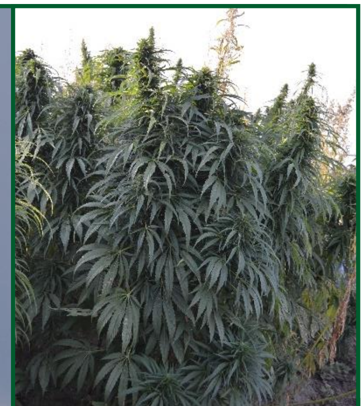
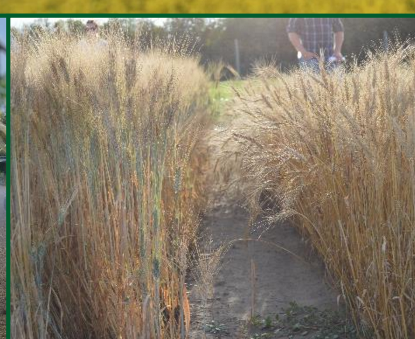
2015

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 2015

ICDC Staff

Garry Hnatowich, PAg
Research Agronomist
306-867-5405
garry.icdc@sasktel.net

Desseri Ackerman
Administrator
306-831-5282
admin.icdc@sasktel.net

Saskatchewan Ministry of Agriculture Crops and Irrigation Branch Staff

Kelly Farden, PAg
Manager, Agronomy Services
Crops and Irrigation, Ministry of Agriculture
306-867-5507
kelly.farden@gov.sk.ca

Jeff Ewen, AAg
Irrigation Agrologist
Crops and Irrigation, Ministry of Agriculture
306-867-5512
jeff.ewen@gov.sk.ca

Gary Kruger, PAg
Irrigation Agrologist
Crops and Irrigation, Ministry of Agriculture
306-867-5524
gary.kruger@gov.sk.ca

Joel Peru, AAg
Irrigation Agrologist
Crops and Irrigation, Ministry of Agriculture
306-867-5528
joel.peru@gov.sk.ca

Sarah Sommerfeld, PAg
Regional Forage Specialist
Crops and Irrigation, Ministry of Agriculture
306-867-5559
sarah.sommerfeld@gov.sk.ca

ICDC Research and Demonstration Program Report 2015

© 2015 Irrigation Crop Diversification Corporation

ISSN: 1926-7789

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:

Irrigation Crop Diversification Corporation
Box 609
Outlook, SK S0L 2L0

Phone: 306-867-5500
Email: admin.icdc@sasktel.net
www.irrigationsaskatchewan.com

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.

CONTACT

Irrigation Crop Diversification Corporation

410 Saskatchewan Ave. W.
P.O. Box 609
OUTLOOK, SK S0L 2N0
Bus: 306-867-5500 Fax: 306-867-9868
email: admin.icidc@irrigationsaskatchewan.com
Web: www.irrigationsaskatchewan.com

BOARD OF DIRECTORS

Director	Position	Irrigation District	Development Area Represented	Term Expiry (current term)
Jay Anderson	Chairman	SSRID	LDDA	2017 (2nd)
Greg Oldhaver	Alt. Vice Chairman	Miry Creek	SWDA	2017 (2nd)
Ryan Miner	Director	Riverhurst	SEDA	2015 (1st)
David Bagshaw	Director	Luck Lake	LDDA	2016 (2nd)
Paul Heglund	Director	Consul-Nashlyn	SWDA	2017 (1st)
Vacant	Director		NDA	
Colin Ahrens	Director	Individual Irrigators	Non-District	2015 (2nd)
Joel Vanderschaaf	Director	SSRID	SIPA representative	Appointed
Rob Oldhaver	Director	Miry Creek	SIPA representative	Appointed
Kelly Farden	Director	N/A	SA representative	Appointed
Penny Mcall	Director	N/A	SA representative	Appointed

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.

TABLE OF CONTENTS

ONGOING TRIALS

Crop Varieties and Agronomy for Irrigation CSIDC Based Trials

Principal Investigator

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

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Science and Technology Branch, Agriculture and Agri-Food Canada (AAFC)

Objectives

The objectives of this study were to:

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

(2) Update ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

The CSIDC locale (on-station and Knapik fields) and 6 acres of rented land (R. Pederson) were used as the test locations in 2015 for conducting variety evaluation trials under intensive irrigated conditions. The sites selected included a range of soil types. Crop and variety selection for the project was made in consultation with plant breeders from AAFC, universities, the private sector, and associated producer groups.

Trials were conducted for registered varieties of cereals (spring wheat, barley, oat, corn, winter wheat, fall hybrid rye), oilseeds (canola, flax), pulses (pea, dry bean, faba bean, soybean, chickpea), and perennial forage grass (hybrid bromegrass). Further, pre-registration co-op trials were conducted for selected crops to assess the adaptability of new lines to irrigated conditions. This project was conducted in collaboration with the federal government, academic institutions, and industry partners, including AAFC research centres, the Crop Development Centre, University of Saskatchewan, among others (see Table 4). Between the CSIDC land base and the rented land location, in excess of 5,000 individual plots were established and maintained throughout the growing season.

Data collection included days to flower and maturity, plant height, lodge rating, seed yield, protein (cereals), test weight, seed weight, and any observed agronomic parameters deemed of benefit to the studies. All field operations, including land preparation, seeding, herbicide, fungicide, and insecticide application, irrigation, data collection, and harvest were conducted by ICDC and CSIDC staff.

The trials consisted of small plots (1.2 m x 4 m; 1.2 m x 6 m; 1.5 m x 4 m; 1.5 m x 6 m), which were appropriately designed (RCBD, Lattice, etc.) with multiple replications (three or four reps) so that statistical analyses could be performed to determine differences among varieties and to determine the variability of the data at each site.

ICDC staff also assisted in the establishment and maintenance of numerous CSIDC and CDC projects in 2015.

Results

Climatic conditions in the 2015 growing season (May–September) with respect to precipitation and accumulated heat units and Cumulative Corn Heat Units are shown in Tables 1 to 3. Total seasonal precipitation, seasonal cumulative growing degree days and corn heat units ended near historical values.

The 2015 variety trials were established within recommended seeding date guidelines for the selected crops (Table 4).

Table 1. 2015 Growing Season Precipitation vs Long-Term Average

	mm (inches)		
Month	**2015**	**Long-Term**	**% of Long-Term**
May	3.8 (0.1)	45.0 (1.8)	8
June	39.2 (1.5)	63.0 (2.5)	62
July	125.0 (4.9)	55.0 (2.2)	227
August	63.2 (2.5)	42.0 (1.7)	150
September	44.0 (1.7)	36.0 (1.4)	122
Total	275.2 (10.8)	241.0 (9.6)	114

Table 2. 2015 Cumulative Growing Degree Days (Base 0° C) vs Long-Term Average

	Year		
Month	**2015**	**Long-Term**	**% of Long-Term**
May	212	226	94
June	730	710	103
July	1323	1291	102
August	1866	1844	101
September	2242	2058	109

Table 3. 2015 Cumulative Corn Heat Units vs Long-Term Average

	Year		
Month	**2015**	**Long-Term**	**% of Long-Term**
May	197	211	93
June	779	742	105
July	1474	1409	105
August	2092	2024	103
September	2444	2338	105

Early Season Trial Establishment

In general, early season establishment was good, although cold soils delayed seeding emergence. Plant establishment of all crops was generally excellent, particularly later seeded crops. The ICDC canola variety trials at the Pederson location were adversely influenced by volunteer RR canola and deemed unusable for meaningful analysis.

Midseason to Harvest

In general, for all crops, vegetative growth development was excellent. Cereals indicated very little foliar leaf disease, some *Fusarium* head blight was apparent in some wheat and durum varieties but far less than in recent years. Oilseed crops were relatively disease free. Further, no insect pests appeared in any magnitude to be of concern.

At the time of printing, quality analysis and data interpretation was still underway on harvested trials. The data from these trials will be analyzed and only data that meet minimum statistical criteria for variability will be used to update the CSIDC variety database. The *Crop Varieties for Irrigation* guide will be updated with the addition of the new data collected and printed in time for distribution at the 2016 Crop Production Show. It will be mailed to irrigators early in 2016.

A list of projects based at CSIDC, or affiliated off-station locations, conducted in 2015 is outlined in Table 4. This work provides current and comprehensive variety information to assist irrigators in selecting crop varieties suited to intensive irrigated production conditions.

Table 4. 2015 Variety Trial Locations, Soil Type, Trial Title, and Collaborators

Site	**Legal Location**	**Soil Type**	
CSIDC Main	SW15-29-08 W3	Bradwell – very fine sandy loam	
CSIDC Off Station (Knapik)	NW12-29-08 W3	Asquith – sandy loam	
R. Pederson	NE20-28-07-W3	Elstow loam	
Cereal Variety Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
1. ICDC Irrigated Wheat Trials	20	G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station
2. SVPG CWRS (Hex1) Wheat Regional	37	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG G. Hnatowich, ICDC	CSIDC Main
3. SVPG High Yield (Hex2) Wheat Regional	20	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG G. Hnatowich, ICDC	CSIDC Main
4. SVPG CWAD Wheat Regional Trials	16	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station
5. Soft White Spring Wheat Coop	17	Dr. H. Randhawa, AAFC G. Hnatowich, ICDC	CSIDC Main

Cereal Variety Trials *(continued)*	Varieties/Entries Evaluated	Collaborators	Location
6. SVPG 2-Row Barley Regional Trial	14	Dr. A. Beattie, CDC M. Japp, SMA S. Piche, SVPG G. Hnatowich, ICDC	CSIDC Main
7. SVPG Oat Regional	11	Dr. A. Beattie, CDC M. Japp, SMA S. Piche, SVPG G. Hnatowich, ICDC	CSIDC Off Station
8. SK Winter Wheat Regional Trial – Irrigated	17	Dr. R. Graf, AAFC G. Hnatowich, ICDC	CSIDC Main
9. SK Winter Wheat Regional Trial – Dry Land	17	Dr. R. Graf, AAFC G. Hnatowich, ICDC	CSIDC Main
10. ICDC Hybrid Silage Corn Performance Trials	10 irrigated 10 dry land	S. Sommerfeld, SMA G. Hnatowich, ICDC	CSIDC Main
11. ICDC Hybrid Grain Corn Performance Trials	12	J. Peru, SMA G. Hnatowich, ICDC	CSIDC Main
12. Alberta Corn Committee Silage Corn Performance Trial	15	Dr. B. Bares, AAFC G. Hnatowich, ICDC	CSIDC Main
13. Alberta Corn Committee Grain Corn Performance Trial	21	Dr. B. Bares, AAFC G. Hnatowich, ICDC	CSIDC Main
Oilseed Variety Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
14. ICDC Irrigated Canola Evaluation Trials	17	G. Hnatowich, ICDC	CSIDC Main Pederson
15. Canola Coop (XNL1)	25	R. Gadoua, CCC G. Hnatowich, ICDC	CSIDC Main
16. Canola Coop (XNL2)	25	R. Gadoua, CCC G. Hnatowich, ICDC	CSIDC Main
17. Canola Performance Trial	24	Dr. R. Gjuric, Halpotech G. Hnatowich, ICDC	CSIDC Main
18. Flax Regional Trials	13	G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station
Pulse Variety Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
19. Dry Bean Narrow Row Regional (Saskatchewan) Trials	18	Dr. K. Bett, CDC G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station
20. Short Season Wide Row Irrigated Coop	30	Dr. P. Balasubramanian, AAFC G. Hnatowich, ICDC	CSIDC Main
21. Irrigated Bean Variety Trials – Wide Row	9	Dr. P. Balasubramanian, AAFC G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station
22. Irrigated Bean Variety Trials – Narrow Row	12	Dr. P. Balasubramanian, AAFC G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station
23. Irrigated Prairie Regional Variety Trials	32	Dr. T. Warkentin, CDC G. Hnatowich, ICDC	CSIDC Main Pederson
24. Rudy Agro Marrowfat Pea Evaluation	4	Rudy Agro G. Weiterman G. Hnatowich, ICDC	CSIDC Main Pederson

25. MCVET Irrigated Soybean Performance Trial	36	Manitoba Pulse & Soybean Growers G. Hnatowich, ICDC	CSIDC Main
26. MCVET Dry Land Soybean Performance Trial	36	Manitoba Pulse & Soybean Growers G. Hnatowich, ICDC	CSIDC Main
27. CDC Faba Bean and Dry Bean Advanced Line Trials	1650 plots	Drs. B. Vandenberg & K. Bett, CDC G. Hnatowich, ICDC	CSIDC Main CSIDC Off Station Pederson
Perennial Forage Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
28. Hybrid Bromegrass	4	Dr. B. Coulman, U of S T. Nelson, AAFC G. Hnatowich, ICDC	CSIDC Main
Agronomic Trials	**Treatments**	**Collaborators**	**Location**
29. Chickpea/Flax Intercropping	10 mono or intercrop strategies	G. Hnatowich, ICDC, ADOPT	CSIDC Main
30. Lentil/Flax Intercropping	4 mono or intercrop strategies	G. Hnatowich, ICDC	CSIDC Main
31. Soybean Inoculation Study	16 treatments	G. Hnatowich, ICDC, ADF, WGRF	Pederson
32. Soybean Date of Seeding with or without seed treatment	6 planting dates No/yes seed treat	G. Hnatowich, ICDC, ADF, WGRF	CSIDC Main
33. Soybean Plant Population and Row Spacing Study	5 populations 10” vs 20” spacing	G. Hnatowich, ICDC, ADF, WGRF	CSIDC Main
34. Soybean Nitrogen Fertilizer/Inoculant Trial	16	G. Hnatowich, ICDC, SPG, Agri-ARM	Pederson
35. Soybean Phosphorus Fertility Trial	10	G. Hnatowich, ICDC, SPG, Agri-ARM	Pederson
36. Faba bean Inoculation Trial	16	G. Hnatowich, ICDC, SPG, Agri-ARM	Pederson
37. Faba bean Seeding Rate Trial	5	G. Hnatowich, ICDC, U of S, SPG, Agri-ARM	CSIDC Main
38. Faba bean Fungicide Trial	9	G. Hnatowich, ICDC, U of S, SPG, Agri-ARM	CSIDC Main
39. Plant Growth Regulators on CWRS Wheat – Normal vs Intensive Irrigation	18	J. Ewen, SMA G. Hnatowich, ICDC	CSIDC Main
40. Plant Growth Regulators on CWAD Wheat – Normal vs Intensive Irrigation	18	J. Ewen, SMA G. Hnatowich, ICDC	CSIDC Main
41. Demonstration of Potential Crops (hemp, quinoa, safflower) under both Irrigation and Dry Land Conditions	11	J. Peru, SMA G. Hnatowich, ICDC	CSIDC Main
42. Copper and Zinc Fertilization of Alfalfa	9	G. Kruger, SMA D. Tomasiewicz, AAFC G. Hnatowich, ICDC	CSIDC Off Station
43. Demonstration of Cantaloupe and Watermelon Production	10	J. Peru, SMA G. Hnatowich, ICDC	CSIDC Main

44. Demonstration of Ethnic Vegetable Production	6	J. Peru, SMA G. Hnatowich, ICDC	CSIDC Main
45. Fruit Nursery Fertilization (Saskatoon, Haskap, sour cherry)	18	J. Peru & F. Scharf, SMA G. Hnatowich, ICDC	CSIDC Main
46. Perennial Forage Grass and Legume Species Demonstration	20	S. Sommerfeld, SMA G. Hnatowich, ICDC	CSIDC Off Station
47. Forage Salinity Tolerance Demonstration	10	S. Sommerfeld, SMA G. Hnatowich, ICDC	CSIDC Main
48. AC Saltlander Green Wheatgrass Saline Tolerance Study – Slight vs Moderate Salinity	6	Alan Awassa, AAFC G. Hnatowich, ICDC	CSIDC Main
49. Burger & Fries Farm		S. Sommerfeld, SMA G. Hnatowich, ICDC	CSIDC Main
50. 2015 SMA Crop Diagnostic School		SMA G. Hnatowich, ICDC	CSIDC Main

Abbreviations

AAFC = Agriculture and Agri-Food Canada

ACC = Alberta Corn Committee

ADF = Agriculture Development Fund

ADOPT = Agriculture Demonstration of Practices and Technologies

CCC = Canola Council of Canada

CDC = Crop Development Centre, University of Saskatchewan

CSIDC = Canada-Saskatchewan Irrigation Diversification Centre

ICDC = Irrigation Crop Diversification Corporation

SMA = Saskatchewan Ministry of Agriculture

SPG = Saskatchewan Pulse Growers

SVPG = Saskatchewan Variety Performance Group

MAFRI = Manitoba Agriculture, Food and Rural Initiatives

U of S = University of Saskatchewan

WGRF = Western Grains Research Foundation

Irrigated Canola Performance Trial

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

Research Plan

The irrigated canola performance trial was conducted at CSIDC (Field #8). Canola varieties were tested for their agronomic performance under irrigation. Two Clearfield, four Liberty and fourteen Roundup tolerant canola hybrids where evaluated in 2015. Seeding date was May 16. Plot size was 1.5 m x 6.0 m, varieties were blocked into their respective herbicide tolerance grouping for the 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 40 kg N/ha as 46-0-0, and phosphorus at 25 kg P_2O_5/ha as 12-51-0, both 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 16. All plots received a tank-mix application of Headline EC (pyraclostrobin) and Lance (boscalid) fungicide at the early flowering stage for disease control. Varieties were swathed at the appropriate time of maturity and all plots were combined September 10. Total in-season irrigation was 60.5 mm.

Results

Results are outlined in Table 1. The results from this trial will be used to update the irrigation variety database at ICDC and provide information to irrigators on the best canola varieties suited to irrigation production practices. If experimental lines are registered, results of the 2015 Irrigated Performance Trials will be used to update ICDCs annual publication, *Crop Varieties for Irrigation.*

Table 1. Yield and Agronomic Data for the 2015 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)	Lodging (1=erect; 5=flat)
Clearfield-tolerant									
5525 CL	HYB	4378	43.1	62.7	3.6	124	45	97	3.0
13DL30217	HYB	3798	42.9	63.8	3.5	124	45	97	3.3
Liberty-tolerant									
5440	HYB	4621	44.1	63.7	3.7	116	46	95	2.0
L252	HYB	5175	46.5	64.8	3.6	106	46	96	2.5
L261	HYB	4751	43.0	64.4	3.7	123	47	97	2.5
L140P	HYB	4713	43.0	63.1	3.4	117	45	96	3.3
Roundup-tolerant									
1990	HYB	4742	45.2	62.2	4.0	112	44	95	3.5
6074 RR	HYB	4688	43.2	65.0	3.4	126	47	100	3.0
6056 RR	HYB	4404	44.9	64.0	3.4	117	46	100	2.8
14DL30420 RR	HYB	4351	44.6	62.8	3.6	116	46	99	2.8
SX1501	HYB	3822	45.6	63.0	3.8	123	46	97	3.3
SY4157	HYB	4602	45.5	63.0	3.7	124	46	98	2.8
V12-1	HYB	4047	43.7	62.9	3.8	119	46	99	3.0
V12-3	HYB	4332	44.8	62.5	3.9	118	47	97	3.0
14H1176	HYB	4532	45.3	64.2	3.5	132	48	100	2.8
PV 2015A	HYB	4400	43.2	63.6	4.0	125	46	98	2.5
PV 2015B	HYB	4012	42.8	62.1	3.7	118	43	98	2.5
14DL30209	HYB	4031	43.7	61.8	3.6	118	45	98	3.3
CS2000	HYB	4470	43.3	63.1	3.7	131	47	98	3.0
CS2100	HYB	4439	44.6	64.6	3.9	117	45	98	2.8
LSD (0.05)		486	1.3	0.8	0.2	12.6	1.0	2.0	NS
CV (%)		7.8	2.1	0.9	4.6	7.4	1.6	1.5	20.7

HYB = Hybrid NS = Not Significant

Irrigated Canola Variety Trial

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 ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

Every year, ICDC conducts the Irrigated Canola Variety Trial. Selection of canola varieties is based upon results obtained in 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 ICDCs irrigation variety database at CSIDC and provide recommendations to irrigators on the best canola varieties suited to irrigation conditions and will be used to update ICDCs annual publication, *Crop Varieties for Irrigation.*

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 #8)
Pederson Off-station: Elstow loam (Pederson)

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 on May 16 and Pederson Off-station on May 28. Plot size was 1.5 m x 4.0 m; all plots were seeded on 25 cm row spacing. All seed was treated by the seed suppliers for seed-borne disease and early season flea beetle control. Supplemental fertilizer was applied at an application rate of 100 kg N/ha at CSIDC and 120 kg N/ha at Pederson as 46-0-0, both trials received supplemental phosphorus at 25 kg P_2O_5/ha (CSIDC) or 30 kg P_2O_5/ha (Pederson), as 12-51-0, all fertilizer was granular Edge (ethalfluralin) supplemented by some hand weeding. As well, both sites received a post-emergent tank-mix application of Muster (75% ethametsulfuron-methyl) + Poast UltraLontrel (sethoxydim). Sites received a tank-mix application of Headline EC (pyraclostrobin) and Lance (boscalid) fungicide at the early flowering stage for disease control.

CSIDC plots were swathed August 27 and, after proper dry down, harvested September 15. Total in-season irrigation was 69.5 mm at CSIDC.

Results

Results obtained at the CSIDC location are shown in Table 1. The check, canola variety 5440, was the highest yielding hybrid and statistically significantly different from varieties yielding less than 5200 kg/ha. Median yield of varieties was 5364 kg/ha (95.7 bu/ac).

Percent oil content ranged from 42.4 (45H76) to 46.4% (L252). Median oil content of all varieties was 44.2%. Median test weight was 62.0 kg/hl and thousand seed weight 4.0 gm. Hybrid Canterra 1990 was the first variety to flower (10% flower) and was statistically earlier than all other varieties, except 45H33. L261 was the last hybrid to flower. Median days to 10% flower was 46 days. Days to maturity were greatest for variety 46M343 and lowest for 45H29. Median days to mature for canola hybrids was 96 days. Plant height was greatest for variety L261 and shortest for variety L252. Variety 45S52 exhibited the greatest degree of lodging, median lodge rating was 2.0.

The Pederson location was established only for yield and seed quality parameters, as distance from the main station prevented capturing other agronomic characteristics. However, although the trial was seeded into cereal stubble, volunteer canola at this trial was extreme, and the trial was abandoned.

Table 1. Yield and Agronomic Data for the 2015 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)	**Lodging** (1=erect; 5=flat)
L261	5779	43.8	63.1	4.0	148	48	96	1.3
L140P	5838	43.6	61.8	3.6	137	46	96	2.3
L252	5623	46.4	63.4	3.7	129	47	97	2.0
Canterra 1970	4909	43.3	60.1	4.0	138	46	97	2.0
Canterra 1990	5273	45.7	61.3	4.2	135	43	96	2.5
6074 RR	5816	43.7	63.5	4.0	135	46	97	2.0
CS 2000	5337	44.3	61.5	3.8	146	47	96	2.3
CS 2100	5105	43.5	63.4	4.3	140	46	96	2.3
CS 2200CL	5057	44.4	62.7	3.8	135	47	97	2.0
5440*	**5910**	**43.9**	**62.4**	**3.7**	**144**	**47**	**97**	**1.3**
45H29	4937	44.6	61.0	3.7	146	44	95	2.5
45H33	4989	44.4	60.1	3.8	130	44	96	2.0
45H76	4741	42.4	61.5	4.1	130	46	96	2.5
45S56	5514	45.1	62.6	4.1	147	45	96	2.0
45S52	4462	44.6	59.9	4.2	138	46	96	2.8
45H31	5244	45.2	61.6	4.0	142	45	96	1.8
46M34	5463	44.1	63.5	4.1	140	45	97	1.8
LSD (0.05)	776	0.9	0.6	0.2	10.3	0.9	1.1	0.7
CV (%)	10.3	1.4	0.7	3.7	5.2	1.3	0.8	24.5

* Check Variety

Western Canada Irrigated Canola Co-operative Trials
XNL1 and XNL2

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 crop varieties for intensive irrigated production; and
(2) Update ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

The canola co-operative trials were conducted on an irrigated site at CSIDC (Field #8). Twenty-five canola hybrids were evaluated in each of the XNL1 and XNL2 trials and check varieties 45H29 and 5440 where included in both trials. Trials were seeded on May 16. 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 applied at 100 kg N/ha as 46-0-0 and phosphorus at 25 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 (ethametsulfuron-methyl) and Poast Ultra (sethoxydim), supplemented with periodic hand weeding. Each trial received a tank-mix application of Headline EC (pyraclostrobin) and Lance (boscalid) fungicide at the early flowering stage for disease control. Neither disease nor insect incidence of any degree occurred in 2015. Both trials where swathed on August 25 and combined on September 14. Total in-season irrigation was 69.5 mm.

Seeding establishment was erratic in both these trials due to improper seed distribution by the seeder used in both trials. It was not observed during the seeding operation, but after emergence it became apparent the electric seed distributor on the cone had operated intermittently, resulting in uneven seed distribution between and within seed rows. This likely accounts for the high coefficient of variation within each trail for yield. Seed yield results from these trials are deemed unreliable and will not be included in the ICDC data base.

Results

Results of agronomic measurements for each trial are outlined in Tables 1 and 2. The results from these trials are used to assist in the registration decision process for proposed new canola varieties. These trials will be repeated in 2016 with new entries. Some results from these trials are used to update the irrigation variety database at ICDC and provide recommendations to irrigators on the best canola varieties suited to irrigation conditions. If experimental lines are registered, results of the 2015 Western Canada Irrigated Canola Co-operative Trials will be used to update ICDCs annual publication, *Crop Varieties for Irrigation.*

Table 1. Yield and Agronomic Data for the Irrigated Canola Cooperative Trial XNL1, 2015

Entry	**Yield** (kg/ha)	**Oil** (%)	**Test Weight** (kg/hl)	**TKW** (gm/1000 seed)	**Height** (cm)	**First Flower** (days)	**Maturity** (days)	**Lodging** (1=erect; 5=flat)
5440*	***5359***	***43.7***	***63.0***	***3.8***	***150***	***46***	***97***	***2.3***
45H29	4845	43.9	61.6	3.5	142	45	97	3.7
4CN0118	5727	43.1	61.1	4.1	134	46	98	2.3
5CN0125	5602	45.2	63.6	4.0	134	46	96	2.3
5CN0127	5579	45.8	65.9	3.5	134	48	99	2.7
5CN0130	5888	43.1	62.8	4.0	127	46	97	3.0
5CN0131	4989	45.2	62.5	3.7	137	46	96	3.3
14H1187	4488	45.6	61.4	4.2	143	47	97	3.3
14DL30213	5407	45.0	59.6	3.7	126	45	97	2.7
G32176	4263	43.1	63.8	4.5	138	46	97	4.3
G49720	5332	43.8	61.7	4.6	121	45	95	1.7
G49732	4747	46.7	63.4	4.2	137	46	96	2.7
G49733	5270	46.1	63.7	4.8	125	45	97	3.0
G49735	4791	46.3	63.4	4.3	127	46	97	2.7
G49738	4486	44.8	63.6	4.6	125	46	97	2.3
G49740	4930	44.1	64.1	4.4	129	45	96	2.7
G49741	5530	45.3	62.8	4.6	131	45	96	2.3
14SS05541	4077	44.0	63.3	3.5	130	48	99	3.0
13N0911R	5930	44.5	63.7	4.1	129	45	96	2.7
13N0913R	5161	44.4	61.2	4.3	140	45	96	3.0
13N0924R	5751	46.2	63.4	4.2	131	46	97	2.3
13N0925R	5163	44.9	63.9	4.3	138	46	96	2.7
13N1296R	5247	45.1	57.8	4.2	141	45	96	2.7
14GG1204R	5892	43.4	61.4	4.1	144	46	97	2.3
14GG1205R	4800	43.0	59.4	4.2	142	45	96	2.0
LSD (0.05)	NS	1.4	1.3	0.3	NS	0.7	1.5	NS
CV (%)	16.3	1.9	1.3	4.5	7.5	1.0	1.0	30.2

* Check Variety   NS = Not Significant

Table 2. Yield and Agronomic Data for the Irrigated Canola Cooperative Trial XNL2, 2015

Entry	Yield (kg/ha)	Oil (%)	Test Weight (kg/hl)	TKW (gm/1000 seed)	Height (cm)	First Flower (days)	Maturity (days)	Lodging (1=erect; 5=flat)
5440*	***4361***	***44.2***	***63.9***	***3.6***	***149***	***46***	***97***	***1.7***
45H29	4518	45.1	62.1	3.7	135	45	97	2.3
4CN0024	5317	44.8	65.2	3.7	123	47	97	1.3
4CN0044	5281	45.8	64.9	3.6	125	47	96	1.3
4CN0059	5988	45.2	65.1	4.0	118	47	97	2.3
4CN0064	6149	47.1	64.1	3.7	123	46	97	1.0
4CN0065	4774	44.7	63.3	3.6	143	47	97	1.7
4CN0102	4897	42.8	64.6	4.0	141	49	99	2.0
5CN0136	4244	43.2	63.9	3.8	137	48	98	1.3
5CN0214	6209	43.7	64.1	4.2	127	48	97	2.0
5CN0216	5339	45.9	64.8	3.5	125	48	97	1.7
14H1176	5270	45.0	64.0	3.8	131	48	99	3.3
14DL30122	5741	43.2	64.1	4.3	128	46	98	2.3
13DL30323	5678	44.5	64.2	3.9	124	47	97	2.3
14DL30209	3955	42.8	61.7	3.8	130	46	97	2.7
14DL30404	4496	43.3	62.8	3.4	123	47	97	2.3
14DL30419	4783	45.2	62.7	3.7	133	47	98	2.7
14DL30420	4352	44.0	62.4	3.9	126	46	97	1.7
14DL30513	5844	43.6	62.7	3.6	132	47	98	3.3
13N0471I	4122	43.6	62.3	3.7	129	47	98	3.3
13N0486I	4775	42.8	63.8	3.6	140	48	98	2.7
13N1416R	5722	45.7	63.3	3.9	133	47	97	2.0
13N1418R	5898	45.0	63.1	4.1	130	46	96	2.0
13N1424R	5054	45.0	62.0	3.9	123	47	96	2.3
13H3615	4672	44.4	61.5	3.6	108	47	97	2.7
LSD (0.05)	NS	1.0	0.9	0.2	10.7	0.9	1.1	1.4
CV (%)	17.4	1.3	0.9	3.8	5.0	1.2	0.7	38.2

* Check Variety   NS = Not Significant

Irrigated Flax Variety Trial

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 ICDCs 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, nine registered and four experimental entries, were tested for their agronomic performance under irrigation. Both the CSIDC site and the CSIDC Off Station site were seeded on May 19. Plot size was 1.5 m x 4.0 m. Each trial received supplemental fertilizer applied at an application rate of 95 kg N/ha as 46-0-0 and 25 kg P_2O_5/ha as 12-51-0; all fertilizer was side-banded at the time of seeding. Weed control consisted of a spring pre-plant soil-incorporated application of granular Edge (ethalfluralin) and a post-emergence application of Poast Ultra (sethoxydim) + Buctril M (bromoxynil +MCPA ester) supplemented by some hand weeding. All sites received an application of Headline EC (pyraclostrobin) fungicide at the 40–50% bloom stage for Pasmo (septoria) control. Both sites also received a season-end desiccant application of Reglone (diquat) twice prior to combining. Combining occurred on October 13 at CSIDC and September 25 at CSIDC Off Station. Total in-season irrigation was 65 mm at CSIDC and 92.5 mm at the off-station site.

Results

Results obtained at the CSIDC location are shown in Table 1 and at the CSIDC Off Station location in Table 2. The NuLin VT50 variety was the highest yielding entry at CSIDC and Prairie Sapphire the highest at the CSIDC Off Station location. Individual site results will not be further discussed.

Combined site analysis is shown in Table 3. Yields produced at CSIDC were greater than at CSIDC Off Station. This is attributed in part to considerable wind damage at the CSIDC Off Station site just before harvest. Significant boll loss and seed shatter was observed at this site. Statistically, the only significant yield differences compared to check variety CDC Bethune occurred with CDC Plava and experimental entries FP2316 and FP2457, all of which were significantly lower yielding. No varieties had test weights significantly different from the check, except NuLin VT 50, which was statistically higher. Seed weights differed significantly within varieties. WESTLIN 72 took longest to mature, Prairie Sapphire and experimental entry FP2454 were the earliest to mature. The check variety, CDC Bethune, was the tallest variety, CDC Plava and experimental FP2454 were the shortest; however, CDC Plava exhibited the highest degree of lodging.

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. The results will be used to update ICDCs annual publication, *Crop Varieties for Irrigation*, and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2016.*

Table 1. Yield and Agronomic Data for the Saskatchewan Variety Performance Group Irrigated Flax Regional Trial—CSIDC

Variety	**Yield** (kg/ha)	**Test Weight** (kg/hl)	**Seed Weight** (mg)	**Maturity** (days)	**Height** (cm)	**Lodging** (1=erect; 9=flat)
CDC Bethune (check)	***2738***	***62.9***	***6.4***	***105***	***75***	***1.3***
CDC Glas	2671	62.1	5.5	106	72	3.3
CDC Neela	2547	61.6	6.3	106	74	3.3
CDC Plava	2544	63.5	6.1	103	63	3.7
AAC Bravo	2768	63.1	6.9	108	70	2.0
Prairie Sapphire	2976	63.7	6.4	101	71	1.7
NuLin VT50	3346	65.6	5.6	109	60	1.7
WESTLIN 71	2892	63.9	6.1	107	68	1.3
WESTLIN 72	3247	65.2	6.0	109	72	1.0
FP2316	2038	61.8	6.6	109	73	4.0
FP2454	2998	63.2	6.1	101	64	1.0
FP2457	2131	62.9	6.1	105	73	2.0
FP2388	3121	64.3	6.1	102	65	1.3
LSD (0.05)	626	NS	0.3	2.2	NS	1.6
CV (%)	13.4	3.2	2.5	1.3	8.5	43.8

NS = Not Significant

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

Variety	**Yield** (kg/ha)	**Test Weight** (kg/hl)	**Seed Weight** (mg)	**Maturity** (days)	**Height** (cm)	**Lodging** (1=erect; 9=flat)
CDC Bethune (check)	***1997***	***64.6***	***6.1***	***105***	***69***	***1.0***
CDC Glas	1835	63.2	5.5	107	71	1.0
CDC Neela	1728	65.6	6.1	108	68	1.3
CDC Plava	1450	63.2	6.4	104	56	2.0
AAC Bravo	1370	65.2	6.9	109	70	1.3
Prairie Sapphire	2235	63.4	6.1	105	68	1.0
NuLin VT50	1909	65.9	5.5	112	62	1.0
WESTLIN 71	1611	63.6	5.8	110	66	1.3
WESTLIN 72	1982	65.8	5.9	113	68	1.0
FP2316	1556	65.2	6.0	109	70	1.7
FP2454	1607	62.7	6.2	105	57	1.0
FP2457	1427	62.1	6.0	108	68	1.0
FP2388	1772	64.2	6.2	106	61	1.3
LSD (0.05)	295	1.7	0.3	2.6	5.8	NS
CV (%)	10.1	1.5	3.2	1.4	5.3	50.7

NS = Not Significant

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

Treatment	**Yield** (kg/ha)	**Test Weight** (kg/hl)	**Seed Weight** (mg)	**Maturity** (days)	**Height** (cm)	**Lodging** (1=erect; 9=flat)
Trial Site						
CSIDC	2770	63.3	6.2	106	69	2.1
CSIDC – Off station	1729	64.2	6.1	108	66	1.2
LSD Yield (0.10) LSD (0.05)	462	NS	NS	1.0	NS	0.8
CV	12.9	2.5	2.9	1.4	7.2	47.2
Variety						
CDC Bethune (check)	***2367***	***63.8***	***6.3***	***105***	***72***	***1.2***
CDC Glas	2253	62.7	5.5	107	71	2.2
CDC Neela	2138	63.6	6.2	107	71	2.3
CDC Plava	1997	63.4	6.3	104	60	2.8
AAC Bravo	2069	64.1	6.9	109	70	1.7
Prairie Sapphire	2605	63.6	6.2	103	69	1.3
NuLin VT50	2628	65.8	5.5	110	61	1.3
WESTLIN 71	2252	63.7	5.9	109	67	1.3
WESTLIN 72	2614	65.5	5.9	111	70	1.0
FP2316	1797	63.5	6.3	109	71	2.8
FP2454	2303	63.0	6.1	103	60	1.0
FP2457	1779	62.5	6.1	107	70	1.5
FP2388	2447	64.3	6.2	104	63	1.3
LSD (0.05)	337	1.8	0.2	1.7	5.6	0.9
Location x Variety Interaction						
LSD (0.05)	NS	NS	S	NS	NS	NS

S = Significant   NS = Not Significant

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 ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

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

CSIDC: Bradwell loam-silty lloam (Field #8)
CSIDC Off Station: Elstow loam (Pederson)

Pea varieties were tested for their agronomic performance under irrigation. The CSIDC location was seeded on May 7 and the CSIDC Off Station site was seed on May 14. Plot size was 1.5 m x 4 m. All plots received 15 kg P_2O_5/ha as 12-51-0 as a seed-placed application and granular inoculant at a rate of 9 kg/ha as a seed-placed 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) at both sites. Supplemental hand weeding was conducted at both locations. Fungicide applications at both sites included Headline EC (pyraclostrobin) and Lance WDG (boscalid) for Mycosphaerella blight, Powdery mildew and White mold control. The trials were arranged in a randomized complete block design with three replicates. 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 at CSIDC on August 13 and at the CSIDC Off Station trial on September 2. Total in-season irrigation at CSIDC was 69.5 mm.

Thirty-two pea varieties representing five market classes were evaluated in 2015. Ten registered varieties and seven unregistered entries were Yellow pea market class, eight registered and two unregistered were Green market class, one registered variety in each of the Maple and Dun market classes, and two unregistered red cotyledon entries.

Results of the CSIDC pea trial are shown in Table 1. Varieties differed widely with respect to yield. Abarth was the highest yielding Yellow pea; experimental CDC 3422-8 was the highest unregistered; and CDC Limerick the highest yielding registered Green class pea. The experimental red cotyledon entry 2799-3 was the lowest yielding. Median yield of all varieties was 5879 kg/ha and average yield was 5931 kg/ha. The Dun class variety CDC Dakota was the highest registered entry with respect to protein. Median protein content was 24.1%. Median test weight was 80.2 kg/hl; seed weight was 243 mg. Varieties ranged from 50 to 57 days to flower. The Red experimental entry CDC 2799-3 was the longest to both flower and mature, the Yellow pea Abarth was the earliest to flower and equal with AC Earlystar to mature. Plant heights ranged from 59 to 87 cm. CDC Patrick exhibited the highest degree of lodging. The entries with the lowest lodging were primarily experimental lines and the registered variety CDC Amarillo.

Results of the CSIDC Off Station pea trial are shown in Table 2. As with the CSIDC site, varieties differed widely with respect to yield. AC Earlystar was the highest yielding Yellow pea and CDC Raezer the highest yielding Green class pea. The experimental red cotyledon entry 2799-3 was the lowest yielding. Median yield of all varieties was 5337 kg/ha, average yield 5429 kg/ha. The Maple class experimental entry CDC 3012-1LT was the highest with respect to protein content. Median protein content was 25.8%. Median test weight was 80.1 kg/hl; seed weight was 190 mg. Varieties ranged from 51 to 55 days to flower. The Yellow experimental entry CDC 3094-5 was the longest to flower, AC Earlystar the earliest. CDC 2799-3 required the longest to mature; AC Earlystar was the first to mature. Plant heights ranged from 70 to 94 cm. CDC 2710-1 exhibited the highest degree of lodging, CDC 3094-5 exhibited the lowest.

Combined site analyses of the two 2015 Regional Variety Trials are shown in Table 3. The CSIDC site was significantly lower in protein, days to maturity, and plant height compared to the off-station site. The off-station site had significantly lower seed weights. The Yellow variety AC Earlystar was the highest yielding upon combined location analysis, the Red experimental entry 2799-3 the lowest yielding. CDC 3012-1LT had the highest protein, AC Liscard the highest test weight, CDC 3094-5 the highest seed weight, CDC 2799-3 the longest to flower and mature, CDC 3094-5 was the tallest entry, and LN4236 the last to mature.

The results from these trials are used to update ICDCs irrigation variety database and provide recommendations to irrigators on the best field pea varieties suited to irrigation conditions. Results of the 2015 Irrigated Field Pea Regional Variety Trials will be used to update ICDCs annual publication *Crop Varieties for Irrigation* and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2016*.

