy Research Technician

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Saskatchewan Vegetable Growers' Association (SVGA)

Project Objective
This project was intended to demonstrate the potential to produce La Rouge type red peppers commercially in high tunnels in Saskatchewan, to provide opportunities for producers and buyers to see the crops being grown and to compare cultivars for suitability in Saskatchewan conditions and market.

Most of the Red peppers are sold in Saskatchewan are commercially grown in greenhouses in Alberta. Last summer ADOPT 20150495 demonstrated that commercial production of green peppers and jalapeno type peppers in high tunnel is viable. Red peppers such as, La Rouge types, require slightly more time to ripen than green peppers. Growing them in summer in high tunnels with less infrastructure than greenhouse should make production commercially viable.

Based on the results of ADOPT 20150495, the Prairie Fresh Food Corporation (PFFC) is looking for a producer to grow jalapeno and green peppers in Saskatchewan at commercial level. Additionally, buyers are very interested in the new La Rouge peppers. If this demonstration shows that red peppers can successfully be grown in high tunnels in Saskatchewan, another opportunity will be open to producers. Red peppers are not grown in large quantities in Saskatchewan, so entering the market early and commanding a good price will benefit the Saskatchewan vegetable industry.

Project Plan
The demonstration was implemented using one 96 by 20 foot high tunnel at the CSIDC research farm in orchard area. This demonstration consisted of 4 rows of mulch with trickle irrigation installed beneath (Fig 1). There were 6 varieties demonstrated. They were replicated 4 times and randomized in each row. Each rep was 10 feet in length and consisted of 9 plants of each red pepper variety. The varieties included Kapello, Giant Szegedi, Giant Marconi, Super Shepherd, Carmen, Marcato, sourced from Stokes seed company., The plants were seeded into pots in a greenhouse on April 20th. On May 31th, they were transplanted into plastic mulch in the high tunnel.

The drip line irrigation for this project was equipped with fertilizer injectors which allowed fertigation of this crop with soluble 20-20-20 throughout the growing season. These plots were irrigated on a daily basis which provided sufficient water for the crops to reach yield potential. Some plants were supported with iron or wooden stakes.

Results

There were total of 7 harvests, spanning from September 8, to October 4rd. The results of the cumulative harvests for the 4 reps of each variety are shown in Table 2. The variety, Kepello produced the greatest amount of marketable red peppers with the total count of 898. The variety, Marcato produced the lowest number of Red pepper with the count of 557. The green line running through bars in Figure 5 shows that difference between marketable and unmarketable peppers. Kapello had the lowest amount of unmarketable peppers and Carmen produced the highest.

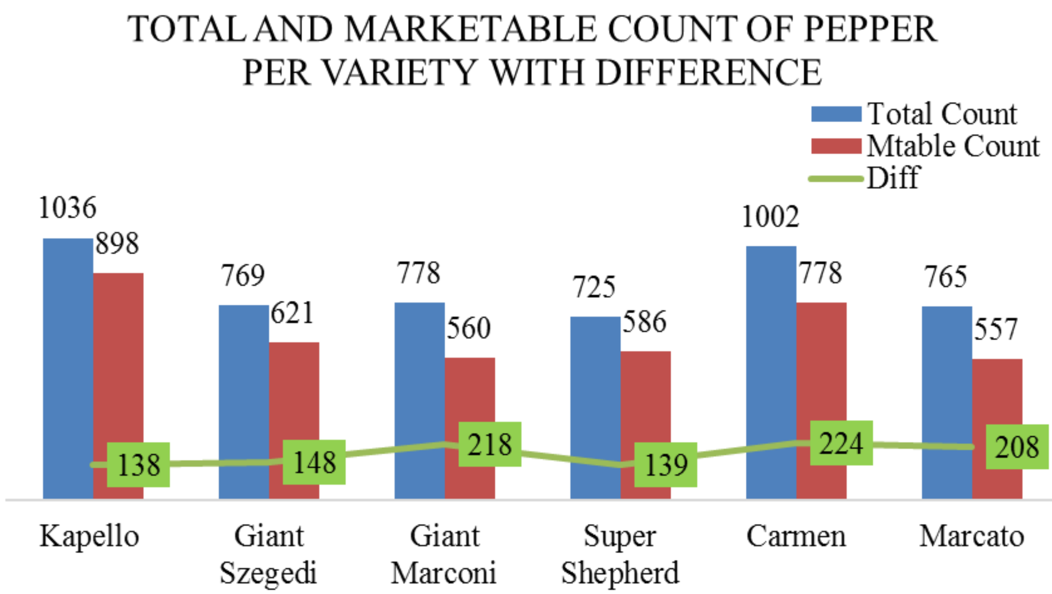

Fig 5. Blue bars in combo chart show the total count and red bars show the marketable count while green line with labels show the difference between total and marketable count obtained in the current demonstration.