Table 1. Irrigated Pea Regional Variety Trial—CSIDC Site (* CDC Golden = Check Variety)

Variety	Yield (kg/ha)	Protein (%)	Test weight (kg/hl)	1 K Seed weight (mg)	10% Flower (days)	Maturity (days)	Height (cm)	Lodging (1=erect; 10=flat)
Yellow								
CDC Golden (check)	***6340***	***24.1***	***80.6***	***227***	***52***	***86***	***69***	***6.0***
Abarth	7197	23.1	78.7	286	50	84	76	3.3
Agassiz	5914	24.4	79.6	266	51	88	73	5.3
AAC Ardill	5960	22.5	80.5	255	53	86	70	4.0
AAC Lacombe	6330	23.3	81.3	295	54	91	80	2.3
CDC Amarillo	5811	22.3	80.6	241	53	88	75	1.7
AC Earlystar	6964	22.3	80.1	225	51	84	84	3.3
CDC Inca	6913	23.6	80.7	230	54	89	76	2.7
CDC Meadow	5915	22.1	81.0	227	51	87	67	5.7
CDC Saffron	6715	23.6	80.3	258	53	85	64	3.3
CDC 2936-7	6409	24.7	79.5	250	54	91	72	2.3
CDC 3094-5	6456	25.0	79.9	327	53	91	86	2.0
CDC 3360-7	5924	22.8	81.6	248	50	87	83	2.7
CDC 3525-9	6913	24.2	80.2	245	53	88	81	2.0
CDC 3760-15	6344	23.8	78.1	268	52	86	75	3.0
CM3404	4490	25.2	78.6	309	55	89	87	5.7
LN4236	6740	24.2	79.0	250	52	86	77	6.0
Green								
AAC Radius	5424	23.5	79.4	228	54	89	77	5.7
AAC Royce	5684	24.1	78.9	252	53	89	64	4.7
CDC Greenwater	5539	23.2	80.9	246	54	90	75	2.7
CDC Limerick	5952	26.6	80.7	221	51	90	69	3.3
CDC Patrick	5708	22.9	80.8	191	52	87	71	6.7
CDC Raezer	5923	24.3	79.1	247	53	88	83	3.3
CDC Striker	4760	24.9	80.3	246	53	86	67	4.0
CDC Tetris	5731	25.2	79.3	242	56	91	73	2.7
CDC 3007-6	5820	23.8	79.7	252	54	91	78	3.3
CDC 3422-8	6314	24.6	80.2	247	53	90	75	3.7
Red								
CDC 2710-1	5329	23.7	79.1	204	50	87	63	5.7
CDC 2799-3	3891	26.5	79.9	177	57	92	73	3.0
Maple								
AAC Liscard	5505	24.6	83.7	200	55	88	79	2.3
CDC 3012-1LT	5827	27.4	81.1	203	53	89	59	4.3
DUN								
CDC Dakota	5054	26.9	80.1	214	56	91	70	2.7
LSD (0.05)	1041	1.0	1.6	25.0	1.1	2.2	13.6	1.8
CV (%)	10.8	2.5	1.3	6.3	1.3	1.5	11.3	30.0

Table 2. Irrigated Pea Regional Variety Trial—CSIDC Off Station (* CDC Golden = Check)

Variety	Yield (kg/ha)	Protein (%)	Test weight (kg/hl)	1 K Seed weight (mg)	10% Flower (days)	Maturity (days)	Height (cm)	Lodging (1=erect; 10=flat)
Yellow								
***CDC Golden** (check)*	***4663***	***27.0***	***80.0***	***167***	***52***	***89***	***70***	***5.3***
Abarth	6539	25.1	78.8	259	51	91	88	3.0
Agassiz	5052	26.2	79.0	192	51	91	88	4.0
AAC Ardill	5570	23.1	81.3	197	53	90	88	3.7
AAC Lacombe	5967	24.9	81.0	225	53	93	81	3.3
CDC Amarillo	4676	25.2	80.7	190	53	92	89	3.3
AC Earlystar	7258	22.1	79.3	177	51	87	80	4.7
CDC Inca	6684	25.1	79.9	188	53	95	82	3.0
CDC Meadow	4981	25.4	80.9	169	53	92	71	4.7
CDC Saffron	5140	26.1	79.8	204	53	92	79	4.7
CDC 2936-7	5324	25.8	80.7	212	53	100	94	3.0
CDC 3094-5	5755	25.3	79.3	257	55	95	93	2.0
CDC 3360-7	6046	25.7	81.1	192	52	91	83	4.0
CDC 3525-9	6315	26.1	79.7	195	52	92	84	2.7
CDC 3760-15	5747	26.0	79.6	208	53	92	75	3.3
CM3404	6349	25.8	80.1	272	53	92	91	3.0
LN4236	6244	26.3	77.0	210	52	88	74	6.7
Green								
AAC Radius	5190	26.3	79.7	179	53	92	92	4.0
AAC Royce	5542	25.5	79.0	230	52	91	70	4.7
CDC Greenwater	4555	25.8	80.2	187	54	94	89	4.0
CDC Limerick	5078	27.5	79.9	169	52	93	81	2.3
CDC Patrick	5042	25.5	79.9	146	53	91	91	5.0
CDC Raezer	6290	24.4	80.3	198	52	91	87	2.3
CDC Striker	5949	25.6	80.3	213	52	92	70	5.0
CDC Tetris	4772	26.6	80.4	190	55	101	84	3.0
CDC 3007-6	5477	25.0	80.6	234	53	95	80	4.0
CDC 3422-8	5247	26.0	80.0	190	53	93	79	3.0
Red								
CDC 2710-1	4764	27.1	78.6	158	52	90	75	6.7
CDC 2799-3	2806	28.5	80.2	145	54	101	86	4.7
Maple								
AAC Liscard	5684	25.8	82.6	165	54	92	82	4.0
CDC 3012-1LT	4530	30.5	80.6	143	52	100	94	4.7
DUN								
CDC Dakota	4481	29.1	80.2	165	54	97	82	3.3
LSD (0.05)	938	0.8	1.2	30.4	1.9	2.4	10.0	1.5
CV (%)	10.6	2.0	0.9	9.6	2.2	1.6	7.4	23.8

Table 3. Yield and Agronomic Data for Irrigated Pea Regional Trial, Combined Site Analysis

Treatment	Yield (kg/ha)	Protein (%)	Test Weight (kg/hl)	1 K Seed Weight (mg)	10% Flower (days)	Maturity (days)	Height (cm)	Lodging (1=erect; 10=flat)
Trial Site								
CSIDC	5931	24.2	80.1	243	53	88	74	3.7
CSIDC – Off station	5429	26.0	80.0	195	53	93	83	3.9
LSD Yield (0.10) LSD (0.05)	NS	1.0	NS	22	NS	1.6	8.5	NS
CV	10.7	2.3	1.1	7.8	1.8	1.5	9.3	26.9
Variety								
Yellow								
CDC Golden (check)	***5502***	***25.6***	***80.3***	***197***	***52***	***88***	***69***	***5.7***
Abarth	6868	24.1	78.8	273	51	87	82	3.2
Agassiz	5483	25.3	79.3	229	51	89	80	4.7
AAC Ardill	5765	22.8	80.9	226	53	88	79	3.8
AAC Lacombe	6149	24.1	81.2	260	54	92	81	2.8
CDC Amarillo	5244	23.8	80.6	216	53	90	82	2.5
AC Earlystar	7111	22.2	79.7	201	51	85	82	4.0
CDC Inca	6798	24.3	80.3	209	54	92	79	2.8
CDC Meadow	5448	23.8	81.0	198	52	90	69	5.2
CDC Saffron	5928	24.9	80.1	231	53	89	71	4.0
CDC 2936-7	5866	25.3	80.1	231	54	96	83	2.7
CDC 3094-5	6106	25.2	79.6	292	54	93	89	2.0
CDC 3360-7	5985	24.3	81.4	220	51	89	83	3.3
CDC 3525-9	6614	25.2	80.0	220	53	90	83	2.3
CDC 3760-15	6046	24.9	78.9	238	53	89	75	3.2
CM3404	5420	25.5	79.4	291	54	90	89	4.3
LN4236	6492	25.2	78.0	230	52	87	76	6.3
Green								
AAC Radius	5307	24.9	79.6	203	54	91	85	4.8
AAC Royce	5613	24.8	78.9	241	53	90	67	4.7
CDC Greenwater	5047	24.5	80.6	217	54	92	82	3.3
CDC Limerick	5515	27.0	80.3	195	52	92	75	2.8
CDC Patrick	5375	24.2	80.3	169	53	89	81	5.8
CDC Raezer	6107	24.4	79.7	222	53	90	85	2.8
CDC Striker	5354	25.3	80.3	229	53	89	69	4.5
CDC Tetris	5251	25.9	79.8	216	55	96	78	2.8
CDC 3007-6	5648	24.4	80.2	243	54	93	79	3.7
CDC 3422-8	5781	25.3	80.1	219	53	92	77	3.3
Red								
CDC 2710-1	5046	25.4	78.9	181	51	89	69	6.2
CDC 2799-3	3349	27.5	80.1	161	56	97	80	3.8
Maple								
AAC Liscard	5594	25.2	83.2	182	55	90	81	3.2
CDC 3012-1LT	5178	28.9	80.8	173	52	94	76	4.5

Treatment	**Yield** (kg/ha)	**Protein** (%)	**Test Weight** (kg/hl)	**1 K Seed Weight** (mg)	**10% Flower** (days)	**Maturity** (days)	**Height** (cm)	**Lodging** (1=erect; 10=flat)
DUN								
CDC Dakota	4767	28.0	80.1	189	55	94	76	3.0
LSD (0.05)	694	0.6	1.0	19.5	1.1	1.6	8.4	1.2
Site x Variety Interaction								
LSD (0.05)	S	S	NS	NS	0.0002	0.0001	0.007	0.015

NS = Not Significant

Saskatchewan Dry Bean Narrow Row Regional Variety Trial

Project Lead

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

Organizations

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

Objectives

Regional performance trials provide information about 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 2015 at CSIDC. The trial was seeded on May 28. Eighteen dry bean varieties consisting of six market classes (pinto, black, navy, yellow, cranberry and fleur de jaune) were evaluated (Table 1). Phosphorus fertilizer was side-banded at a rate of 40 kg P_2O_5/ha during the seeding operation. Fertilizer N was broadcast and incorporated with irrigation scheduling post-planting at 50 kg N/ha as 46-0-0, as granular inoculants were not commercially available. At no time during dry bean growth did plants exhibit symptoms of nitrogen deficiencies. Weed control consisted of a post-emergence application of Basagran (bentazon) + Poast (sethoxydim), supplemented by some hand weeding. The trial received an application of Lance (boscalid) fungicide and Parasol WG (copper hydroxide) for Sclerotinia stem rot (white mold) 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 9 and harvested on September 18. Total in-season irrigation at CSIDC was 77.5 mm.

Results

Results of the trial are shown in Table 1. CDC Marmot was the first variety to flower, CDC Jet the last, and median days to flower for the test was 48 days. Experimental entry 2918-25 and CDC Marmot were the first varieties to mature, experimental entry 3620-3 the last, and median days to mature for the test was 99 days. Experimental entry 3620-3 produced the tallest plants but exhibited the least amount of lodging. CDC Marmot was the shortest variety but exhibited a high degree of lodging. Experimental entry 2918-25 exhibited the greatest pod clearance, CDC Marmot the least.

The results from these trials are used to update the irrigation variety database at ICDC and provide recommendations to irrigators on the best dry bean varieties suited to irrigation conditions. Results of the 2015 Irrigated Dry Bean Regional Variety Trial will also be used in the development of ICDCs annual *Crop Varieties for Irrigation* guide and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2016.*

Table 1. Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial—CSIDC

Variety	**Yield** (kg/ha)	**Test Weight** (kg/hl)	**Seed Weight** (mg)	**Flower** (days)	**Maturity** (days)	**Lodge Rating** 1=upright 5=flat	**Pod Clearance** (%)	**Height** (cm)
Pinto								
Winchester (check)	***7158***	***79.3***	***396***	***47***	***97***	***2.7***	***72***	***40***
AC Island	9533	79.7	456	48	99	4.0	60	46
CDC Marmot	8109	75.3	430	45	94	3.7	50	35
CDC Pintium	6220	77.3	394	46	95	2.7	75	42
CDC WM-2	9295	78.3	423	48	97	3.0	68	42
Medicine Hat	9120	78.6	403	53	100	3.3	67	39
3119-3	7737	79.2	432	49	99	3.0	70	44
Black								
CDC Blackstrap	8219	76.0	244	48	96	1.7	87	45
CDC Jet	7137	78.3	308	54	102	2.7	77	52
CDC Superjet	7218	77.7	200	53	100	3.0	72	50
Navy								
Bolt	7391	82.1	221	52	101	2.7	82	49
Envoy	6685	83.7	204	49	100	3.3	65	40
Portage	8825	82.2	206	48	97	1.7	88	52
2918-25	5618	80.8	206	48	94	1.3	93	47
3458-7	8031	80.9	241	47	95	3.0	77	41
NA6-27-2	7712	82.3	196	49	99	2.0	85	53
Yellow								
CDC Sol	5343	85.1	492	46	101	1.3	87	46
Cranberry								
7ab-3bola-3	5551	77.7	428	46	97	2.0	80	39
Fleur de Jaune								
3620-3	10922	81.1	359	53	106	1.0	87	56
LSD (0.05)	1307	0.9	77	1.4	1.4	1.0	13.2	4.7
CV (%)	10.3	0.7	14.2	1.8	0.9	24.0	10.5	6.3

Alberta Dry Bean Narrow Row and Wide Row Regional Variety Trials

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 2015 at CSIDC and CSIDC Off Station sites.

The Narrow Row trial included thirteen dry bean varieties consisting of three market classes (pinto, black and great northern). The Wide Row trial consisted of ten dry bean varieties in three market classes (pinto, black and great northern). 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. For both trials phosphorus fertilizer was side-banded at a rate of 15 kg P_2O_5/ha during the seeding operation. Granular inoculant was unavailable so nitrogen requirements were met by supplemental broadcast urea, applied twice and irrigated immediately, for a total application of 100 kg N/ha. Both trials were established on May 28. 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 Headline EC (pyraclostrobin) and Lance WDG (boscalid) fungicide at the early flowering and mid-flowering growth stages for sclerotinia stem rot (white mold) and powdery mildew control. An application of Quadris (azoxystrobin) followed two weeks later. Yields were estimated by harvesting the entire plot. All trials plot were under-cut and windrowed, allowed to dry in the windrow, and then threshed to determine yield. Total in-season irrigation was 77.5 mm at CSIDC and 83.5 mm at the CSIDC Off Station site.

Results

Narrow Row

Agronomic data collected from each narrow row trial is shown in Tables 1 and 2. Experimental entry L10GN821 Great Northern class bean was the highest yielding variety while the pinto class variety CDC Marmot was the lowest yielding variety at the CSIDC site. AAC Black Diamond 2 (black) was the highest yielding varieties while Resolute (great northern) was the lowest yielding variety at the CSIDC Off Station site. Median yield of all varieties at CSIDC was 7863 kg/ha and 6136 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. Yield was statistically higher at the CSIDC site as compared to the SCIDC Off-station trial. Highest yield was obtained with the pinto variety, AC Island, which was significantly higher than all, yielding less than 7000 kg/ha. CDC Marmot (pinto) was the lowest yielding variety. Median yield of the combined sites was 6901 kg/ha.

Test weight and seed weight produced did not differ between the two sites. Varieties did not statistically differ with respect to test weight. Thousand seed weight of the great northern class bean entry L10GN821 was the highest of entries, the black variety, CDC Blackcomb, was statistically lower than all other entries. Varieties at the CSIDC Off Station trial matured earlier compared to those at CSIDC. The CSIDC Off Station trial was located on a lighter textured soil than that at CSIDC, and despite frequent irrigation, was likely prone to some moisture stress, which advanced maturity. Combined site analysis indicated the pinto variety, Medicine Hat, took the longest to mature, the Pinto bean variety CDC Marmot was statistically earlier to mature compared with all other varieties. No difference in mean plant height occurred between sites. CDC Blackcomb was the tallest structured variety, CDC Marmot the shortest. Varieties grown at CSIDC exhibited a greater degree of lodging than plants grown at the CSIDC Off Station location. Medicine Hat exhibited the greatest degree of lodging, Winchester the least. Pod clearance was correlated to lodging in that Medicine Hat had the least amount of pod clearance, Winchester the greatest. Pod clearance was statistically lower (i.e. fewer pods had acceptable pod clearance) at CSIDC as compared to the CSIDC Off Station site.

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 5600 kg/ha. The black class variety, CDC Blackcomb, was the lowest yielding. AAC Black Diamond 2 (black) bean was the highest yielding variety at the CSIDC Off Station site, statistically significant from other varieties yielding less than 4200 kg/ha. As was the case at CSIDC, the black class variety, CDC Blackcomb, was the lowest yielding. Median yield of all varieties at the CSIDC trial was 5450 kg/ha and 4342 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 was statistically higher at the CSIDC site compared with the CSIDC Off Station trial. Highest yield was obtained with the pinto variety, AC Island; this yield was not statistically significant from varieties with yields exceeding 5000 kg/ha. The black variety, CDC Blackcomb, was the lowest yielding variety. Median yield of the combined sites was 4737 kg/ha.

Test weight did not differ between sites. Great northern varieties AAC Tundra and AAC Whitehorse had the highest and lowest test weights respectively. Seed weight was significantly higher at the CSIDC trial. The seed weight of the great northern classes, L10GN821 and AAC Whitehorse, were statistically higher than all other varieties; CDC Blackcomb had the lowest seed weight. Varieties at the CSIDC Off Station trial matured prior to those at CSIDC, as with the narrow row trial, periodic moisture stress likely attributed to this observation. Median days to maturity was 96.5 days. AAC Burdett was significantly earliest maturing, AC Island was the latest maturing. The black variety, CDC Blackcomb, produced the tallest plants, the great northern variety, AAC Tundra, the shortest. Lodging was significantly greater at CSIDC, with AC Island exhibiting the greatest lodging, CDC Blackcomb the least. Pod clearance was higher at the CSIDC Off Station site, AC Island (the greatest lodged) had the least pod clearance, CDC Blackcomb (the tallest stature variety) 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. Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial—CSIDC

Variety	**Yield** (kg/ha)	**Test Weight** (kg/hl)	**Seed Weight** (mg)	**Flower** (days)	**Maturity** (days)	**Height** (cm)	**Lodging** (1–5)	**Pod Clearance** (%)
Pinto								
Winchester	7158	79.3	396	NC	96	40	1.5	88
AC Island	8661	79.9	385	NC	99	45	3.8	50
CDC WM-2	8410	78.5	344	NC	97	41	2.8	71
Medicine Hat	8502	78.1	398	NC	99	42	4.0	53
AAC Burdett	7802	77.5	413	NC	94	43	2.0	80
CDC Marmot	5774	76.7	400	NC	93	37	2.3	76
Black								
AC Black Diamond	8102	78.6	314	NC	97	45	2.3	80
AAC Black Diamond 2	8080	79.4	313	NC	97	48	1.8	86
CDC Blackcomb	6502	78.5	215	NC	97	49	2.0	85
Great Northern								
Resolute	7725	77.9	394	NC	98	42	3.5	68
AAC Tundra	8588	80.9	402	NC	98	40	3.3	63
AAC Whitehorse	7965	78.8	411	NC	99	45	3.5	65
L10GN821	8843	78.3	420	NC	99	50	2.8	73
LSD (0.05)	910	0.9	49		1.1	4.2	0.8	9.8
CV (%)	8.1	0.8	9.3		0.8	6.7	21.3	9.5

NC = data not captured

Table 2. Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial—CSIDC Off Station

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	5351	78.9	358	NC	94	44	1.0	90
AC Island	6636	70.8	378	NC	96	45	2.0	83
CDC WM-2	6280	77.8	390	NC	96	42	2.8	79
Medicine Hat	6371	77.3	389	NC	97	44	2.0	80
AAC Burdett	5873	76.9	360	NC	93	48	1.5	89
CDC Marmot	6122	75.6	431	NC	93	37	2.3	80
Black								
AC Black Diamond	6009	78.8	275	NC	96	46	1.3	90
AAC Black Diamond 2	6709	80.0	283	NC	96	49	1.0	90
CDC Blackcomb	6128	78.6	188	NC	95	52	1.0	90
Great Northern								
Resolute	5194	77.5	388	NC	97	42	1.3	88
AAC Tundra	6688	79.8	395	NC	96	41	2.0	80
AAC Whitehorse	5291	77.1	415	NC	96	43	1.5	88
L10GN821	5739	77.7	421	NC	96	47	1.0	90
LSD (0.05)	999	NS	16		0.9	5.0	0.7	5.5
CV (%)	11.6	5.4	3.2		0.7	7.9	30.7	4.5

NC = data not captured

Table 3. Saskatchewan Irrigated Dry Bean Narrow Row Regional Variety Trial—Combined Site Analysis

Location/Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weigh t (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
CSIDC	7855	78.6	369	NC	97	43	2.7	72
CSIDC – Off Station	6030	77.4	359	NC	95	45	1.6	86
LSD (0.05)	1029	NS	NS		0.4	NS	0.4	2.8
CV (%)	9.6	3.8	7.0		0.8	7.4	24.9	7.0
Variety								
Pinto								
Winchester	6255	79.1	377	NC	95	42	1.3	89
AC Island	7648	75.3	382	NC	98	45	2.9	66
CDC WM-2	7345	78.1	367	NC	96	42	2.8	75
Medicine Hat	7437	77.7	394	NC	98	43	3.0	66
AAC Burdett	6837	77.2	386	NC	94	45	1.8	84
CDC Marmot	5948	76.1	415	NC	93	37	2.3	78
Black								
AAC Black Diamond	7056	78.7	294	NC	96	45	1.8	85
AAC Black Diamond 2	7395	79.7	298	NC	96	48	1.4	88
CDC Blackcomb	6315	78.6	201	NC	96	50	1.5	88
Great Northern								
Resolute	6460	77.7	391	NC	97	42	2.4	78
AAC Tundra	7638	80.4	398	NC	97	41	2.6	71

Location/Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
AAC Whitehorse	6628	77.9	413	NC	97	44	2.5	76
L10GN821	7291	78.0	420	NC	97	49	1.9	81
LSD (0.05)	664	NS	S		0.7	3.2	0.5	5.5
Location x Variety Interaction								
LSD (0.05)	S	NS	S		S	NS	S	S

NC = data not captured S = Significant NS = Not Significant

Table 4. Saskatchewan Irrigated Dry Bean Wide Row Regional Variety Trial—CSIDC

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	5238	80.2	358	NC	96	42	3.0	68
AC Island	6223	79.8	391	NC	100	46	4.0	50
AAC Burdett	5697	77.7	413	NC	95	43	2.0	88
Black								
AC Black Diamond	5388	78.3	318	NC	97	49	2.0	85
AAC Black Diamond 2	5343	80.3	313	NC	97	47	2.0	85
CDC Blackcomb	4978	78.5	219	NC	97	52	1.5	86
Great Northern								
Resolute	5084	78.5	388	NC	99	42	3.8	59
AAC Tundra	5537	80.3	407	NC	97	38	3.3	63
AAC Whitehorse	5517	77.7	423	NC	99	47	3.3	64
L10GN821	5903	78.3	424	NC	99	48	2.5	76
LSD (0.05)	556	0.9	17.6		1.0	3.5	0.6	8.9
CV (%)	7.0	0.8	3.3		0.7	5.3	14.1	8.5

NC = data not captured

Table 5. Saskatchewan Irrigated Dry Bean Wide Row Regional Variety Trial—CSIDC Off Station

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto								
Winchester	3933	79.5	354	NC	95	43	1.0	90
AC Island	4420	78.5	392	NC	97	43	2.3	78
AAC Burdett	4067	77.4	347	NC	93	49	1.0	88
Black								
AC Black Diamond	4199	78.5	278	NC	96	52	1.3	89
AAC Black Diamond 2	4847	80.1	272	NC	96	51	1.0	90
CDC Blackcomb	3846	77.9	201	NC	95	52	1.3	90

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Great Northern								
Resolute	3976	78.2	383	NC	97	45	1.5	88
AAC Tundra	4632	80.2	392	NC	96	42	2.0	85
AAC Whitehorse	4262	77.1	413	NC	96	45	2.0	84
L10GN821	4495	77.4	432	NC	97	52	1.8	84
LSD (0.05)	608	0.7	27		0.7	5.8	0.6	5.0
CV (%)	9.8	0.6	5.3		0.5	8.5	29.8	4.0

NC = data not captured

Table 6. Saskatchewan Irrigated Dry Bean Wide Row Regional Variety Trial—Combined Site Analysis

Location/Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Flower (days)	Maturity (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
CSIDC	5491	78.9	365	NC	97	45	2.7	72
CSIDC – Off station	4268	78.5	346	NC	96	47	1.5	86
LSD (0.05)	756	NS	11		0.8	NS	0.4	2.6
CV (%)	8.2	0.7	4.4		0.6	7.1	19.7	6.3
Variety								
Pinto								
Winchester	4586	79.8	356	NC	96	42	2.0	79
AC Island	5322	79.2	391	NC	98	44	3.1	64
AAC Burdett	4882	77.6	380	NC	94	46	1.5	88
Black								
AAC Black Diamond	4793	78.4	298	NC	96	50	1.6	87
AAC Black Diamond 2	5095	80.2	293	NC	96	49	1.5	88
CDC Blackcomb	4412	78.2	210	NC	96	52	1.4	88
Great Northern								
Resolute	4530	78.3	386	NC	98	44	2.6	73
AAC Tundra	5085	80.2	400	NC	97	40	2.6	74
AAC Whitehorse	4890	77.4	418	NC	97	46	2.6	74
L10GN821	5199	77.9	428	NC	98	50	2.1	80
LSD (0.05)	403	0.5	16		0.6	3.3	0.4	5.0
Location x Variety Interaction								
LSD (0.05)	NS	NS	S	NC	S	NS	S	S

NC = data not captured   S = Significant   NS = Not Significant

Short Season Wide Row Irrigated Dry Bean Co-operative Registration Trial

Project Lead

- Garry Hnatowich
- 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

This project evaluated new dry bean germplasm for its adaptation to western Canada under irrigated row crop production conditions. The germplasm included advanced lines from AAFC Lethbridge Research Centre. These lines were compared to registered varieties (when possible) within each market class.

Research Plan

An irrigated site was conducted at CSIDC. The test consisted of thirty entries that included six registered varieties from six market classes (pinto, black, cranberry, pink, red, and yellow). There were twenty-four advanced breeding lines from AAFC-Lethbridge, including four pinto, one black, seven cranberry, three pink, one red and eight yellow (Table 1). The dry bean lines were evaluated for agronomic traits, including yield, test weight, seed weight, days to maturity, plant height, lodging, and pod clearance. Individual plots consisted of two rows with 60 cm row spacing and measured 1.2 m x 4 m. Phosphorus fertilizer was side-banded at a rate of 29 kg P_2O_5/ha during the seeding operation. Granular inoculant was unavailable, so nitrogen requirements were met by supplemental broadcast urea applied twice and irrigated immediately, for a total application of 140 kg N/ha. The trial was seeded on May 28. 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 two in-season cultivations and periodic in-row hand weeding. The trial received a tank-mix application of Headline EC (pyraclostrobin) and Lance WDG (boscalid) fungicide at the early flowering and mid-flowering growth stages for sclerotinia stem rot (white mold) and powdery mildew control on July 14. An application of Quadris (azoxystrobin) followed on July 29. Yields were estimated by harvesting the entire plot. Both rows in each plot were under-cut and windrowed on September 9, allowed to dry in the windrow and then threshed on September 28 to determine yield. Total in-season irrigation at CSIDC was 77.5 mm.

Results

Yield trends varied, in general, both between and within market classes (Table 1). Pinto bean entries tended to be the highest yielding within market classes. Yellow market class bean varieties were among the lowest yielding. The four experimental pinto entries were not statistically different in yield from registered pinto varieties. Experimental entry L13PS389 was the highest yielding pink bean but not statistically higher yielding than the two other experimental pink class entries. Red experimental line L13SR389 was the highest yielding of its class, with yields rivalling pinto entries. Black class experimental line L13BM650 was not statistically lower yielding than AC Black Diamond. Within the cranberry class beans, experimental entry L13CB014 was statistically higher yielding than all other cranberry entries, except experimental entry LB13CB029. Yellow class beans were the lowest yielding, with no experimental entry achieving yields statistically different from the control, CDC Sol. Mean yield of all thirty entries was 4868 kg/ha.

Yellow entries (lowest yielding) tended to have the highest test weights. Seed weights obtained for cranberry class entries were among the highest, with black being the lowest. Median days to maturity was 97 days, most classes had entries above or below this time. Median plant height was 46 cm; yellow, were taller than the median value. In general, pinto and black market class entries exhibited the highest degree of lodging, yellow the least. Percent pod clearance (number of pods per plant with 37.5 mm between soil surface and bottom of pods) varied among and within market classes.

The results from this trial are used to assist in the registration decision process for new proposed dry bean varieties.

Table begins on the next page.

Table 1. Short Season Wide Row Irrigated Dry Bean Co-operative Trial

Variety	Yield (kg/ha)	Test Weight (kg/hl)	Seed Weight (mg)	Mature (days)	Height (cm)	Lodging (1–5)	Pod Clearance (%)
Pinto							
Winchester	5238	80.2	358	96	43	3.0	68
AC Island	6638	78.7	400	99	50	3.3	65
CDC WM-2	6188	77.8	411	97	42	3.3	63
L12PT324	7003	77.8	411	95	44	3.5	60
L12PT325	5942	78.7	385	96	44	3.5	58
L13PT383	6365	79.5	399	100	48	3.3	64
L13PT393	6703	79.3	411	98	54	1.8	85
Pink							
L11PS211	5006	78.7	378	97	39	3.8	53
L13PS375	5090	80.4	409	99	38	3.5	65
L13PS389	5676	78.8	416	98	38	3.8	55
Red							
Redbond	4926	79.3	352	94	42	3.0	65
Red Rider	1571	74.0	513	99	48	1.0	88
L13SR650	6611	79.1	398	95	43	3.3	60
Black							
AC Black Diamond	5183	77.8	314	97	45	2.5	75
L13BM650	5001	78.2	227	97	53	2.8	81
Cranberry							
L12CB002	5026	75.1	594	101	44	2.3	75
L12CB004	4657	72.6	691	95	48	2.0	83
L12CB007	3479	70.9	599	96	44	1.5	90
L13CB014	6256	75.7	581	104	46	2.0	80
L13CB020	3712	76.1	553	107	44	2.3	78
L13CB024	4043	74.0	676	101	42	2.0	83
L13CB029	5549	77.2	574	96	44	2.3	81
Yellow							
CDC Sol	3764	83.7	478	101	47	1.0	91
L11YL012	4021	84.6	454	100	48	1.5	81
L11YL015	3679	83.3	452	98	48	2.0	76
L13YL045	4493	83.8	442	97	56	1.0	90
L13YL046	4020	83.2	455	97	47	1.0	88
L13YL047	4046	82.0	464	99	46	1.3	80
L13YL049	3571	84.8	449	99	49	1.0	91
L13YL060	3496	81.4	512	95	44	1.3	86
L13YL062	3960	81.7	518	95	51	1.3	90
LSD (0.05)	1131	1.8	61	1.8	7.3	0.8	11.2
CV (%)	16.5	1.6	9.4	1.3	11.5	26.1	10.5

Western Canada Soybean Performance Evaluation

Project Lead

- Garry Hnatowich
- Co-investigators: D. Lange, Manitoba Agriculture, Food & Rural Initiatives;
  Dr. T. Warkentin, Crop Development Centre, University of Saskatchewan, Saskatoon

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Crop Development Centre
- Manitoba Agriculture, Food & Rural Initiatives
- Manitoba Soybean and Pulse Growers

Objectives

The objectives of this study were to:

- Evaluate the potential of soybean varieties for production in the irrigated west-central region of Saskatchewan;
- Assess the suitability of soybean to irrigation as opposed to dry land production; and
- Create a data base on soybean for ICDCs annual publication, *Crop Varieties for Irrigation*.

Research Plan

Thirty-five soybean varieties were obtained through the Manitoba Pulse and Soybean Growers for evaluation under both dry land and irrigation production. Plot size was 1.2 m x 4 m. All plots received 45 kg P_2O_5/ha as 12-51-0 sideband application during the seeding operation. Granular inoculant of the appropriate Rhizobium bacteria strain (*Bradyrhizobium japonicum*) specific for soybean was seed-placed during the seeding operation. Both trials were seeded on May 27. Weed control consisted of a pre- and a post-emergence application of Roundup (glyphosate) supplemented by some hand weeding. Total in-season irrigation was 69.5 mm to the irrigated plots, and in May and June, a total of 32 mm was applied to the dry land plots to alleviate drought stress during emergence and seedling establishment. First frost occurred early on the morning of September 23, and although not a killing frost, it was enough to result in leaf drop of all entries. Most of the entries had reached, or were extremely close, to 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%.

Results

Thirty-five Roundup Ready soybean varieties were evaluated. Plant emergence and seedling development was extremely excellent. Ideal conditions through June until frost established excellent yield potential. Seed quality and agronomic data collected for the irrigated soybean are shown in Table 1. Yields were very high, with a median yield for all thirty-five entries of 4586 kg/ha (68.2 bu/ac). Yields of irrigated soybean ranged from a low of 3855 kg/ha (57.3 bu/ac) to a high of 5263 kg/ha (78.2 bu/ac). Oil content varied among entries with a 3.5% difference between the lowest and highest oil entries. Median protein content was 33.7%. Test weight and seed weight also exhibited a wide variance between entries. Median maturity was 116 days, which is considerably earlier than previous trials conducted at CSIDC. Most entries did reach physiological maturity (95% of pods had turned from green to yellow or brown). Plant height was also much higher than previously measured in soybean trials at Outlook. Lodging resistance of most entries was very good.

Seed quality and agronomic data collected for the dry land soybean are shown in Table 2. The median yield of all thirty-five entries was 4265 kg/ha (63.4 bu/ac). Yields of dry land soybean ranged from a low of 3455 kg/ha (51.4 bu/ac) to a high of 4970 kg/ha (73.9 bu/ac). Oil content varied among entries with a 4.2% difference between the lowest and highest oil entries. Median protein content was 32.5%. Test weight and seed weight also exhibited a wide variance between entries. Median maturity was 115 days. Plant height was much higher than previously measured in soybean trials at Outlook, and lodging resistance of most entries was very good.

Combined test analysis between irrigation and dry land studies is shown in Table 3. Irrigation resulted in a statistically higher seed yield compared to dry land production. Irrigation provided an 8.8% yield response over dry land production. Irrigation did not influence oil produced, but statistically increased protein. Between the two production systems, there were not differences to test weight, seed weight or maturity. Irrigation did induce a statistically higher degree of lodging, although the difference between the two systems would not result in harvest difficulties.

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.

Tables begin on the next page.

Table 1. Agronomics of WC Soybean Performance Evaluation—Irrigated Soybean

Variety	Yield (kg/ha)	% Oil	% Protein	Test Weight (kg/hl)	Seed Weight (g/1000)	Maturity (days)	Height (cm)	Lodge (1-5)
23-10RY	4893	16.3	35.4	72.0	181	113	97	1.3
22-60 RY	4817	16.9	33.7	70.4	130	114	91	1.3
23-11 RY	4479	17.2	33.2	69.5	143	117	106	1.7
23-60RY	5115	15.7	34.6	70.4	149	115	115	2.7
900Y61	4301	17.1	34.2	67.9	173	118	98	2.0
Akras R2	4775	15.8	32.7	71.7	140	117	97	2.3
Bishop R2	4665	16.7	34.7	71.1	154	113	100	3.0
CFS13.2.01 R2	4657	16.9	32.5	70.2	151	117	108	2.3
Hero R2	4651	16.8	35.1	66.9	162	120	98	4.0
HS 006RYS24	4774	16.2	34.2	68.8	172	120	113	3.3
LS 003R24N	4450	16.2	34.5	67.6	196	118	106	2.3
LS NorthWester	4307	17.6	34.8	68.7	157	119	107	3.0
LS002R24N	4163	16.6	32.7	69.6	172	115	107	2.0
Mahony R2	4587	18.1	32.6	69.3	158	117	98	2.7
McLeod R2	4590	16.8	33.7	69.4	178	115	109	2.0
Notus R2	4972	16.7	34.0	67.7	174	113	92	1.3
NSC Anola RR2Y	4065	18.2	32.4	69.5	141	117	85	1.0
NSC Gladstone RR2Y	4479	15.9	34.5	69.3	181	119	104	3.0
NSC Moosomin RR2Y	4566	17.0	34.4	70.2	138	112	85	1.0
NSC Reston RR2Y	4985	16.0	35.1	70.3	135	116	94	2.7
NSC Tilston RR2Y	4703	18.0	32.2	70.1	153	116	109	2.3
NSC Watson RR2Y	4742	18.6	32.4	69.5	175	111	95	2.3
P001T34R	4687	18.9	34.2	71.4	142	111	85	1.3
P002T04R	4247	18.6	32.9	69.3	132	112	92	1.0
P006T78R	5263	17.2	34.8	70.0	175	114	93	1.7
Pekko R2	4605	16.5	33.2	70.7	143	115	106	1.3
PRO 2525R2	4251	16.9	33.5	64.6	166	121	104	2.0
PS 0035 R2	3855	16.5	33.8	68.7	182	115	96	3.0
S0009-M2	4936	19.2	33.2	69.4	159	111	87	2.0
S007-Y4	4997	16.9	33.7	70.0	162	117	100	4.7
TH 32004R2Y	4619	17.5	33.0	69.8	151	116	101	1.7
TH 33003R2Y	4770	17.2	33.7	70.1	147	119	91	3.0
TH 33005R2Y	4932	16.4	33.5	68.4	175	120	106	3.0
TH 35002R2Y	4573	17.1	32.2	70.4	135	115	99	2.0
Vito R2	4493	18.0	33.7	70.1	143	117	108	3.0
LSD (0.05)	670	0.8	1.7	2.7	15.7	2.7	13.1	NS
CV (%)	8.9	3.0	3.1	2.4	6.1	1.4	8.1	56.4

NS = Not Significant

Table 2. Agronomics of WC Soybean Performance Evaluation—Dry Land Soybean

Variety	**Yield** (kg/ha)	**% Oil**	**% Protein**	**Test Weight** (kg/hl)	**Seed Weight** (g/1000)	**Maturity** (days)	**Height** (cm)	**Lodge** (1-5)
23-10RY	4307	17.1	33.2	70.9	196	114	93	1.0
22-60 RY	4529	17.2	32.4	69.9	157	114	88	1.0
23-11 RY	4312	17.0	32.3	71.5	150	115	104	3.0
23-60RY	4408	16.3	32.5	71.4	156	115	104	1.7
900Y61	3747	16.9	32.7	71.9	171	118	89	1.3
Akras R2	4470	15.9	32.3	71.7	151	116	95	2.0
Bishop R2	3597	17.8	32.2	71.7	152	113	88	2.3
CFS13.2.01 R2	3999	16.7	32.1	72.6	152	117	98	2.3
Hero R2	3932	17.0	33.5	70.6	165	120	93	3.3
HS 006RYS24	4264	15.8	33.2	71.6	177	117	111	2.7
LS 003R24N	4462	15.9	34.0	71.9	204	116	107	2.7
LS NorthWester	3647	18.6	32.1	71.6	159	115	117	1.7
LS002R24N	3998	16.0	32.6	70.8	178	116	108	2.3
Mahony R2	4967	17.7	32.9	69.0	159	115	99	2.3
McLeod R2	4062	16.4	33.3	71.1	183	116	103	1.7
Notus R2	4792	17.3	33.0	68.4	190	112	85	1.0
NSC Anola RR2Y	4389	17.3	33.1	70.2	157	119	94	1.0
NSC Gladstone RR2Y	4051	15.8	33.6	70.8	215	117	99	2.7
NSC Moosomin RR2Y	3455	18.6	31.0	70.7	154	112	84	1.0
NSC Reston RR2Y	4292	16.1	34.2	69.6	139	116	99	4.0
NSC Tilston RR2Y	4303	18.2	31.1	71.9	151	115	111	2.0
NSC Watson RR2Y	4021	19.4	30.5	71.0	174	111	92	1.0
P001T34R	3921	18.9	33.8	70.7	170	110	88	1.0
P002T04R	4012	18.0	33.1	71.9	161	112	92	1.0
P006T78R	4970	18.0	33.2	70.1	180	114	92	1.0
Pekko R2	4322	17.0	32.3	71.5	147	115	104	1.0
PRO 2525R2	3873	16.1	33.3	71.6	176	120	105	1.0
PS 0035 R2	4122	16.2	32.7	70.0	191	115	107	2.0
S0009-M2	4284	19.8	31.9	69.6	157	111	88	1.3
S007-Y4	4103	17.5	31.6	70.3	160	114	95	1.0
TH 32004R2Y	4603	17.7	32.2	70.9	164	115	99	1.3
TH 33003R2Y	4442	18.2	31.4	70.6	155	116	102	2.0
TH 33005R2Y	4328	15.6	33.0	72.0	166	121	106	2.3
TH 35002R2Y	4850	16.8	31.9	71.0	139	115	93	1.3
Vito R2	3857	18.3	32.9	72.9	152	116	105	2.3
LSD (0.05)	691	0.8	1.7	2.1	20	2.2	7.4	1.0
CV (%)	10.0	3.0	3.3	1.8	7.5	1.2	4.6	35.5

Table 3. Agronomics of WC Soybean Performance Evaluation—Irrigated vs Dry Land Soybean

System/Variety	Yield (kg/ha)	% Oil	% Protein	Test Weight (kg/hl)	Seed Weight (g/1000)	Maturity (days)	Height (cm)	Lodge (1-5)
Irrigated	4628	17.1	33.7	69.5	158	116	99	2.3
Dry Land	4220	17.2	32.6	71.0	166	115	98	1.8
LSD (0.05)	248	NS	1.08	NS	NS	NS	NS	0.2
CV (%)	9.4	3.0	3.2	2.1	6.9	1.3	6.6	49.8
Variety								
23-10RY	4600	16.7	34.3	71.5	189	114	95	1.2
22-60 RY	4673	17.0	33.1	70.2	144	114	90	1.2
23-11 RY	4395	17.1	32.7	70.5	147	116	105	2.3
23-60RY	4761	16.0	33.5	70.9	153	115	110	2.2
900Y61	4024	17.0	33.5	69.9	172	118	94	1.7
Akras R2	4622	15.8	32.5	71.7	146	117	96	2.2
Bishop R2	4131	17.3	33.5	71.4	153	113	94	2.7
CFS13.2.01 R2	4328	16.8	32.3	71.4	152	117	103	2.3
Hero R2	4291	16.9	34.3	68.7	163	120	96	3.7
HS 006RYS24	4519	16.0	33.7	70.2	174	118	112	3.0
LS 003R24N	4224	16.1	34.3	69.8	200	117	106	2.5
LS NorthWester	3977	18.1	33.5	70.2	158	117	112	2.3
LS002R24N	4313	16.3	32.7	70.2	175	116	107	2.2
Mahony R2	4777	17.9	32.8	69.2	158	116	99	2.5
McLeod R2	4326	16.6	33.5	70.2	180	115	106	1.8
Notus R2	4882	17.0	33.5	68.1	182	113	89	1.2
NSC Anola RR2Y	4227	17.7	32.7	69.9	149	118	89	1.0
NSC Gladstone RR2Y	4265	15.9	34.1	70.1	198	118	101	2.8
NSC Moosomin RR2Y	4011	17.8	32.7	70.4	146	112	85	1.0
NSC Reston RR2Y	4638	16.1	34.7	70.0	137	116	96	3.3
NSC Tilston RR2Y	4503	18.1	31.7	71.0	152	116	110	2.2
NSC Watson RR2Y	4382	19.0	31.4	70.3	175	111	94	1.7
P001T34R	4304	18.9	34.0	71.1	156	111	86	1.2
P002T04R	4129	18.3	33.0	70.6	146	112	92	1.0
P006T78R	5116	17.6	34.0	70.0	177	114	92	1.3
Pekko R2	4463	16.8	32.7	71.1	145	115	105	1.2
PRO 2525R2	4062	16.5	33.4	68.1	171	121	105	1.5
PS 0035 R2	3988	16.4	33.2	69.4	187	115	102	2.5
S0009-M2	4610	19.5	32.5	69.5	158	111	88	1.7
S007-Y4	4550	17.2	32.7	70.2	161	116	98	2.8
TH 32004R2Y	4611	17.6	32.6	70.4	158	116	100	1.5
TH 33003R2Y	4606	17.7	32.6	70.3	151	118	97	2.5
TH 33005R2Y	4630	16.0	33.2	70.2	170	121	106	2.7
TH 35002R2Y	4712	16.9	32.1	70.7	137	115	96	1.7
Vito R2	4175	18.2	33.3	71.5	148	116	107	2.7
LSD (0.05)	477	0.6	1.2	1.7	12.7	1.7	7.5	1.2
System x Variety Interaction								
LSD (0.05)	NS	S	NS	S	NS	NS	NS	NS

S = Significant NS = Not Significant

Irrigated Wheat, Barley and Oat Regional Variety Trials

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 ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

The Saskatchewan Variety Performance Group (SVPG) wheat, barley and oat regional trials were seeded between May 8 and 15. Plot size was 1.5 m x 4.0 m. Nitrogen fertilizer was applied to both trials at a rate of 110 kg N/ha as 46-0-0 as a sideband application and 30 kg P_2O_5/ha as 12-51-0 seed placed. 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 and 6-row barley. The durum study was duplicated at the CSIDC Off Station site (Knapik). The soft white spring wheat CWSWS Coop is not part of the SVPG program but rather a separate evaluation; it is included here for an inclusive cereal report. Weed control consisted of a post-emergence tank mix application of Bison (tralkoxydim) and Buctril M (bromoxynil +MCPA ester). An application of Headline EC (pyraclostrobin) fungicide was applied at the early flag leaf stage for suppression of leaf diseases. 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 was 65 mm at CSIDC and 92.5 mm at the off-station site.

Results

No results were obtained for the Hex 1 trial; during seeding a fertilizer setting was accidentally knocked open, resulting in a very high rate of N fertilizer being directed into a seed placed positon, which resulted in lost plots. Later, the test was subject to standing water, varieties lodged excessively, and whole plants were briefly submerged in pooled water. Analyses of variance procedures indicated such a high degree of variability as to make results of this trial unusable.

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

Results of these trials are used for registration purposes, to update the irrigation variety database at ICDC, to provide recommendations to irrigators on the best wheat and barley varieties suited to irrigation conditions, and will be used to update ICDCs annual *Crop Varieties for Irrigation* guide and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2016*.

Table 1. Saskatchewan Variety Performance Group Irrigated Hex 2 Wheat Regional Variety Trial—CSIDC

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*	***6825***	***100***	***14.9***	***74.0***	***33.3***	***51***	***97***	***79***	***2.3***
Canada Prairie Spring – Red (CPSR)									
AAC Crusader	7161	105	14.7	74.8	37.0	53	97	85	4.7
AAC Penhold	7140	105	14.4	76.6	37.8	54	97	73	1.7
AAC Ryley	7404	108	13.9	73.2	42.8	52	97	83	5.0
AAC Tenacious	5914	87	13.9	76.9	36.2	56	96	96	5.0
Enchant VB	6443	94	13.6	75.4	42.6	54	98	87	5.3
HY537	6738	99	14.6	75.3	38.7	54	98	86	5.7
SY995	6669	98	13.9	75.6	37.0	55	99	81	2.7
Canada Western Soft White Spring (CWSWS)									
AAC Chiffon	8405	123	12.4	75.9	40.8	57	101	94	5.3
AAC Indus	9178	134	12.0	75.2	39.2	61	105	94	1.7
SWS433	9754	143	12.4	77.4	39.2	56	98	90	2.7
Canada Western General Purpose (CWGP)									
AAC Foray VB	7146	105	14.5	76.9	43.4	56	99	87	5.7
AAC Innova	8059	118	12.4	76.1	37.9	59	101	84	3.3
AAC NRG097	6392	94	12.9	75.4	37.3	52	99	78	4.7
AAC Proclaim	6985	102	12.7	75.5	34.5	55	98	88	5.3
Elgin ND	6589	97	14.7	76.5	33.5	51	97	84	3.7
GP131	7355	108	14.0	76.1	39.5	55	101	89	5.0
Pasteur	7923	116	13.8	78.8	38.7	57	100	85	1.7
SY087	7607	111	14.9	76.2	34.3	53	98	84	4.7
WFT603	6501	95	13.7	75.6	41.9	56	102	91	4.3
LSD (0.05)	981		0.3	2.2	3.1	1.2	2.3	4.8	1.7
CV (%)	8.1		1.5	1.8	4.9	1.5	1.4	3.4	26.2

* Check Variety

Table 2. Soft White Spring Wheat Irrigated Coop Variety Trial—CSIDC

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	6364	78	14.4	76.3	34.1	52	97	79	3.5
AC Andrew (SWS 241)*	***8190***	***100***	***11.4***	***74.3***	***34.9***	***56***	***97***	***78***	***1.3***
AC Meena (SWS 234)	6662	81	10.9	73.3	33.3	56	97	78	5.0
AC Chiffon (SWS 408)	7848	96	11.5	75.4	40.8	57	98	89	4.3
Sadash (SWS 349)	7092	87	10.9	76.4	35.0	56	98	82	2.0
AAC Indus (SWS 427)	7510	92	11.3	76.5	37.8	58	100	87	2.8
SWS 447	8057	98	11.3	77.0	36.4	56	98	84	5.0
SWS 448	8329	102	10.9	76.6	37.8	57	99	84	3.0

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
SWS 450	7463	91	11.2	76.4	37.4	56	99	86	3.8
SWS 451	8000	98	10.9	76.9	36.9	57	98	84	1.8
SWS 452	7944	97	11.0	76.6	37.2	56	98	84	3.0
SWS 453	7600	93	11.1	76.4	36.9	56	98	82	4.3
SWS 454	7397	90	10.9	76.0	36.2	56	98	80	4.3
SWS 455	7600	93	11.2	76.3	36.9	56	98	82	4.5
SWS 456	7222	88	11.1	76.6	34.4	57	98	84	3.8
SWS 457	6112	75	11.4	76.6	32.5	56	98	76	3.0
SWS 458	7302	89	11.2	76.5	35.6	56	98	80	1.8
LSD (0.05)	770		0.4	0.7	1.9	0.7	1.0	3.7	1.6
CV (%)	7.3		2.3	0.6	3.7	0.9	0.7	3.1	3.3

* Check Variety

Table 3. Saskatchewan Variety Performance Group Irrigated CWAD Wheat Regional Variety Trial—CSIDC

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
Carberry	5175	101	15.3	78.2	33.9	52	98	78	2.0
Strongfield*	***5130***	***100***	***15.6***	***76.0***	***38.4***	***56***	***98***	***85***	***7.0***
AAC Cabri	6041	118	16.4	73.8	39.3	57	100	90	6.7
AAC Carbide VB	6080	119	15.7	75.1	38.5	56	98	91	7.0
AAC Current	5818	113	15.4	76.0	39.0	54	97	88	6.3
AAC Durafield	6707	131	15.6	76.8	41.1	56	99	86	5.0
AAC Marchwell VB	5319	104	16.2	74.7	36.2	56	99	87	6.7
AAC Raymore	5547	108	15.9	75.7	41.4	55	98	86	6.0
AAC Spitfire	6918	135	15.5	73.9	42.3	55	99	85	5.7
CDC Desire	6350	124	15.5	76.1	36.9	55	98	88	4.3
CDC Fortitude	5432	106	15.0	75.0	36.4	55	98	83	3.3
CDC Vivid	6566	128	15.4	75.9	41.1	56	99	92	2.7
DT577	7066	138	15.6	76.5	39.5	55	99	88	4.0
DT578	5656	110	15.9	75.8	38.1	56	98	91	5.0
DT579	6236	122	15.7	75.7	36.9	56	99	90	6.7
DT856	6936	135	15.5	76.2	39.2	56	99	88	6.7
LSD (0.05)	979		0.4	1.5	2.9	1.3	1.5	4.0	1.4
CV (%)	9.7		1.7	1.2	4.4	1.4	0.9	2.8	16.2

* Check Variety

Table 4. Saskatchewan Variety Performance Group Irrigated CWAD Wheat Regional Variety Trial—CSIDC Off Station

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
Carberry	3670	102	16.3	77.1	33.6	46	96	83	1.3
Strongfield*	***3613***	***100***	***17.3***	***71.4***	***34.6***	***54***	***94***	***90***	***6.3***
AAC Cabri	3969	110	16.8	72.9	34.4	57	97	89	6.3
AAC Carbide VB	3890	108	17.1	71.3	34.2	55	96	88	5.3

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
AAC Current	3407	94	17.2	71.6	34.0	54	94	92	4.3
AAC Durafield	3774	104	16.9	73.0	34.5	54	96	90	5.7
AAC Marchwell VB	2768	77	17.3	67.4	32.3	56	94	88	6.3
AAC Raymore	3101	86	17.7	69.1	36.6	53	93	91	5.3
AAC Spitfire	4015	111	17.0	71.0	34.5	56	94	86	5.7
CDC Desire	3325	92	17.2	71.8	34.3	54	94	85	4.3
CDC Fortitude	3348	93	16.8	71.4	34.5	56	97	85	4.0
CDC Vivid	3735	103	16.4	72.0	36.6	54	95	84	2.7
DT577	4362	121	16.3	74.7	35.4	54	97	88	4.7
DT578	4266	118	16.8	72.9	33.4	57	96	90	4.3
DT579	4017	111	17.1	71.9	35.5	55	96	90	5.7
DT856	4094	113	16.5	72.8	35.7	56	98	87	6.3
LSD (0.05)	578		0.3	2.0	1.9	1.7	2.0	4.9	2.0
CV (%)	9.3		1.2	1.6	3.3	1.8	1.2	3.4	24.5

* Check Variety

Table 5. Saskatchewan Variety Performance Group Irrigated CWAD Wheat Regional Variety trial—Combined Site Analysis

Location/ 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	6061		15.6	75.7	38.7	55	98	87	5.3
CSIDC Off Station	3710		16.9	72.0	34.6	55	95	88	4.9
LSD (0.05)	571		1.2	1.6	1.5	NS	0.0001	NS	NS
CV (%)	9.9		1.5	1.4	4.0	1.6	1.1	3.1	20.4
Variety									
Carberry	4422	101	15.8	77.6	33.8	49	97	81	1.7
Strongfield*	**4371**	**100**	**16.5**	**73.7**	**36.5**	**55**	**96**	**87**	**6.7**
AAC Cabri	5005	115	16.6	73.4	36.9	57	98	89	6.5
AAC Carbide VB	4985	114	16.4	73.2	36.4	55	97	90	6.2
AAC Current	4612	106	16.3	73.8	36.5	54	96	90	5.3
AAC Durafield	5240	120	16.3	74.9	37.8	55	97	88	5.3
AAC Marchwell VB	4044	93	16.7	71.0	34.3	56	96	88	6.5
AAC Raymore	4324	99	16.8	72.4	39.0	54	96	88	5.7
AAC Spitfire	5466	125	16.3	72.5	38.4	56	97	86	5.7
CDC Desire	4838	111	16.4	73.9	35.6	55	96	86	4.3
CDC Fortitude	4390	100	15.9	73.2	35.4	56	98	84	3.7
CDC Vivid	5151	118	15.9	74.0	38.8	55	97	88	2.7
DT577	5714	131	15.9	75.6	37.5	55	98	88	4.3
DT578	4961	113	16.3	74.3	35.8	57	97	91	4.7
DT579	5127	117	16.4	73.8	36.2	56	98	90	6.2
DT856	5515	126	16.0	74.5	37.5	56	99	87	6.5
LSD (0.05)	557		0.3	1.2	1.7	1.0	1.2	3.1	1.2
Location x Variety Interaction									
LSD (0.05)	S		S	S	S	S	1.1	S	NS

* Check Variety   S = Significant   NS = Not Significant

Table 6. Saskatchewan Variety Performance Group Irrigated 2-Row Barley Regional Variety Trial—CSIDC Site

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*	***5774***	***100***	***11.9***	***55.0***	***34.8***	***53***	***88***	***77***	***8.0***
AAC Synergy	6838	118	12.2	55.2	38.9	55	88	80	7.0
CDC PolarStar	5505	95	12.0	55.5	35.3	55	88	75	7.3
CDC PlatinumStar	6317	109	11.9	56.3	36.5	56	88	81	7.0
Feed-Hulled									
Amisk	6532	113	12.5	51.9	34.3	52	88	76	5.7
Canmore	5750	100	11.7	56.5	33.5	56	90	77	7.3
Feed-Hulless									
CDC Clear	5665	98	10.8	71.6	42.9	58	90	83	6.7
Forage									
CDC Maverick	4621	80	11.5	56.1	40.6	56	90	84	7.0
Experimental Entries									
TR10214	6274	109	11.6	56.1	39.1	57	88	75	7.0
TR11127	6151	107	12.0	55.1	36.8	57	88	76	7.0
TR12135	6882	119	12.0	55.3	39.3	56	88	79	6.3
TR12733	7434	129	12.7	55.5	37.0	57	88	75	8.0
TR12735	6124	106	12.4	56.4	38.8	57	89	70	7.7
TR13740	5930	103	12.5	57.6	38.7	55	89	73	7.3
LSD (0.05)	871		0.7	2.3	3.1	1.6	0.5	4.5	1.2
CV (%)	8.5		3.5	2.4	4.8	1.7	0.7	3.5	9.8

* Check Variety

Table 7. Saskatchewan Variety Performance Group Irrigated Oat Regional Variety Trial—CSIDC Off Station

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*	***5802***	***100***	***11.9***	***51.7***	***31.3***	***52***	***90***	***115***	***2.7***
AC Stride	5751	99	13.2	48.6	27.1	55	97	106	3.0
AAC Justice	6588	114	11.5	50.5	30.0	53	95	102	3.3
CS Camden	6803	117	12.5	48.0	32.1	52	90	103	2.3
CDC Haymaker	5698	98	12.8	41.2	34.8	56	100	105	2.7
CDC Ruffian	5993	103	12.8	48.6	31.4	53	92	97	5.0
Akina	6104	105	12.0	46.6	31.6	52	91	99	3.7
Bia	7143	123	12.5	46.5	29.6	55	92	110	5.7
Kara	6416	111	12.5	48.2	32.1	52	92	103	4.3
Nice	6133	106	12.5	50.2	33.8	52	90	111	3.0
OT3066	6115	105	12.5	45.7	30.3	52	96	110	3.0
LSD (0.05)	NS		0.7	1.3	2.9	1.0	1.3	6.7	1.2
CV (%)	10.9		3.1	1.5	5.5	1.1	0.8	3.7	20.7

* Check Variety   NS = Not Significant

ICDC Irrigated Wheat Variety Trial

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 ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

The irrigated wheat variety trials were conducted at two locations in the Outlook area. The sites and soil types were as follows:

- CSIDC (SW15-29-08-W3): Bradwell loam – silty loam (Field #110)
- CSIDC Off Station (NW12-29-08-W3): Asquith sandy loam (Knapik SW quadrant)

Twenty spring wheat varieties of different market classes and two durum varieties were tested for their agronomic performance under irrigation. The CSIDC site was seeded on May 8, and the CSIDC Off Station site was seeded on May 15. Plot size was 1.5 m x 4.0 m. The seed was treated with Cruiser Maxx Cereals (thiamethoam + difenoconazole + metalaxyl-M) for seed and soil-borne disease and wireworm control. Nitrogen fertilizer was applied to both trials at a rate of 110 kg N/ha as 46-0-0 as a sideband application and 30 kg P_2O_5/ha as 12-51-0 seed placed. Weed control consisted of a post-emergence tank mix application of Bison (tralkoxydim) and Buctril M (bromoxynil +MCPA ester). An application of Headline EC (pyraclostrobin) fungicide was applied at the early flag leaf stage for suppression of leaf diseases. Proline 480 SC (prothioconazole) was applied at approximately 75% heading to suppress 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%. Total in-season irrigation was 65 mm at CSIDC.

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.

Within the CWRS market class the check variety, Carberry, was the highest yielding variety in the CSIDC trial and was statistically higher yielding than AAC Prevail VB and CDC Plentiful within this class. CWSWS variety AAC Chiffon was the highest yielding spring wheat and was statistically higher than all other varieties. CWRS variety CDC Plentiful VB was statistically lower yielding than all other varieties in the test at this location. At the CSIDC Off Station trial, no CWRS variety was statistically higher yielding than Carberry (the check). At the CSIDC Off Station trial, CWSWS variety AAC Chiffon was statistically higher yielding compared to all varieties within the trial. Median grain yield at CSIDC was 5992 kg/ha and at CSIDC Off Station was 4563 kg/ha. Other agronomic differences measured within sites are shown in their respective tables but will not be discussed.

Combined site analysis of the two trials is outlined in Table 3. Mean yield of the CSIDC site was 22% greater than yield obtained at the CSIDC Off Station site. Partial reasons for this wide yield difference include a later seeding date, lighter soil texture, and less irrigation. On combined analysis, CDC Plentiful was statistically lower yielding than other CWRS varieties. All varieties with a yield less than 4900 kg/ha were statistically lower yielding than the check variety, Carberry. The highest yielding entry on combined site analysis was CWSWS AAC Chiffon, which was statistically higher yielding than all other varieties. CWRS variety CDC Plentiful was the lowest yielding.

The lower yielding off station location had higher protein produced in seed than the higher yielding CSIDC trial. Within varieties, the CWRS class and durum had higher protein content, as might be expected. Test weight and seed weight varied within and between classes. The check variety, AC Carberry, was the first to head, CWGP variety AAC Innova the latest to head and to mature. The CWHWS varieties, AAC Whitefox and Whitehawk, were the earliest-maturing varieties. AAC Penhold was the shortest variety and AAC Whitefox the tallest. The short stature variety, AAC Penhold, had the greatest observed lodging resistance; AAC Plentiful and AAC Current exhibited the greatest degree of lodging.

Results from these trials are used to update the irrigation variety database at ICDC and provide recommendations to irrigators on the best wheat varieties suited to irrigation conditions. These results will be used to update ICDCs annual *Crop Varieties for Irrigation* guide and the Saskatchewan Ministry of Agriculture's *Varieties of Grain Crops 2016.*

Tables begin on the next page.

Table 1. Yield and Agronomic Data for the ICDC Irrigated Wheat Variety Trial—CSIDC

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 (check)	***6375***	***100***	***14.4***	***76.6***	***36.1***	***52***	***97***	***77***	***2.8***
AAC Elie	5850	92	14.9	76.4	35.0	53	98	73	4.0
AAC Prevail VB	5539	87	14.8	75.7	35.1	55	98	90	4.0
CDC Plentiful	4456	70	15.0	75.3	31.3	53	97	83	6.0
Canada Western Amber Durum (CWAD)									
Strongfield	5105	80	14.5	75.2	41.2	55	98	82	5.0
AAC Current	5308	83	14.5	75.8	42.6	54	98	89	5.5
AAC Marchwell VB	5466	86	15.4	73.7	39.0	57	96	85	5.5
AAC Spitfire	6731	106	14.6	75.1	44.7	55	98	84	3.8
AAC Raymore	5392	85	14.7	75.6	43.1	55	98	90	4.8
Canada Prairie Spring Red (CPSR)									
AAC Foray	6670	105	13.1	74.6	43.3	56	98	82	2.8
AAC Penhold	6533	102	13.4	75.8	38.4	55	98	72	1.5
AAC Ryley	6195	97	13.7	71.3	40.8	54	97	82	6.0
Canada Western General Purpose (CWGP)									
AAC Innova	7046	111	12.2	73.6	38.8	59	99	82	2.5
Canada Western Soft White Spring (CWSWS)									
AAC Chiffon	7989	125	11.6	74.7	40.8	56	99	90	4.5
Canada Western Hard White Spring CWHWS)									
AAC Whitefox	5970	94	13.9	76.2	37.6	51	96	90	2.5
AAC Whitewood	5448	85	14.0	75.2	34.3	52	96	82	3.3
Whitehawk	5327	84	14.8	76.3	34.3	51	96	86	1.7
Presently Unregistered									
CN Prosper	7064	111	13.0	76.4	39.3	55	97	80	3.0
Elgin ND	5983	94	14.1	75.3	34.3	53	98	83	2.8
Faller ND	7197	113	13.4	76.0	38.9	54	98	84	4.5
LSD (0.05)	664		0.6	1.0	2.7	1.1	0.98	4.7	1.7
CV (%)	7.4		3.0	0.9	4.8	1.4	0.7	3.8	30.0

Table 2. Yield and Agronomic Data for ICDC Irrigated Wheat Variety Trial—CSIDC Off Station

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 (check)	***4198***	***100***	***16.2***	***78.2***	***35.0***	***50***	***96***	***79***	***2.0***
AAC Elie	4006	95	16.4	76.7	33.3	53	97	81	2.5
AAC Prevail VB	4197	100	16.0	77.0	32.0	54	95	95	4.0
CDC Plentiful	4202	100	16.2	78.2	31.3	53	93	90	4.5
Canada Western Amber Durum (CWAD)									
Strongfield	3988	95	16.7	71.9	37.3	56	97	89	5.0
AAC Current	3621	86	17.1	71.8	35.8	54	95	92	5.0
AAC Marchwell VB	3554	85	16.3	69.4	35.5	57	97	81	3.8
AAC Spitfire	5347	127	15.7	72.6	36.8	56	98	86	2.8
AAC Raymore	3741	89	17.0	71.6	37.8	54	96	85	4.8
Canada Prairie Spring Red (CPSR)									
AAC Foray	5346	127	14.8	76.2	41.5	56	97	87	2.0
AAC Penhold	5344	127	15.4	78.7	40.1	52	97	78	1.3
AAC Ryley	5225	124	14.7	74.6	43.1	54	98	83	1.8
Canada Western General Purpose (CWGP)									
AAC Innova	6087	145	12.4	73.1	34.5	62	99	91	1.5
Canada Western Soft White Spring (CWSWS)									
AAC Chiffon	6717	160	12.4	73.9	35.7	58	98	86	1.8
Canada Western Hard White Spring CWHWS)									
AAC Whitefox	4631	110	15.4	78.5	35.1	52	92	97	5.3
AAC Whitewood	3783	90	16.3	77.2	34.0	53	94	82	2.5
Whitehawk	4033	96	15.4	78.3	31.4	52	93	96	2.5
Presently Unregistered									
CN Prosper	5592	133	14.7	77.2	35.1	54	97	85	3.3
Elgin ND	4788	114	16.1	77.1	34.0	53	97	87	2.5
Faller ND	5910	141	14.9	77.7	31.4	53	97	91	2.5
LSD (0.05)	514		0.4	1.7	1.9	1.1	1.6	5.6	1.9
CV (%)	7.7		2.0	1.6	3.8	1.4	1.1	4.5	41.9

Table 3. Yield and Agronomic Data for ICDC Irrigated Wheat Variety Trial—Combined Site Analysis

Location/ 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
CSIDC	6082		14.0	75.2	38.4	54	97	83	3.8
CSIDC Off Station	4715		15.5	75.5	36.0	54	96	87	3.1
LSD (0.05)	603		1.3	NS	1.1	NS	0.7	NS	NS
CV (%)	7.6		2.5	1.3	4.3	1.4	0.9	4.2	35.4
Variety									
Canada Western Red Spring (CWRS)									
Carberry (check)	***5286***	***100***	***15.3***	***77.4***	***35.5***	***51***	***96***	***78***	***2.4***
AAC Elie	4928	93	15.6	76.6	34.2	53	97	77	3.3
AAC Prevail VB	4868	92	15.4	76.4	33.5	54	96	93	4.0
CDC Plentiful	4329	82	15.6	76.8	31.3	53	95	87	5.3
Canada Western Amber Durum (CWAD)									
Strongfield	4546	86	15.6	73.5	39.3	55	97	86	5.0
AAC Current	4464	84	15.8	73.8	39.2	54	96	90	5.3
AAC Marchwell VB	4510	85	15.8	71.5	37.2	57	97	83	4.6
AAC Spitfire	6039	114	15.1	73.8	40.8	55	98	85	3.3
AAC Raymore	4567	86	15.8	73.6	40.5	54	97	87	4.8
Canada Prairie Spring Red (CPSR)									
AAC Foray	6008	114	13.9	75.4	42.4	56	97	85	2.4
AAC Penhold	5938	112	14.4	77.3	39.2	54	97	75	1.4
AAC Ryley	5710	108	14.2	73.0	41.9	54	97	83	3.9
Canada Western General Purpose (CWGP)									
AAC Innova	6567	124	12.3	73.4	36.7	60	99	86	2.0
Canada Western Soft White Spring (CWSWS)									
AAC Chiffon	7353	139	12.0	74.3	38.2	57	99	88	3.2
Canada Western Hard White Spring CWHWS)									
AAC Whitefox	5301	100	14.7	77.3	36.4	51	94	93	3.9
AAC Whitewood	4615	87	15.1	76.2	34.1	52	95	82	2.9
Whitehawk	4680	89	15.1	77.3	32.8	51	94	91	2.1
Presently Unregistered									
CN Prosper	6328	120	13.8	76.8	38.9	54	97	83	3.1
Elgin ND	5386	102	15.1	76.2	33.9	53	97	85	2.6
Faller ND	6554	124	14.2	76.8	38.5	53	97	87	3.5
LSD (0.05)	413		0.4	1.0	1.6	0.7	0.9	3.6	1.3
Location x Variety Interaction									
LSD (0.05)	S		S	S	S	0.0001	0.0001	0.0002	0.0009

S = Significant NS = Not Significant

Alberta Corn Committee Hybrid Performance Trials

Project Lead

- Garry Hnatowich
- Co-investigator: Dr. B. Beres, AAFC Lethbridge Research Centre

Organizations

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

Project Objective

The objectives of this study were to:

- Evaluate the potential of corn grain and silage hybrids for production in the irrigated west-central region of Saskatchewan; and
- Create a data base on grain and silage corn for ICDCs annual *Crop Varieties for Irrigation* guide.

Research Plan

The Alberta Corn Committee (ACC) grain and silage hybrid performance trials were established in the spring of 2015 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 specially designed small plot, six row, double 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. Treatments consisted of selected corn hybrids with varying corn heat unit maturity ratings. The corn was seeded at 75 cm row spacing. Two rows were seeded per pass. The grain corn plots consisted of four rows and measured 3 m x 6 m, while the silage corn plots consisted of two rows and measured 1.5 m x 6 m. A seeding rate of ~59,000 plants/ha and ~74,000 plants/ha were used for grain and silage corn, respectively. Separate trials were established for grain and silage corn hybrids. The treatments were arranged in a randomized complete block design and replicated four times.

The trials were seeded on May 21. Fertilizer was broadcast and incorporated prior to seeding at a rate of 160 kg N/ha as Urea (46-0-0), and an additional 40 kg N/ha was side banded at seeding. As well, phosphorus fertilizer was side band applied at a rate of 40 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) supplemented by hand weeding.

Ears of all plants of the centre two rows of grain corn were hand harvested at maturity. The silage trial was harvested with a forage harvest combine, wet field yield was recorded, and subsamples of chopped material sampled for processing. Silage grain was harvested September 16 and grain corn on October 6.

Growing season rainfall (May 15 to September 30) and irrigation was 272 mm and 83 mm, respectively. Cumulative corn heat units (CHU) were 2444 for the period May 15–September 30. Climatic conditions in 2015 were slightly warmer and wetter than historic norms.

Grain Corn

Twenty-one grain corn hybrids were tested, and agronomic measurements are shown in Tables 1 and 2.

Grain corn yield was very high; median yield of all hybrids was 11339 kg/ha (181 bu/ac), ranging from a low of 9571 kg/ha (152.4 bu/ac) to 12640 kg/ha (201.4 bu/ac). All the hybrids had oil content greater than 3.5%, which is generally the lower limit of normal corn oil content. Oil content ranged from 3.75% to 4.75%, with a median of 4.20%. Protein ranged from 9.1% to 10.5%, with a median level of 9.8%. Starch ranged from 70.2% to 71.4%, with a median level of 70.9%. Both test weight and seed weight varied widely between hybrids; median test weight was 76.8 kg/hl and thousand seed weight of 239 g/1000 seed. Final plant stand did differ between hybrids, with a median population of 82222 plants/ha. Why these differences occurred is unclear.

Silage Corn

Fifteen silage corn hybrids were tested, and agronomic measurements are shown in Table 3.

Dry yield did not statistically differ between hybrids, ranging from 19.9–23.2 T/ha. Hybrid 4093 was the lowest yielding, and HL R219 the highest yielding. Moisture content at harvest was above the recommended range of 55–65%. Harvest was conducted at this stage, when most hybrids exhibited the milk line halfway down the kernel. Plant stand ranged from 78,000– 97,000 plants/ha, exceeding the targeted plant population of 74,000 plants/ha. Differences in plant populations between hybrids were not statistically significant. Seed was weighed and sent by ACC; these high populations will require discussion with ACC in future years.

Results from these trials are posted on the Alberta Corn Committee website at www.albertacorn.com.

Table 1. Alberta Corn Committee Irrigated Grain Corn Hybrid Performance Trial—CSIDC Site

Hybrid	Yield @ 15.5% Moisture (kg/ha)	Yield @ 15.5% Moisture (bu/ac)	Oil (%)	Protein (%)	Starch (%)
Focus GT	9596	152.9	4.43	10.5	70.2
13B 3110	11224	178.7	4.25	10.1	71.0
Magnum 3111	10900	173.7	4.38	10.3	70.3
DKC23-17	11478	182.8	4.05	9.6	71.1
DKC26-28RIB	12005	191.1	4.08	9.4	71.4
DKC30-07RIB	12109	192.8	3.75	9.9	71.3
A4025G3RIB	9571	152.4	4.48	10.3	70.8
XP4199	11942	190.1	3.98	9.5	70.7
TH7578VT2P	11985	190.9	3.90	9.2	71.1
TH7574VT2P	11620	185.0	4.15	9.6	71.2
EXP73VT2P	11441	182.3	4.00	9.8	70.7
E46J77R	11269	179.6	4.30	10.3	70.5
E47A12R	12640	201.4	4.75	9.6	70.4
BAXXOS RR	12306	195.9	4.75	10.4	70.5
4078	10193	162.4	4.28	10.4	70.5
3085	10555	168.2	4.38	9.7	70.8
P7005AM	11193	178.3	4.65	10.0	70.5
39B90	11554	184.0	4.03	9.1	71.4
P7211HR	11235	179.0	4.13	9.6	70.8
P7213R	10795	172.1	4.23	9.5	71.0
P7332R	11222	178.7	4.03	9.2	71.1
LSD (0.05)	1089	17.4	0.20	0.4	0.8
CV (%)	6.8	6.8	3.90	2.7	0.8

Table 2. Alberta Corn Committee Irrigated Grain Corn Hybrid Performance Trial—CSIDC Site

Hybrid	Test Weight (kg/hl)	Seed Weight (g/1000)	Plant Stand (#/ha)
Focus GT	72.1	216	76667
13B 3110	75.3	212	91389
Magnum 3111	81.2	222	83333
DKC23-17	77.9	248	85278
DKC26-28RIB	74.6	253	81111
DKC30-07RIB	73.1	216	86944
A4025G3RIB	77.1	193	77778
XP4199	78.4	258	89167
TH7578VT2P	76.2	263	78889
TH7574VT2P	78.2	252	67778
EXP73VT2P	80.6	244	78611
E46J77R	80.0	233	85555
E47A12R	73.2	236	89722
BAXXOS RR	76.8	238	91111
4078	74.2	230	75833
3085	73.4	237	88611
P7005AM	78.9	227	84722
39B90	80.6	262	78334

Hybrid	Test Weight (kg/hl)	Seed Weight (g/1000)	Plant Stand (#/ha)
P7211HR	75.9	263	75000
P7213R	80.5	231	83333
P7332R	73.4	248	72222
LSD (0.05)	2.9	19.4	12197
CV (%)	2.7	5.8	10.5

Table 3. Alberta Corn Committee Irrigated Silage Corn Hybrid Performance Trial—CSIDC

Hybrid	Dry Yield (T/ha)	Dry Yield (T/ac)	Plant Stand (#/ha)	Harvest Whole Plant Moisture (%)
Focus GT	22.30	9.03	79444	74.3
DKC27-55RIB	22.53	9.11	93611	73.2
DKC30-07RIB	21.85	8.84	85556	76.2
A4705HMRR	22.89	9.27	78333	74.3
TH4126RR	22.34	9.04	85278	75.8
THEXP81VT2P	23.11	9.35	84722	75.8
PS 2210VT2P RIB	22.23	8.99	79445	74.8
PS 2348VT2P RIB	22.55	9.12	85000	74.8
BAXXOS RR	21.74	8.79	85278	73.5
3085	21.30	8.62	90833	75.6
4093	19.92	8.06	85834	75.8
X13002S2	21.73	8.79	96945	76.2
HL R219	23.25	9.41	83889	73.7
X14008GH	20.60	8.34	89167	78.0
4164	23.14	9.36	86667	75.6
LSD (0.05)	NS	NS	NS	1.7
CV (%)	7.50	7.50	1.0	1.6

NS = not significant

FIELD CROPS

Soybean Row Spacing and Plant Population Study

Principal Investigator

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

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Agriculture Development Fund
- Western Grains Research Foundation

Objectives

The objectives of this study were to determine optimal soybean seeding rates for both irrigated solid seeded and row cropped production.

Research Plan

The trial was established at CSIDC and the variety 23-10RY treated with Cruiser Maxx Vibrance Beans (thiamethoxam, metalaxyl-M, fludioxonil and sedaxane) was used in both production systems. All seed was pre-packaged by weight after adjusting for seed weight, % germination, and assuming a 90% seedling survival. The trial was established in a randomized split plot design with four replications. Row spacing of the main plots was 25 or 50 cm. Sub-plots were assigned target plant populations starting at 300,000 plants/ha and increasing at 100,000 plants/ha increments to 700,000 plants/ha. Prior to seeding, the plots were worked with a heavy harrow to encourage soil surface exposure to warm the soil. The trial was seeded on May 22. At seeding, all treatments received a side band application of 25 kg P_2O_5/ha and seed-placed granular inoculant at an above recommended rate of 12 kg/ha. Plots were maintained weed free by a pre-plant burn-off and two post-emergent glyphosate applications. Quadris (azoxystrobin) was applied at the R2 stage. The harvest area was 1.5 x 8.0 m and plots were combined with a Wintersteiger plot combine when the plants were dry enough to thresh and seed moisture content was < 20%. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser.

Results

Agronomic data collected is shown in Table 1. Per cent emergence of target population for each row spacing is illustrated in Figure 1. Final plant establishment was higher than target for all treatments. Seed rate was adjusted to assume 10% seed/seedling mortality; the results suggest that this assumption in 2015 was not required. Actual plant population versus targeted plant population is graphically illustrated in Figure 2.

In 2015, row cropping soybeans at 50 cm (row spacing similar to that typically used in irrigated dry bean production in Saskatchewan) was statistically lower-yielding than solid seeded soybean.

Narrow or solid-seeded row production was 12% higher in yield than the wide row system. A portion of this yield increase might be associated with the higher plant populations achieved in the narrow rows. On average, final plant populations of the narrow row production system was 4% higher than the population achieved in narrow row production. Soybean emergence and seedling growth early in June was associated with low seasonal rainfall. Irrigation (25 mm) was applied to the trial in late May to assist emergence and establishment; no irrigation was applied in June, as the crop did not exhibit indications of drought stress. It is possible, however, that during this period the solid seeded system had higher water use efficiency due to less evapotranspiration from soil between rows, thereby contributing to higher yields.

Mean yield increased significantly for plant populations above 300,000 plants/ha. Row spacing response was similar among each plot, as graphically shown in Figure 3. Analysis of variance procedures indicate that there was not a significant interaction between row spacing and plant populations, indicating that both row spacing sizes responded in the same manner to higher plant populations.

Neither row spacing nor plant population had an impact on measured seed quality parameters (% oil, % protein, test weight or thousand seed weight) or plant height.

Conclusions based upon a single year's trial cannot be made. This concludes the second year of a three-year study. It appears that with soybean, as all other crops, establishing ideal plant populations will be critical for successful agronomic production. This trial will be repeated in 2016.

Table 1. Effect of Row Spacing and Plant Population on Agronomic Measurements, 2015

Treatment	**Yield** (kg/ha)	**Yield** (bu/ac)	**Oil** (%)	**Protein** (%)	**Test weight** (kg/hl)	**Seed weight** (mg)	**Height** (cm)	**Final Plants** (ha)	**Final Plants** (ac)
25 cm	4165	61.9	16.5	34.9	71.1	168	91	566500	229352
50 cm	3723	55.3	16.6	35.1	70.7	180	91	543458	220024
LSD (0.05)	244	3.7	NS	NS	NS	NS	NS	NS	NS
CV	8.4	8.4	2.1	2.0	0.8	5.8	3.7	11.5	11.5
Plant Population									
300,000	3486	51.8	16.5	34.9	71.0	172	91	354583	143556
400,000	3897	57.9	16.6	34.7	70.8	168	91	463959	187838
500,000	4149	61.7	16.6	35.2	70.7	178	92	561458	227311
600,000	3974	59.1	16.6	34.9	71.1	174	91	629479	254850
700,000	4214	62.6	16.5	35.3	70.8	177	92	765417	309885
LSD (0.05)	342	5.1	NS	NS	NS	NS	NS	66115	26767
Row Spacing x Plant Population									
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = not significant

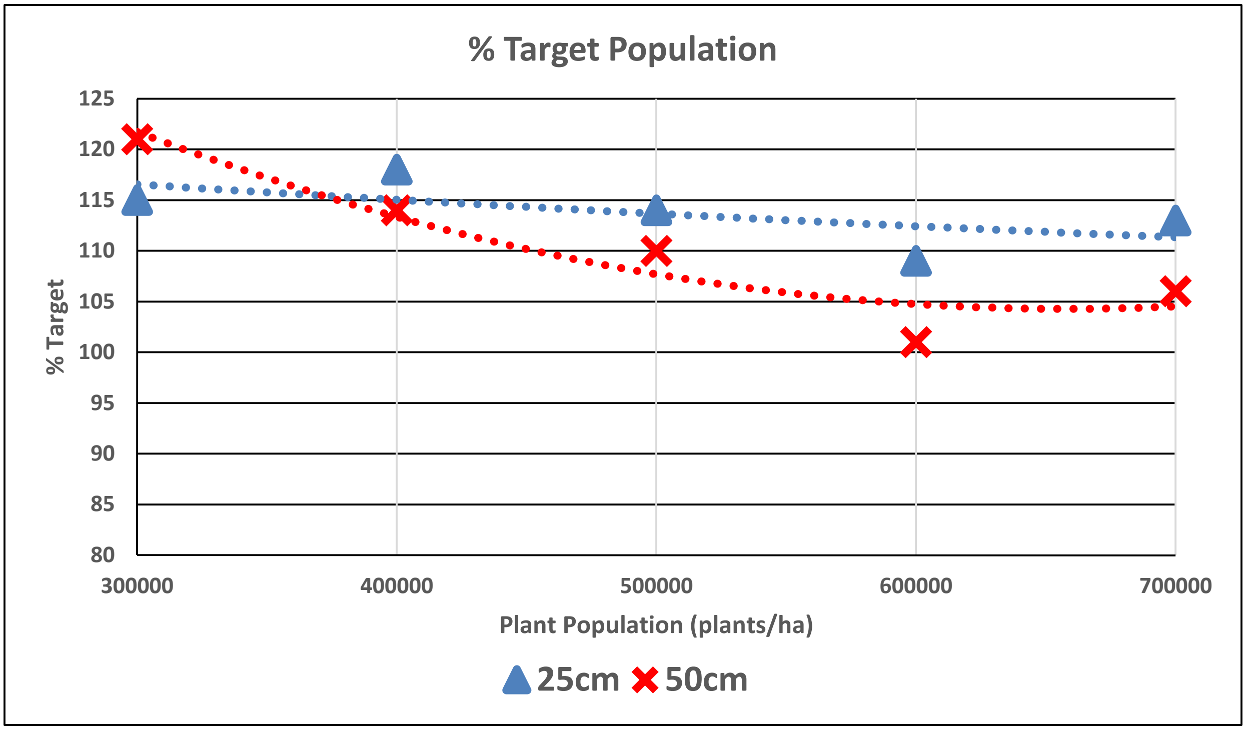


Figure 1. Effect of row spacing and plant population on % target emergence.

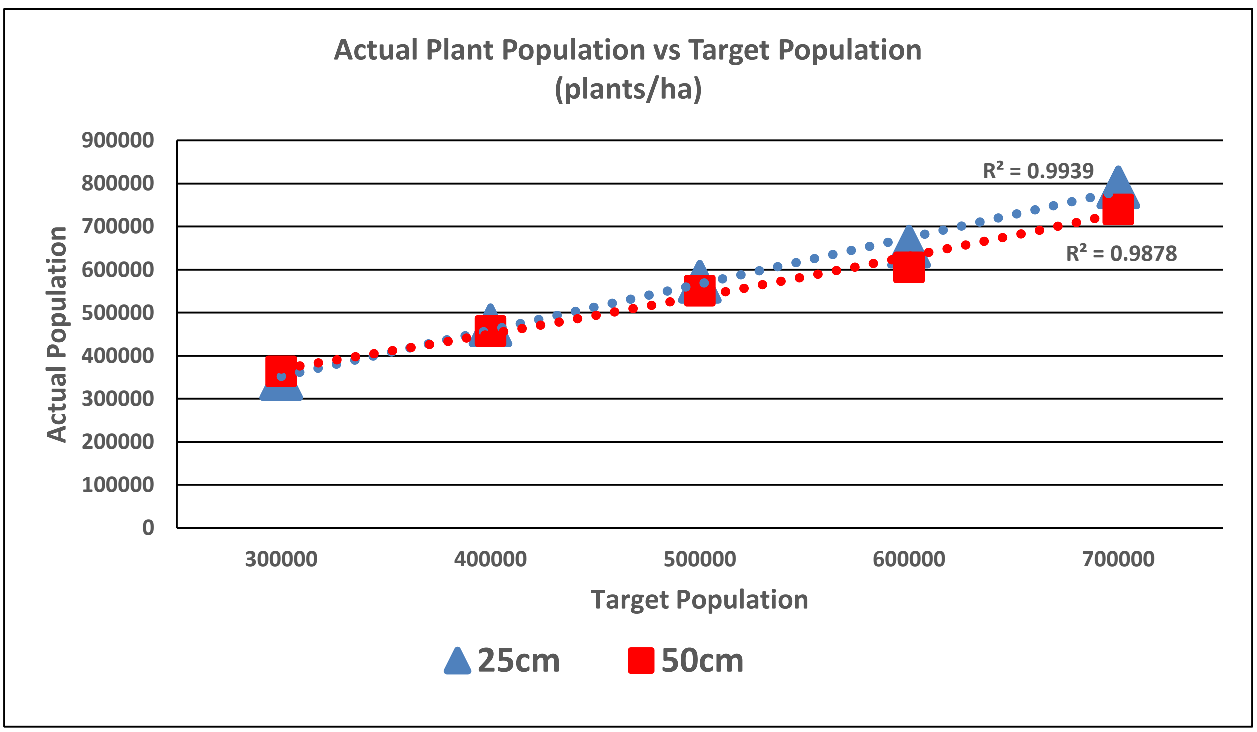


Figure 2. Effect of row spacing and target plant population on stand establishment.

Soybean Seeding Date & Seed Treatment Study

Principal Investigator

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

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)
- Science and Technology Branch, Agriculture and Agri-Food Canada (AAFC)

Objectives

The objectives of this study were to determine optimal soybean seeding date ranges and the effect dates have on yield and seed quality.

Research Plan

The trial was established at CSIDC. The soybean variety 23-10RY 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 445,000 plants/ha. The trial was established in a randomized split plot design with four replications. Main plot planting dates were: May 7, May 14, May 21, May 28, June 4, and June 11. Subplots within each planting date was bare untreated seed or seed treated with Cruiser Maxx Vibrance Beans (thiamethoxam, metalaxyl-M, fludioxonil and sedaxane). Prior to seeding, the plots were worked with a heavy harrow to encourage soil surface exposure to warm the soil. All treatments received a side band application at seeding of 15 kg P_2O_5/ha and seed-placed granular inoculant at an above recommended rate of 12 kg/ha. Plots were maintained weed free by a pre-plant burn-off and two post-emergent glyphosate applications. Quadris (azoxystrobin) was applied at the R2 stage. Prior to combining, 10 plants from each plot were cut at the soil surface and pod counts and pod clearance determined. Harvest area was 1.5 x 8.0 m and plots were combined with a Wintersteiger plot combine when the plants were dry enough to thresh and the seed moisture content was < 20%. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser.

Results

Agronomic data collected for seed yield and seed quality are shown in Table 1. Mean seed yield continued to increase with each seeding date until the last date in May and then began leveling. Yields obtained for the May 7 and May 14 planting dates were statistically lower than the last four seeding dates, the last four dates did not differ statistically in yield from each other. Early planting dates (May 7 and 14) were planted into cool soils and environmental temperature conditions remained below historic norms for the month. Ramifications of this will be discussed below. Statistically, seed treatment had a significant impact on mean seed yield: mean seed treatment yield was 147% of bare seed yield. Analysis of variance procedures indicated no interaction between seeding date and seed treatment. The effect of both seeding dates and seed treatments on yield is illustrated in Figure 1. Seed oil content decreased with each seeding date, while seed protein was not influenced by seeding date. Test weight generally increased with each delay in seeding date, and although not statistically significant, seed weight also increased. The mean effect of seed treatment was to decrease oil and increase protein; seed treatment had no effect on test weight or seed weight.