Yields were variable among the different varieties in this trial. Giant Marconi and Carmen produced the largest total marketable yield at 90kgs for the 4 replicates (Fig 6). Each variety had different size and weight characteristics. The difference between total and marketable yield was in Fig 6, is shown by the green line running through the graph.

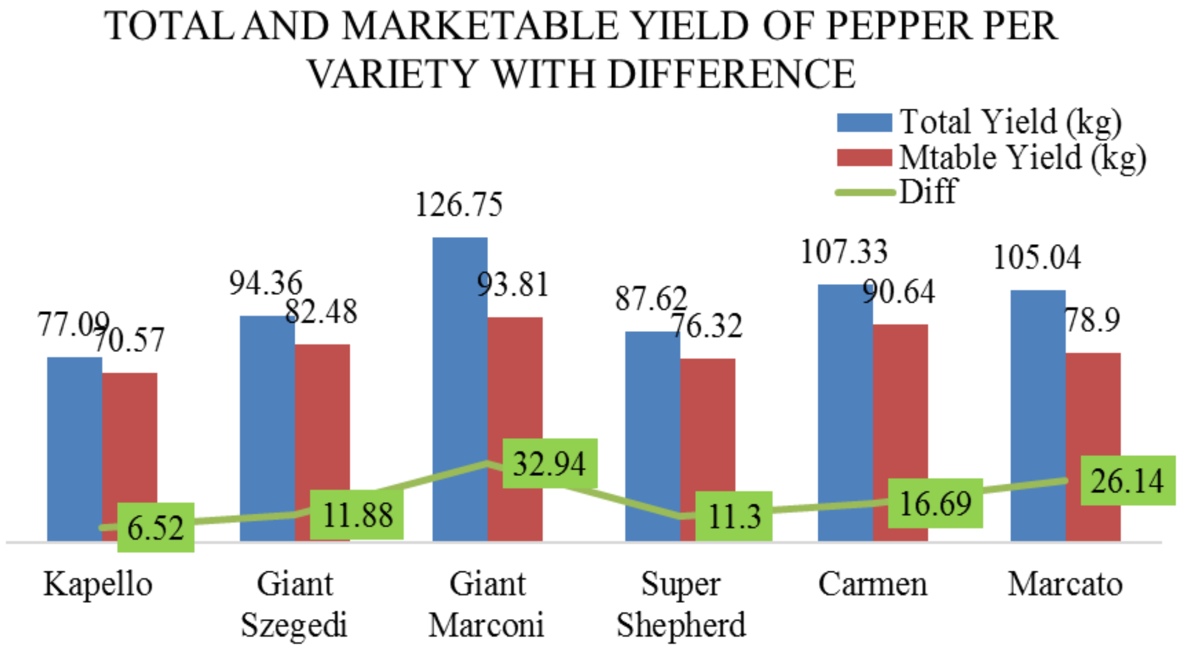

Fig 5. Blue bars in combo chart show the total yield and red bars show the marketable yield while green line with labels show the difference between total and marketable yield obtained in the current demonstration

Table 1. Results of Sweet Red pepper Harvest

Variety	Plant Count	Total Count	Total Yield (kg)	Mtable Count	Mtable Yield (kg)	Count/ Plant	Yield/ Plant (kg)	Mtable Count/ Plant	Mtable Yield/ Plant (kg)
Kapello	36	1036	77.09	898	70.57	28.8	2.1	24.9	2.0
Giant Szegedi	36	769	94.36	621	82.48	21.4	2.6	17.3	2.3
Giant Marconi	36	778	126.75	560	93.81	21.6	3.5	15.6	2.6
Super Shepherd	35	725	87.62	586	76.32	20.7	2.5	16.7	2.2
Carmen	30	1002	107.33	778	90.64	33.4	3.6	25.9	3.0
Marcato	34	765	105.04	557	78.9	22.5	3.1	16.4	2.3