Agronomic observations on soybean growth are shown in Table 2. Plant height statistically increased such that May 7 and 14 < May 21 < May 28, June 4, and 11. Treated seed produced significantly taller plants than bare seed, analysis of variance procedures indicated a significant seeding date by seed treatment interaction, the majority of height difference between bare and treated seed occurred with the May seeding dates. Target plant population for all treatments was 450,000 plants/ha. Plant establishment with the first three seeding dates was generally significantly lower than the last three seeding dates. Treated seed produced statistically higher plant populations than bare seed. The effect of planting dates and seed treatment on plant population is illustrated in Figure 2. The greatest benefits on plant populations occurred with the May planting dates, these benefits declined as temperatures improved and no benefit was derived from seed treatment for the June plantings. In effect, the seed treatment protected the May plantings from adverse conditions. Seed planted on May 7 and 14 did not begin to emerge at approximately the same time as the May 21 planting date. During that period, seed without seed treatment was observed to rot and was also adversely affected by wireworms. Seed treatment protected against these negative factors and provided final plant establishment stability across seeding dates.

Table 1. Effect of Seeding Dates and Seed Treatment on Yield and Seed Quality

Treatment	**Yield** (kg/ha)	**Yield** (bu/ac)	**Oil** (%)	**Protein** (%)	**Test Weight** (kg/hl)	**Seed Weight** (mg)
Seeding Date						
May 7	1719	25.5	17.2	35.7	70.3	178
May 14	1623	24.1	17.1	35.7	70.4	179
May 21	2344	34.8	16.7	35.9	71.3	176
May 28	2537	37.6	16.1	35.7	71.8	171
June 4	2621	39.0	15.6	36.0	71.6	169
June 11	2377	35.4	15.0	35.7	72.3	163
LSD (0.05)	499	7.4	0.18	NS	0.4	NS
CV	30.0	30.0	1.5	1.3	0.6	6.7
Seed Treatment						
Bare seed	1782	26.5	16.4	35.5	71.3	171
Treated seed	2625	39.0	16.2	36.1	71.3	174
LSD (0.05)	401	5.9	0.15	0.3	NS	NS
Seeding Date x Seed Treatment						
LSD (0.05)	NS	NS	NS	S	NS	NS

S = significant NS = not significant

The ten harvested plants collected from each plot were used to estimate the total number of pods produced per plant and this was extrapolated to the number of pods/ha. These same samples were also used to estimate pod clearance. Pod clearance is defined as the distance between the soil surface and the bottom of the lowest pod. If pod clearance is less than 31.25 mm (1.25”), it is likely the combine cutter bar would shatter these pods, resulting in harvest loss. The effect of seeding date and seed treatment on pod clearance is shown in Figure 3. The number of "problematic" pods declines significantly with delays in seeding, until the third week of May, in particular with bare seed; later seeding's did not differ greatly in the number of pods of poor clearance.

Table 2. Field Observations of Seeding Dates on Soybean Growth

Treatment	Height (cm)	% Target Population	Plant Population (plants/ha)	*Pod Clearance
Seeding Date				
May 7	49	71	316,979	3.0
May 14	49	62	280,000	3.5
May 21	54	68	307,917	2.7
May 28	58	80	360,104	1.6
June 4	61	93	418,646	1.0
June 11	60	89	401,667	0.7
LSD (0.05)	3.6		45,405	1.1
CV	10.3		32	53.8
Seed Treatment				
Bare seed	53	60	268854	2.9
Treated seed	58	95	426250	1.3
LSD (0.05)	3.4		67578	0.7
Seeding Date x Seed Treatment				
LSD (0.05)	10.3		NS	53.8

* Pod Clearance = # pods per plant with < 31.25 mm from the bottom of the pod to soil surface

S = significant NS = not significant

Table 3. Effect of Seeding Date and Seed Treatment on Plant Pod Production

Treatment	1 Seed/Pod (# pods/ha)	2 Seed/Pod (# pods/ha)	3 Seed/Pod (# pods/ha)	4 Seed/Pod (# pods/ha)	Total Pods (pods/ha)
Seeding Date					
May 7	564,250	1.79 E+06	4.80 E+06	167,302	7.32 E+06
May 14	446,771	1.65 E+06	3.91 E+06	133,073	6.14 E+06
May 21	617,896	2.04 E+06	5.25 E+06	216,667	8.13 E+06
May 28	635,708	2.36 E+06	5.77 E+06	277,875	9.05 E+06
June 4	666,875	2.20 E+06	5.71 E+06	189,448	8.77 E+06
June 11	964,792	2.35 E+06	5.20 E+06	222,083	8.74 E+06
LSD (0.05)	NS	NS	1.16 E+06	NS	1.87 E+06
CV	44.3	33.4	29.5	41.6	28.5
Seed Treatment					
Bare seed	545,965	1.88 E+06	4.57 E+06	178,042	7.17 E+06
Treated seed	752,799	2.25 E+06	5.65 E+06	224,108	8.88 E+06
LSD (0.05)	174,530	NS	914,738	NS	1.39 E+06
Seeding Date x Seed Treatment					
LSD (0.05)	NS	NS	NS	NS	NS

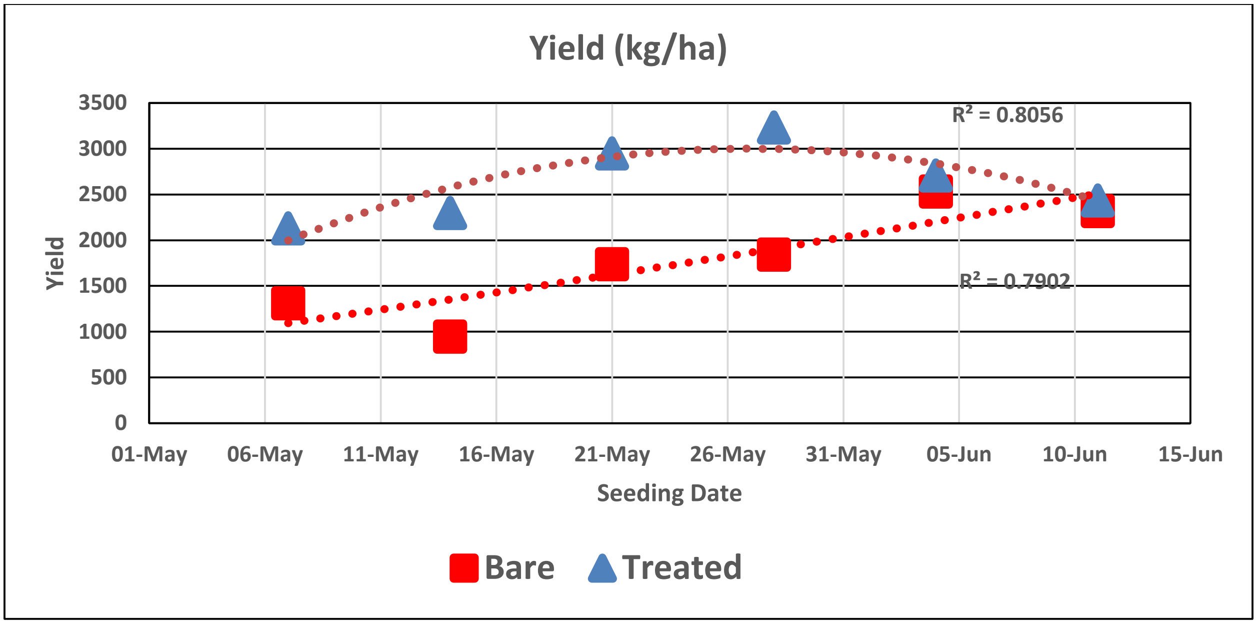


Figure 1. Effect of seeding date and seed treatment on grain yield.

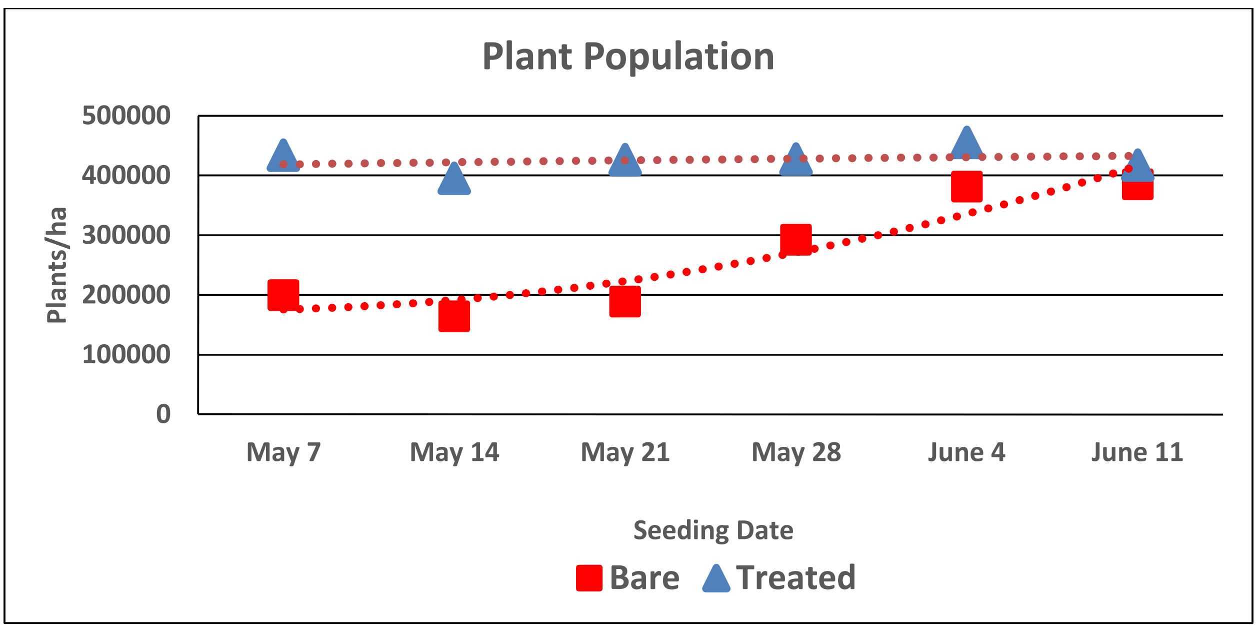


Figure 2. Effect of seeding date and seed treatment on plant establishment.

The effect of seeding date and seed treatment on pod production is shown in Table 3. In general, the mean effect of seeding date was increased pod formation and development for seeding dates after May 14. Total pods/ha did not statistically differ between the May 21, 28, June 4 and June 11 seeding dates. Total pods per hectare was statistically higher with a seed treatment. The effect of seeding date and seed treatment on pod production is illustrated in Figure 4.

In general, seed yield was increased significantly with seed treatments for early seeding. Higher yields attributed to later seeding are a function of increasing plant populations, pods (and seed) produced, and less pods prone to harvest losses.

This completes the second of three years for this study; the project will be repeated in 2016.

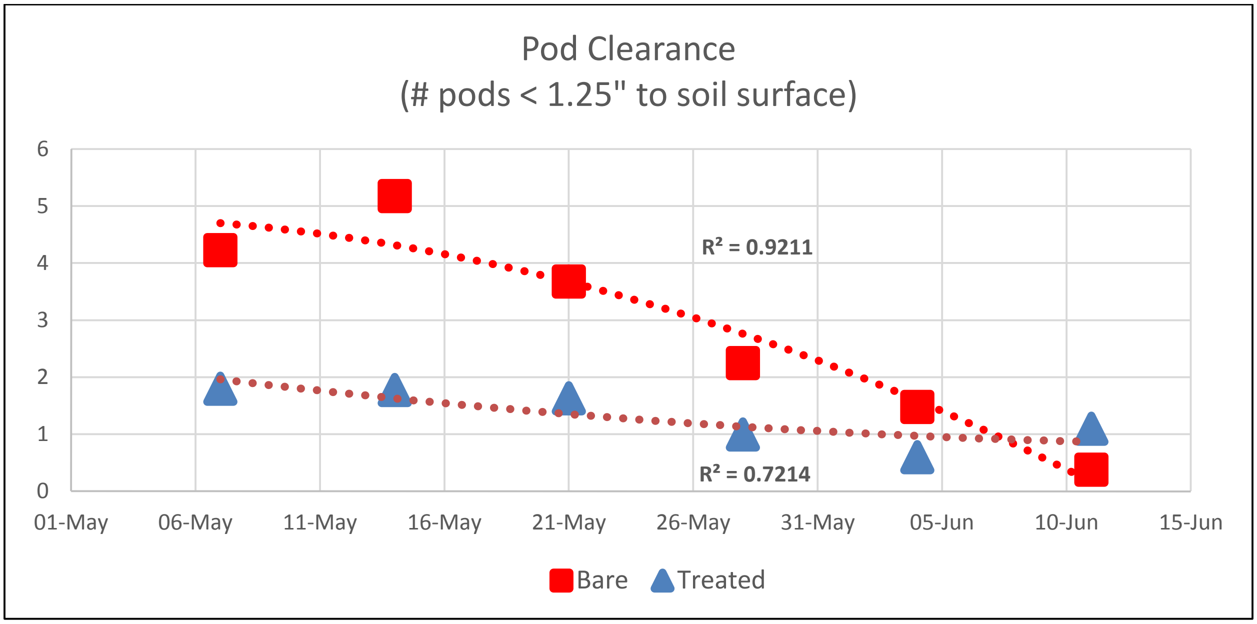


Figure 3. Number of pods per plant with insufficient pod clearance.

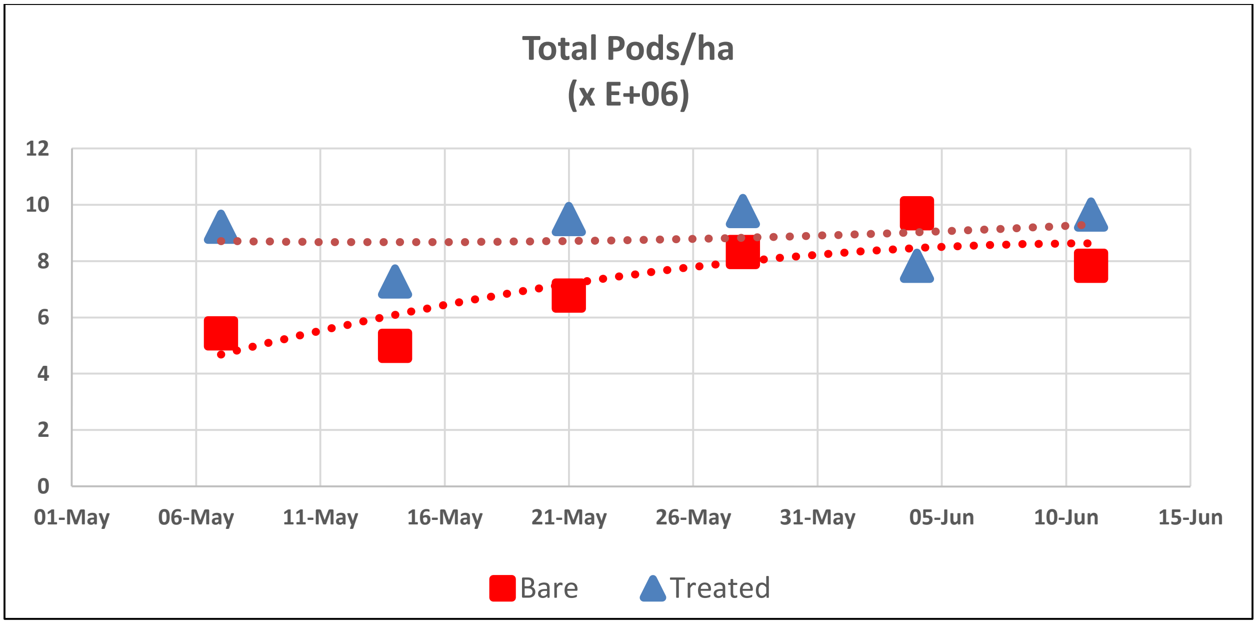


Figure 4. Effect of seeding dates on total pod development.

Developing Nitrogen Management Recommendations for Soybean Production in Saskatchewan

Project Lead

- Project Principal Investigator: 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 Growers

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 a CSIDC Off Station site on an Elstow loam (Pederson). The soybean variety 23-10RY was used due to its relative early maturity. All seed was pre-packaged by weight after adjusting for seed weight, percent germination, and assuming a 90% seedling survival. Target plant population was 445,000 plants/ha. Seed was treated with Cruiser Maxx Vibrance Beans (thiamethoxam, metalaxyl-M, fludioxonil and sedaxane). The trial was established in a randomized complete block plot design with four replications. Plots were seeded on May 26. Granular Cell-Tech soybean inoculant was applied at an application rate of 0, 4.5, 9.0 or 18.0 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 two post-emergent glyphosate applications. Quadris (azoxystrobin) was applied at the R2 stage. Whole plant harvest of a 1 m^2 area occurred at R3 stage (early pod) for N uptake determination. Harvest area was 1.5 m x 7.0 m and plots were combined with a Wintersteiger plot combine when the plants were dry enough to thresh and the seed moisture content was < 20%. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser. Soil test results obtained prior to seeding are shown in Table 1.

Table 1. Soil Test Results

Depth (cm)	NO_3–N	P	K	SO_4–S
	ppm			
0 - 15	12	7	290	16
15 - 30	6			24
30 - 60	4			24

Results

Seed and seed quality parameters measured are outlined in Table 2. Field observations and P tissue concentrations (not available at time of printing) are outlined in Table 3.

The addition of nitrogen fertilizer, regardless of fertilizer source, had no statistically significant impact on seed yield (Table 2). The average yield response to the three nitrogen fertilizer sources at a rate of 55 kg N/ha without inoculant application, compared to the "control" no granular inoculant, was 150 kg/ha (2.2 bu/ac). Granular inoculation, regardless the rate applied, statistically increased grain yield above the un-inoculated control. Granular inoculation at rates beyond the recommended rate of 4.5 kg/ha had no impact on seed yield. This trial was established on ground that had no prior history of soybean production. As the bacteria required to effectively cause biological N-fixation in soybean is not indigenous to native prairie soils in western Canada, and given the relatively low soil test N levels, a greater response to either increased granular inoculant and/or nitrogen fertilizer application might have been expected. This result requires further investigation.

Treatments where no granular inoculant was applied (entries 1, 5, 9 & 13) had significantly higher oil content than all other treatments, conversely these same treatments (no granular inoculant) had significantly lower protein contents. Nitrogen fertilization had no apparent impact on either oil or protein content. Test weight did not differ statistically between treatments. In general, seed weights were increased with the addition of granular inoculant.

In general, treatments did not significantly affect plant population (Table 3). The only statistical difference in plant population indicated that the 4.5 kg/ha inoculant rate alone (entry 2) was significantly greater than the 9.0 kg/ha inoculant with ESN (entry 11) and the absolute control, no inoculant–no N fertilizer (entry 1) treatments. Plant height varied among treatments, however, the average height of the four non-inoculated treatments (entries 1, 5, 9 & 13) was shorter than heights obtained when inoculant was applied. Plant biomass was variable among treatments with no strong defined trends. However, like plant height, non-inoculated treatments produced an average biomass weight that was lower than when inoculant was applied.

Plant tissue and seed N concentrations have not as yet been determined.

This is the first completed year of a three-year study and will be repeated in 2016**.**

Table 2. Effect of Treatments on Seed Yield and Quality

Entry	**N Fertilizer Treatment**	**Granular Inoculant**	**Yield** (kg/ha)	**Oil** (%)	**Protein** (%)	**Test Weight** (kg/hl)	**Seed Weight** (mg)
1	none	no granular inoculant	2858	16.4	34.5	71.3	185
2	none	4.5 kg/ha	4134	15.3	37.3	71.1	200
3	none	9.0 kg/ha	3948	15.2	37.1	71.2	194
4	none	18.0 kg/ha	4176	15.4	37.4	71.5	196
5	Urea	no granular inoculant	2787	16.8	33.2	71.4	179
6	Urea	4.5 kg/ha	3891	15.1	36.9	71.7	193
7	Urea	9.0 kg/ha	4015	15.0	37.3	71.4	202

Entry	N Fertilizer Treatment	Granular Inoculant	Yield (kg/ha)	Oil (%)	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)
8	Urea	18.0 kg/ha	4237	15.0	37.5	71.7	193
9	ESN	no granular inoculant	3183	16.5	34.0	71.6	187
10	ESN	4.5 kg/ha	4004	15.3	37.1	71.4	201
11	ESN	9.0 kg/ha	3998	15.2	37.2	70.8	195
12	ESN	18.0 kg/ha	4153	15.0	37.6	71.4	193
13	UAN	no granular inoculant	3055	16.5	34.5	71.4	190
14	UAN	4.5 kg/ha	3926	15.4	36.9	71.0	194
15	UAN	9.0 kg/ha	3893	15.3	37.1	71.6	193
16	UAN	18.0 kg/ha	4059	15.1	37.2	71.0	189
		LSD (0.05)	415	0.4	0.6	NS	11
		CV	7.7	1.9	1.2	0.8	3.9

Table 3. Effect of Treatments on Field Observations and N Concentration

Entry	N Fertilizer Treatment	Granular Inoculant	Plant Population (plants/ha)	Plant Biomass (g/1 m^2)	Biomass N (%)	Seed N (%)	Pod Clearance (mm)	Height (cm)
1	none	no granular inoculant	546458	485				75
2	none	4.5 kg/ha	623333	553				83
3	none	9.0 kg/ha	563333	544				83
4	none	18.0 kg/ha	595208	581				85
5	Urea	no granular inoculant	567500	575				84
6	Urea	4.5 kg/ha	569167	638				87
7	Urea	9.0 kg/ha	598542	616				87
8	Urea	18.0 kg/ha	594583	638				86
9	ESN	no granular inoculant	590833	661				85
10	ESN	4.5 kg/ha	621250	636				87
11	ESN	9.0 kg/ha	556458	668				89
12	ESN	18.0 kg/ha	567917	785				86
13	UAN	no granular inoculant	603542	502				77
14	UAN	4.5 kg/ha	605833	564				81
15	UAN	9.0 kg/ha	563333	549				79
16	UAN	18.0 kg/ha	594583	673				84
		LSD (0.05)	64936	147				6.0
		CV	7.8	17.1				5.1

Developing Phosphorus Management Recommendations for Soybean Production in Saskatchewan

Project Lead

- Project Principal Investigator: 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 a CSIDC Off Station site on an Elstow loam (Pederson). The soybean variety 23-10RY was used due to its relative early maturity. All seed was pre-packaged by weight after adjusting for seed weight, percent germination and assumed a 90% seedling survival. Target plant population was 445,000 plants/ha. Seed was treated with Cruiser Maxx Vibrance Beans (thiamethoxam, metalaxyl-M, fludioxonil and sedaxane). The trial was established in a randomized complete block plot design with four replications. Plots were seeded on May 26. Broadcast phosphorus as monoammonium phosphate (11-52-0) was applied prior to seeding and incorporated with the seeding operation or side banded or seed-placed at seeding. 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 two post-emergent glyphosate applications. Quadris (azoxystrobin) was applied at the R2 stage. Whole plant harvest of a 1 m^2 area occurred at R3 stage (early pod) for P uptake determination. Harvest area was 1.5 m 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%. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser.

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

Table 1. Soil Test Results

Depth (cm)	NO_3-N	P	K	SO_4-S
	ppm			
0 - 15	12	7	290	16
15 - 30	6			24
30 - 60	4			24

Results

Seed and seed quality parameters measured are outlined in Table 2. Field observations and P tissue concentrations (not available at time of printing) are outlined in Table 3.

Phosphorus fertilizer applications had no positive effect of grain yield of soybean. Given the low soil P test level this result is somewhat surprising, in that a response to phosphorus fertilization might have been expected. Soybeans are known to be effective scavengers of soil phosphorus, which could explain a portion of the non-response. Seed placed phosphorus at 40 and 80 kg P_2O_5/ha significantly reduced yield when compared to the control treatment. Present recommendations for soybean suggest a sensitivity to seed-placed fertilizer and rates exceeding 20 kg P_2O_5/ha may be damaging. Phosphorus fertilization had no statistically significant impact on % oil, % protein, test weight or 1000 seed weight.

Phosphorus fertilization did not significantly affect plant population or plant height. Biomass and tissue P concentrations are yet to be analyzed.

This is the first year of this trial; it will be repeated in 2016 and 2017.

Table 2. Seed Quality Measurements

Entry	P_2O_5 Rate	P_2O_5 Placement	Yield (kg/ha)	Oil (%)	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)
1	Control (0 P_2O_5)	N/A	4419	15.5	36.9	71.0	188
2	20 P_2O_5 kg/ha	1_Seed-Placed	4380	15.3	37.2	70.8	190
3	20 P_2O_5 kg/ha	2_Side-Banded	4317	15.5	37.1	70.8	181
4	20 P_2O_5 kg/ha	3_Broadcast	4295	15.4	37.2	71.3	188
5	40 P_2O_5 kg/ha	1_Seed-Placed	4121	15.1	37.1	71.1	184
6	40 P_2O_5 kg/ha	2_Side-Banded	4277	15.3	37.3	70.9	185
7	40 P_2O_5 kg/ha	3_Broadcast	4227	15.4	37.2	71.3	187
8	80 P_2O_5 kg/ha	1_Seed-Placed	3619	15.3	37.0	71.2	183
9	80 P_2O_5 kg/ha	2_Side-Banded	4240	15.3	37.2	70.8	186
10	80 P_2O_5 kg/ha	3_Broadcast	4324	15.4	37.1	71.1	192
LSD (0.05)			286	NS	NS	NS	NS
CV			4.7	1.1	0.5	0.5	5.8

NS = not significant

Table 3. Field Observations and Plant P Concentrations

Entry	P_2O_5 Rate	P_2O_5 Placement	Plant Population (plants/ha)	Plant Height (cm)	Plant Biomass (g/1m^2)	Biomass P (%)	Seed P (%)
1	Control (0 P_2O_5)	N/A	565000	80			
2	20 P_2O_5 kg/ha	1_Seed-Placed	602500	81			
3	20 P_2O_5 kg/ha	2_Side-Banded	712500	79			
4	20 P_2O_5 kg/ha	3_Broadcast	612500	80			
5	40 P_2O_5 kg/ha	1_Seed-Placed	822500	82			
6	40 P_2O_5 kg/ha	2_Side-Banded	647500	84			
7	40 P_2O_5 kg/ha	3_Broadcast	662500	79			
8	80 P_2O_5 kg/ha	1_Seed-Placed	422500	78			
9	80 P_2O_5 kg/ha	2_Side-Banded	750000	85			
10	80 P_2O_5 kg/ha	3_Broadcast	680000	78			
		LSD (0.05)	NS	NS			
		CV	39.5	6.1			

NS = not significant

Soybean Inoculation Study

Project Lead

- Garry Hnatowich

Organizations

- Irrigation Crop Diversification Corporation (ICDC)
- Saskatchewan Ministry of Agriculture
- Western Grains Research Foundation

Objectives

A study was initiated to determine optimal soybean inoculation for irrigated crop production. This strategy assumes that soybeans will be established on fields with no prior history of soybean in the rotation.

Research Plan

The trial was established at an off-station location approximately 10 km southeast of CSIDC, and the variety 23-10RY was used in all treatments. All seed was pre-packaged by weight after adjusting for seed weight and percent germination and assumed a 90% seedling survival, for a target population of 445,000 plants/ha. The trial was established in a randomized complete block design (RCBD) with four replications. Inoculants from two companies, BASF and Novozymes (now Monsanto BioAg), were included, as each carry a second, but differing, active organism in addition to their respective Bradyrhizobium strain. However, the purpose of the study was not a head-to-head inoculant brand comparison. These two companies together represent the greatest market share of inoculants in western Canada. Both companies provided liquid and granular soybean inoculant formulations. These formulations were evaluated by themselves and in combination, along with a seed treatment. The fungicidal seed treatment used was Cruiser Maxx Vibrance Beans (thiamethoxam, metalaxyl-M, fludioxonil, and sedaxane). The seed treatment was applied at the recommended rate and allowed to dry approximately two weeks prior to seeding. Liquid inoculants were applied at recommended rates, allowed to dry, and seeded immediately. Granular inoculants were calibrated through granular boxes on the plot seeder and applied as a seed-placed application. Treatments were:

#	Treatment
1	control bare seed
2	seed treatment
3	liquid Novozymes
4	liquid BASF
5	8 lb/ac granular Novozymes
6	8 lb/ac granular BASF
7	8 lb/ac granular Novozymes + liquid Novozymes
8	8 lb/ac granular BASF + liquid BASF
9	8 lb/ac granular Novozymes + liquid Novozymes + seed treatment
10	8 lb/ac granular BASF + liquid BASF + seed treatment

#	Treatment
11	12 lb/ac granular Novozymes
12	12 lb/ac granular BASF
13	12 lb/ac granular Novozymes + liquid Novozymes
14	12 lb/ac granular BASF + liquid BASF
15	12 lb/ac granular Novozymes + liquid Novozymes + seed treatment
16	12 lb/ac granular BASF + liquid BASF + seed treatment

Prior to seeding, the plots were worked with a heavy harrow to encourage soil surface exposure in order to warm the soil. The trial was seeded on May 25. All treatments received a side band application at seeding of 15 kg P_2O_5/ha. Plots were maintained weed free by a pre-plant burn-off and two post-emergent glyphosate applications. Quadris (azoxystrobin) was applied at the R2 stage. Harvest area was 1.5 m x 6.0 m. Plots were combined with a Wintersteiger plot combine when the plants were dry enough to thresh and seed moisture content was < 20%. Harvested samples were cleaned and yields adjusted to a moisture content of 14%. Oil and protein content was determined with a Foss NIR analyser.

Results

Agronomic data collected is shown in Tables 1 and 2.

Table 1. Effect of Inoculation on Yield

Inoculant Treatment	Yield (kg/ha)	Yield (bu/ac)	Oil (%)	Protein (%)
control bare seed	3695	54.9	17.0	33.2
seed treatment	4325	64.3	17.0	33.5
liquid Novozymes	5276	78.4	15.6	36.8
liquid BASF	4950	73.6	15.7	36.1
8 lb/ac granular Novozymes	4058	60.3	16.4	34.4
8 lb/ac granular BASF	4552	67.7	16.2	34.4
8 lb/ac granular Novozymes + liquid Novozymes	5195	77.2	15.5	36.3
8 lb/ac granular BASF + liquid BASF	5137	76.4	15.7	36.6
8 lb/ac granular Novozymes + liquid Novozymes + seed treatment	5118	76.1	15.4	36.9
8 lb/ac granular BASF + liquid BASF + seed treatment	4854	72.2	15.8	36.5
12 lb/ac granular Novozymes	3903	58.0	16.0	35.6
12 lb/ac granular BASF	4703	69.9	16.1	35.8
12 lb/ac granular Novozymes + liquid Novozymes	5221	77.6	15.3	37.0
12 lb/ac granular BASF + liquid BASF	5256	78.1	15.6	36.4
12 lb/ac granular Novozymes + liquid Novozymes + seed treatment	5529	82.2	15.6	36.7
12 lb/ac granular BASF + liquid BASF + seed treatment	5409	80.4	15.8	36.1
LSD (0.05)	679	10.1	0.6	1.3
CV (%)	9.9	9.9	2.6	2.6

All inoculant applications, except the 8 and 12 lb/ac Novozyme granular inoculants by themselves, statistically increased yield. The lack of response to the Novozymes granular applications alone is unexplainable. All inoculants were maintained in a packaged, unopened, refrigerated state until use, no plugging or bridging of any granular inoculant occurred. It is assumed the product was viable so the lack of response is unsettling.

The individual seed treatment had no statistical impact on seed yield at a 5% confidence level but was statistically greater in yield compared to the bare seed control at the 10% confidence level. Slightly higher in yield to the seed treatment was the granular BASF inoculant at both 8 and 12 kg/ha. Possibly of some surprize was the relatively high yield of the liquid inoculant-only treatments, which, statistically, were as good as the 8 and 12 lb/ac granular-alone applications. The highest yielding treatments were the high rate of granular in combination with a liquid application and the seed treatment. The effect of inoculation on yield is illustrated in Figure 1.

Table 2. Effect of Inoculation on Seed Characteristics

Inoculant Treatment	**Test Weight** (kg/hl)	**Seed Weight** (mg)	**Plant Height** (cm)
control bare seed	70.9	170	76
seed treatment	70.8	177	75
liquid Novozymes	70.6	191	79
liquid BASF	70.6	188	80
8 lb/ac granular Novozymes	71.1	176	77
8 lb/ac granular BASF	71.2	175	81
8 lb/ac granular Novozymes + liquid Novozymes	71.0	185	86
8 lb/ac granular BASF + liquid BASF	71.3	186	79
8 lb/ac granular Novozymes + liquid Novozymes + seed treatment	71.1	187	84
8 lb/ac granular BASF + liquid BASF + seed treatment	70.8	190	80
12 lb/ac granular Novozymes	71.3	184	73
12 lb/ac granular BASF	70.7	186	85
12 lb/ac granular Novozymes + liquid Novozymes	70.9	169	81
12 lb/ac granular BASF + liquid BASF	70.9	180	80
12 lb/ac granular Novozymes + liquid Novozymes + seed treatment	70.0	188	84
12 lb/ac granular BASF + liquid BASF + seed treatment	71.1	182	80
LSD (0.05)	NS	NS	6.9
CV (%)	0.7	6.8	6.0

NS = not significant

The solid horizontal line in Figure 1 represents the average yield obtained with an application of a Bradyrhizobium inoculant. Single granular formulation applications by themselves are below or just achieve the average response; liquid inoculation alone or in combination with other formulations generally exceed the average yield.

The effect of inoculation on seed characteristics is shown in Table 2. Inoculation, in general, decreased oil content and increased seed protein. This would also be expected to occur if supplemental nitrogen fertilizer was applied to the crop, and indirectly indicates active biological nitrogen fixation was occurring with inoculation. Inoculation had no statistical impact on test weight or seed weight. Inoculation generally resulted in increased plant height.

Conclusions based upon a single year's trial cannot be made. However, it appears that with soybean, a double inoculation of granular and liquid formulations, as is presently suggested, be followed. This trial will be repeated in 2016.

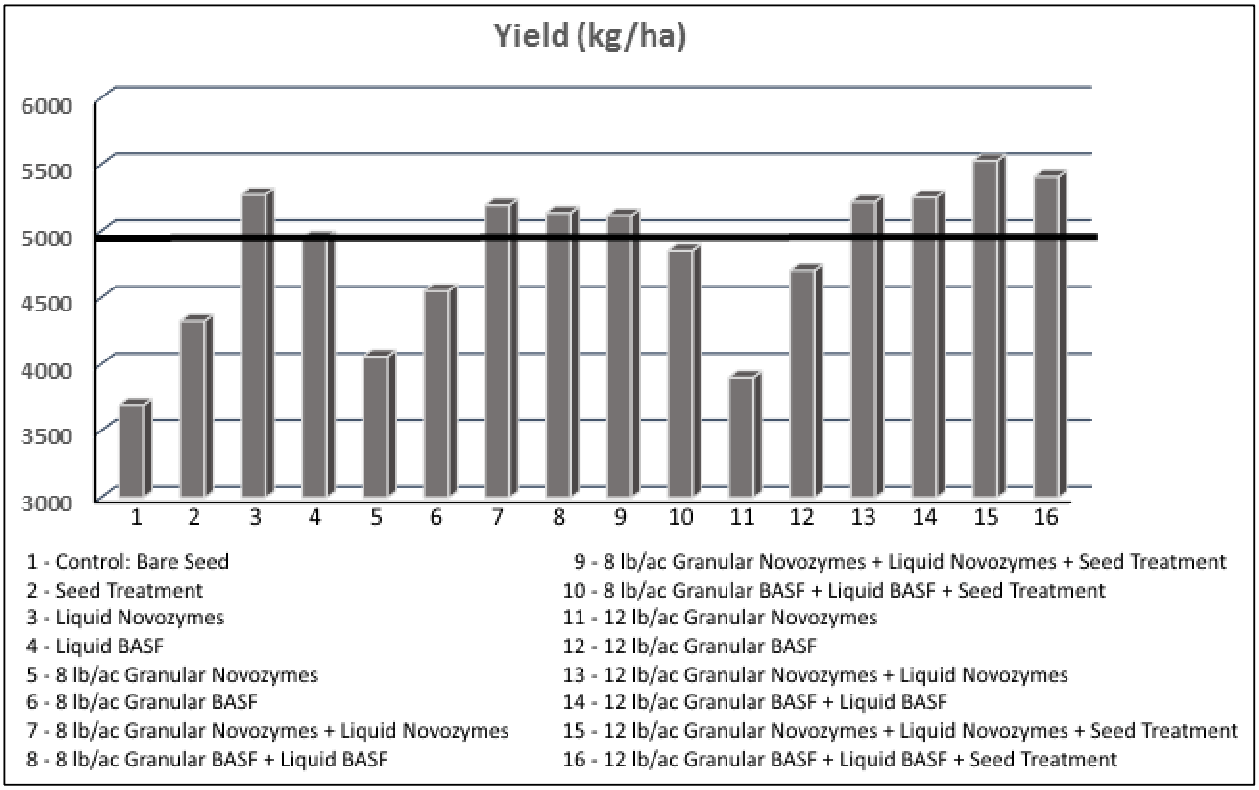


Figure 5. Effect of inoculation on yield.

Rudy Agro Irrigated Field Pea Evaluation

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 evaluate three marrow fat class pea and a yellow pea line being contracted by Rudy Agro.

Research Plan

These pea variety evaluation trials were conducted for Rudy Agro at two locations in the Outlook irrigation area. The sites and soil types are as follows:

- CSIDC: Bradwell loam-silty lloam (Field #8)
- CSIDC Off Station: Elstow loam (Pederson)

Pea varieties were tested for their agronomic performance under irrigation. The CSIDC location was seeded on May 7 and the CSIDC Off Station site on May 14. Plot size was 1.5 m x 4 m. All plots received 15 kg P_2O_5/ha as 12-51-0 as a seed-placed application and granular inoculant at a rate of 9 kg/ha as a seed-placed 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) at both sites. Supplemental hand weeding was conducted at both locations. Fungicide applications at both sites included Headline EC (pyraclostrobin) and Lance WDG (boscalid) for Mycosphaerella blight, powdery mildew, and white mold control. The trials were arranged in a randomized complete block design with three replications. 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 at CSIDC on August 13 and at the CSIDC Off Station trial, September 2. Total in-season irrigation at CSIDC was 69.5 mm.

Three Rudy Agro-acquired pea entries were compared to the agronomic performance of CDC Golden. Rudy Agro varieties entered were the Yellow variety 757-1 and three Marrowfat varieties: Neon, Midori, and Hitomi.

Results

Results of the agronomic performance of the CSIDC site, the CSIDC Off Station site, and combined site analysis are shown in Tables 1, 2, and 3 respectively. In general, the Rudy Agro varieties were significantly lower yielding than the check variety, CDC Golden. Marrowfat pea varieties are generally lower yielding than yellow or green class peas but demand a premium price. Plans for further evaluations of these varieties are under discussion.

Table 1. Rudy Agro Irrigated Pea Evaluation—CSIDC

Variety	Yield (kg/ha)	Protein (%)	Test Weight (kg/hl)	1 K Seed Weight (mg)	10% Flower (days)	Maturity (days)	Height (cm)	Lodge Rating (1=erect; 10=flat)
Yellow								
CDC Golden (check)	***6340***	***24.1***	***80.6***	***227***	***52***	***86***	***69***	***6.0***
757-1	4599	25.0	77.9	340	55	91	71	7.3
Neon	4123	24.6	79.1	328	53	87	85	3.3
Midori	4203	26.1	76.4	353	52	89	57	8.0
Hitomi	4511	24.4	78.9	300	56	91	72	6.0
LSD (0.05)	923	0.8	1.9	21.9	0.8	NS	NS	1.3
CV (%)	10.3	1.8	1.3	3.8	0.8	2.3	13.2	10.9

NS = Not Significant

Table 2. Rudy Agro Irrigated Pea Evaluation–CSIDC Off Station

Variety	Yield (kg/ha)	Protein (%)	Test Weight (kg/hl)	1 K Seed Weight (mg)	10% Flower (days)	Maturity (days)	Height (cm)	Lodge Rating (1=erect; 10=flat)
Yellow								
CDC Golden (check)	***4663***	***27.0***	***80.0***	***167***	***52***	***89***	***70***	***5.3***
757-1	4171	25.8	78.4	308	53	91	83	6.0
Neon	5249	25.8	80.4	268	53	96	98	2.0
Midori	4302	27.6	76.3	341	52	91	86	6.3
Hitomi	4118	25.4	79.5	314	54	92	79	6.7
LSD (0.05)	NS	0.8	1.2	77.1	1.2	1.5	9.9	2.1
CV (%)	11.8	1.7	0.8	14.7	1.2	0.9	6.4	21.5

NS = Not Significant

Table 3. Yield and Agronomic Data for Irrigated Pea Evaluation—Combined Sites

Treatment	Yield (kg/ha)	Protein (%)	Test Weight (kg/hl)	1 K Seed Weight (mg)	10% Flower (days)	Maturity (days)	Height (cm)	Lodge Rating (1=erect; 10=flat)
Trial Site								
CSIDC	4755	24.8	78.6	310	53	89	71	6.1
CSIDC – Off Station	4500	26.3	78.9	280	53	92	83	5.3
LSD Yield (0.10) LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	0.6
CV	11.0	1.7	1.1	10.2	1.0	1.7	9.9	16.3
Variety								
CDC Golden (check)	***5502***	***25.6***	***80.3***	***197***	***52***	***88***	***69***	***5.7***
757-1	4385	25.4	78.1	324	54	91	77	6.7
Neon	4686	25.2	79.8	298	53	92	91	2.7
Midori	4252	26.8	76.4	347	52	90	72	7.2
Hitomi	4314	24.9	79.2	307	55	91	75	6.3
LSD (0.05)	624	0.5	1.0	36.9	0.7	1.9	9.3	1.1
Site x Variety Interaction								
LSD (0.05)	S	S	NS	NS	S	S	NS	NS

S = Significant NS = Not Significant

Response to Sulphur Fertilization of Canola under Irrigation in a Sandy Soil

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Jay Anderson, Grower, Outlook, South Saskatchewan River Irrigation District
- Peter Hiebert, Grower, Riverhurst, SK, Riverhurst Irrigation District

Project Objective

The objective of this demonstration is to evaluate the effect of banded and broadcasted ammonium sulphate application on the yield of canola in a sandy soil under irrigation.

Due to the high levels of precipitation in that last few years, producers have been irrigating less. Many producers rely on the sulphur from irrigation water to meet canola nutrient requirements as water from Lake Diefenbaker contains around 4 lb of sulphur per irrigated inch. For sandy soils, it is possible that during wet years, yield potential is lower due to sulphur deficiencies. The results from this demonstration should help producers decide whether or not to add ammonium sulphate. If the results are non-responsive to the treatment, producers who apply ammonium sulphate to canola under irrigation can determine the cost effectiveness of doing so.

It is known that canola is a high sulphur-using crop and that intensive agricultural production has dramatically reduced historic organic sulphur in soil. Sandy soils are known to be deficient in sulphur due to the presence of low amounts of organic matter and the fact that S is highly mobile and is readily leached in these soils. It is common practice in Saskatchewan to fertilize canola with sulphur, although irrigated producers are less likely to do so because irrigated water contains sulphate-sulphur.

Project Plan

Two sites were selected for this demonstration. One site was located in the South Saskatchewan River Irrigation District and the second site was located in the Riverhurst Irrigation District. The cost of applying ammonium sulfate for this project was approximately $14.89/ac, given the then current price of $525 per tonne.

Treatments:

- Banded 62.5 lb/ac of ammonium sulfate (21-0-0-24)
- Broadcast 62.5 lb/ac of ammonium sulfate (21-0-0-24)
- Control 27 lb/ac of urea (supplement) (46-0-0)

Soils tests for both sites were conducted prior to seeding to determine initial fertility. The treatments were replicated twice at both sites. The treatment strips were the length of the field and the width of the sprayer being used, but the harvested test area was approximately 1 acre per rep.

Tissue tests were taken at the budding stage at the SSRID site.

Demonstration Site

Site 1 was located in the Riverhurst Irrigation District at NE 30-23-6 W3M. Soil texture of this site is a sandy loam from the Hatton soil association and is irrigated with a low pressure pivot system. A soil test was taken on May 1 from a representative area of the field. The results showed marginal amounts of sulphur in the top 12 inches (Table 1). According to the soil test, to achieve full yield potential, an external source of sulphur was needed for this field.

Table 1. Results from Soil Test for Riverhurst Site (0–12 inch depth; lb/ac)

Total N	P	K	SO4-S
16	6	182	8

Site 2 was located south of Broderick at NW34-27-7 W3M. Soil texture of this site is a sandy clay loam from the Bradwell association and is irrigated with a low pressure pivot system. A soil test was taken on May 1 from a representative area of the field. This soil test showed moderate amounts of sulphur in the top 12 inches (Table 2). According to the soil test, to achieve full yield potential an external source of sulphur is needed for this field.

Table 2. Results from Soil Test for SSIRD Site (0–12 inch depth; lb/ac)

Total N	P	K	SO4-S
26	24	>300	18

Project Methods and Observations

Riverhurst Site

Invigor 5440 canola was seeded May 14 at 5 lb/ac on dry bean stubble using an air drill. The field was fertilized with 145 lb/ac of actual N by broadcast and banding combined. The rate of ammonium sulphate application was approximately 62.5 lb/ac which provided 15 lb/ac of actual sulphur. On the control test strips, no ammonium sulphate was applied and approximately 12.5 lb/ac of actual N was applied to make up for the nitrogen difference. This field was sprayed with the fungicide Proline when the crop was at around the 30% flowering stage. There was approximately 3.4 inches of effective irrigation applied throughout the growing season, which contributed 13.6 lb/ac of sulphur.

The field was harvested on September 22, and yield was measured with a weigh wagon. Two reps were taken for the treatments and the control (Table 3). The crop performed well, although there was no response to the ammonium sulphate treatment. The decrease in yield is most likely due to pre-existing variability of the field. Since this field already had some residual levels of sulphur from prior treatments, it is possible that the irrigation water provided the canola with sufficient amounts of sulphur fertility.

Table 3. Riverhurst Site Yield Results

Treatment	Yield
Banded 62.5lb/ac of ammonium sulfate	61.2 bu/ac
Broadcast 62.5lb/ac of ammonium sulfate	64.7 bu/ac
Control 27lb/ac of urea (supplement)	65.3 bu/ac

SSRID Site

Pioneer 45h29 canola was seeded May 16 at 5 lb/ac on flax stubble using an air drill. There were 40 lb of P2O5 and 60 lb of N applied through a side band, and an additional 70 lb of N was added through fertigation. The application rate of ammonium sulphate was approximately 62.5 lb/ac, which provided 15 lb/ac of actual sulphur. On the control test strips, no ammonium sulphate was applied, and approximately 12.5 lb/ac of actual N was applied to make up for the nitrogen difference. This field was not sprayed with fungicide and displayed Sclerotinia disease problems, which caused lodging and yield loss. There was roughly 4.8 inches of effective irrigation applied, which contributed 19.2 lb/ac of sulphur.

The field was harvested on October 14, and yield was measured with a weigh wagon. Two reps were taken for the treatments and the control (Table 4). The yield data suggests that the crop responded to the sulphur treatments, with the banded treatment showing the best results.

Although it appears that there may have been a yield response, the tissue test did not provide any indication of a sulphur deficiency.

Table 4. SSRID Site Yield Results

Treatment	Yield
Banded 62.5lb/ac of ammonium sulfate	58.7 bu/ac
Broadcast 62.5lb/ac of ammonium sulfate	55.9 bu/ac
Control 27lb/ac of urea (supplement)	53.3 bu/ac

In Table 5, the economic return from both sites is shown. The net return is based on the cost of ammonium sulphate being $525.00/tonne and the price for canola being $9.14/bu.

Table 5. Economic Return from Application of Ammonium Sulphate

Site	Yield Response bu/ac	Net Return $/ac
Riverhurst (banded)	-4.1	-$52.17
Riverhurst (broadcast)	-0.6	-$20.18
SSRID (banded)	5.4	$34.66
SSRID (broadcast)	2.6	$9.06

Final Discussion

From 2010–2014, our province has experienced a wet cycle and received large amounts of precipitation. During this period, irrigators watered less frequently because there was adequate soil moisture from natural perception. As a result, less sulphur has been applied to crops from irrigation water sourced from Lake Diefenbaker. Water from Lake Diefenbaker contains 64.8 ppm of SO4, which translates to approximately 4 lb/ac of sulphur. During a year that a producer applies 8 inches of irrigated water, 32 lb/ac of S is added to the field, an amount sufficient for a 60 lb/ac canola crop. This project was meant to demonstrate this effect and show the economic benefit of adding additional sulphur during wet years when less irrigation water is applied.

The 2015 growing season was characterized as dry and warmer than average from late-spring to mid-summer. More irrigation was applied because of these conditions, which reduced the response to the ammonium sulphur treatments. The response of the SSRID site demonstrates the benefit of adding sulphur to irrigated canola on sandy soils, especially when a low amount of irrigated water is applied.

This project showed mixed results: one site appeared to respond to applied sulphur and the other site did not appear to respond. When evaluating whether or not it is a wise investment to apply sulphur to irrigated canola, producers are encouraged to consider soil test results. If the soil test shows low sulphur presence and the field is course in texture, applying 10 to 15 lb of sulphur at a cost of $1 per pound will ensure adequate S availability for the crop and improved yield.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Gary Kruger, Irrigation Agrologist, Saskatchewan Ministry of Agriculture, for providing agronomic guidance and support on this project
- Adam Tomasiewicz, 2015 summer student, Saskatchewan Ministry of Agriculture for helping with irrigation scheduling with this project

Evaluation of Straight Cut Canola under Irrigation

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Ryan Miner, Grower, Riverhurst, SK, Riverhurst Irrigation District

Project Objective

The objective of this project was to evaluate the value of straight cutting canola versus swathing as a plan for eliminating one field operation.

Project Plan

The demonstration occurred on a 130 acre irrigated field with a center pivot. The field was seeded to Bayer Liberty Link L140P and was monitored throughout the year for insects, disease, and irrigation scheduling. When 60% seed color change occurred, which is traditionally the correct time for swathing, approximately 10 acres of the L140P was swathed. At 80% seed color, the remainder of the field was sprayed with pre-harvest glyphosate to ensure even maturity and for weed control. The swaths were harvested with a pickup header when they matured sufficiently. The remaining standing canola was harvested when mature. Yield was measured to determine the better practice.

Site

The demonstration site was in the Riverhurst Irrigation District (NE10-22-7 W3) and is 130 acre field with a center pivot located. The soil texture is clay loam, and the field was seeded to dry beans in 2014.

Project Methods

The canola variety L140P was seeded May 4. Detailed agronomics are shown in Table 1. Extensive monitoring occurred weekly throughout the growing season, and water needs were predicted using the Alberta Irrigation Management Model (AIMM) calculator to ensure soil moisture was kept above 50% (Figure 1). Monitoring of plant stage was also important for staging swathing, spraying, and harvesting. Swathing occurred August 22 at 60–70% seed color change. Pre-harvest glyphosate was applied August 26 at 80–90% seed color change. Harvest occurred September 3 for the swathed canola and straight cut harvest occurred on September 21. Yields were determined to ascertain the success of the different treatments.

Table 1. Crop Management Agronomics

Event	Date	Variety/Product
Seeding Fertilizer	May 4, 2015	L140P N 150 lb, P 35 lb, S 18 lb
Herbicide	June 8, 2015	Liberty and Centurion
Fungicide	July 2, 2015	Proline

Event	Date	Variety/Product
Swathed—*60-70% seed colour change*	August 22, 2015	
Pre-Harvest Spray—*80-90% seed colour change*	August 26, 2015	Roundup
Harvest - Swathed - Straight Cut	 September 3, 2015 September 21, 2015	
Precipitation - Rainfall - Irrigation	 175.4 mm (6.9 in) 101.6 mm (5.6 in)	

Results

Table 2. Harvest Results by Harvest Method

Harvest Method	Number of Acres	Gross Weight (lb)	Tare (lb)	Net (bu/ac)
Swathed	6.72	49,640	28,580	62.64
Straight Cut	14.10	73,460	28,500	63.77

Final Discussion

Canola is an important crop to irrigators in the Lake Diefenbaker area and comprises about one third of farmed land in the area. Farmers are always looking for a way to reduce costs and improve efficiency. The ability to remove the swathing operation from production and instead straight cut canola would help achieve that. The intended benefit would be to receive the same or better yields as the traditional swathing method, while removing the management time, cost, and labour associated with swathing.

The results in the first year of this demonstration show that straight cutting canola is about the same or slightly better than swathing. It is important to keep in mind that conditions in 2015 were ideal, with no major wind events; the crop came into maturity well and remained standing. ICDC will continue to evaluate straight cutting canola under irrigation to gain a better understanding of the results of this practice in different scenarios.

Acknowledgements

The project lead would like to acknowledge Rory Cranston of Bayer Crop Science for contributing L140P Seed.

Response to Foliar Applied Boron on Canola during Early Flowering

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Peter Hiebert, Grower, Riverhurst, SK, Riverhurst Irrigation District
- Chris Ellert, Grower, Li Sieux, SK, non-district

Project Objective

The objective of this demonstration was to display the yield benefit of applying boron to irrigated canola during the early flowering stage.

Project Background

Canola is one of the main crops grown under irrigation in the Lake Diefenbaker Development Area. Producers who irrigate desire methods to maximize their yields in order to achieve economic benefits for the high-cost inputs they invest in. The benefit of this demonstration is to give local producers information on a practice that could potentially increase canola yield and profitability. This product can be tanked mixed with fungicide, which makes application easier for irrigators because fungicides are commonly applied to irrigated canola.

In 2007, Dr. Hugh Earl, University of Guelph, implemented a project in which boron was applied at the early flowering stage. Yields improved by 5.7%. He hypothesized that the boron helped prevent pods from aborting when temperatures were higher than 29° C. He later confirmed this in a controlled greenhouse test and discovered that boron does help prevent canola pods from aborting[1].

Demonstration Plan

Two sites were selected for this demonstration. One site was located in the Riverhurst Irrigation District and the second was located south of Assiniboia with a non-district irrigator.

Treatments:

(1) Control
(2) 0.23 lb/ac actual Boron, foliar applied
(3) 0.11 lb/ac actual Boron, foliar applied

---

[1] Laxhman Ramsahoi1, Hugh J. Earl1 and Brian Hall2, *Response of Spring Canola Yields to Foliar Boron Application*. 2009. (1)Department of Plant Agriculture, Univ. of Guelph, Guelph, ON, Canada (2) Ontario Ministry of Agriculture, Food and Rural Affairs, Stratford, ON, Canada.

The treatments were replicated twice at the Assiniboia site but were not replicated at the Riverhurst site due to field constraints. The treatment strips were the length of the field and the width of the sprayer being used; the harvested test area was approximately 1 ac.

Tissue tests were taken at early pod stage to compare the boron levels of the treatments to the control.

Demonstration Sites

Site 1 was located in the Riverhurst Irrigation District at NE 30-23-6 W3M. Soil texture of this site is a sandy loam with a Hatton soil association and is irrigated with a low pressure pivot system. A soil test was done and it showed moderate amounts of boron (Table 1).

Site 2 was located south of Assiniboia at SW 10-4-29 W2M. Soil texture of this site is a sandy clay loam with a Fife Lake association and is irrigated with a low pressure pivot system using water from a nearby reservoir. Soil test results for this site indicated low levels of boron (Table 2).

Table 1. Results from Soil Test for Site South of Assiniboia (0–6 inch depth, lb/ac)

Total N	P	K	SO4-S	B
12	8	188	8	2.2

Table 2. Results from Soil Test for Riverhurst (0–12 inch depth, lb/ac)

Total N	P	K	SO4-S lb/ac Sub	B
69	34	18.2	78	0.8

Project Methods and Observations

Site 1 – Riverhurst

Invigor 5440 canola was seeded May 14 at 5 lb/ac on dry bean stubble using an air drill. The field was fertilized with 145 lb/ac of actual N by broadcast and banding combined. The boron was tank-mixed with an application of Proline at about the 30% flower stage. Rates of application were 0.8 L boron product (10% actual B) and 0.4 L boron product. Tissue test samples were taken August 6 for each treatment and the control group. Tissue test results, including the control, showed boron levels of over 80 ppm, which is considered high. For this reason, the tissue tests showed no apparent response to boron, although this could have been due to the late sampling date.

The field was harvested on September 22 and yield was measured with a weigh wagon. As shown in Table 3, the yield was just over a one bushel per acre less for the high-rate boron treatment and about one bushel higher for the low-rate boron treatment when compared to the control. These differences in yield are not large enough to conclude whether or not boron was responsible for the yield variance.

Table 3. Sample Yields Taken From Riverhurst Site on September 22

Treatment	Yield (bu/ac)
0.8L/ac Boron product	64.5
0.4L/ac Boron product	66.5
Control	65.3

Site 2 – Assiniboia

Invigor L252 canola was seeded on May 15 at a rate of 4.2 lb/ac on spring wheat stubble. The field was fertilized with 96 lb of actual N side banded and 90 lb of MicroEssentials S15 (13-33-0-13) fertilizer with the seed. An additional 67.2 lb of actual N was applied later with a spreader. This field was sprayed with the fungicide Proline prior to application of boron. The foliar boron product was applied at approximately the 25% flowering stage on July 6. Rates of application were 0.8 L of boron product (10% actual B) and 0.4 L. Each treatment on this site was replicated twice. Tissue test samples were taken on August 4 for each treatment as well as the control. Tissue test results, including the control, showed boron levels of over 80 ppm, which is considered high. For this reason, the tissue tests showed no apparent response to boron, although this could have been due to the late sampling date.

The field was harvested on September 24, and yield was measured with a weigh wagon. As shown in Table 4, the high-rate treatment showed a yield that was two bushels greater than the control, and the low-rate treatment showed a yield that was about five bushel less than the control. These differences in yield are not large enough to conclude whether or not boron was responsible for the yield variance.

Table 4. Sample Yields Taken from Assiniboia Site on September 24

Treatment	Yield (bu/ac)
0.8L/ac Boron product	64.9
0.4L/ac Boron product	57.5
Control	62.6

Table 5 shows the calculated economic return from both of sites. The net return is based on a cost of $5/litre for boron product and a canola price of $9.14/bu.

Table 5. Economic Return from Boron Application

Site	Yield Response bu/ac	Net Return/ac
Riverhurst (high rate)	-0.74	-$10.76
Riverhurst (low rate)	1.20	$6.87
Assiniboia (high rate)	2.26	$16.66
Assiniboia (low rate)	-5.10	-$46.61

Final Discussion

Micronutrient products, including foliar boron fertilizers have an increasing presence in the market place. Producers are strongly encouraged to try strip trials of these products before committing to an investment to apply boron across an entire parcel of land. In Saskatchewan, boron deficiencies are very uncommon, which raises the question of the effectiveness of applying these products. The hot, dry July experienced in Saskatchewan in 2015 created an ideal environment for attempting to replicate the yield response that Dr. Hugh Earl achieved in his greenhouse work. Although his results were not achieved on the two sites in this demonstration, the results from this field trial suggest that there could be a small response to foliar-applied boron during early flowering, but more practical work needs to be done to confirm this.

Figure 1: Canola field prior to boron application.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Gary Kruger, Irrigation Agrologist, Saskatchewan Ministry of Agriculture, for providing agronomic guidance and support on this project
- Adam Tomasiewicz, 2015 summer student, Saskatchewan Ministry of Agriculture for helping with irrigation scheduling with this project

Fertigation Application Timing on Irrigated Canola

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Gary Ewen, Grower, Riverhurst, SK, Riverhurst Irrigation District (RID)

Project Objective

The objective of this project was to demonstrate the proper timing for liquid nitrogen application injected into irrigation water to improve yield.

Project Plan

A 130 acre field with a center pivot equipped with a 1600 gal liquid fertilizer tank, injection pump, and injection valve was used in this demonstration. The field was seeded to canola and a variable rate map produced by Farmers Edge was used to split the field in half for the demonstration. After seeding, there was intensive irrigation management and fertigation was applied at the timing set for each application area. Tissue tests were taken at bolting to determine plant nitrogen levels. Yield from each plot was determined and a combine yield map received from the producer.

Demonstration Site

The demonstration site, SW27-22-7W3, is 130 acres located in the Riverhurst Irrigation District and has a center pivot. The soil texture is clay loam, and the field was seeded to flax in 2014.

Project Methods

Soil tests were taken in the spring to determine residual nutrients and the optimal application rates that would be required to reach the grower's targeted yield. The canola variety Liberty 5440 was seeded May 2. Nitrogen application zones were provided by Farmers Edge. Figure 1 shows the Farmers Edge As-Applied Map. Detailed agronomics are in Table 1. Extensive monitoring occurred weekly throughout the growing season and predicted using the Alberta Irrigation Management Model (AIMM) to ensure soil moisture was kept above 50% (Figure 2). Monitoring of plant stage was also important for staging fertigation events. Table 2 shows the different events. Plant tissue samples were taken during bolting stage and results are shown in Table 3. Harvest yields were taken to determine the success of the different treatments. Soil samples were taken in the fall to determine residual nitrogen levels between the different treatments.

Table 1. Detailed Agronomics/Crop Management

Nutrients (lb/ac)	**N**	**P**	**K**	**S**
Soil Test (0-6")				
W 1/2	13	10	480	9
NE Quadrant	10	12	700	118
SE Quadrant	15	14	600	18
Soil Test (6-24")				
W 1/2	34			66
NE Quadrant	50			2700
SE Quadrant	55			468
Soil Test (24-36")				
W 1/2	9			320
NE Quadrant	14			2400
SE Quadrant	10			2600
Applied (lb/ac)	80-140	51		20

Seeding		
Date	May 2, 2015	
Variety	5540	
Rate	6 lb/ac	
Herbicide		
Date	June 7, 2015	
Product	Liberty and Centurion	
Fungicide		
Date	June 26, 2015	
Product	Proline and Matador	
Swathed	August 15, 2015	
Harvest	September 11, 2015	
Available Moisture	**mm**	**inches**
Rainfall	175.4	6.9
Irrigation	279.4	11.0

Table 2. Fertigation Events

Quadrant	**Pivot Angle**	**Timing**	**Date**	**N** (lb/ac)	**H_2O** (inches)
NE	3° – 90°	Full Cabbage	18 Jun	46	0.30
SE	90° – 180°	5–10% Bloom	24 Jun	46	0.30
W 1/2	180° – 337°	5–10% Bloom	25 Jun	23	0.16

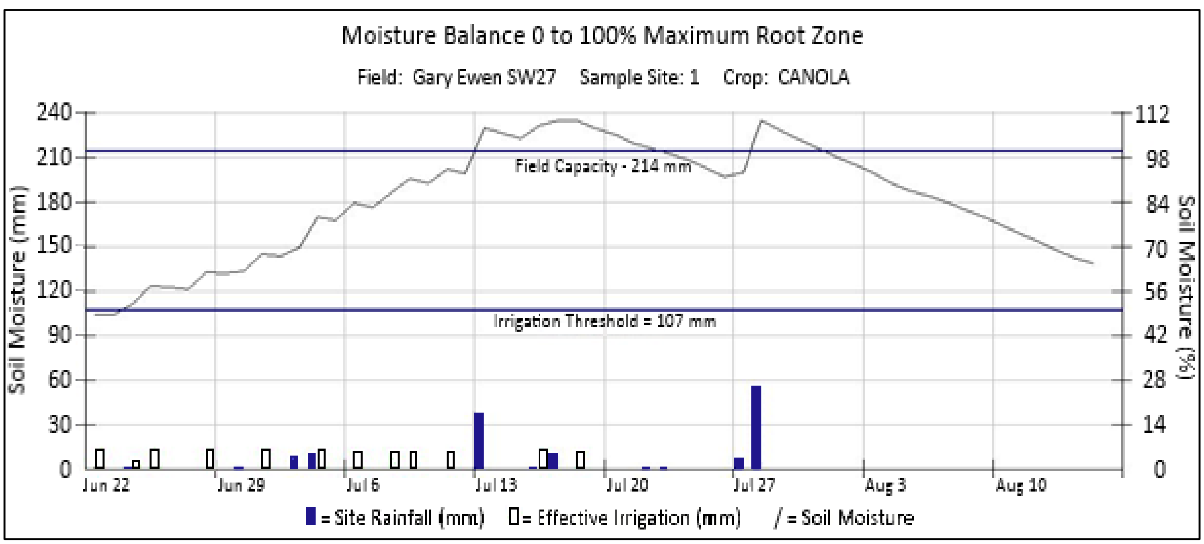


Figure 1. Alberta Irrigation Management Model (AIMM) rainfall and irrigation record for site.

Table 3. Plant Tissue Analysis of Canola Samples Collected from the Fertigation Treatments at the Early Flower Stage of Development (June 24, 2015)

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
W 1/2	6.15	0.52	1.28	1.05	2.48	0.53	6.34	100.0	137	41.3	52.4
NE	6.31	0.54	1.50	0.98	2.65	0.44	6.82	102.0	108	37.6	43.2
SE	6.02	0.44	1.37	0.97	2.39	0.45	5.76	84.6	106	42.6	43.6
Threshold	**4.00**	**0.30**	**2.00**	**0.40**	**0.50**	**0.20**	**4.50**	**40.0**	**20**	**15.0**	**30.0**

Results

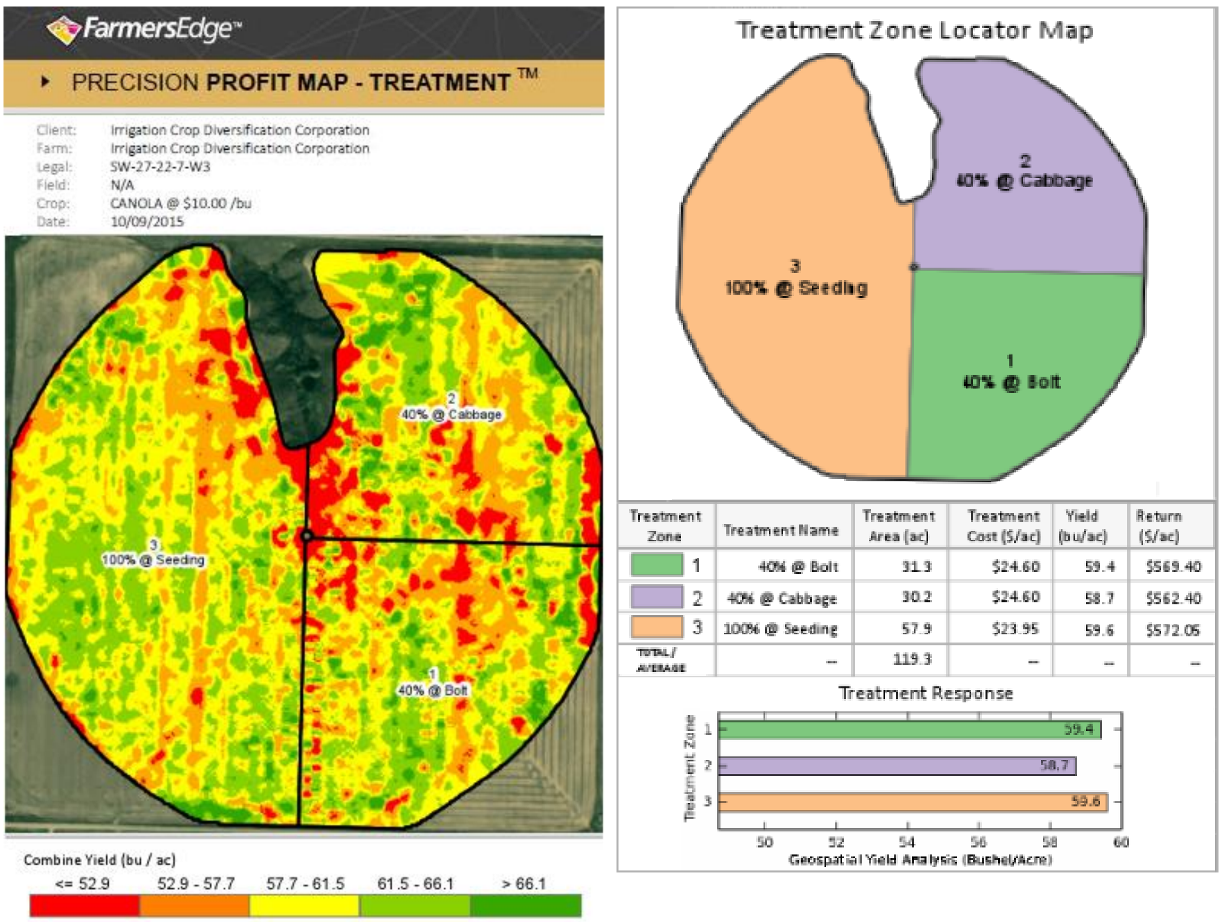


Figure 2. FarmersEdge Precision Profit report.

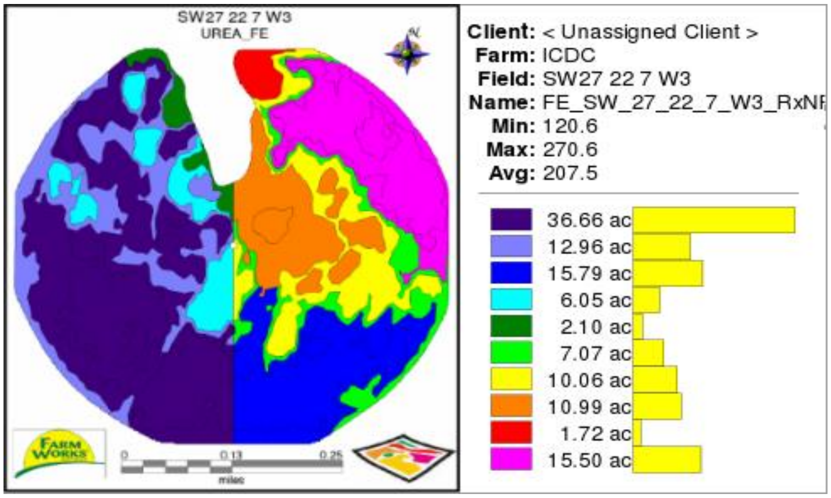


Figure 3. FarmersEdge as applied map.

Final Discussion

Fertigation has been used over the years on irrigation to supply the crop with top-up nitrogen throughout the growing season. There is the question of proper timing for applying fertigation to increase yield. More than 75% of nitrogen uptake occurs before full flower.

In 2015, conditions were very favorable for applying fertigation because there was limited precipitation. Yield results showed no difference between the different treatment areas. Fall soil samples showed similar residual nitrogen levels to what was found in spring soil samples. This shows that the crop used all applied nitrogen and it did not matter when nitrogen was applied. Although there is added costs for installing a fertigation system (i.e., a tank and injection pump), along with the added cost of liquid nitrogen (which is usually at a higher cost than granular nitrogen), using fertigation can be practical the entire amount of nitrogen that a canola crop requires cannot be applied at seeding.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Farmers Edge – for application zone map, soil sampling, tissue analysis, and yield maps
- ADOPT

Winter Wheat Variety Evaluation for Irrigation

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

The project objectives were to identify the top producing and 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.

Research Plan

Seed of sixteen registered winter wheat varieties was acquired from winter wheat breeder, Dr. R. Graf, AAFC-Lethbridge. Varieties were direct seeded into canola stubble on September 2, 2015. Winter wheat varieties were established in a small plot randomized trial design replicated 3 times. All varieties were 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 pre-seed application of glyphosate; no other herbicide was required. No foliar fungicides were applied for either leaf disease or fusarium head blight. Total in-season irrigation was 77.5 mm to the irrigated trial, and in May a total of 25 mm was applied to the dry land trial to alleviate drought stress upon spring re-growth. 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 4, 2015.

Results

Results obtained for the irrigated trial are shown in Table 1, the dry land trial in Table 2, and combined site analysis in Table 3.

Irrigated Trial

Swainson was the highest yielding variety under irrigation (Table 1), AC Broadview the lowest. A large variation in average grain yield occurred within the 16 varieties evaluated. Median grain yield of all varieties under irrigation was 8096 kg/ha (120 bu/ac). Grain protein ranged from a low of 9.6% (CDC Ptarmigan) to a high of 12.9% (AC Emerson). Median test weight and seed weights for all evaluated varieties was 75.7 and 30.0, respectively. Heading of all varieties occurred within a period of 5 days from earliest to latest, maturity was spread over a duration of 7 days. AC Broadview was the earliest maturing variety, Sunrise the latest. CDC Falcon was the shortest variety and had the greatest lodging resistance, Peregrine was the tallest variety, but Pintail exhibited the greatest degree of lodging.

Dry Land Trial

Swainson was the highest yielding variety under the dry land conditions (Table 2), AC Broadview the lowest, as was found under irrigated conditions. A large variation in average grain yield occurred within the 16 varieties evaluated. Median grain yield of all varieties under dry land was 7899 kg/ha (117 bu/ac). Grain protein ranged from a low of 9.5% (AC Ptarmagan) to a high of 12.9% (AC Gateway). Median test weight and seed weights for all evaluated varieties was 75.7 and 31.7, respectively. Heading of all varieties occurred within a period of 5 days from earliest to latest, maturity was spread over a duration of 6 days. AC Falcon was the earliest maturing variety, CDC Ptarmigan the latest. CDC Falcon was the shortest variety and had the greatest lodging resistance, CDC Chase was the tallest variety but the next tallest CDC Ptarmigan exhibited the greatest degree of lodging.

Combined Analysis

Combined analysis of the two production systems indicated there was no significant difference in grain yield between systems, although average production under irrigation produced 275 kg/ha (3%) more grain (Table 3). Combined system analysis indicates that the grain yield of Swainson was statistically higher than all other varieties and 133% higher yielding than check variety CDC Buteo. Swainson was the highest yielding variety under both cropping systems. CDC Broadview was the lowest yielding under both systems and therefore on combined system analysis. Median grain yield of all varieties was 7983 kg/ha. Grain protein content was highest for AC Emerson and lowest with CDC Ptarmigan, median protein content of all varieties was 11.6%. Median test weight and seed weights for all evaluated varieties was 77.2 and 31.2, respectively. Heading of all varieties occurred within a period of 5 days from earliest to latest, maturity was spread over a duration of 7 days. AC Broadview was the earliest maturing variety, Sunrise the latest. CDC Falcon was the shortest variety and had the greatest lodging resistance, Peregrine was the tallest variety, but Pintail exhibited the greatest degree of lodging.

ADOPT funding will be applied for to repeat this trial.

Table 1. Winter Wheat Variety Evaluation, Irrigated Trial, 2015

Variety	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)	Heading	Maturity	Height (cm)	Lodging 1=erect; 9=flat
***CDC Buteo** (check)*	***6846***	***100***	***11.9***	***75.0***	***28.7***	***12 June***	***17 July***	***91***	***4.7***
AC Broadview	6347	93	11.6	71.3	25.9	12 June	15 July	84	2.7
AC Emerson	7687	112	12.9	78.0	27.8	13 June	20 July	90	4.3
AC Flourish	8048	118	12.0	73.7	33.5	11 June	17 July	86	1.0
AC Radiant	8550	125	11.1	77.6	32.8	12 June	21 July	99	1.7
AAC Elevate	8133	119	11.5	75.4	29.6	12 June	18 July	85	1.0
AAC Gateway	7678	112	12.3	76.7	33.0	11 June	15 July	85	1.0
CDC Chase	8263	121	12.1	77.5	30.8	10 June	19 July	101	4.7
CDC Falcon	7630	111	11.8	74.0	27.4	13 June	16 July	78	1.0
CDC Ptarmigan	7278	106	9.6	70.9	30.0	13 June	20 July	92	4.3
Accipiter	8242	120	11.0	76.2	29.3	13 June	19 July	90	1.0
Moats	9276	135	11.9	75.6	34.8	9 June	19 July	100	1.7
Peregrine	8932	130	11.2	79.8	34.7	11 June	18 July	102	3.0
Pintail	8516	124	11.2	73.0	26.3	14 June	21 July	92	7.7
Swainson	9630	141	11.6	79.2	39.1	11 June	21 July	99	4.3
Sunrise	8494	124	11.3	74.6	26.7	13 June	22 July	93	3.3
LSD (0.05)	8.4		1.0	3.6	7.3	2.4	1.2	6.5	2.6
CV (%)	1139		5.3	2.9	14.2	0..9	0.4	4.3	52

Table 2. Winter Wheat Variety Evaluation, Dry Land Site, 2015.

Variety	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)	Heading	Maturity	Height (cm)	Lodging 1=erect; 9=flat
***CDC Buteo** (check)*	***7014***	***100***	***12.2***	***78.9***	***30.7***	***11 June***	***17 July***	***89***	***2.3***
AC Broadview	6279	90	12.3	75.1	28.9	10 June	15 July	81	2.3
AC Emerson	7490	107	12.3	79.6	30.2	10 June	18 July	89	1.7
AC Flourish	8326	119	11.6	78.0	36.1	8 June	15 July	88	1.0
AC Radiant	7858	112	11.6	78.3	34.3	10 June	17 July	91	1.0
AAC Elevate	7887	112	11.2	77.5	35.5	11 June	18 July	86	1.0
AAC Gateway	7923	113	12.9	77.8	32.6	10 June	16 July	83	1.0
CDC Chase	7792	111	12.0	79.8	32.0	10 June	18 July	100	2.7
CDC Falcon	6615	94	12.1	73.8	28.1	11 June	14 July	77	1.0
CDC Ptarmigan	8532	122	9.5	75.1	33.3	12 June	20 July	99	3.7
Accipiter	7980	114	11.3	78.9	30.2	12 June	16 July	87	1.0
Moats	8024	114	11.8	77.4	30.3	8 June	18 July	98	2.3
Peregrine	8389	120	11.2	80.3	34.3	11 June	19 July	99	2.7

Variety	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)	Heading	Maturity	Height (cm)	Lodging 1=erect; 9=flat
Pintail	7781	111	11.0	76.6	29.1	13 June	16 July	84	2.3
Swainson	9342	133	11.6	80.7	42.1	9 June	18 July	99	2.0
Sunrise	7924	113	11.2	74.6	28.5	12 June	17 July	86	2.0
LSD (0.05)	7.6		7.1	2.7	11.9	0.9	0.7	6.0	66
CV (%)	991		1.4	3.4	6.4	2.5	2.2	8.9	NS

NS = not significant

Table 3. Winter Wheat Variety Evaluation, Irrigated vs Dry Land, 2015.

Treatment	Yield (kg/ha)	Yield % of CDC Buteo	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)	Heading	Maturity	Height (cm)	Lodging 1=erect; 9=flat
Trial Site									
Irrigated	8097	104	11.6	75.5	30.7	June 11	July 19	92	3.0
Dry Land	7822	100	11.6	77.7	32.3	June 10	July 17	90	1.9
LSD (0.05)	NS		NS	NS	NS	NS	0.7	NS	1.0
CV	8.0		6.3	2.8	13.1	0.9	0.5	5.2	58
Variety									
***CDC Buteo** (check)*	***6930***	***100***	***12.0***	***76.9***	***29.7***	***June 11***	***July 17***	***90***	***3.5***
AC Broadview	6313	91	12.0	73.2	27.4	June 11	July 15	83	2.5
AC Emerson	7589	110	12.6	78.8	29.0	June 11	July 19	89	3.0
AC Flourish	8187	118	11.8	75.9	34.8	June 9	July 16	87	1.0
AC Radiant	8204	118	11.3	78.0	33.5	June 10	July 19	95	1.3
AAC Elevate	8010	116	11.4	76.5	32.5	June 11	July 18	85	1.0
AAC Gateway	7801	113	12.6	77.3	32.8	June 10	July 16	84	1.0
CDC Chase	8027	116	12.1	78.7	31.4	June 10	July 18	100	3.7
CDC Falcon	7123	103	12.0	73.9	27.8	June 11	July 15	77	1.0
CDC Ptarmigan	7905	114	9.6	73.0	31.7	June 12	July 20	95	4.0
Accipiter	8111	117	11.1	77.5	29.8	June 12	July 18	88	1.0
Moats	8650	125	11.9	76.5	32.5	June 8	July 18	99	2.0
Peregrine	8660	125	11.2	80.1	34.5	June 11	July 19	100	2.8
Pintail	8148	118	11.1	74.8	27.7	June 13	July 19	88	5.0
Swainson	9486	137	11.6	80.0	40.6	June 9	July 20	99	3.2
Sunrise	8209	118	11.3	74.6	27.6	June 12	July 19	90	2.7
LSD (0.05)	739		0.8	2.5	4.7	1.7	1.2	5.4	1.6
Location x Variety Interaction									
LSD (0.05)	NS		NS	NS	NS	NS	S	NS	NS

S = significant   NS = not significant

Demonstration of Plant Growth Regulator Application on Irrigated Wheat Production

Project Lead

- Garry Hnatowich, PAg, Research Director, ICDC
- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Canada Saskatchewan Irrigation Diversification Center (CSIDC), Outlook, SK

Project Objective

The objective of this project was to demonstrate the effect of an application of a plant growth regulator on irrigated hard red spring wheat and durum wheat production. This project demonstrated the optimal stage for application, fertility levels, and irrigation amounts in an intensive verses normal irrigation program. This project will continue to build off of results found at CSIDC in 2014.

Project Plan

This project occurred at the Canada Saskatchewan Irrigation Diversification Centre (CSIDC) in Outlook. It demonstrated two different times of application: growth stage 32 and flag leaf timing. Three different nitrogen levels were used based on soil test recommendations, 100%, 125% and 150% of recommended nitrogen. Two different irrigation levels were demonstrated: normal and intensive. Normal irrigation will be determined using water scheduling based on the Alberta Irrigation Management Model (AIMM). The intensive irrigation treatment was an increased application compared to normal, with the purpose of attempting to lodge the crop through extra watering.

Demonstration Site

The demonstration was conducted on Field 10 under a variable rate center pivot at CSIDC.

Project Methods

Detailed agronomics are shown in table 1. Extensive monitoring occurred throughout the growing season to ensure that irrigation was regulated between regular and intensive irrigations. Monitoring of plant stage was also important for staging the PGR. Following PGR application, the field was monitored and any differences between treated and untreated were noted.

Table 1. Crop Management

Nutrients	N	P
Recommended	120	30
125%	150	30
150%	180	30

Operation	Date	Product	Notes
Seeding	May 15/16, 2015	HRSW Variety: Unity VB Durum Variety: Brigade	
Herbicide	June 10, 2015	Bison and Buctril M	
Plant Growth Regulator	June 11, 2015 July 2, 2015	Manipulator	Applied Growth Stage 32 Applied Growth Stage Flag Leaf
Fungicide	None Applied		
Harvest	September 1, 2015		

Precipitation	mm	inches
Rainfall	226	8.9
Regular Irrigation	52.5	2.0
Intensive Irrigation	97.5	3.8

Results

Complete results are recorded below in Tables 2 and 3. No significant differences in the measured parameters measured were found between the hard red spring wheat and durum. Visually, throughout the plots, plant height differences were observed where the plant growth regulator had been applied. Very minimal lodging occurred in the normal and intensive irrigation plots of both the durum and hard red spring wheat. Lodging that did occur showed no particular pattern between treatments. No durum yield differences were noted between the plant growth regulator treatments. The hard red spring wheat did show approximately a 4 bu/ac response to the plant growth regulator treatments, but this was not statistically significant.

Table 2. Effect of N Fertility & PGR Application on Durum – Combined Site Analysis

Treatment	Yield (kg/ha)	Yield (bu/ac)	Protein (%)	Test Weight (kg/hl)	Seed Weight (mg)	Height (cm)
Irrigation						
Normal	4903	64.5	15.0	73.7	35.7	85.9
Intensive	4340	72.9	14.7	76.8	39.4	83.7
LSD (0.05)	NS	NS	0.2	0.6	1.3	NS
CV	6.8	6.8	0.9	0.7	4.2	3.3
Nitrogen Fertilizer Rate						
1.00 X	4581	68.1	14.8	75.3	37.6	84.5
1.25 X	4663	69.3	14.8	75.3	37.4	85.5
1.50 X	4621	68.7	14.9	75.1	37.6	84.4
LSD (0.05)	NS	NS	NS	NS	NS	NS
Plant Growth Regulator (PGR)						
Control	4673	68.5	14.9	75.8	38.6	88.6
GS 32	4655	69.2	14.8	75.3	37.7	85.8
Flag Leaf	4536	67.4	14.8	74.7	36.3	80.0
LSD (0.05)	NS	NS	NS	0.3	0.9	1.7
Irrigation x Seeding Date x PGR						
LSD (0.05)	NS	NS	NS	NS	NS	NS

S = significant NS = not significant

Table 3. Effect of N Fertility & PGR Application on CWRS Wheat – Combined Site Analysis.

Treatment	Yield (kg/ha)	Yield (bu/ac)	Protein (%)	Test weight (kg/hl)	Seed Weight (mg)	Height (cm)
Irrigation						
Normal	4700	69.9	15.3	78.2	32.9	82.6
Intensive	5053	75.1	14.7	77.9	36.3	78.3
LSD (0.05)	NS	NS	0.4	NS	0.7	1.3
CV	6.1	6.1	2.1	0.7	2.6	3.4
Nitrogen Fertilizer Rate						
1.00 X	4913	73.0	15.0	78.2	34.4	80.4
1.25 X	4737	70.4	15.0	77.8	34.7	80.3
1.50 X	4979	74.0	15.0	78.0	34.7	80.6
LSD (0.05)	183	2.7	NS	0.3	NS	NS
Plant Growth Regulator (PGR)						
Control	4963	69.8	15.3	78.0	35.3	84.0
GS 32	4965	73.8	14.7	78.1	33.9	78.1
Flag Leaf	4971	73.9	14.9	78.0	34.6	79.2
LSD (0.05)	174	2.6	0.2	NS	0.5	1.6
Irrigation x Seeding Date x PGR						
LSD (0.05)	NS	NS	NS	NS	NS	NS

S = significant NS = not significant

Final Discussion

Lodging is a major issue in cereal production under irrigation. When the crop lodges, it becomes much more difficult to harvest and there is potential for yield loss. A plant growth regulator has the potential to shorten the crop, and thus reduce the possibility that the crop will lodge.

This demonstration was built on a similar project carried out in 2014 on irrigated wheat. It was decided that a more extensive demonstration that considered both durum and hard red spring wheat would be of value. Other considerations included increased nitrogen rates, increased irrigation intensity, and two different PGR application timings.