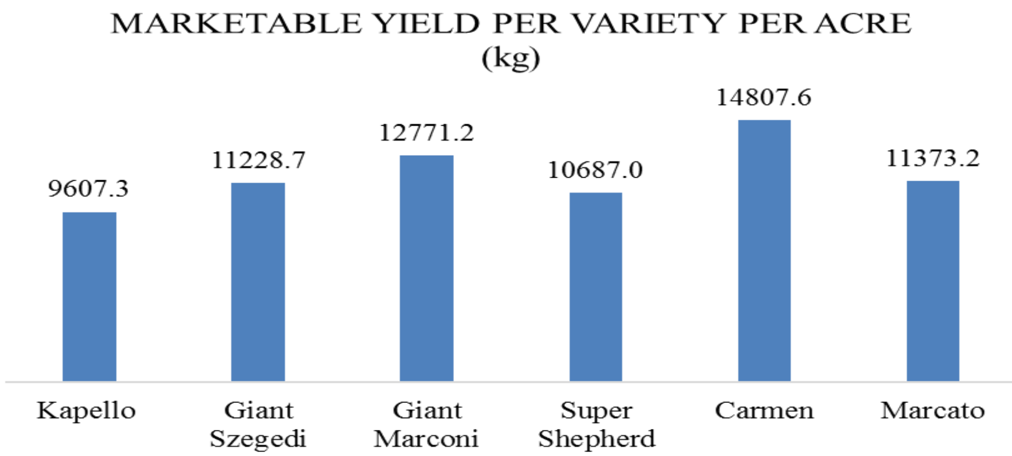

Fig 7. The bar graph shows the marketable yield per variety obtained in the current demonstration as if grown on one acre of land.

Note: The difference in the numbers of marketable yield in Fig 6, and Fig 7, are because, in Fig 6 the marketable yield was calculated as harvested from plants of all 4 replication and in fig 7, the calculation was done by taking the average yield per plant and multiplied that with the expected number of plants per acre.

An economic analysis (Table 2) was done in order to determine the gross retail value per acre this crop can generate. The price used for this economic analysis was $7.50/kg although this can vary greatly depending on the supply and demand during the season. The prices shown in Table 3 would be a gross value if directly sold to the consumer (at farmers market, etcetera). The results of this trial suggest that growing field varieties in high tunnel production can be significantly profitable.

Table 2. Economic Analysis of high tunnel Red pepper and expected earning in Canadian dollars

Variety	Mtable Yield Per Plant (kg)	Plant per acre	Mtable Yield Per acre (kg)	Tonnes per acre	Retail price per kg	Dollar amount per acre
Kapello	2.0	4901	9607.3	9.6	$7.50	$72054.90
Giant Szegedi	2.3	4901	11228.7	11.2	$7.50	$84215.50
Giant Marconi	2.6	4901	12771.2	12.8	$7.50	$95783.90
Super Shepherd	2.2	4901	10687.0	10.7	$7.50	$80152.40
Carmen	3.0	4901	14807.6	14.8	$7.50	$111056.70
Marcato	2.3	4901	11373.2	11.4	$7.50	$85299.00

Conclusions

This demonstration was conducted in order to determine the potential to produce sweet La Rouge type red pepper commercially in Saskatchewan. Another reason was to provide opportunities, for Saskatchewan producers and buyers, to see the crops being grown in high tunnel. Lastly, to compare cultivars for suitability in Saskatchewan conditions using a irrigated high tunnel production system. This demonstration suggests that almost all the varieties performed well in terms of total yield. However, the size and weight of the peppers of all varieties differ significantly (Photo Gallery). Some varieties produced large number of red pepper per plant but variable size and weight of red peppers influenced the total yield (Fig 6). For example the average number of total and marketable peppers per plant was highest in variety Carmen and lowest in Giant Marconi but the variety, Giant Marconi produced higher yield in terms of weight.

The results of economic analysis were encouraging. Though there was not much difference in term of earning the dollar amount per acre but, Carmen has the highest gross return.
The shape of the different varieties was also taken into account. Though all varieties slightly differ in shape from each other , Giant Szegedi was significantly different of the others.