No significant differences were found in either the hard red spring wheat or the durum for any of the parameters measured. Plant height differences and lodging were noted between treatments, but were not consistent in the replications in either the durum or hard red spring wheat at both plant growth regulator timings. There was no yield response detected in the durum. The hard red spring with did show approximately a 4 bu/ac response to a plant growth regulator treatment. Increased nitrogen had no effect on any of the parameters for either the durum or hard red spring wheat.

Notable differences were found that did not directly pertain to the demonstration. In both the durum and hard red spring wheat, significant yield responses were seen between normal and intensive irrigation—there was a 5 to 9 bushel increase under intensive irrigation. The difference in precipitation was 45 mm (1.8 inches).

Different varieties and classes of wheat respond differently to plant growth regulators. We have found it is difficult to simulate results from small plots in a production-size field due to the size of plots. Doing this work on the research station also proved to be difficult due to the amount of residual nutrients, lack of variability, and lack of exposure to climatic elements that may occur in a producer's field.

ICDC will continue to investigate and demonstrate plant growth regulators in 2016.

Acknowledgements

The project lead would like to acknowledge Engage Agro, Phil Bernardin, for demonstration product, PGR Manipulator.

Fertigation Application Timing on Irrigated Durum

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Gary Ewen, Grower, Riverhurst, SK, Riverhurst Irrigation District (RID)

Project Objective

The objective of this demonstration was to show the proper timing for the application of liquid nitrogen injected into irrigation water and to determine the optimal application timing that will most improve yield and protein.

Project Plan

The demonstration occurred on a 130 acre field with a center pivot equipped with a 1600 gal liquid fertilizer tank, injection pump, and injection valve. The pivot was seeded to durum and a variable rate map produced by Farmers Edge was used to split the field in half for the demonstration. After seeding, intensive irrigation management occurred and fertigation was applied at the timing set for each application area. Tissue tests were taken at the flag leaf stage to determine plant nitrogen levels. Yield was determined for each plot and a combine yield map was obtained from the producer.

Site

The demonstration site is located in the Riverhurst Irrigation District (NW22-22-7W3) and is a 130 acre field with a center pivot. The soil texture is clay loam, and the field was seeded to canola in 2014.

Project Methods

Soil samples were taken in the spring from the different application areas for testing to determine residual nutrients and to determine the optimal application rates required to reach the grower's target yield. The durum variety, Fortitude, was seeded April 30. Nitrogen application zones were provided by Farmers Edge. Figure 1 shows the Farmers Edge As-Applied Map. Agronomic details are shown in Table 1. Extensive monitoring occurred weekly throughout the growing season and water needs were predicted using the Alberta Irrigation Management Model (AIMM) to ensure soil moisture was kept above 50% (Figure 2). Monitoring of plant stage was also important for staging fertigation events. Table 1 shows the different water events. Plant tissue samples were taken during flag leaf stage, and results are shown in Table 2. Harvest yields and protein were determined to ascertain the success of the different treatments. Soil samples were taken in the fall to determine the differences in residual nitrogen levels between the different treatments.

Table 1. Crop Management

Nutrients (lb/ac)	N	P	K	S
Soil Test (0–6")				
W ½	22	68	1680	44
NE Quadrant	28	22	1080	104
SE Quadrant	26	36	1760	68
Soil Test (6–24")				
W ½	23			96
NE Quadrant	9			4800
SE Quadrant	24			48
Soil Test (24–36")				
W 1/2	12			251
NE Quadrant	21			5600
SE Quadrant	16			1040
Applied: (lb/ac)	110–145	35–40		

Seeding		
Date	April 30, 2015	
Variety	Fortitude	
Rate	120 lb/ac	
Herbicide		
Date	June 5, 2015	
Product	Octain and Traxos	
Fungicide		
Date	July 4, 2015	
Product	Prosaro	
Harvest		
Date	August 29, 2015	
Available Moisture	**mm**	**inches**
Rainfall	175.4	6.9
Irrigation	208.3	8.2

Table 2: Fertigation Events

Quadrant	Pivot Angle	Timing	Date	N (lb/ac)	H_2O (inches)
NE	0° - 90°	4-6 leaf	Jun 14	23	0.16
SE	90° - 180°	Flag Leaf	Jun 24	23	0.16

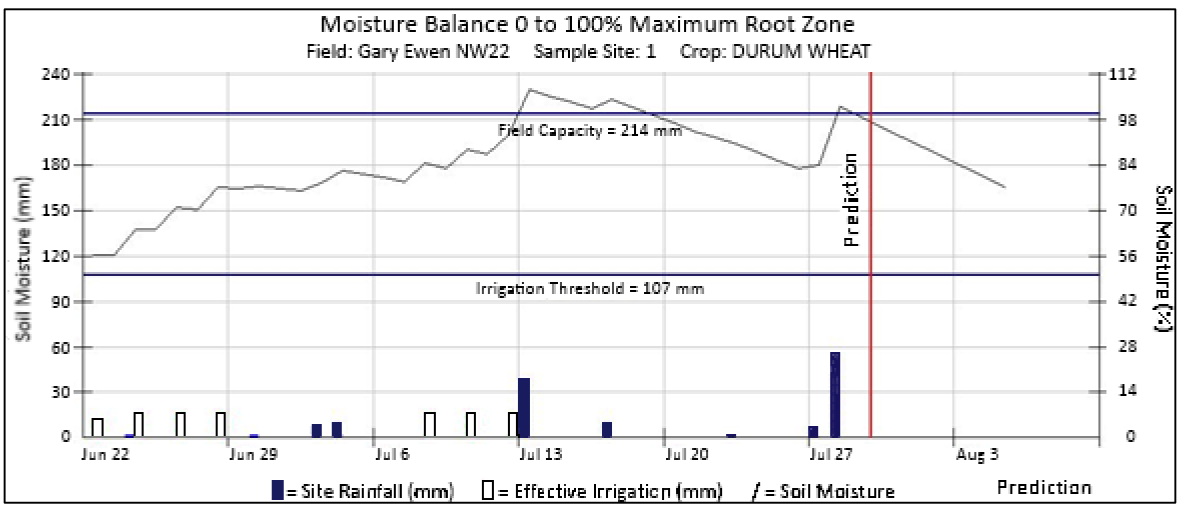


Figure 1. AIMM graph of rainfall and irrigation record for NW 22-22-7-W3.

Table 3. Plant Tissue Analysis of Durum Samples Collected from the Fertigation Treatments at the Flag Leaf Stage of Development (June 24, 2014)

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ppm	Fe ppm	Mn ppm	Zn ppm	B ppm
W 1/2 (Seed Placed)	4.93	0.28	2.67	0.31	0.40	0.17	14.6	90.8	104	39	5.87
NE (Post-fertigation)	4.89	0.25	2.66	0.27	0.34	0.17	14.7	84.2	102	31.7	5.66
SE (Pre-Fertigation)	4.64	0.29	2.62	0.29	0.35	0.16	12.8	82.3	90.5	36.2	5.74
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.50**	**0.25**	**8**	**50**	**20**	**20**	**5**

Results

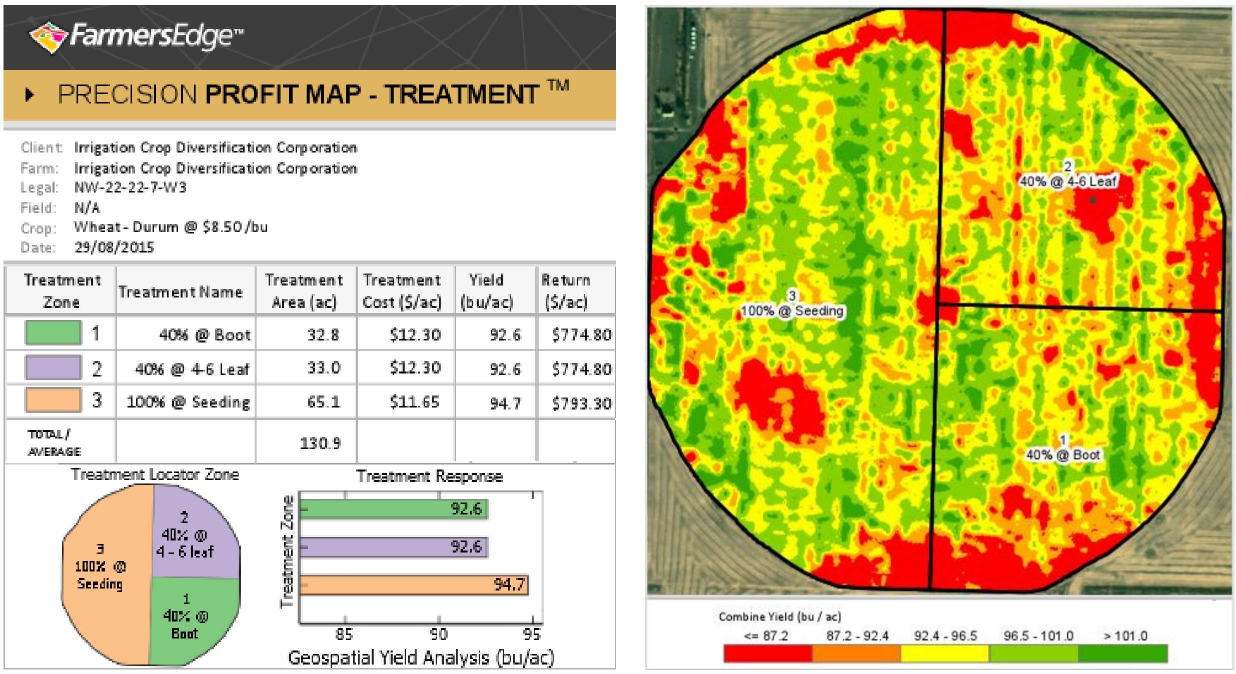


Figure 2. FarmersEdge Profit Treatment results.

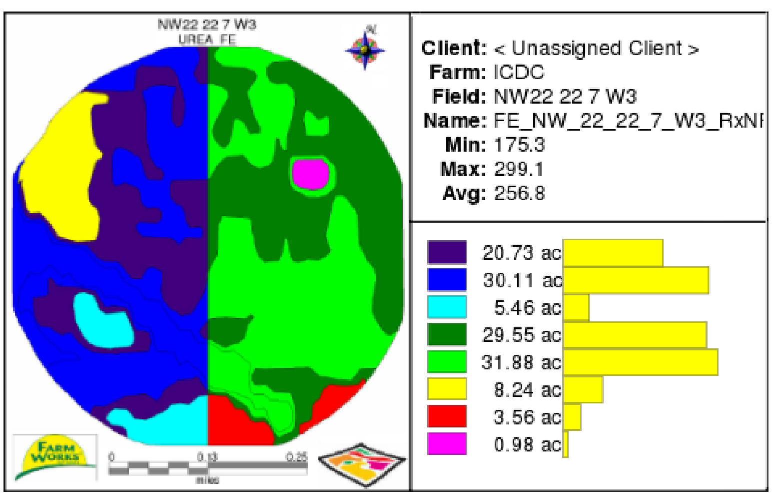


Figure 3. FarmersEdge as applied map.

Final Discussion

Fertigation has been used over the years in conjunction with irrigation to supply crops with top up nitrogen throughout the growing season. The question is when to apply nitrogen to a cereal crop for greater yield and when to apply to increase protein. Yield is determined at flag leaf timing and more than 75% of nitrogen uptake occurs before the 6 leaf stage.

Results from 2014 showed that the best yield response occurred when the entire nitrogen requirements for durum was placed at seeding and that there was no yield benefit from applying nitrogen through fertigation, although fertigation did result in a small protein increase. Tough conditions in 2014 when there was above average precipitation made it difficult to apply fertigation. In 2015, conditions were very favorable for fertigation because there was limited precipitation. In 2015, there were very similar results to those from 2014: applying all nitrogen at seeding produced the highest yield. Protein levels were increased by approximately 1% by both fertigation application timings.

The demonstration of applying nitrogen on durum for the past two years shows that fertigation does not show a yield advantage over placing all nitrogen at seeding. Although there is added cost to a fertigation system (i.e., cost of a tank and injection pump) along with the added cost of liquid nitrogen (compared to the cost of granular nitrogen), fertigation can be practical for producers who are not able to apply high rates of nitrogen at seeding to a level required for cereal crops. In years where premiums are offered for protein can make this practice more attractive to increase returns.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Farmers Edge – for application zone map, soil sampling, tissue analysis, and yield maps, and
- Cargill Rosetown – for grading harvest samples.

Demonstration of Potential Irrigated Crops

Project Lead

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

Organizations

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

Project Objectives

This demonstration will give producers the opportunity to view some unfamiliar crops and will compare different varieties, which will help them decide whether to incorporate them into their crop rotations. Producers are interested in new crop opportunities to potentially capitalize on favorable markets and also for agronomic considerations such as managing disease and pest problems. Recent trends have shown that irrigating producers in the Lake Diefenbaker 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 the selected crops for Saskatchewan. It is important for producers to know what varieties are available to them and how they perform in their area to make informed decisions on crop choice. The project also demonstrated growing the crops under irrigation, as opposed to dryland, to determine how well adapted they are to growing under irrigated conditions in Saskatchewan.

Project Background

Producers are looking for new types of crops to add into their rotation 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 when grown under irrigation. This demonstration evaluated each crop's growing potential and also provided producers with a side-by-side comparison of dryland and irrigated production.

These crops have been tested on dryland and/or irrigated land in the past and have successfully matured and been harvested in Saskatchewan. Quinoa is currently grown commercially in Saskatchewan, but is only available under contract. There were approximately 40,000 acres of hemp grown in Saskatchewan in 2015, about 210 of those acres were grown under irrigation. Safflower has been grown in Canada since the 1980s, and Canadian cultivars were first released in 1985. Alberta currently has a small number of acres seeded to safflower, while Saskatchewan acres have diminished to next to nothing.

Project Methods

This demonstration was seeded with a no-till drill on May 22 on field 9 at the CSIDC site. The irrigated plots were placed in a lower lying area, which was detrimental to a portion of the treatments due to water log damage. Three crops were selected for this trial, eight varieties of hemp, two varieties of quinoa and one variety of safflower (Table 1). A separate irrigated and dryland trial was established for each crop. The seeding depth and rate for each crop is described in Table 1.

Each treatment consisted of 6 rows, each 8 x 1.5 m. The demonstration was fertilized with 264 lb/ac actual N and 55 lb/ac P2O5, all side banded. Hand weeding was done throughout the growing season, as there is little or no in crop herbicide options for these crops. Harvest took place between Oct 27 and Oct 29. The quinoa and safflower were straight cut with a plot combine and the hemp was hand cut and fed through a combine to avoid fibres winding around the beater bar.

Table 1. Crops and Varieties Grown and General Agronomy for this Demonstration

Crop	Variety	Seeding Rate	Seeding Depth
Quinoa	Norquin NQ94PT	10 lb/ac	¾ inch
Quinoa	Norquin Black	10 lb/ac	¾ inch
Hemp	CRS-1	100 plants/m^2	¾ inch
Hemp	Finola	100 plants/m^2	¾ inch
Hemp	X-59	100 plants/m^2	¾ inch
Hemp	Joey	100 plants/m^2	¾ inch
Hemp	Picolo	100 plants/m^2	¾ inch
Hemp	Grandi	100 plants/m^2	¾ inch
Hemp	Kantani	100 plants/m^2	¾ inch
Hemp	GranMa	100 plants/m^2	¾ inch
Safflower	Safire	34.8 lb/ac	1¼ inch

Results

Quinoa

<u>Background</u>

Quinoa is a spinach-like plant that has historically been grown as a staple food in South America. 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 1. Photo of quinoa on September 9.

Quinoa is being used more as an ingredient to packaged foods, such as granola bars and cereal, which will help increase consumer demand. Consumers are currently demand local products. So the combination of all these factors indicates an expectation that the quinoa market will grow in North America.

Production has been increasing in Saskatchewan, with around 5,000 acres contracted in 2014. Currently, Northern Quinoa sells all the seed, buys all the grain, and processes all Quinoa grown in Saskatchewan. Quinoa yields are highly variable and can range from 300 to 2,000 lb/ac. Since there are no herbicide options, it is important to grow this crop on land that does not have significant broadleaf weed pressure.

Producers who grow Quinoa in Saskatchewan pay a $40/ac fee for seed but are guaranteed a buyer. Quinoa is a high-input crop and responds well to nitrogen. Northern Quinoa recommends applying 25–30 lb/ac of Phosphate and a minimum of 130 lb of N to achieve optimum yields. Prices for quinoa are typically around $0.60/lb, so a producer can make a good profit if yields of close to a 2,000 lb/ac are achieved.

Figure 2. Photo of quinoa prior to harvest.

2015 ICDC Trial Results and Discussion

The quinoa in this demonstration produced little to no seed, as seen in the results shown in Table 2. The plants seemed to be healthy throughout the growing season (Figure 1), but no seed was found during routine hand threshing before harvest (Figure 2). There are a few potential causes for why this occurred, although a final conclusion was not determined with certainty. The warm and hot spring could have caused severe stress to this cool-climate crop and sterilized the seed or caused it to abort. There was potentially too much residual fertility, which may have caused the quinoa to become too vegetative. There were reports of insect issues on quinoa this year, so this trial could have been severely damaged by aphids or flea beetles. The medium-textured site for the demonstration may have hurt the growth of these plants. Quinoa will be grown under irrigation again in 2016 on a sandier soil with lower fertility to correct for this possibility.

Table 2. Quinoa Harvest Results

	Dryland (lb/ac)	**Irrigated** (lb/ac)
Norquin NQ94PT	10.4	0
Norquin Black	4.5	0

Safflower

Background

Safflower is an oilseed crop that can be traced back to ancient Egypt when it was grown for dye and textile purposes. Only around 600,000 tonnes per year is currently produced worldwide, with the major producers being India, the United States, and Mexico. Today, Safflower is grown mostly for its use as an edible oil with a smaller amount grown for the birdseed market. Safflower oil, like canola oil, is considered healthy because of its high amount of unsaturated fat. Its high smoke point and neutral taste also make it ideal for cooking. Safflower also has advantages in the birdseed market because rodents, like squirrels, find it inedible.

Safflower has been grown in Saskatchewan in the past, peak acreage being in the early 1990s. Early frosts and disease issues have brought the acres down to next to nothing in Saskatchewan. This is a long season crop and yield can be affected by an early frost. Safflower has a long taproot that facilitates moisture uptake in moderately saline conditions. This crop may be considered as an aid in managing saline land.

Safflower yield can reach up to 2,000 lb/ac if fertilized with 100 lb/ac of nitrogen and 22 to 31 lb/ac of phosphorus with the seed. Safflower sells at about $0.14 to $0.26 per pound in the birdseed market, which is typically higher than the oilseed market.

<u>2015 ICDC Trial Results and Discussion</u>

Figure 3. Irrigated safflower on July 22.

Due to current low Safflower acres in western Canada, the only variety available for this trial was Safire. The crop had good establishment and looked healthy throughout the growing season (figure 3). The dryland treatment out yielded the irrigated treatment by over double (table 3). This was most likely due to the safflower being water logged due to the positon of the irrigated treatments on the field. The safflower crop matured and produced nice looking seed as seen in figure 4. Due to the lack of market potential and producer interest in this crop, there will not be any safflower trials in 2016.

Figure 4. Yield sample of safflower seed.

Table 3. Safflower Harvest Results

	Dryland (lb/ac)	**Irrigated** (lb/ac)
Safflower (Safire)	1889.2	807.4

Hemp

<u>Background</u>

Hemp has been cultivated for centuries as a source of fiber for rope, sail, and clothing, and the seed crushed for oil, food, and feed. Hemp is grown in Canada mostly for its seed and oil content due to a lack of processing available for fiber. The oil is used for cooking and cosmetic purposes and is praised for its low saturated fat content, and its omega 3 and omega 6 fatty acid content. It is a close relative to marijuana, although it has no medicinal purposes because of its lack of tetrahydrocannabinol (THC). Because of this, it has been legal to grow in Canada only since 1998. A licence must be obtained from Health Canada to carry out any activity involving hemp.

Hemp is a very fast growing crop, which has a high potential for production under irrigation in Saskatchewan. It is a high water user and should be fertilized like a high-yielding wheat crop. The yields for this crop vary greatly, although yields are typically 660–1100 lb/ac in Saskatchewan. The prices have consistently been between $0.45 and $0.66 cents per pound over the past 5 years.

<u>2015 ICDC Trial Results and Discussion</u>

The results from the hemp harvest displayed much higher yields in the dryland portion of the demonstration (Table 4). This is most likely due to the field location where the irrigated hemp was seeded and the pooling of water that occurred. Four of the hemp cultivars were completely destroyed from a combination of water logging and storm damage, and there was no salvageable yield (Figure 5).

The selected varieties typically grow shorter than the observed 7–9 foot plants that were produced in these trials (Figure 6). Over-fertilization may have been a factor in the abnormal plant height. The dryland treatments showed above average yields for Saskatchewan. Shatter loss was a factor in yield loss due to the late harvest date. The variety X-59 is the only variety that is considered shatter resistant, making it possible to obtain comparably high yields. Due to the difficulty in harvesting this crop with plot equipment, modifications and improvements will have to be made if ICDC is to continue evaluating this crop.

Table 4. Hemp Harvest Results.

Hemp Variety	**Dryland** (lb/ac)	**Irrigated** (lb/ac)
CRS-1	2567.2	572.8
Finola	991.8	204.5
X-59	3223.7	1836.4
Joey	2387.3	988.8
Picolo	1376.9	0
Grandi	1577.7	0
Kantani	1676.6	0
GranMa	2020.0	0

Figure 5. Water log damage on irrigated portion of hemp demonstration

Figure 6. Dryland hemp plots.

Figure 7. Yield sample of hemp seed.

Final Discussion

This demonstration displayed growing three specialty crops under irrigation and dryland conditions in Outlook, Saskatchewan. The irrigation portion of this trial was lower lying and endured significant water stress contributing to yield loss. The quinoa did not produce seed which is uncommon according to industry and other growers in Saskatchewan. Growing quinoa under irrigation will be revisited in 2016 by planting the crop on sandier soil to determine if this crop is better suited to a different soil type. The safflower performed well although this crop has diminished in Saskatchewan and will likely not be making a return in the foreseeable future. This demonstration showed that hemp is susceptible to water logging damage and excess water late in the growing season can completely wipe out a crop. The dryland yields were fairly high although harvest- ability of this tall, fibrous crop proved to be a significant challenge.

For crops that are new or have small acres in Saskatchewan, demonstrations are useful tools for producers to help determine if they want to try growing these crops on their farms. Although there were many adverse factors contributing to the poor yields of this trial, this project demonstrated the potential risks in growing these crops.

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.
- Colin Dutcheshen, Northern Quinoa Corp for supplying quinoa seed and agronomic guidance and speaking at the CSIDC field day.
- Jeff Kostuik, Diversification Specialist, Manitoba Agriculture, Food and Rural Development for supplying hemp seed.
- Brian Otto, Alberta Safflower Growers, for supplying safflower seed.
- Darrell McElroy, Hemp Oil Canada for providing agronomic support and talking at CSIDC field day.

Reclamation of Sodium-Affected Soil

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture
- Ken Wall, PAg, Senior Hydrology Technician, Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada,
- Craig Gatzke, Agro Environmental Services Branch, Agriculture and Agri-Food Canada

Co-operator

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

Project Objective

The project was initiated to demonstrate three alternatives for replacement of sodium on the soil exchange complex of heavy textured 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 and limit infiltration of water into the soil profile. Calcium is able to displace the sodium from the cation exchange sites. If the sodium can be flushed from the soil profile, the calcium can restore adequate water infiltration. Three different calcium products (calcium chloride, calcium nitrate, and calcium sulphate) were broadcast on the surface of sodium-affected soils to test their impact on soil properties and forage yield. Each product has different solubility and mobility in soil. The application rate selected for these sites was 100 lb of calcium per acre, which is substantially less than the rate indicated by the theoretical gypsum requirement. It is planned that the applications will be repeated for several years to test whether low cost applications can correct structural problems when continued over time.

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 in the past with high SAR water from Gouveneur Reservoir.

The Miry Creek site is located on orthic Willows-Sceptre lacustrine soils that show reduced water infiltration compared to the adjacent area. Plot 13 in Miry Creek Irrigation District is near the bay at the edge of the South Saskatchewan River. The soil is heavy textured and suffers from waterlogging in a low lying area. High sodium has been confirmed in the soil profile.

At each site, two replicates of the soil applications were made in the spring and fall of 2014. 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 location. These soil results are reported in Table 1. The Ponteix site is sown to a variety of annual crops. The Miry Creek site is currently sown to alfalfa, but rotates to annual crops when the productivity of the alfalfa stand tapers off as the stand ages.

Table 1 (a). Soil Properties of Sodium-Affected Soils from the Ponteix Site Sampled in Spring 2014

	Ponteix Plot 22 - South Plot			Ponteix Plot 22 - North Plot		
Parameter	**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 of the Sodium-Affected Soils from the Miry Creek Site Sampled in Spring 2014

	Miry Creek Plot 13 -Southside			Miry Creek Plot 13 - Northside		
Parameter	**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

Project Methods and Observations

The amendments were applied to the soils on May 20, 2014 and November 8, 2014. The rate of calcium applied was 100 lb/ac for each application. The application rate was based on gypsum rates applied to cultivated potato fields to improve harvest conditions for potato. The approach attempts to correct water infiltration issues at a lower cost than rapid remediation practiced on 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 first year of results were reported in the 2014 ICDC Research and Demonstration report (available on the ICDC website). The second year yield results are reported in Table 3. With only three calcium applications to date, conclusions for this project at this time would be premature. The calcium nitrate and calcium sulphate amendments also supply plant nutrients. This effect must be considered when interpreting the results. For 2014 and 2015, 70 lb/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 nitrogen was applied to the control area adjacent to the research area. A control with added nitrogen was not included in the experimental design, which complicates assessment of the observations. This deficiency will be corrected in 2016.

Table 2. Productivity of Irrigated Soils Treated with Calcium Amendment

	Ponteix – Field Pea				Miry Creek – Alfalfa		
	Emergence (plants/m^2)		Dry Matter Yield (t/ac)		Dry Matter Yield (t/ac)		
Treatment	Rep 1	Rep 2	Rep 1	Rep 2	1st Cut	2nd Cut	2015 Yield
Control (no 70 lb N/ac)	-	-	1.102	1.139	1.48	1.36	2.84
Calcium Chloride	25	33	0.955	1.350	1.44	1.62	3.06
Calcium Nitrate	21	20	1.230	1.396	1.53	1.74	3.27
Calcium Sulphate	14	15	1.038	1.295	1.28	1.82	3.10

The third application of calcium products was broadcast by hand on November 8, 2014, just prior to the first snowfall of the season. The Ponteix site was sown to field pea in 2015, while the Miry Creek site continued as alfalfa hay. Harvest of the field pea dry matter at Ponteix was completed by sampling four quadrats of plant material by hand on July 24, 2015. This timing was a little premature, as the peas within the pods were very shrunken once dried. For this reason, grain yield was not determined on the field pea. The alfalfa hay measurements during the 2015 growing season were conducted by sampling four quadrats by hand from each of the two replicates on July 2, 2015, for the first cut and by harvesting the entire plot area with the Haldrop forage harvester on August 27, 2015, for the second cut yield.

The spring was very harsh on the alfalfa at Miry Creek. The late spring frosts injured the new growth. Adding insult to injury was the lack of spring rain. Spring irrigation at Miry Creek was delayed by low water levels at the pump site. Absence of rainfall and irrigation in late fall 2014 and delayed irrigation in 2015 combined to hurt forage production at Miry Creek for 2015.

Final Discussion

The calcium treatments are having an effect on growth of the crops. An effect on the field pea seedling emergence was evident in this year's field pea crop. The field pea seedlings where the calcium had been applied emerged more quickly than elsewhere in the field. Similarly, the alfalfa plot area bloomed prior to the second cut, while the rest of the field was still in vegetative stage. The reason for both observations is not fully understood but could be attributed to the 70 lb N/ac of urea applied to compensate for the nitrogen in calcium nitrate treatment. These observations also call into question the assumption that the sulphur contributed by the irrigation water and the residual sulphur in the soil are adequate to meet crop needs.

Copper Fertility on Low Soil Test Production Fields under Irrigation

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Peter, Frank, and Ferdinand Hiebert, Riverhurst, SK
- Joe Tindall, Nexus Ag, Saskatoon, SK

Project Objective

The project objective was to demonstrate the yield response of CPS spring wheat to soil application of copper granular fertilizer on soils that test low in available copper.

Demonstration Site

The irrigated field is located just outside Riverhurst Irrigation District at the northern end of the Riverhurst-Grainland triangle on SW27-24-5-W3. The site is mapped as Birsay soil association: medium to moderately fine textured, moderately calcareous sandy glacio-lacustrine deposits with over 15% clay. The demonstration was located in an area with a surface texture of sandy loam. The field was developed for irrigation in 1999. The water is supplied from a pump site on Lake Diefenbaker.

Project Methods and Observation

The site was sampled in spring for nutrients (Table 1) and results showed that available N, P, K, S, and Cu levels were low on the site. Evaluation of P, K, and micronutrients is more effective when completed with a 0–6" sample. The field had not previously grown beans or potatoes, so supplements of copper and zinc have not been previously applied with fungicides.

Table 1. Soil Analysis of Site Selected for Copper Fertilizer Demonstration

	pH	EC	N	P	K	S	Cu	Fe	Mn	Zn	B
Riverhurst Site		dS/m	ppm								
0–12”	7.7	0.2	8	3	91	4	0.3	5	2	0.2	0.7
12–24”	8.4	0.5	5			13					
24–36”	8.9	0.3	2			3					

Copper sulphate was banded with an airdrill in spring prior to seeding. The grower used a global positioning guidance system to mark the passes where the copper was applied. The copper was applied at two rates: 3.5 lb and 5 lb copper/ac. A control with no copper separated each pass of copper. Nitrogen was applied following seeding using fertigation in three separate applications of 29 lb/ac. This strategy maximized the efficiency of the nitrogen by minimizing risk of leaching on this sandy soil. Phosphorus (P205) was seed-placed at 50 lb/ac. Potassium (K20) was broadcast at 60 lb/ac prior to seeding. Although the rate of potassium applied was very significant, the K level in the plant tissue sample remained low to marginal for CPS wheat.

Plant tissue samples were collected from the strips where the copper sulphate had been applied. The level of copper present in the plant tissue as shown in Table 2 was above the commonly accepted critical level of copper for wheat. This means copper deficiency should not occur on this wheat crop. Copper chelate was also applied with herbicide to a portion of the production field. A plant tissue sample and grain yield was not collected from this area.

Table 2. Plant Tissue Analysis Determined on Whole-Plant Tissue Samples Collected from Copper Fertility Demonstrations at the Flagleaf Stage of Development

Treatment (Fertilizer/ac)	**N** (%)	**P** (%)	**K** (%)	**S** (%)	**Ca** (%)	**Mg** (%)	**Cu** ug/g	**Fe** ug/g	**Mn** ug/g	**Zn** ug/g	**B** ug/g
No Copper	4.3	0.31	2.0	0.25	0.26	0.17	7.7	94	52	32	7
3.5 lb Copper	4.6	0.30	1.9	0.27	0.27	0.19	6.9	100	53	27	7
5 lb Copper	4.4	0.32	2.0	0.25	0.28	0.18	10.6	89	50	25	8
Threshold	**2.1**	**0.25**	**2.0**	**0.15**	**0.20**	**0.15**	**4.5**	**40**	**20**	**15**	**5**

Grain yield from the strips was determined on October 16, 2015 using a weigh wagon. These results are summarized in Table 3. These yields are low for an irrigated CPS crop. A number of factors contributed to this observation. Potassium levels in the plant tissue were low for CPS wheat. The grower missed a planned application of N with the fertigation system which may have limited the yield potential of the crop. Nitrogen levels in the plant tissue and grain samples were not unusually low. Weathering of the grain from the wet fall weather reduced the bushel weight by 4 lb/bu according to the grower. The grain was graded by Cargill AgHorizons at Rosetown. Differences in bushel weight, ergot infection and thousand kernel weight were small. Analysis of the copper content in the grain was conducted by ALS Laboratories in Saskatoon and is reported in Table 3. The copper content is much higher than the critical level for wheat determined in Australia.

Table 3. Grain Yield and Quality of CPS Conquer Wheat Sampled from the Copper Demonstration

Treatment (Fertilizer/ac)	**Grain Yield** (bu/ac)	**Grade**	**Protein** (%)	**Bushel Weight** (lb/bu)	**Ergot** (%)	**Thousand Kernel Weight** (g)	**Fusarium** (%)	**Cu Content** (%)
No Copper	53	Feed	14.2	59.9	None	36.1	2.1	7.7
3.5 lb Copper	56	Feed	14.0	59.0	None	36.4	1.7	6.9
5 lb Copper	55	Feed	14.1	60.6	None	37.5	1.5	10.6

Table 4. Analysis of Canada Prairie Spring Grain Samples Collected from Copper Application Strips

Treatment (Fertilizer/ac)	**N** (%)	**P** (%)	**K** (%)	**S** (%)	**Ca** (%)	**Mg** (%)	**Cu** ug/g	**Fe** ug/g	**Mn** ug/g	**Zn** ug/g	**B** ug/g
No Copper	2.5	0.37	0.37	0.15	0.04	0.15	3.4	34	33	25	<3
3.5 lb Copper	2.5	0.32	0.33	0.15	0.04	0.13	3.4	29	31	23	<3
5 lb Copper	2.4	0.28	0.29	0.15	0.04	0.11	3.0	29	26	20	<3
Threshold	**2.0**	**0.25**	**-**	**0.12**	**-**	**-**	**2.5**	**10**	**11**	**5**	**1**

Copper fungicides are commonly used to control bacterial blight in dry beans and late blight in potatoes. These two crops are grown on lighter-textured soils in the irrigated region. Potatoes were produced on a portion of the field where the wheat demonstration was established. Rates of application for copper fungicide can be as much as 0.5 lb/ac for each bacterial blight control application. Up to six applications on beans and ten applications on potatoes are registered for the control of disease in these crops. Rates of copper fertilizer application for deficient sites range between 3.5 and 5 lb/ac. The rates of fungicide application are adequate to correct copper deficiency in wheat for ten or more years. Fungicide use on beans and potatoes can easily supply sufficient copper to correct any deficiency on soils that require supplemental copper. If copper deficiency is suspected on a field, rotating to one of these two crops will fix this production challenge and eliminate copper fertility from the list of potential limiting factors for the irrigated field.

Understanding Soil Variability in Availability of Nutrients for Irrigated Soils

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Dale Ewen, Riverhurst, SK

Project Objective

This project evaluated a technique to apply specific types and amounts of nutrients to the areas of a field where they were needed based on work with a consultant. Certain soil nutrients are deficient only in small areas of the field. The yield response of these nutrients is very cost effective if the nutrient application can be limited to the responsive area. The challenge is to limit the application to these responsive areas. Variable rate application technology is available to determine both where and how to apply fertilizer to achieve this.

Project Plan

The demonstration occurred on a 170 acre centre pivot. Farmers Edge provided the service of mapping soil texture and soil salinity within the field using the combination of the tools of global positioning and electromagnetic radiation. The transmission of electomagnetic radiation in soil is affected by the soil texture, soil salinity, and moisture content. This tool allows a field to be divided into zones for soil sampling to identify areas with needs for specific plant nutrients. The pivot was seeded to durum and managed with intensive irrigation management. Tissue tests were taken at the flag leaf stage to determine plant nutrient levels. Yield was determined using combine yield data obtained from the producer using global positioning software.

Demonstration Site

The project was located at NE23-23-7-W3 on a quarter-section corner arm pivot located on Birsay Orthic Brown soil developed on moderately coarse to moderately fine textured, moderately calcareous, sandy glacio-lacustrine parent material. The quarter is located in the Riverhurst Irrigation District and was developed for irrigation in 1983.

Project Methods and Observations

Evaluation of soil fertility at the site started with mapping the field using an EM38 to measure variations in soil salinity and texture. This information together with satellite imagery was used to delineate areas for soil sampling (Figure 1). Soil sample results (Table 1) were then interpreted to prepare a variable rate prescription map. The field was divided into six zones based on the soil properties. Because this process did not identify any zones deficient in micronutrients, potassium was chosen as the nutrient to work with. Potassium soil test levels were low for one of the zones.

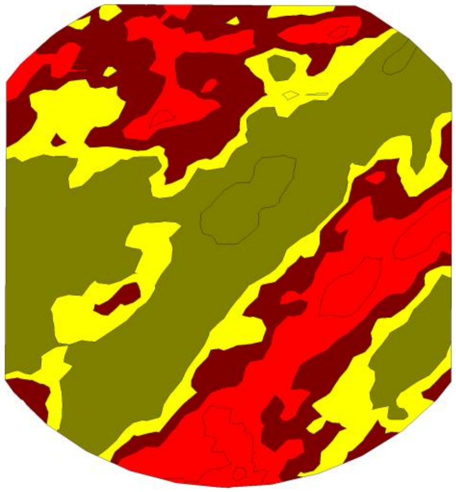


Figure 6. FarmersEdge soil sampling zone map

The potassium application was increased from 9 to 12 lb K_2O/ac for zones 1 and 2 for the demonstration. A check strip was inserted into the variable rate prescription map (Figure 2) to be able to compare treatments. Detailed agronomics are listed in Table 3. Extensive monitoring occurred weekly throughout the growing season and water needs were predicted using the Alberta Irrigation Management Model (AIMM) to ensure soil moisture was kept above 50% (Figure 2). Tissue samples were collected from the two treatment areas (Table 3). Yield was used to evaluate the success of the different treatment areas by analysing yield data collected from a calibrated combine yield monitor.

Table 1. Farmers Edge Soil Test Results by Zone

Zone	**Acres**	**N (lb/ac)**			**P (ppm)**	**K (ppm)**	**S (lb/ac)**		**EC (dS/m)**		**OM (%)**
		0-6"	6-24"	Total	0-6"	0-6"	0-6"	6-24"	Surface	Depth	
	26	36	84	120	11	95	30	72	0.52	0.43	2.3
	37	30	57	87	9.4	160	26	55	0.50	0.41	2.7
	33	38	84	122	11	160	32	140	0.50	0.57	2.8
	62	42	84	126	10	220	52	140	0.59	0.56	2.9

Zone	**Ca (ppm)**	**Mg (ppm)**	**Na (ppm)**	**Cu (ppm)**	**Fe (ppm)**	**Mn (ppm)**	**Zn (ppm)**	**B (ppm)**	**Cl (ppm)**		**pH (1:2)**	
	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0.6"	0-6"	6-24"	Surface	Depth
	4300	560	54	0.5	9.3	1.2	0.6	0.7	14	44	7.6	8.5
	4700	540	44	0.5	16	1.9	0.7	0.5	11	18	7.8	7.9
	4300	680	66	0.5	14	1.6	0.6	0.9	11	40	6.9	8.0
	4200	760	75	0.5	13	1.7	0.8	0.4	20	38	8.1	8.7

Table 2. Crop Management

Seeding	Strongfield seeded April 30, 2015	
Herbicide	Octane/ Traxos applied June 12, 2015	
Fungicide	Prosaro applied July 7, 2015	
Harvest	September 15, 2015	
Available Moisture	mm	inches
Rainfall	175.4	6.9
Irrigation	127	5.0

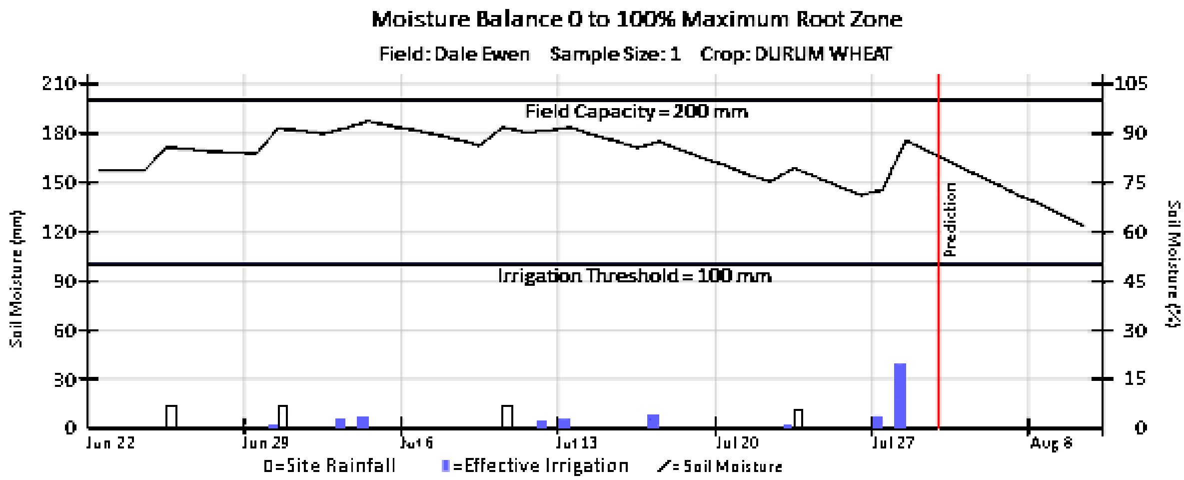


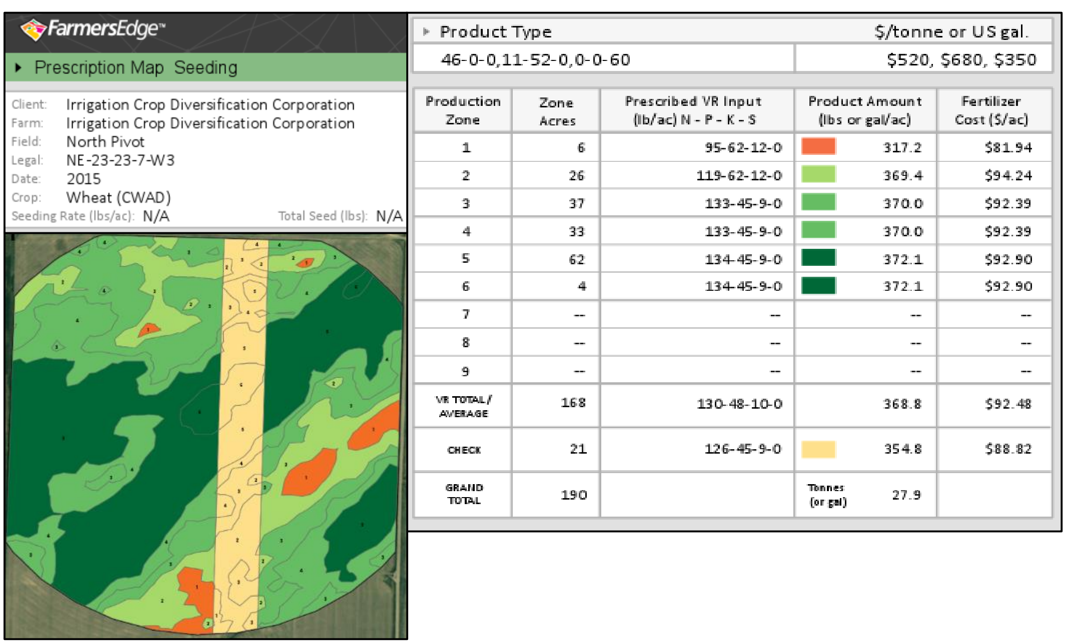
Figure 7. AIMM graph for NE23-23-7-W3.

Table 3. Plant Tissue Analysis of Durum Samples Collected from the High and Low Potassium Treatments at the Flag Leaf Stage of Development (July 3, 2014)

Location	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ppm	Fe ppm	Mn ppm	Zn ppm	B ppm
(No K)	5.3	0.37	2.92	0.34	0.46	0.21	11.0	91.2	113.0	42.7	2.63
(K Applied)	5.4	0.38	2.09	0.36	0.69	0.29	12.4	89.6	71.0	45.9	5.43
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.50**	**0.25**	**8.0**	**50.0**	**20.0**	**20.0**	**5.00**

Results

Results are shown in the following maps provided courtesy of FarmersEdge.


FarmersEdge

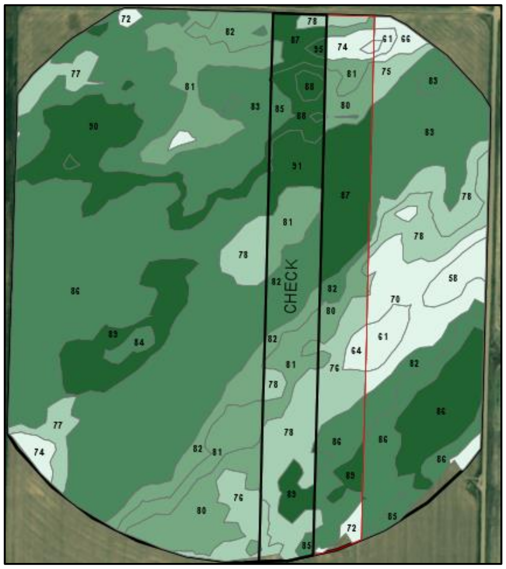
Prescription Map Seeding

Client: Irrigation Crop Diversification Corporation
Farm: Irrigation Crop Diversification Corporation
Field: North Pivot
Legal: NE-23-23-7-W3
Date: 2015
Crop: Wheat (CWAD)
Seeding Rate (lbs/ac): N/A Total Seed (lbs): N/A

Product Type	$/tonne or US gal.
46-0-0,11-52-0,0-0-60	$520, $680, $350

Production Zone	Zone Acres	Prescribed VR Input (lb/ac) N - P - K - S	Product Amount (lbs or gal/ac)	Fertilizer Cost ($/ac)
1	6	95-62-12-0	317.2	$81.94
2	26	119-62-12-0	369.4	$94.24
3	37	133-45-9-0	370.0	$92.39
4	33	133-45-9-0	370.0	$92.39
5	62	134-45-9-0	372.1	$92.90
6	4	134-45-9-0	372.1	$92.90
7	--	--	--	--
8	--	--	--	--
9	--	--	--	--
VR TOTAL/ AVERAGE	168	130-48-10-0	368.8	$92.48
CHECK	21	126-45-9-0	354.8	$88.82
GRAND TOTAL	190		Tonnes (or gal) 27.9	

Figure 3. Farmers Edge Prescription Map — Seeding



FarmersEdge™

PRECISION **PROFIT** MAP™ - VARIABLE RATE

Client: Irrigation Crop Diversification Corporation
Farm: Irrigation Crop Diversification Corporation
Field: North Pivot
Legal: NE-23-23-7-W3
Date: 02/09/2015 - 03/09/2015
Crop: Wheat - Durum @ $8.00 /bu

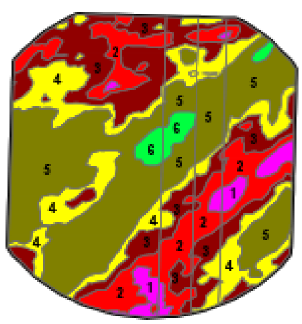
Element	Fertilizer Type	$/tonne or US gal.
N	46-0-0	$520
P	11-52-0	$680
K	0-0-60	$350
S	15-0-0-20	$0

Volume by Production Zone (bu / ac)

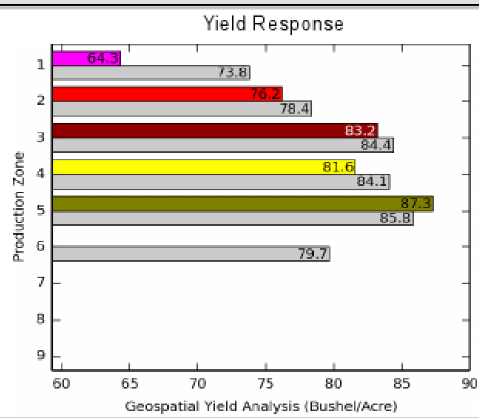
<= 74.5 | 74.5 - 78.9 | 78.9 - 81.8 | 81.8 - 86.0 | > 86.0

Figure 4. Farmers Edge Precision Profit Map – volume by production zone

Production Zone Map



Production Zone	Zone Acres	Variable Rate Input (lb/ac) N - P - K - S	Fertilizer Cost ($/ac)	VR cost per Bu	Conv. cost per Bu	Variable Rate Advantage ($/ac)
1	6.4	95-62-12-0	$81.94	$1.27	$1.20	-$68.98
2	26.0	119-62-12-0	$94.24	$1.24	$1.13	-$23.26
3	37.1	133-45-9-0	$92.39	$1.11	$1.05	-$13.10
4	33.1	133-45-9-0	$92.39	$1.13	$1.06	-$23.81
5	62.1	134-45-9-0	$92.90	$1.06	$1.04	$8.04
6	4.3	134-45-9-0	$92.90	N/A	N/A	N/A
7	--	--	--	--	--	--
8	--	--	--	--	--	--
9	--	--	--	--	--	--
TOTAL/ AVERAGE	168.9					-$13.04



	Fertilizer N - P - K - S	Avg. Fert. Cost ($/ac)	Avg. Yield (bu/ac)
VR Strip(s)	129-49.1-9.7-0	$92.49	81.8
Check Strip	126-45-9-0	$88.82	82.7
VR Full Field	130-48-10-0	$92.51	82.4

Figure 5. Farmers Edge Precision Profit Map – yield.

Final Discussion

Certain soil nutrients are deficient in irrigated crop production in only small areas of the field. The yield response of these nutrients is very cost effective if the nutrient application can be limited to the responsive area. The challenge is to limit the application to responsive areas. The benefits to varible rate technology can be received by both increasing fertilizer rates in areas that are deficient, but also decreasing rates in areas that residual nutrients are above the requirements of the crop.

The site in 2015 was chosen because of its variablity in soil characteristics and topography. After zones were determined with an EM38 and soil testing took place, abnormally high residual nutrients were found across the field. Irrigation is a high input, high output system and because of this the producer was reluctant to decrease nutrient level in some areas to what recomendations were made. A pre-purchased blend of phosphate and potassium was also used which did not allow for the variabilty in potassium that was recommended. In the end the results did not show a economic benefit to variable rate fertilization.

2015 is the first year ICDC has undertaken work on demonstrating variable rate technology. ICDC will continue to develop projects to evaluate variable rate techology in 2016.

Acknowledgements

The project lead would like to acknowledge Farmer's Edge- Kris Ewen and Scott Phillips- For variable rate consulting and data analysis.

FORAGE CROPS

Saline Tolerant Forage Demonstration

Project Lead

- Sarah Sommerfeld, PAg, Regional Forage Specialist, Saskatchewan Agriculture

Industry Co-operators

- Norm Klemmer, AgVision Seeds
- Perry Ross, Viterra
- Glenda Clezy, Dupont
- Chad Keisig, Pickseed
- Neil Mcleod, Northstar Seeds Ltd.
- Al Vancaaseele, BrettYoung

Project Objective

The objective of this project was to demonstrate the performance of new and existing forage varieties with differing salinity tolerances under varying soil salinity levels.

Project Background

Saline areas are a concern for Saskatchewan producers as these areas limit growth and production of many agricultural crops. One option to improve the productivity of these areas is to seed perennial forages. When seeding forages in saline areas, the recommendation is to seed varieties that have greater tolerance to saline conditions. More saline-tolerant forage varieties may have limited production potential due to slow establishment, reduced yield potential, and poor forage quality at later plant maturity. New forages are available with improved salt tolerance and production potential. Demonstration results of these more saline-tolerant forage varieties offer producers the opportunity to adopt their use in saline areas and improve overall site productivity and profitability.

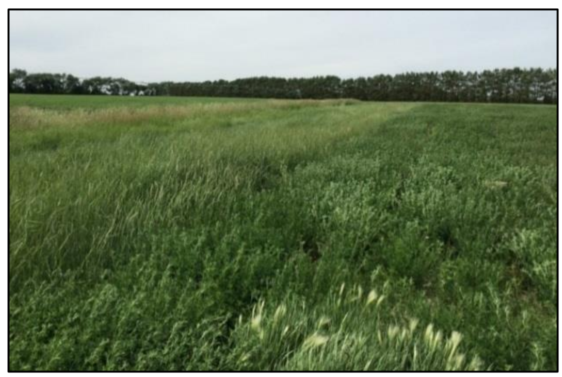


Figure 1. Alfalfa plots under severe to moderate salinity conditions – June 18, 2015.

Project Plan

The project site was located at CSIDC; the specific project location on the site was dependent on soil salinity ratings. Soil samples and EM38 maps were used to determine a suitable plot area. Project design allowed for the comparison of forage varieties over a range of salinity readings. No randomization or replication of forage varieties was undertaken.

Demonstration Site

The project site has a fine sandy loam soil texture in the 0–30 cm (0–12 inch) profile. All plots are irrigated. Figures 1 and 2 illustrate the plot area in relation to the soil salinity levels.

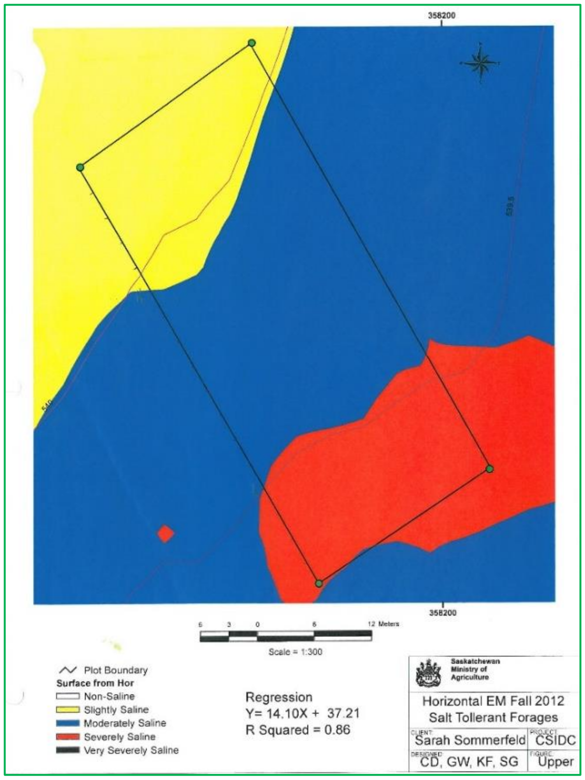


Figure 2. Horizontal EM38 map of plot site.

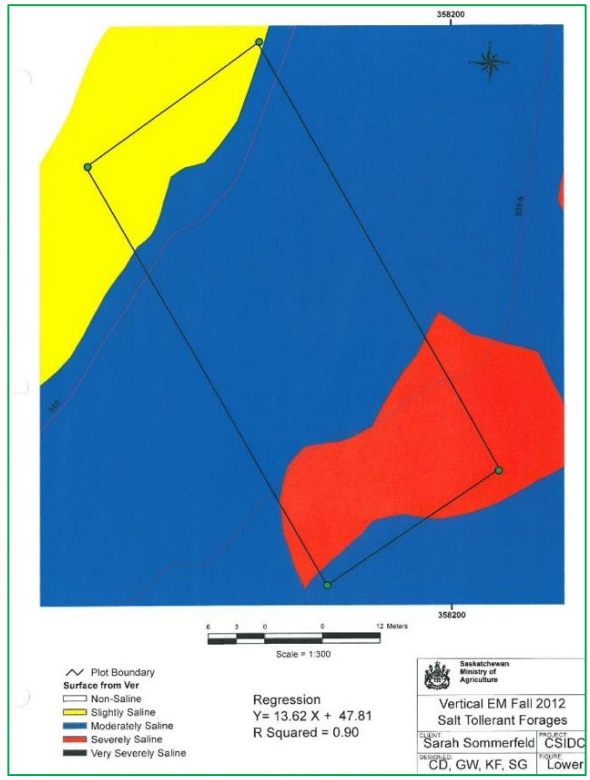


Figure 3. Vertical EM38 map of plot site.

Project Methods and Observations

All plots were direct seeded on June 18, 2013 into wheat stubble using an eight-row small plot seeder with 8” row spacing. Table 1 lists the forages planted and their respective seeding rates. Carlton smooth bromegrass and Dupont Pioneer 54Q32 alfalfa served as the check varieties for each of the respective species.

Table 1. Forage Varieties and Seeding Rates

Grass Variety	Seeding rate (lb/ac)	Alfalfa Variety	Seeding rate (lb/ac)
Garrison Creeping Foxtail	5	Halo Alfalfa	9
Carlton Smooth Bromegrass	8	Barricade Alfalfa	9
Common Slender Wheatgrass	8	Rugged ST Alfalfa	9
Common Tall Wheatgrass	12	Assalt Alfalfa	9
AC Saltlander Green Wheatgrass	10	55V50 Alfalfa	9
--	--	54Q32 Alfalfa	9

In 2015, the plot area received 299 mm of rainfall from May 15 to September 30. First cut forage harvest occurred on July 6, 2015. Forage yields were collected from the slight, moderate, and severely saline areas of each forage variety. Dry matter forage yields are shown in Tables 2 and 3.

Table 2. Dry Matter Forage Yield – Grasses – July 6, 2015

	Yield (t DM/ac)		
Grass Variety	**Severely Saline Area**	**Moderately Saline Area**	**Slightly Saline**
Creeping foxtail	3.2	2.1	3.2
Smooth bromegrass	3.4	2.0	4.3
Slender wheatgrass	3.4	1.8	2.6
Tall wheatgrass	1.7	1.4	2.3
Green wheatgrass	2.0	2.1	3.0

Table 3. Dry matter forage yield – Alfalfa

	Yield – First Cut July 6, 2015 (t DM/ac)		Yield – Second Cut August 25, 2015 (t DM/ac)	
Alfalfa Variety	**Severe Salinity**	**Slight Salinity**	**Severe Salinity**	**Slight Salinity**
Halo	3.2	4.5	1.7	2.5
Barricade	2.0	3.0	1.3	1.7
Rugged	2.3	3.3	1.6	1.9
Assalt	2.9	3.9	1.2	1.6
55V50	2.5	3.8	1.6	1.7
54Q32	1.8	3.2	1.5	2.3

Discussion

The successful establishment of forages across the salinity gradient indicates that forage production is a viable management option for saline areas. The forage yield data shows that following establishment, forage production is sustainable and effective in improving overall site productivity. The yield data presented in Tables 2 and 3 represent only a single plot in a single year, and should be considered accordingly. To discuss the suitability of these forage species under a hay or grazing management system, contact your Regional Forage Specialist.

Acknowledgements

The project lead would like to acknowledge Garry Hnatowich, ICDC Research Director for his agronomic support on this project. The lead would also like to acknowledge the CSIDC staff who assisted with the irrigation operations for this project.

Demonstration of Perennial Forage Crops

Project Lead

- Sarah Sommerfeld, PAg, Regional Forage Specialist, Saskatchewan Agriculture
- Industry Co-operators

All seed for this project was donated. The project lead would like to thank Secan, Pickseed, BrettYoung, Northstar Seed Ltd., and Viterra for their contributions.

Project Objective

The objective of this project is to provide a side-by-side demonstration of new and unique forage varieties compared to those that have been more commonly used. The intent is to demonstrate differences in growth habit, maturity, and yield of perennial forage varieties, including grasses and legumes.

Project Background

Perennial forage crops are a vital component of the livestock industry, providing forage and feed through grazing or hay production. Forage and livestock producers need forage species and forage varieties that will establish easily, provide adequate forage production, and persist under varying management systems.

Forage specialists are asked to respond to inquiries regarding performance of specific forage species and varieties and suitability for different soil zones and growing conditions. As establishment success, yield, and persistence varies with moisture conditions and soil types, it is beneficial to have side-by-side comparisons of perennial forages at the local level.

Project Plan

This project was designed as a small plot demonstration with no replication or randomization to allow for inclusion of several legume and grass species and to minimize cost and land requirements. The plots were established in 2013.

Demonstration Site

The site was located at CSIDC on a fine sandy loam soil texture. All plots are irrigated.

Project Methods and Observations

Forage biomass harvest of all plots took place on July 6, 2015. Dry matter yields are reported in Tables 1 and 2. No harvest weights were recorded for three grass plots due to poor establishment.

Discussion

Perennial forage establishment can be challenging, even under the best seeding and growing conditions, and this demonstration project was no exception. After much effort, establishment of both the grass and legume plots was relatively successful. The project site offers the opportunity to compare several new and unique perennial forage varieties in a local area. The yield data presented in Tables 1 and 2 represent only a single small plot in a single year, and should be considered with caution. More information on the relative yield of these forage cultivars is available in the factsheet *Relative Cultivar Yields for Perennial Species* found on the Saskatchewan Ministry of Agriculture website. To discuss the suitability of these forage species under a hay or grazing management system, contact your Regional Forage Specialist.

Table 1. Legume Plot Harvest Weights – July 6, 2015

Crop	Variety	**Yield** (t M/ac)
Alfalfa	AC Grazeland	2.3
Alfalfa	AC Dalton	3.0
Alfalfa	Stealth	3.3
Alfalfa	Equinox	2.7
Alfalfa	Spreador 4	2.2
Alfalfa	4010 BR	2.2
Alfalfa	PS 3006	2.6

Crop	Variety	**Yield** (t M/ac)
Alfalfa	HB 2410	2.1
Alfalfa	Halo	2.8
Alfalfa	Rugged	2.6
Alfalfa	AC Yellowhead	2.9
Cicer milkvetch	Oxley II	2.3
Cicer milkvetch	AC Veldt	4.0
Birdsfoot Trefoil	Leo	2.9
Sainfoin	Common	3.5

Table 2. Grass Plot Harvest Weights – July 6, 2015

Crop	Variety	**Yield** (t DM/ac)
Smooth bromegrass	Carlton	4.7
Smooth bromegrass	AC Rocket	4.0
Meadow bromegrass	AC Armada	4.5
Meadow bromegrass	AC Admiral	4.0
Meadow bromegrass	MBA	3.7
Hybrid bromegrass	AC Knowles	4.1
Hybrid bromegrass	AC Success	4.2
Hybrid bromegrass	Bigfoot	2.6
Russian wildrye	Swift	2.5
Dahurian wildrye	Common	3.4
Altai wildrye	Common	n/a
Green needlegrass	Common	2.8
Tall fescue	Courtenay	2.2
Sheep fescue	Common	1.8
Creeping red fescue	Boreal	3.1
Tall wheatgrass	Common	1.6

Crop	Variety	**Yield** (t DM/ac)
Crested wheatgrass	Fairway	4.4
Crested wheatgrass	Kirk	4.7
Crested wheatgrass	AC Goliath	3.5
Intermediate wheatgrass	Chief	3.4
Pubescent wheatgrass	Greenleaf	1.7
Slender wheatgrass	Common	3.7
Norther Wheatgrass	Common	1.2
Western Wheatgrass	Common	2.5
Western Wheatgrass	Common	2.6
Timothy	AC Pratt	2.4
Creeping foxtail	Garrison	1.1
Meadow foxtail	Common	n/a
Orchardgrass	AC Kootenay	2.2
Orchardgrass	AC Killarney	2.4
Kentucky bluegrass	Troy	n/a
Reed canarygrass	Venture	3.8

Acknowledgements

The project lead would like to acknowledge Garry Hnatowich, ICDC Research Director and ICDC summer staff for their assistance on this project. The lead would also like to acknowledge the CSIDC staff who assisted with the field and irrigation operations for this project.

Copper and Zinc Fertilization of Alfalfa

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Dale Tomasiewicz, Irrigation Agronomist, Agriculture and Agri-Food Canada
- Joel Peru, Irrigation Agrologist, Saskatchewan Agriculture
- Dwayne Summach, Livestock Specialist, Saskatchewan Agriculture

Co-operator

- Jeff Schoenau, Professor of Soil Science, University of Saskatchewan, Saskatoon, SK
- Rigas Karamanos, Research Scientist, Koch Fertilizers
- Barry Vestre, Farm Manager, Agriculture and Agri-Food Canada

Project Objective

This project was undertaken to determine the forage yield response of an alfalfa stand to fertilization with copper (Cu) and zinc (Zn) when potassium (P), phosphorous (K), and sodium (S) are also applied.

Project Background

Adequate zinc and copper are both required for high-performance N fixation. Copper (5 lb/ac) and zinc (4 lb/ac) fertilization are essentially one time practices for a grower—with these nutrients, the treatment is sufficient for 10–20 years. This consideration is important when evaluating the economics of this practice.

Demonstration Plan

Composite soil samples were collected from the 0–6" depth from each of the five replications of the demonstration in fall 2014 and submitted to ALS Laboratories for analysis.

Site

The project is located at NW12-29-8-W3 on Asquith fine sandy loam. The site has been prone to wind erosion when farmed with conventional tillage. The site is punctuated with areas of buried topsoil throughout the demonstration site. Each of the five reps for the demonstration were sampled separately at the 0–6" depth in fall 2014. The analysis for each of the replications is shown in Table 1.

Table 1. Soil Analysis of Reps for Alfalfa Copper and Zinc Demonstration (0–6")

Site	pH	EC (dS/m)	OM (%)	N	P	K	S	Cu	Fe	Mn	Zn	B
				ppm								
Rep 1	7.9	0.2	1.3	2	22	125	6	0.1	12	2.2	0.5	0.6
Rep 2	7.9	0.2	1.5	3	17	117	10	0.1	8	2.1	0.4	0.6
Rep 3	7.9	0.2	1.0	5	15	137	3	0.1	5	1.5	0.3	0.5
Rep 4	8.0	0.2	0.8	3	12	119	3	0.1	5	1.2	0.3	0.4
Rep 5	8.0	0.2	1.0	3	13	116	2	0.1	5	1.4	0.3	0.5

Project Methods and Observations

The project experimental design was a factorial with five replications. Copper and zinc fertilizer were broadcast on an established alfalfa stand with a 16 foot Valmar pneumatic applicator at rates of 5 lb/ac and 4 lb/ac actual nutrient on April 20, 2015. The products chosen for the demonstration were Pestell Copper Sulphate 10XL and Agrium Zink-Gro MAXI-Granular 35.5% Zinc Sulphate Monohydrate. The copper source was a coarse blue crystalline product with guaranteed analysis of 25.2% Cu and 12% S. The zinc source was a granular grey-white product with 35.5% Zn and 16.5% S. Ammonium sulphate was also broadcast to supply 20 lb S as sulphate-S on April 20, 2015, as insurance of adequate S for the alfalfa. The retail cost of copper and zinc are $11.52 and $4.60 per pound respectively. The one time applications of copper and zinc would be $57.60 and $18.20 per acre. This cost should be amortized over 20 years to get a realistic picture of the true cost of this practice.

Irrigation

Good precipitation fell early in spring and in July, but May and June were quite dry. Rainfall and irrigation quantities for 2015 are reported in Table 2.

Table 2. Precipitation and Irrigation at CSIDC on Knapik Quarter

Month	**Rainfall** (mm)	**Irrigation** (mm)	**Total** (mm)
April	34	0	34
May	9	13	21
June	42	38	80
July	166	15	181
August	62	0	62
September	49	0	49
Total	360	65	425

Plant tissue samples were collected from replicates 1 and 4 from the first cut growth at early bloom on June 15 and replicates 2 and 5 from the second cut growth on August 5. These results are reported in Table 3. Levels of nutrients that were suspect in early June were potassium and copper. Other levels tested adequate. The late July samples showed an improvement in potassium and copper uptake, but the nitrogen content of the alfalfa was slightly lower, a decrease of 0.5% on average. This time, nitrogen and copper concentrations were suboptimal, according to interpretative criteria.

Table 3. Plant Tissue Analysis of Alfalfa Samples Collected from Fertilizer Treatments for Cut 1 at the Early Flower Stage at Knapik Alfalfa Demo (June 2015)

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Replicate 1											
None	5.0	0.35	1.7	0.39	2.1	0.30	4.0	80	39	33	45
5 lb Cu	5.1	0.37	1.8	0.40	2.0	0.34	3.5	75	41	41	45
4 lb Zn	5.0	0.32	1.4	0.38	2.4	0.36	4.4	72	45	30	49
5 lb Cu + 4 lb Zn	5.1	0.31	1.9	0.43	2.3	0.30	4.1	77	45	32	62
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.5**	**0.25**	**8.0**	**50**	**20**	**20**	**30**
Replicate 4											
None	4.8	0.30	2.0	0.36	2.1	0.23	4.5	76	38	36	51
5 lb Cu	4.2	0.27	1.8	0.33	2.0	0.26	3.9	75	41	24	47
4 lb Zn	4.6	0.27	1.9	0.39	2.2	0.25	3.7	76	38	33	49
5 lb Cu + 4 lb Zn	4.8	0.28	2.1	0.35	2.0	0.29	4.9	75	39	27	52
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.5**	**0.25**	**8.0**	**50**	**20**	**20**	**30**

Table 4. Plant Tissue Analysis of Alfalfa Samples Collected from Fertilizer Treatments for Cut 2 at the Early Flower Stage at Knapik Alfalfa Demo (August 2015)

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Replicate 2											
None	4.2	0.31	2.0	0.28	1.7	0.32	5.0	68	37	23	44
5 lb Cu	4.3	0.31	2.2	0.30	1.9	0.32	4.9	69	34	21	48
4 lb Zn	4.6	0.34	2.4	0.31	1.8	0.36	5.2	75	43	25	47
5 lb Cu + 4 lb Zn	4.4	0.33	2.0	0.30	1.9	0.36	4.1	75	41	24	43
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.5**	**0.25**	**8.0**	**50**	**20**	**20**	**30**
Replicate 5											
None	4.2	0.29	2.4	0.31	1.6	0.31	5.4	67	27	22	44
5 lb Cu	4.3	0.32	2.4	0.30	1.6	0.33	6.3	71	30	25	44
4 lb Zn	4.3	0.32	2.5	0.29	1.7	0.28	4.2	71	29	33	42
5 lb Cu + 4 lb Zn	4.3	0.32	2.3	0.30	1.7	0.34	5.5	74	33	24	45
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.5**	**0.25**	**8.0**	**50**	**20**	**20**	**30**

The forage yield is presented in Table 5. Yields were strong in 2015. The first cut represented over half of the annual yield, with a third from the second cut and only about one-tenth from the third cut. It was interesting to see that the period of growth for this perennial crop and yield were not closely related. Although the first cut had the shortest period of growth, the crop benefitted from the long daylight hours of June to produce most of its production in the first cut harvest.

Table 5. Alfalfa Forage Yield

Treatment	1st cut (ton/ac)	2nd cut (ton/ac)	3rd cut (ton/ac)	2015 Forage Yield (ton/ac)
Check	3.17	1.90	0.61	5.68
Cu	3.03	1.80	0.60	5.43
Zn	2.92	1.96	0.60	5.48
CuZn	2.91	1.84	0.62	5.36
Harvest Date	June 23	Aug 10	Sept 23	
Days of Growth	39	48	44	
Proportion of Yield	0.56	0.33	0.11	

Statistical analysis of the forage yields was completed using the program Statistix 10.0. Of the three cuts and total yield, the copper treatments of cut 2 were the only evidence of significant yield effects, with F = 8.21 and P = 0.0142.

Feed analysis of one replicate from Cut 2 and all observations of Cut 3 were completed. Table 6 summarizes the analysis of replicate 5 from Cut 2 and the third cut.

Table 6. Feed Analysis of Replicate 5, 2nd Cut and 3rd Cut Alfalfa (Average of All 5 Replicates)

Treatment	Replicate 5, 2nd cut				3rd cut alfalfa samples			
	Check	Copper	Zinc	Cu & Zn	Check	Copper	Zinc	Cu & Zn
Moisture (%)	9.85	10.54	9.33	9.63	7.96	8.09	7.96	8.16
Dry Matter (%)	90.15	89.46	90.67	90.37	92.04	91.91	92.04	91.84
Crude Protein (%)[1]	16.19	20.98	17.95	17.96	27.27	27.83	26.65	27.28
Calcium (%)[1]	1.09	1.37	1.50	1.23	1.72	1.79	1.67	1.71
Phosphorus (%)[1]	0.24	0.29	0.26	0.25	0.34	0.35	0.34	0.34
Magnesium (%)[1]	0.26	0.30	0.25	0.31	0.30	0.33	0.31	0.31
Potassium (%)[1]	2.61	3.49	2.78	2.68	3.65	3.69	3.49	3.45
Copper (mg/kg)[1]	5.29	5.85	5.11	5.88	6.1	6.5	5.7	6.9
Sodium (%)[1]	0.06	0.05	0.04	0.07	0.06	0.07	0.09	0.09
Zinc (mg/kg)[1]	11.60	14.60	13.90	13.70	18	18	19	20
Manganese (mg/kg)[1]	18.80	25.80	24.60	23.90	26	28	28	27
Iron (mg/kg)[1]	63.00	59.00	63.00	53.00	77	77	75	79
Acid detergent fiber (%)[1]	48.40	39.30	43.70	45.20	27.9	26.6	28.8	27.8
Neutral detergent fiber (%)[1]	55.60	45.80	52.60	52.20	33.3	32.2	34.5	34.5
Non fiber carbohydrate (%)[1]	17.40	22.50	18.60	19.00	28.7	29.2	28.1	27.4
Total digestible nutrients (%)[1]	46.90	56.60	52.00	50.30	68.8	70.3	67.9	68.9
Metabolizable energy (Mcal/kg)[1]	1.72	2.08	1.90	1.84	--	--	--	--
Digestible energy (Mcal/kg)[1]	2.07	2.50	2.29	2.22	--	--	--	--
Relative feed value (%)[1]	86	118	97	96	188	198	180	181

[1] DM basis

The changes in forage quality with a copper application were quite significant, contributing to an increase of over 4.5% in protein content and a reduction in both ADF and NDF. This observation may be suspect as it is based on a single dried sample. Follow up analysis of the 2016 forage samples is needed to verify the trends that are indicated. When these changes are input into the MILK 2006 program, a milk yield response of over 1500 lb/ac is predicted. Zinc fertilization had a significant reduction, at 10% probability for non-fiber carbohydrates. Copper and zinc are antagonistic for uptake into plants. Zinc usually increases carbohydrate levels when copper is adequate. Total digestible nutrients were significantly increased by copper fertilization and significantly decreased by zinc fertilization. Copper fertilization also significantly increased the copper concentration in the forage. This interpretation is, again, based on a single sample and needs to be evaluated with caution. It was hoped that the feed analysis of the third cut would assist in understanding the effect of copper and zinc fertilization. The premature harvest of a third cut improves the feed quality, but the growth may not be mature enough to show the quality changes observed with the second cut analysis.

Final Discussion

In this demonstration, alfalfa showed no forage yield response to copper, zinc, or the combined application. It did show an increased crude protein content and non-fiber carbohydrates, as well as reduced ADF and NDF with copper fertilization. Continued observation will occur next year to determine whether this trend is present in 2016. Zinc fertilization had the opposite effect from the copper fertilization because copper and zinc uptake are antagonistic within the plant.

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

Corn Variety Demonstration for Silage and Grazing

Project Lead

- Sarah Sommerfeld, PAg, Regional Forage Specialist, Saskatchewan Agriculture

Co-investigators

- Garry Hnatowich, PAg, Research Director, ICDC

Industry Co-operators

- Glenda Clezy, DuPont Pioneer
- Andrew Chilsom, 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 dry land and 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.

Project Plan

The project was designed as a small plot randomized and replicated demonstration. Corn varieties were planted to both dry land and irrigation treatments, at 30 inch row spacing. Each plot consisted of two corn rows. A seeding rate of 32,000 seeds per acre for irrigated plots and 28,000 seeds per acre for dry land plots was targeted. Seed for each individual plot was packaged according to individual seed weights and adjusted for estimated per cent germination. All seed received from suppliers was treated. Data collection included plant population, corn heat units (CHU) accumulated, days to 10% anthesis, days to 50% silk, and dry matter yield.

Demonstration Site

The trial was established at CSIDC on loam textured soil.

Project Methods and Observations

The trial was seeded May 21. Irrigation plots received 160 kg N/ha (143 lb N/ac) broadcast prior to seeding plus 40 kg N/ha (35 lb N/ac) and 40 kg P_2O_5/ha (35 lb P_2O_5/ac) side banded at seeding. Dry land plots received a broadcast and incorporated application of 80 kg N/ha (71 lb N/ac), prior to seeding plus 40 kg N/ha (35 lb N/ac) and 40 kg P_2O_5/ha (40 lb P_2O_5/ac) side banded at seeding.

Ten corn hybrids were planted in each production system. Hybrid selection was made by seed companies with the criteria being that each variety selected was recommended for the corn heat units accumulated in the Lake Diefenbaker area (Table 1). Weed control included a pre-plant application of glyphosate and one in-crop glyphosate application at the recommended rates, as well as periodic hand weeding.

Cumulative Corn Heat Units (CHU) from May 15 to September 23 was 2359. Cumulative precipitation from May 15 to September 30 was 299 mm. All plots were harvested on September 23.

Table 1. Corn Varieties Included in Dry Land and Irrigation Treatments

Company	Variety	Corn Heat Unit Rating
Dekalb	DKC 30-07RIB	2325
Dekalb	DKC 33-78RIB	2500
Dupont	39v05 RR	2250
Dupont	P8210HR	2475
Dupont	P7632HR	2200
Dupont	P7213R	2050
Dow Agro Sciences	HL3085RR	2400
Dow Agro Sciences	X14008GH	
Dow Agro Sciences	X13002S2	
Dow Agro Sciences	Baxxos	2300

Results and Discussion

The average established plant population of irrigated plots was 36,527 plants/ac. Average established plant population of dry land plots was 30,623 plants/ac (Table 2). Established plant populations of each corn hybrid within the two production systems are shown in Figure 1.

Table 2. Agronomic Data of Irrigated vs Dry Land Silage Corn

Treatment	Plant Population (plants/ac)	Dry Yield (t/ac)	Whole Plant Moisture (%)
Production System			
Irrigation	36527	9.77	72.6
Dry Land	30623	8.08	72.5
LSD (0.05)	3019	NS	NS
CV (%)	8.1	8.4	1.5
Hybrid			
P7213R	33176	8.81	69.8
P7632HR	32108	8.15	70.9
P8210HR	32839	8.78	71.8
39V05 RR	35200	9.65	69.7
DKC 33-78 RR	34357	8.90	74.5
DKC 30-07 RR	34019	9.45	73.3
Baxxos RR	34694	9.59	71.4
X13002S2	33401	8.24	74.8
X14008GH	32332	9.00	76.2
3085F1	33626	8.67	73.5
LSD (0.05)	NS	0.75	1.1
Production System vs Hybrid			
LSD (0.05)	NS	NS	NS

The irrigation treatment produced greater dry matter (DM) silage yields compared to the dry land treatment (Figure 2) by an average of 1.7 t/ac (17.3% higher). Based on the 2015 yield data (Table 2 and Figure 2), the variety that performed the best under irrigated conditions for silage production was DKC30-07RIB. Under dry land conditions, the two varieties that performed the best for silage production were Baxxos RR and 39v05. Baxxos RR was used as the check variety to which all other corn varieties were compared.

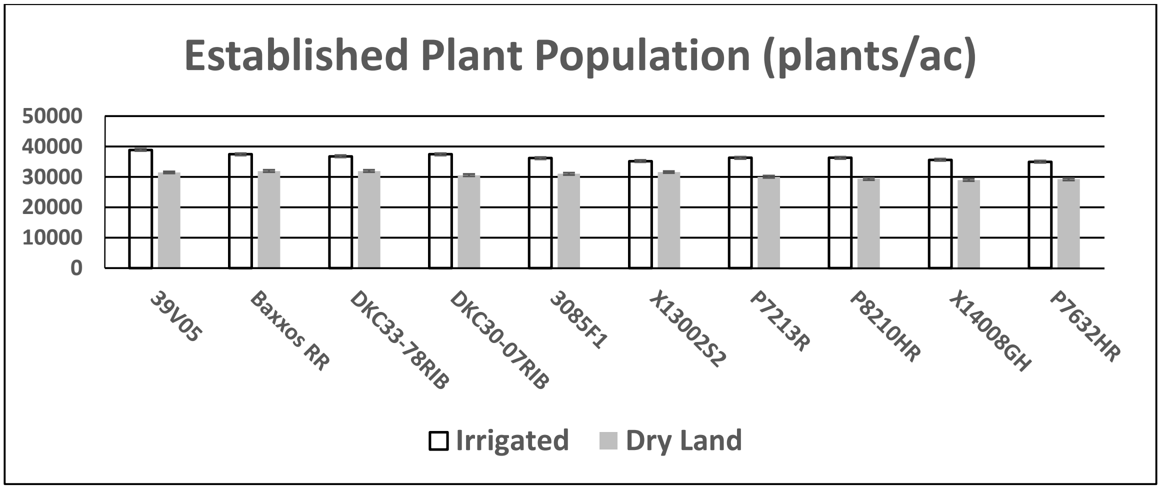


Figure 1. Established plant population by hybrid; irrigated vs dry land.

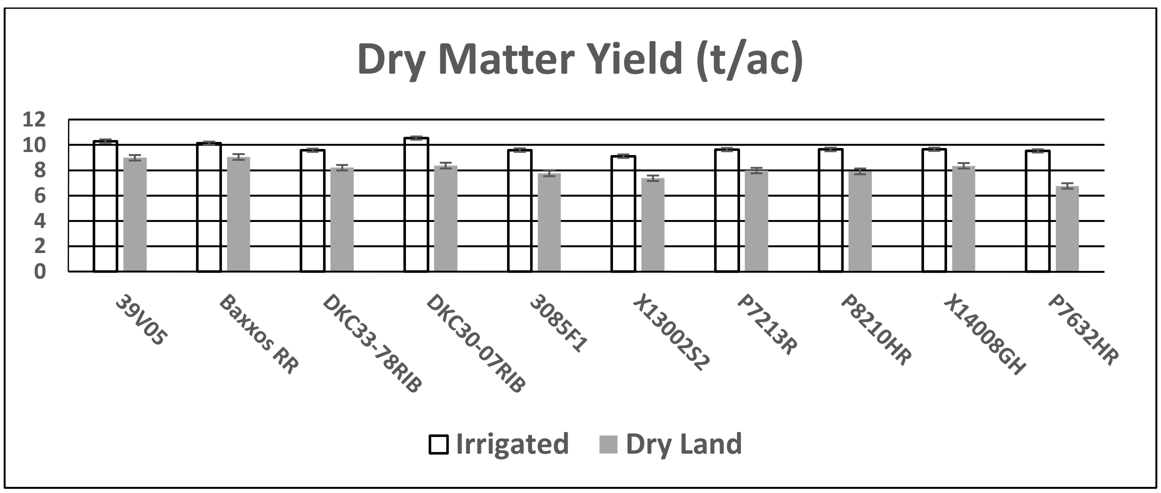


Figure 2. Dry matter yield of hybrids; irrigated vs dry land.

Whole plant moisture content did not differ between irrigation and dry land treatments (Figure 3). Target harvest moisture was 65%. Actual average harvest moisture was 72.6%for irrigated treatment and 72.5% for the dry land treatment. Days to tasselling or silking data was not recorded in 2015.

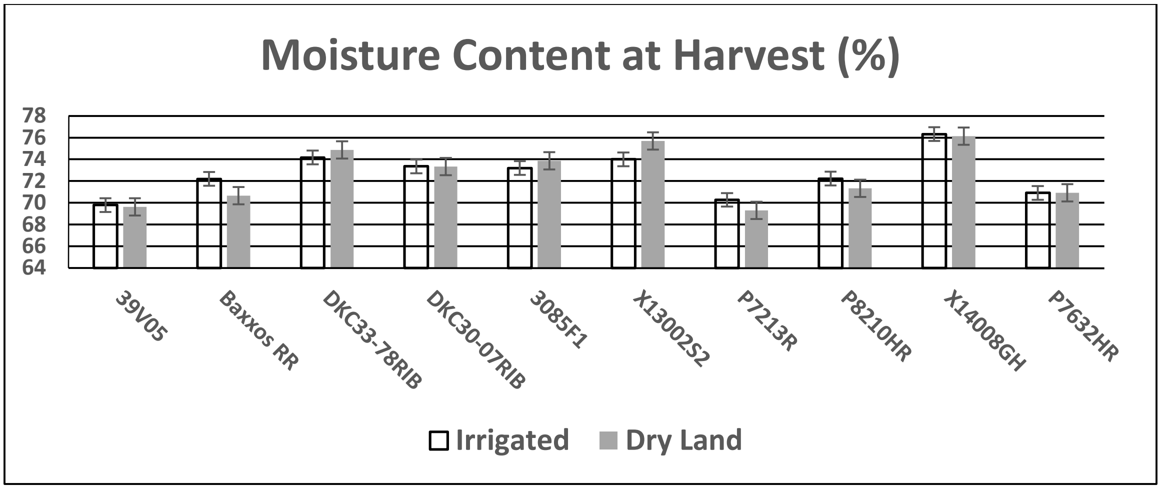


Figure 3. Whole plant moisture content.

FRUIT & VEGETABLE CROPS

Demonstration of Cantaloupe and Watermelon Production in Saskatchewan

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Organizations

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

Project Objective

This project demonstrated the potential for growing seedless, personal-sized watermelon and cantaloupe commercially in high tunnels in Saskatchewan and provided opportunities for producers and stakeholders to see the crops. This project included different varieties of watermelon and cantaloupe, which allowed for a side by side comparison.

The Saskatchewan vegetable industry has been working collaboratively with The Grocery People (TGP) to increase the supply of Saskatchewan-grown produce into retail. TGP has specified that they would like small striped seedless watermelon; previously, the indsutry more frequently sought large, open-pollinated melons. This trial observed 4 varieties of watermelon and 3 varieties of cantaloupe that would fit the retail market. This project evaluated marketable yield and quality based on market standards to determine whether melons are a viable commercial crop for retail.

Project Plan

This demonstration consisted of two 18 foot rows of each watermelon variety and four 14 foot rows of each cantaloupe variety. One row of the watermelon pollinator variety Ace was planted between the treatment rows. In-row plant spacing for both the watermelon and cantaloupe was 2 feet. The watermelon varieties included Gentility, Serval, Vanessa, and Citation. The cantaloupe varieties included Fast Break, Athena, and Goddess.

Demonstration Site

The project was located in the enclosed Orchard area at the Canada-Saskatchewan Irrigation Diversification Centre (CSDIC). It consisted of 1.5 high tunnels with the watermelons taking up one and the cantaloupe taking up a half.

The watermelon and cantaloupe were planted in peat pots in a greenhouse on May 7 (Figure 1). While 98% of the cantaloupe germinated, only about 40% of the seedless watermelon actually germinated. This became an issue. Because the seed is expensive ($0.50 per seed), the minimum number of seeds were purchased; starting further seed to compensate for low germination was therefore not possible. The seed packages specified starting the seed in a draft free location, but based on past experience with open pollenated melons, this information was mistakenly discounted. As a result, the planting plan was changed to account for fewer plants.