Photo Gallery of the varieties of sweet La rouge Type Red peppers tried.

Acknowledgements

- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining project, providing agronomic guidance and completing the economic analysis
- ICDC staff for assisting in set up and field work for this project
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

TECHNOLOGY TRANSFER

This section lists the Ministry of Agriculture and ICDC Agrologist Extension events for 2017.

Field Days

CSIDC Irrigation Field Day and Tradeshow, July 13

- 4R Fertility Management- Gary Kruger
- High Tunnel Projects- Joel Peru
- ICDC Research Program- Garry Hnatowhich
- Horticulture Program- Walli Soomro
- Tour Leaders- Jeff Ewen, Joel Peru

Dry Bean Plot Tour- Riverhurst, August 3

- Wide Row vs. Narrow Row Production – Jeff Ewen, Ministry of Agriculture

ICDC Research and Demonstration Field Day Tour, August 15

- 2017 ICDC horticulture program- Joel Peru
- 4R and Intercropping Demonstration- Gary Kruger
- ICDC Research Program- Garry Hnatowhich
- Field 12 Tile Drainage- Kelly Farden

CSIDC – evening tour, August 15

- 2017 ICDC horticulture program- Joel Peru
- ICDC Research Program- Garry Hnatowhich

ICDC/ Ministry of Agriculture– Saskatchewan Soybean Field Day and Roadshow, August 17- 50 in attendance

Workshops

ICDC/ Ministry of Agriculture- Sub-surface Drainage and Water Management, March 21 and 22.

Saskatchewan soils overview- Kelly Farden

- Chair- Kelly Farden, Gary Kruger

ABBREVIATIONS

AAFC	Agriculture and Agri-Food Canada
ac	acre or acres
ACC	Alberta Corn Committee
ADF	Agriculture Development Fund
ADOPT	Agriculture Demonstration of Practices and Technologies (Growing Forward 2)
AIMM	Alberta Irrigation Management Model
bu	bushel or bushels
CCC	Canola Council of Canada
CDC	Crop Development Centre, University of Saskatchewan
cm	centimetre
CSIDC	Canada-Saskatchewan Irrigation Diversification Centre
DM	dry matter
FHB	Fusarium head blight
GPS	Global Positioning System
ICDC	Irrigation Crop Diversification Corporation
L	litre
lb	pound or pounds
m	metre
MAFRI	Manitoba Agriculture, Food and Rural Initiatives
mm	millimetre
SPARC	Semiarid Prairie Agricultural Research Centre
SVPG	Saskatchewan Variety Performance Group
t	tonne
TKW	thousand kernel weight
WGRF	Western Grains Research Foundation

www.irrigationsaskatchewan.com

The Irrigation Saskatchewan website at www.irrigationsaskatchewan.com is designed so that site visitors have access to irrigation topics related to ICDC, SIPA and the Ministry of Agriculture. The site directs visitors to an ICDC subsection, a SIPA subsection, and a link to the irrigation section of the Saskatchewan Ministry of Agriculture's website.

The ICDC section includes ICDC reports, publications, and events, as well as links to information relevant to irrigation crops.

ICDC Publications

ICDC Research and Demonstration Program Report Detailed descriptions of the projects undertaken each year.

Irrigation Economics and Agronomics An annual ICDC budget workbook designed to assist irrigators with their crop selection process. Irrigators can compare their on-farm costs and productivity relative to current industry prices, costs and yields.

Crop Varieties for Irrigation A compilation of yield comparison data from irrigated yield trials managed by CSIDC. It is useful as a guide for selecting crop varieties suitable for irrigation.

Irrigation Scheduling Manual Provides technical information required by an irrigator to effectively schedule irrigation operations for crops grown under irrigation in Saskatchewan.

Irrigated Alfalfa Production in Saskatchewan Provides technical information regarding the production practices and recommendations for irrigated alfalfa forage production.

Management of Irrigated Dry Beans This factsheet provides a comprehensive overview of agronomic management requirements for producing dry beans under irrigation.

Corn Production This factsheet provides information on corn heat units, variety selection and an overview of agronomic management requirements for producing grain, silage and grazing corn under irrigation in Saskatchewan.

Copies of these and other ICDC publications are available from the Ministry of Agriculture's Irrigation Branch office in Outlook, SK, or on the ICDC website at www.irrigationsaskatchewan.