Soil preparation consisted of rototilling. Once the seedlings matured, they were transplanted into the high tunnels on June 3 (Figure 2). The seedlings were planted into rows of black plastic mulch to control weeds. Dripline irrigation was set up along each row. The plants were fertilized with all-purpose 20-20-20 fertilizer three times during the growing season. The soil was watered through the dripline to maintain sufficient moisture throughout the growing season. The black plastic kept weed growth to a minimum. Once the melons established, they outcompeted the weeds so that no herbicides were required.

Normally, bees are used to pollenate watermelon. So at the start of the season, flowers were hand pollenated. This practice was abandoned at the end of July, as any fruit produced past this date was not likely to mature and wild pollinators were present.

The first melons were harvested on July 30, and they continued to produce until September 28. Unripe melons had to be discarded after this date due to frost damage, making them unmarketable. After September 28, the melons that had no frost damage would not ripen, most likely due to the short, cool, and often cloudy days.

Figure 1. Watermelon seedlings in the greenhouse.

Figure 2. Transplanting cantaloupe in the high tunnel.

Results

Watermelon

Harvest of the watermelons occurred on 13 days between July 30 and September 28. The majority of the yield was taken off in late August. Table 1 shows the results of the harvest, including the number of melons, total weight of each variety, and the average weight of each melon. The varieties Citation and Serval were grouped together because they were very similar in appearance and because the treatments had branched out and become interwoven (Figure 3), despite 6 foot divisions between varieties.

Table 1. Results of Watermelon Harvest

Variety	Total Yield (number of melons)	Total Weight (kg)	Average Weight (kg)
Citation, Serval	152	437.16	2.88
Gentility	21	132.70	6.32
Vanessa	60	175.75	2.93

Figure 3. Watermelon treatments – early flowering.

Figure 4. Yield from a watermelon harvest.

Cantaloupe

Harvesting the cantaloupe occurred on 13 days between July 30 and September 28, with most of the yield coming off in late August and early September. Table 2 shows the results of the harvest, including the number of cantaloupe, total weight of each variety, and the average weight per melon.

Figure 5. Cantaloupe varieties: top left, Goddess; top right, Fast Break; bottom, Athena.

Table 2. Results of Cantaloupe Harvest

Variety	Total Yield (number of melons)	Total Weight (kg)	Average weight (kg)
Fast Break	115	161.27	1.40
Athena	50	95.76	1.92
Goddess	77	152.56	1.98

Final Discussion

Melons are grown in British Columbia, Ontario, and Quebec. These three provinces annually produce about 20,000 tonnes of watermelon and 12,000 tonnes of cantaloupe valued at over $10,000,000. Production of melons in Saskatchewan is less common, with some production for local sale and are sought out for their exceptional flavour. This demonstration at CSIDC proved that we have the capability of producing melons to the highest quality standards and a substantial yield in Saskatchewan.

While this project was not replicated, it is interesting to note the potential of this crop. Based on the results, Serval and Citation produced an average of 4.2 melons per plant. During the summer, seedless small melons were selling for $5.00 each at Co-op stores. Therefore, the value of each plant would be $21.00. If planted to one variety, the 1,920 square foot high tunnel could have produced 192 plants valued at $4,032.00. The average of the three cantaloupe varieties was 80.7 plants per variety (2.9 melons per plant). Cantaloupe sold for $3.00 during the summer, so the value per plant would be $8.64. While not as lucrative as the watermelon, at capacity, the high tunnel could have produced a crop valued at $1,659.00. The high tunnel used in this project was small compared to most commercial models. Per acre gross income (5,445 plants per acre) would be $114,345 for watermelon and $47,044 for cantaloupe. Note that these prices are not wholesale prices. Crop costs were minimal, as our dry conditions meant that no fungicides were required, weed control efforts were minimal, and no insecticides were required. Of course the high tunnel infrastructure is a major investment. This project demonstrated that all the varieties planted are able to produce a significant income at the research farm when grown in a high tunnel and adequately irrigated. The project data demonstrated which melons produce the most fruit, the heaviest fruit, and the largest total yield.

For more information about these crops, contact Connie Achtymichuk, Provincial Vegetable Specialist at (306) 867-5526 or Connie.Achtymichuk@gov.sk.ca.

Acknowledgements

- Adam Tomasiewicz, 2015 summer student, Saskatchewan Ministry of Agriculture for helping with irrigation scheduling on this project.
- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining the project, providing agronomic guidance, and completing the economic analysis.
- The project leads would like to acknowledge CSIDC staff that assisted with the field and irrigation operations for this project.

Treatments to Improve Plant Health and Productivity in Mature Saskatoon, Haskap, and Sour Cherry Orchards Located in High pH Soil

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Organizations

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

Project Objective

The objective of this project was to demonstrate and compare soil and foliar iron chlorosis treatments to improve the health of mature Saskatoon berry, dwarf sour cherry, and Haskap plants growing in high pH soil (Figure 1).

Figure 1. Iron chlorosis symptoms affecting Saskatoon berry.

Many growers have planted orchards in high pH soils, and look for solutions to improve plant health and productivity. Plant health issues are complex, but weaknesses often originate from poor soil-plant dynamics, especially in relation to plant ability to absorb iron under cool, wet soil conditions. The condition, known as iron chlorosis, can be identified by interveinal yellowing of leaves that are especially prevalent in new growth tissues.

Soil pH is a site selection factor that is often not given enough consideration when new orchard sites are selected. Most plant species are better able to absorb nutrients when the soil pH is relatively neutral (close to 7). In high pH soils (above pH 7.8), iron chlorosis is far more likely to occur and is much more difficult to prevent. Iron is needed by plants because it is an essential component of many redox enzymes and is required for the synthesis of chlorophyll. Chlorophyll is the most important light-absorbing pigment found in plants and is essential for photosynthesis to occur. Therefore, if a plant suffers from iron chlorosis, iron is not absorbed and creation of chlorophyll is inhibited, which results in leaf yellowing; the plant becomes unable to absorb energy to maintain its overall health. In a weakened state, plants become susceptible to winterkill or diseases and fruit yield is reduced. This project addressed the need for growers to understand the effect of high soil pH, and how to improve conditions in high pH soils using simple tools. In the long-term, it is expected that improved soil conditions through application of project treatments will increase plant productivity and reduce plant death, making operations more profitable and efficient.

Project Plan

Five 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 included University of Saskatchewan varieties Tundra, Borealis, and 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. The Saskatoon berry and dwarf sour cherry treatment plots were 6 meters in row length (since the plants sucker, the number of plants per plot was not prescribed). Haskap plots included 3 plants per plot (plot length was roughly 6 meters).

Table 1. Treatments

Treatment	Method of application
iron chelate	soil applied
iron chelate	foliar applied
iron sulfate	soil applied
iron Sucrate	soil applied
iron monohydrate	soil applied
iron monohydrate	foliar applied
alfalfa pellet (with Humic Acid)	soil applied

Methods

Treatments were randomized and each plot was photographed. Leaf samples were analyzed for nutrient content. Saskatoon berry fruit was harvested on July 16, and fruit samples were taken from dwarf sour cherry on August 5. Fruit production on Haskap was negligible in 2015. Dwarf sour cherry fruit Brix (roughly equivalent to sugar content) was measured using an optical refractometer. Saskatoon berry was not measured this way because variation in sugar content is negligible (at roughly 11%).

Water soluble iron product treatments were applied via a pull-type sprayer. Relatively insoluble granular products were spread within the row using a hand spreader. All iron treatments were applied at a rate equivalent to 10 lb/ac. Soluble iron treatments and humic acid were applied in 60 L of water per treatment on June 1. Humic acid was applied at 2 L of HA-6 per 60 L of water/humic acid solution on May 20.

Major fertilizer application was applied according to soil samples (N-P-K-S at 100-60-40-5 lb/ac was needed), and applications were made at rates based upon fertilizer product nutrient percentages to ensure 110-60-40-5 lb was applied on May 20.

Representative branches were selected and hand harvested to minimize the effect of pre-existing plot variability.

Results

The 2015 season was characterized as dry and warmer than average (especially from late-spring to mid-summer). Under warm, dry conditions, plants are less challenged to absorb iron from soil sources. Therefore, symptoms of iron chlorosis were greatly reduced compared to the previous five years. Photographs of the plots offer some evidence that there were slight treatment differences, but environmental conditions and pre-existing plot variability added complications.

Saskatoon Berry

Some Saskatoon leaves were infected with Hawthorn lace bugs. This caused leaves to appear a dull tan colour (these leaves had been dark green prior to insect infestation; see figure 2). Hawthorn lace bugs are usually not controlled because they are not known to cause significant economic damage. From 2010 to 2014, all plots were significantly lighter yellow, and yields were well below average. The 2015 yields were above average, and plants were significantly greener.

Figure 2. Saskatoon berry showing damage from Hawthorn Lace Bug

Figure 3. Foliar iron monohydrate reducing iron chlorosis on leaves

Obvious evidence of treatment affect could be seen in foliar-applied iron chelate and iron monohydrate, as dark green spots occur where the iron is absorbed into leaves (Figure 3).

The tissue test results are shown in Table 2. Iron (Fe) availability was adequate for all treatments, including control. This largely reflects the fact that under warm and dry conditions, plants are much better able to absorb existing soil iron to meet need. Potassium (K) absorption was marginal to deficient in a number of samples; this did not correlate with treatment. There was a significant amount of pre-existing variability within the plots.

Table 2: Saskatoon Berry Tissue Test Results

Smokey	N	P	K	S	Fe	Zn		Thiessen	N	P	K	S	Fe	Zn
R1 T1	38.0	48.0	53.0	30.0	62.5	30.0		R4 T1	48.0	62.5	25.0	30.0	62.5	37.5
R1 T2	48.0	50.0	25.0	30.0	62.5	30.0		R4 T2						
R1 T3	38.0	41.0	25.0	31.0	62.5	30.0		R4 T3	51.0	62.5	28.0	28.0	62.5	25.0
R1 T4	50.0	48.0	32.0	31.0	62.5	27.0		R4 T4	37.5	68.0	25.0	25.0	62.5	25.0
R1 T5	48.0	50.0	38.0	30.0	62.5	25.0		R4 T5	33.0	87.0	37.0	28.0	37.0	48.0
R1 T6	37.5	50.0	25.0	30.0	62.5	25.0		R4 T6	52.0	69.0	23.0	28.0	62.5	37.5
R1 T7	50.0	51.0	25.0	31.0	62.5	34.0		R4 T7	48.0	62.5	25.0	28.0	62.5	29.0
R1 T8	34.0	36.0	51.0	30.0	62.5	38.0		R4 T8	50.0	72.0	25.0	27.0	62.5	37.5

Smokey	N	P	K	S	Fe	Zn		Thiessen	N	P	K	S	Fe	Zn
R2 T1	42.0	52.0	23.0	27.0	62.5	30.0		R5 T1						
R2 T2	32.0	37.5	30.0	25.0	62.5	25.0		R5 T2	55.0	87.0	67.0	40.0	62.5	37.5
R2 T3	28.0	62.5	51.0	25.0	62.5	25.0		R5 T3	55.0	87.0	50.0	38.0	62.5	38.0
R2 T4	32.0	50.0	25.0	26.0	62.5	26.0		R5 T4	50.0	87.0	40.0	30.0	42.0	37.5
R2 T5	37.5	62.5	60.0	33.0	62.5	25.0		R5 T5	53.0	73.0	38.0	30.0	48.0	34.0
R2 T6	43.0	52.0	25.0	28.0	62.5	27.0		R5 T6	50.0	87.0	67.0	30.0	62.5	34.0
R2 T7	37.5	37.5	25.0	27.0	62.5	25.0		R5 T7	50.0	87.0	48.0	37.0	62.5	38.0
R2 T8	37.5	38.0	25.0	27.0	62.5	25.0		R5 T8	53.0	87.0	51.0	33.0	62.5	40.0
R3 T1	37.5	37.5	37.5	29.0	62.5	25.0								
R3 T2	28.0	37.5	25.0	25.0	34.0	25.0								
R3 T3	34.0	38.0	26.0	26.0	62.5	28.0								
R3 T4	25.0	38.0	48.0	25.0	62.5	28.0								
R3 T5	42.0	40.0	25.0	29.0	62.5	26.0								
R3 T6	40.0	40.0	25.0	28.0	62.5	29.0								
R3 T7	40.0	38.0	26.0	28.0	62.5	26.0								
R3 T8	37.5	75.0	33.0	26.0	62.5	27.0								

R# = Row Number; T# = Treatment Number

Treatment #1 – Foliar-applied iron chelate
Treatment #2 – Soil-applied iron chelate
Treatment #3 – Soil-applied iron sulfate
Treatment #4 – Soil-applied iron sucrate
Treatment #5 – Soil-applied iron Monohydrate
Treatment #6 – Soil-applied humic acid/alfalfa pellets
Treatment #7 – Foliar-applied iron monohydrate
Treatment #8 – Control

Overall, yields were above average, and fruit quality was good (table 3). Some loss occurred prior to harvest due to bird predation, as well as high wind associated with a thunderstorm that caused fruit fall. Iron absorption was not as problematic in 2015 as it had been during the previous five years. Therefore, yield differences relate more to pre-existing conditions than they do to treatment effect.

Table 3: Saskatoon Berry Harvest Yields.

Treatment	Row 1 kg	Row 2 kg	Row 3 kg	Row 4 kg	Average kg
1 – Foliar-applied iron chelate	5.26	1.75	2.98	0.77	2.69
2 – Soil-applied iron chelate	3.28	1.78	1.99	no data	2.38
3 – Soil-applied iron sulfate	4.83	1.79	2.59	1.08	2.57
4 – Soil-applied iron sucrate	2.93	3.42	1.88	2.14	2.59
5 – Soil-applied iron Monohydrate	4.74	1.75	2.33	4.74	3.39
6 – Soil-applied humic acid/alfalfa pellets	2.14	3.80	no data	1.62	2.52
7 – Foliar-applied iron monohydrate	5.06	3.42	1.95	1.24	2.92
8 – Control	5.64	2.27	2.86	no data	3.59

Haskap

Haskap did not perform well throughout Saskatchewan in 2015. Reasons included:

(1) frost damage during early spring,
(2) since it is shallow rooted, lack of consistent moisture may have reduced vascular transfer of nutrients and moisture to fruit in early development stages,
(3) since two flowers need to be pollinated to allow the central ovary to fully develop, insufficient may have resulted in small fruit and reduced fruit set,

(4) more direct sunlight and higher heat levels in early to late summer reduced plant vigour and fruit size.

Due to these factors, the Haskap for this trial did not product a measurable fruit yield.

Consistent with the findings for the Saskatoon berry crop, the warm, dry conditions mitigated problems for Haskap absorption of iron in 2015. Almost all plots had adequate iron content (Table 4), and plots that were marginal had pre-existing weakness that reduced plant ability to absorb all nutrients. Potassium and zinc levels were consistently deficient and nitrogen content was marginal to deficient. Lack of nitrogen and potassium was not as evident in the Saskatoon berries or the dwarf sour cherries, so Haskap may have had either a greater requirement or had greater difficulty absorbing these nutrients.

Table 4. Haskap Leaf Tissue Test Results.

	N	P	K	S	Fe	Zn			N	P	K	S	Fe	Zn
R1 T1	32	88	18.0	67.5	67.5	20.0		R3 T1	25	70.0	12.5	67.5	67.5	18.0
R1 T2	25	88	12.5	67.5	67.5	12.5		R3 T2	25	64.0	14.0	67.5	67.5	25.0
R1 T3	25	88	12.5	67.5	37.5	12.5		R3 T3	25	67.5	13.0	67.5	67.5	25.0
R1 T4	25	88	12.5	67.5	30.0	19.0		R3 T4	25	88.0	15.0	67.5	67.5	25.0
R1 T5	25	88	10.0	67.0	31.0	14.0		R3 T5	25	67.5	11.0	67.5	67.5	17.0
R1 T6	26	88	14.0	67.0	67.5	20.0		R3 T6	25	67.5	13.0	49.0	67.5	17.0
R1 T7	25	88	12.5	67.5	67.5	20.0		R3 T7	25	52.0	13.0	67.5	67.5	17.0
R1 T8	25	88	10.0	67.5	67.5	17.0		R3 T8	25	52.0	17.0	67.5	67.5	25.0
R2 T1	25	88	10.0	67.5	67.0	21.0		R4 T1	22	53.0	13.0	67.5	67.5	13.0
R2 T2	25	88	20.0	67.0	50.0	25.0		R4 T2	25	67.5	19.0	67.5	67.5	18.0
R2 T3	25	88	10.0	67.5	67.5	25.0		R4 T3	25	67.5	14.0	68.0	68.0	13.0
R2 T4	25	88	10.0	67.5	67.5	22.0		R4 T4	23	53.0	14.0	68.0	68.0	20.0
R2 T5	25	88	14.0	67.5	67.5	25.0		R4 T5	25	13.0	5.0	18.0	28.0	10.0
R2 T6	25	88	13.0	67.5	67.5	21.0		R4 T6	25	54.0	14.0	67.5	67.5	13.0
R2 T7	25	88	13.0	67.5	67.5	21.0		R4 T7	24	53.0	14.0	67.5	67.5	17.0
R2 T8	25	54	10.0	67.5	67.5	13.0		R4 T8	24	67.5	22.0	67.5	67.5	24.0

R# = Row Number; T# = Treatment Number

Treatment #1 – Foliar-applied iron chelate
Treatment #2 – Soil-applied iron chelate
Treatment #3 – Soil-applied iron sulfate
Treatment #4 – Soil-applied iron sucrate
Treatment #5 – Soil-applied iron Monohydrate
Treatment #6 – Soil-applied humic acid/alfalfa pellets
Treatment #7 – Foliar-applied iron monohydrate
Treatment #8 – Control

Sour Cherry

Treatment differences in the sour cherries were not visually significant and only slight visual differences were detectable between treated versus control plots. Foliar treatments of iron chelate and iron monohydrate had obvious impacts on chlorotic leaves, as dark green spots were visible where the iron had been directly absorbed into the leaf (figure 4).

Figure 4. Iron monohydrate treatment.

The tissue tests show iron content to be adequate in all samples, but treatment # 2 (soil applied iron chelate) as well as treatment #6 (humic acid/alfalfa pellet) (table 5). The lower nutrient content in these two treatments did not present significant visual symptoms and likely stemmed from pre-existing conditions (rather than 2015 treatment effects).

Zinc content was deemed to be deficient in all treatments, but this did not appear to affect fruit yield or quality.

Table 5. Tissue Test Reults For Dwarf Sour Cherries

Treatment	N	P	K	S	Fe	Zn
1 – Foliar-applied iron chelate	70	53	53.0	37.5	67.5	23
2 – Soil-applied iron chelate	70	52	67.5	37.5	48.0	18
3 – Soil-applied iron sulfate	70	53	88.0	37.5	67.5	18
4 – Soil-applied iron sucrate	70	56	88.0	37.5	67.5	14
5 – Soil-applied iron Monohydrate	70	52	69.0	37.5	62.5	20
6 – Soil-applied humic acid/alfalfa pellets	70	52	87.5	37.5	48.0	20
7 – Foliar-applied iron monohydrate	70	63	88.0	37.5	62.5	20
8 – Control	70	55	88.0	37.5	62.5	22

Sugar content of dwarf sour cherry samples were measured using a standard Brix refractometer (Table 6). Sugar content was not significantly influenced by treatment, so iron and zinc limitations did not significantly affect fruit quality.

Table 6. Sugar Content In Dwarf Sour Cherries (Degrees Brix)

Treatment	Cupid °Bx	Valentine °Bx	Romeo °Bx
1 – Foliar-applied iron chelate	17	15.0	20
2 – Soil-applied iron chelate	20	11.0	20
3 – Soil-applied iron sulfate	18	18.0	19
4 – Soil-applied iron sucrate	19	19.0	20
5 – Soil-applied iron monohydrate	14	17.5	19
6 – Soil-applied humic acid/alfalfa pellets	21	15.0	19
7 – Foliar-applied iron monohydrate	16	19.0	21
8 – Control	15	18.0	19

The warm, dry conditions in 2015 favoured adequate soil-available iron content and this, combined with treatment, reduced symptoms of iron chlorosis. In addition, lack of frost during the bloom period, combined with minimal disease pressure resulted in strong fruit-set and cherry yields that were above average. The fruit yeild showed no consistancies among treatments, which was a result of pre-exisiting varability as well as fruit loss from birds and strong winds (Table 7).

Table 7. Results from Dwarf Sour Cherry Harvest (kg)

Treatment	Cupid kg	Valentine kg	Romeo kg	Average kg
1 – Foliar-applied iron chelate	2.670	1.435	2.155	2.087
2 – Soil-applied iron chelate	2.465	1.715	1.960	2.047
3 – Soil-applied iron sulfate	1.920	1.530	2.535	1.995
4 – Soil-applied iron sucrate	1.435	1.445	1.760	1.547
5 – Soil-applied iron monohydrate	1.965	1.110	3.875	2.317
6 – Soil-applied humic acid/alfalfa pellets	1.995	1.770	1.620	1.795
7 – Foliar-applied iron monohydrate	1.235	1.700	1.780	1.572
8 – Control	1.045	0.695	1.500	1.080

Final Discussion

Treatments to improve iron chlorosis-affected Saskatoon berry, Haskap, and dwarf sour cherry growing in high pH soil resulted in mainly visual effects in 2015, but it is anticipated will also correspond with improved plant vigour over the longer-term. The main visual treatment differences noted were between iron product treatment plots and control plots. In effect, any iron treatment appeared to provide some benefit. However, 2015 temperature and moisture conditions served to minimize treatment differences.

Leaf analyses demonstrated that iron deficiencies were negligible throughout the orchard, including control plots. Nevertheless, other deficiencies were noted, including major nutrients (e.g., potassium) and minor nutrients (e.g., zinc). Deficiencies were especially endemic in Haskap, despite all species having received the same treatments. Since Haskap is shallow rooted, it is likely that nutrient absorption was hindered through the dynamics presented to the plant within the limited soil conditions available in the top soil layer.

In general fruit yields for Saskatoon berry and dwarf sour cherry were above average. Haskap yield was extremely low and fruit size was small for reasons unrelated to treatments. Given better overall health status going into the 2015–16 winter, all plants should stand a better chance of producing high fruit yields in 2016. Flowering and fruit-set should be monitored in 2016.

For more information about these crops and trials, contact Forrest Scharf at (306)-787-4666 or at Forrest.Scharf@gov.sk.ca.

Acknowledgements

- Forrest Scharf, Provincial Fruit Specialist, for help setting up and maintaining the project, providing agronomic guidance, and completing the economic analysis.
- Adam Tomasiewicz, 2015 summer student, Saskatchewan Ministry of Agriculture for helping with irrigation scheduling with this project.
- CSIDC staff who assisted with field and irrigation operations for this project.
- QC Corporation for donating the iron sucrate and iron monohydrate.
- Wapaw Bay Resources Inc. for donating the humic acid product.

Demonstration of Ethnic Vegetable Production in Saskatchewan

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Organizations

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

Project Objective

The objectives of this project were to demonstrate the commercial potential for growing ethnic vegetables in Saskatchewan and provide opportunities for producers and stakeholders to see the crops.

The Saskatchewan vegetable industry has been working collaboratively with The Grocery People 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 Federated Coop, but there is a growing demand for ethnic vegetables to meet demand of the growing Asian population in Canada. Canda imports over $400M worth of ethnic vegetables annually. Growing a good quality supply could be a good opportunity for Saskatchewan's vegetable producers to supply the western provinces.

Project Plan

This project features various ethnic vegetables, some grown in a high tunnel and some direct seeded. The Grocery People provided a list of ethnic vegetables and volumes that they would be interested in purchasing from Saskatchewan sources. The vegetables grown were chosen from this list. Table 1 displays what was seeded and in what environment the specific plant was grown in.

Table 1: Species and Varieties Grown in this Trial

Species/Variety	Growing Location
Daikon/Long White	Direct seeded
Daikon/April Cross	Direct seeded
Mustard Greens/Savanna	Direct seeded
Mustard Greens/Small Gaichoi	Direct seeded
Collard Greens/Flash	Direct seeded
Collard Greens/Tiger	Direct seeded

Species/Variety	Growing Location
Bok Choy/Chin Yu	Direct seeded
Bok Choy/Toy Green	Direct seeded
Napa/Emiko	Direct seeded
Napa/Spring Choice	Direct seeded
Okra/Long Ridged	High tunnel
Okra/Zarah	High tunnel

Demonstration Site

The project was located in the enclosed orchard area at the Canada-Saskatchewan Irrigation Diversification Centre (CSDIC). It consisted of half a high tunnel and two 90 x 16 foot plots.

The Eggplant and the Okra were seeded into seedling trays in a greenhouse on May 7 (Figure 1). Once the seedlings matured, they were transplanted into the high tunnels on June 5. The seedlings were planted into rows of black plastic mulch to control weeds and dripline irrigation was set up along each row. The direct seeding was done on May 15 into plots located in the orchard area at CSIDC. The plants were fertilized with all-purpose 20-20-20 fertilizer three times during the year. The soil was watered through the dripline in the high tunnel and with a sprinkler gun on the directed seeded plots to maintain sufficient moisture throughout the growing season. The daikon radish was seeded at 12 inch spacing and the rest of the crops were seeded at 24 inch spacing. The yield measurements are based on one 16 foot row for the direct seeded crops and one 14 foot row for the high tunnel crops.

The direct seeded plots were sprayed with Desis on June 4 for flea beetles and again on August 11. Due to extreme cabbage moth and cabbage root maggot pressure, the plots were protected using a crop cover, which was installed on June 11 and removed on June 24 (Figure 2).

Figure 1. Eggplant and okra in the greenhouse.

Figure 2. Crop cover on direct seeded plot.

Results and Discussion

Daikon

Table 2. Daikon Harvest Results

Variety	First harvest	Last Harvest	Total Yield
Long White	Aug 11	Aug 11	11.4 kg
April Cross	Aug 11	Aug 11	9.0 kg

Daikon Radishes are ready to harvest when the roots are about 16 inches long, which takes 55 to 60 days. These radishes are much milder than regular radishes or lo bok radishes. While yields were acceptable, the radishes were very badly damaged by root maggots. They also pushed up out of the ground as they grew and so required hilling. The hilling process prevented the shoulders from greening, but many of the roots were not straight. Also, because the roots are so long, harvesting without damaging them was nearly impossible. This was the case with both varieties.

While market opportunities exist for this crop, the challenges associated with growing it on a large scale make it a poor candidate to grow commercially in Saskatchewan.

Table 3 Shows the gross return associated with the two varieties of daikon, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 3. Economics For Daikon Radish

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Long White	684.80	0.98	671.10
April Cross	529.82	0.98	529.83

Mustard Greens

Table 4. Mustard Green Harvest Yield

Variety	First Harvest	Last Harvest	Total Yield
Savanna	Jul 3	Oct 15	13.5 kg
Small Gaichoi	Jul 3	Jul 14	1.1 kg

Mustard greens are a cool weather crop, requiring about 35 days before leaves can be harvested. Usually the crop bolts when weather turns warm; however, one of the varieties chosen, Small Gaichoi had the opposite problem and bolted very early, probably due to the cooler weather in spring. For this reason, it would not have been acceptable for market. The Savanna variety is more cold tolerant and did provide multiple harvests. This crop is extremely hardy and was harvested until October 15. Production slowed during the heat of summer, but it did not bolt. Successive planting could provide high volumes of mustard greens throughout the summer and late into the fall.

Mustard greens are normally sold in bunches of 5 or 6 leaves per bunch. One bunch weighs approximately 96 grams, so the 16 foot section of row produced over 140 bunches.

Further testing of mustard green varieties and successive planting is recommended.

Table 5 Shows the gross return associated with the two varieties of mustard greens using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 5. Economics for Mustard Greens

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Savanna	405.5	1.29	523.07
Small Gaichoi	33.0	1.29	42.53

Collard Greens

Table 6. Collard Green Harvest Yield

Variety	First harvest	Last Harvest	Total Yield
Flash	Jul 21	Oct 15	1.6 kg
Tiger	Jul 21	Oct 15	2.2 kg

Collard greens are a longer season crop than mustard greens, requiring 70 to 80 days before harvesting. The leaves are larger than mustard leaves and have a very mild cabbage flavour. Lower leaves can be harvested when they reach 8 to 10 inches. While the crop is extremely hardy, allowing for harvest into October, yields were low mainly due to the late start. As with mustard greens, collard greens are sold in bunches.

Further testing with successive plantings of earlier varieties and extending the season is warranted.

Table 7 Shows the gross return associated with the two varieties of collard greens, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 7. Economics for Collard Greens

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Flash	48.1	1.30	62.53
Tiger	66.1	1.30	85.91

Lo Bok

Table 8. Yield Results for Lo Bok

Variety	First harvest	Last Harvest	Total Yield
White Luobo	July 7	July 7	0.81 kg
New White Spring	July 7	July 7	1.30 kg

Lo Bok radish is a longer carrot-shaped radish but shorter than Daikon radish and is very hot. They are ready to harvest at about 6 inches. Lo Bok radishes tend not to bolt, get pithy, or split in the summer heat. They require about 45 days to maturity versus a traditional radish, which requires about 30 days.

Figure 3. Harvested Lo Bok

While yields were extremely low, the Lo Bok performed better than the daikon radish, as there was less root maggot damage, rendering most of the product marketable. Size and shape of both varieties were acceptable.

Larger replicated field trials are recommended for this crop, as it has potential if acceptable yields can be obtained. The crop will have to be managed for root maggot.

Table 9 Shows the gross return associated with the two varieties of Lo Bok, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 9. Economics for Lo Bok

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
White Luobo	24.4	1.50	36.58
New White Spring	39.1	1.50	58.66

Bok Choy

Table 10. Yield Results for Bok Choy

Variety	First harvest	Last Harvest	Total Yield
Chung Yu	Aug 14	Aug 14	3.6 kg
Toy Green	Jul 27	Jul 27	4.0 kg

Bok Choy was more challenging to grow than expected. Determining when the crop was ready for harvest was the biggest challenge. The Toy Choy variety is a miniature variety that requires only 30 days to maturity. It could have been harvested at least one week earlier, as some were lost due to bolting. Baby bok choy is usually sold in multiples in a bag.

Figure 4. Harvested bok choy.

The Chung Yu variety should also have been harvested earlier. It is a 45 day variety, but due to inexperience, it too was harvested after some plants bolted. Cabbage root maggots were controlled by the crop covers, and the short days to maturity of both the varieties mean that successive plantings could easily be achieved.

Further investigation of this crop for commercial production is recommended.

Table 11 Shows the gross return associated with the two varieties of bok choy, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 11. Economics for Bok Choy

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Chung Yu	108.2	0.78	84.38
Toy Green	120.2	2.47	269.83

Napa Cabbage

Table 12. Yield Results for Napa Cabbage

Variety	**First harvest**	**Last Harvest**	**Total Yield**
Emiko	Aug 14	Aug 14	16.50 kg
Spring Choice	Aug 24	Aug 24	7.94 kg

As with the Bok Choy, determining the maturity of the crop was difficult. However, nicely shaped, large heads of Chinese cabbage were harvested. This crop is easy to grow from seed. Commercial producers could extend the season by planting successive crops. The ease of production and excellent yield, especially of the Emiko, makes this crop very suitable for production in Saskatchewan.

Table 13 Shows the gross return associated with these two varieties of napa cabbage, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 13. Economics for Napa Cabbage

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Emiko	495.7	1.49	738.56
Spring Choice	238.6	1.49	355.48

Okra

Table 14. Yield Results for Okra

Variety	First harvest	Last Harvest	Total Yield
Long Ridged	Jul 18	Sep 24	1.8 kg
Zarah	Jul 18	Sep 24	2.1 kg

Figure 5. Harvested okra

Okra is not normally grown in Saskatchewan, but under high tunnels, the crop grew late into the fall. The plant produces flowers continually through the summer. The pods are ready to harvest six days after flowering, so production is continuous. Pods between 2½ and 6 inches are considered marketable. Due to fast growth, this crop required harvest twice per week, otherwise the okra pods became too large and stringy. The variety Zarah grew much taller than the Long Ridged variety and also produced larger yields. This crop is too labour intensive, considering the returns.

Table 15 shows the gross return associated with the two varieties of okra, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 15. Economics for Okra.

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Long Ridged	61.45	1.98	121.67
Zarah	71.66	1.98	141.89

Eggplant

Table 16. Yield Results for Eggplant.

Variety	First Harvest	Last Harvest	Total Yield
Classic	Aug 14	Oct 5	12.7 kg
Epic	Aug 4	Oct 5	15.8 kg

While both types of eggplant (Japanese and oval fruited) were seeded in the greenhouse, both Japanese type varieties, Shoya Long and Long Purple, failed to produce vigorous plants, so the Japanese types were not included in the trial. Of the large oval types, the Epic variety performed better than the Classic variety. Fruit of both varieties was almost flawless: shiny, dark skin, with very few blemishes. There were no pest issues with this crop other than the loss of one Epic plant consumed by a deer. Compared to Okra, this crop was very easy to manage.

Figure 6. Harvested eggplant

Producers should consider growing eggplant as a commercial crop in Saskatchewan.

Table 17 Shows the gross return associated with the two varieties of eggplant, using the yields observed in this trial and market price taken from grocery stores in Saskatchewan.

Table 17. Economics for Eggplant

Variety	**Yield** (lb/ac)	**Retail Price** ($/lb)	**Gross** ($/ac)
Classic	464.3	1.98	949.39
Epic	539.1	1.98	1067.42

Final Discussion

The sample size was small to provide an accurate yield or income per acre. However, producing the crops and discussing their production with producers at the various field days and private tours will help producers make informed decisions regarding commercial production of these crops. Larger replicated trials for eggplant, Lo Bok, napa cabbage, and collard and mustard greens should be considered.

For more information about these crops, contact Connie Achtymichuk, Provincial Vegetable Specialist at (306) 867-5526 or connie.achtymichuk@gov.sk.ca.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Adam Tomasiewicz, 2015 summer student, Saskatchewan Ministry of Agriculture, for helping with irrigation scheduling for this project.
- Connie Achtymichuk, Provincial Vegetable Specialist, for help setting up and maintaining the project, providing agronomic guidance, and completing the economic analysis.
- CSIDC staff who 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 2015.

Field Days

CSIDC Irrigation Field Day and Tradeshow – July 9

- Horticulture Tour Leader – Joel Peru, Ministry of Agriculture
- Plant Growth Regulator Demo – Jeff Ewen, Ministry of Agriculture
- Morning Tour Leader – Gary Kruger, Ministry of Agriculture
- Morning Tour Leader – Kelly Farden, Ministry of Agriculture

ICDC Research and Demonstration Field Day Tour – August 20

- Specialty Crop and Grain Corn Trials – Joel Peru, Ministry of Agriculture
- Plant Growth Regulator Demo – Jeff Ewen, Ministry of Agriculture
- Evening Tour Leader – Gary Kruger, Ministry of Agriculture

Crop Diagnostic School – July 28–30

- Soil hand texturing and moisture Analysis – Joel Peru and Cara Drury, Ministry of Agriculture
- Imagery as a Diagnostic Tool – Group Chair – Jeff Ewen, Ministry of Agriculture
- Crop Salinity Demonstration – Gary Kruger, Ministry of Agriculture

Outlook Burger and Fry Farm June 8 and September 15

Booth Display

- Crop Production Week, Saskatoon, January 5–8
- CSIDC Irrigation Field Day and Tradeshow, Outlook, July 9
- Ag in Motion, Langham, July 21–23
- ICDC/SIPA Annual Conference, Moose Jaw, December 8–9

Publications

- Crop Varieties for Irrigation, January
- Irrigation Economics and Agronomics, January
- Research and Demonstration Program Report 2015, December
- The Irrigator, February
- Irrigation Pivot Annual Service Booklet, January

Presentations

Joel Peru

- ICDC Agronomy Workshop, Outlook, April 1 – Specialty Crops under Irrigation
- ICDC Agronomy Workshop, Riverhurst, April 2 – Specialty Crops under Irrigation
- Outlook Burger and Fry Farm, June 8 – Crop Inputs
- CSIDC Irrigation Field Day, July 9 – Specialty Crops – Irrigation vs Dryland
- CSIDC Irrigation Field Day, July 9 – Horseradish production in Saskatchewan
- ICDC Research and Demonstration Field Day Tour, August 20 – Specialty Crop and Grain Corn Trials
- ICDC 2016 Research Program Planning Breakfast, November 17 – 2015 Program Report
- 2015 SIPA/ICDC Conference, December 8 – 2015 Research and Demonstration Report

Jeff Ewen

- ICDC Irrigation Agronomy Workshop, Outlook, April 1 – Plant Growth Regulators
- ICDC Irrigation Agronomy Workshop, Riverhurst, April 2 – Plant Growth Regulators
- CSIDC Irrigation Field Day, July 9 – Plant Growth Regulators
- ICDC Research and Demonstration Field Day Tour August 20 – Plant Growth Regulators
- ICDC 2016 Research Program Planning Breakfast, November 17 – 2015 Program Report
- 2015 SIPA/ICDC Conference, December 8 – 2015 Research and Demonstration Report

Gary Kruger

- Outlook Burger and Fry Farm, June 8 – Wheat Production
- Saskatchewan Seed Potato Growers Field Day, August 17 – Micronutrients in Seed Potato Production
- ICDC Research and Demonstration Field Day Tour August 20 – Copper and Zinc Fertilization of Alfalfa
- Outlook Burger and Fry Farm, September 15 – Utilization of Wheat in Food
- ICDC 2016 Research Program Planning Breakfast, November 17 – 2015 Program Report
- 2015 SIPA/ICDC Conference, December 8 – 2015 Research and Demonstration Report

Sarah Sommerfeld

- Western Beef Development Centre Field Day, June 23 – Hay Harvest Challenge
- Eagle Creek AEGP Pasture Walk, Fogan, July 7 – Plant Identification, Range Health Management
- Eagle Creek AEGP Pasture Walk, Tessier, July 8 – Plant Identification, Forage Establishment, Bale Grazing, Non-Bloat Legumes

Kelly Farden

- ICDC Irrigation Agronomy Workshop, Outlook, April 1 – Irrigation Related Growing Forward 2 Programming
- ICDC Irrigation Agronomy Workshop, Riverhurst, April 2 – Irrigation Related Growing Forward 2 Programming
- Rudy Agro Field Day, Outlook, July 29 – Water Management and AIMM

Agriview Articles

Joel Peru

- April – Preview of Irrigation Research and Demonstration Projects for 2015
- September – The Uses of Vertical Tillage
- November – 2015 SIPA/ICDC Annual Conference

Jeff Ewen

- October – Post Harvest Irrigation Management

Gary Kruger

- May – Irrigation Scheduling Is a Must

Kaeley Kindrachuk

- October – Straight Cutting Canola
- November – PMRA and MRLs
- December – Crop Production Week

Kelly Farden

- September – Development Funding Available for Non-district Irrigators

Farmgate

Joel Peru

- High Value Crop Production Under Irrigation

Kelly Farden

- Irrigation and Water Stewardship

Other Articles

Joel Peru

- Crop Production News, July 23: Critical Times for Irrigating
- The Irrigator – Variance in Crop Water Use
- The Irrigator – Use of Nitrogen Efficiency Enhancers in Irrigation

Jeff Ewen

- The Irrigator – Choosing the Right Seed Variety for Irrigation
- The Irrigator – The Next Crop for Irrigation …

Gary Kruger

- Webinar, February – What Water Does to Dirt
- The Irrigator – Impact of Irrigation on Soil Fertility
- The Irrigator – Update on Copper Fertilizer on Irrigated Soils

Sarah Sommerfeld

- Newspaper – Hay Harvest Management and the Hay Harvest Challenge
- Newspaper – The Cost of Overgrazing
- Newspaper – Funding Options for Forage and Livestock Producers

Kaeley Kindrachuk

- Newspaper/CJWW/Golden West Radio- Use of Seed Treatments
- Newspaper/CJWW/Golden West Radio- Flea Beetles and Cutworms on Canola
- Newspaper/CJWW/Golden West Radio- Harvest Management Tips
- Newspaper/CJWW – Saskatchewan Oilseed Producer Meetings
- Crop Production News – How to tell when your crop is ready to desiccate
- Crop Production News – Fusarium Head Blight (w/Faye Bouchard)
- Crop Production News – PMRA and MRLs (w/Clark Brenzil)
- Radio interviews on crop development (5 CKRM, 1 CTV Morning Live, 1 StarPhoenix)
- Live Tweeting during Crop Diagnostic School, Oilseed Meetings, Agronomy Research Update

Surveys 2015

- Canola Disease Survey (Kaeley Kindrachuk, Joel Peru, Jeff Ewen, Gary Kruger)
- Pea Leaf Weevil Survey (Kaeley Kindrachuk)
- Diamondback Moth (Kaeley Kindrachuk)
- Swede Midge (Kaeley Kindrachuk)
- Bertha Armyworm (Kaeley Kindrachuk)
- Lake Diefenbaker Development Area Cropping Survey (Jeff Ewen, Joel Peru, Gary Kruger)

ICDC Project Funding

Project Title	Funding Agency	ICDC Project	Page
Irrigated Canola Performance Trial	ICDC Ongoing Variety Trial	--	7
Irrigated Canola Variety Trial	ICDC Ongoing Variety Trial	--	9
Western Canada Irrigated Canola Co-operative Trials XNL1 and XNL2	ICDC Ongoing Variety Trial	--	11
Irrigated Flax Variety Trial	ICDC & SVPG	--	14
Irrigated Field Pea Regional Variety Trial	ICDC & SVPG	--	17
Saskatchewan Dry Bean Narrow Row Regional Variety Trial	ICDC & CDC	--	23
Alberta Dry Bean Narrow Row and Wide Row Regional Variety Trials	ADF, WGRF & ICDC	2015-01	25
Short Season Wide Row Irrigated Dry Bean Co-operative Registration Trial	ADOPT, WGRF & ICDC	2015-02	31
Western Canada Soybean Performance Evaluation	ICDC, ADF, WGRF & Manitoba Soybean and Pulse Growers	--	34
Irrigated Wheat, Barley and Oat Regional Variety Trials	ICDC Ongoing Variety Trials	--	39
ICDC Irrigated Wheat Variety Trial	ICDC	--	44
Alberta Corn Committee Hybrid Performance Trials	ICDC & ACC		49
Soybean Row Spacing and Plant Population Study	ADF & ICDC	2015-11	53
Soybean Seeding Date & Seed Treatment Study	ADF & ICDC	2015-11	56
Developing Nitrogen Management Recommendations for Soybean Production in Saskatchewan	Saskatchewan Pulse Growers	2015-18	61
Developing Phosphorus Management Recommendations for Soybean Production in Saskatchewan	Saskatchewan Pulse Growers	2015-19	64
Soybean Inoculation Study	ADF, WGRF & ICDC	--	67
Rudy Agro Irrigated Field Pea Evaluation	ICDC (in house)	2015-53	71
Response to Sulphur Fertilization of Canola under Irrigation in a Sandy Soil	ADOPT	2015-44	74
Evaluation of Straight Cut Canola under Irrigation	ICDC (in house)	2015-46	78
Response to Foliar Applied Boron on Canola during Early Flowering	ADOPT	2015-45	80
Fertigation Application Timing on Irrigated Canola	ICDC (in house)	2015-43	84
Winter Wheat Variety Evaluation for Irrigation	ICDC & ADOPT	2015-51	88
Demonstration of Plant Growth Regulator Application on Irrigated Wheat Production	ADOPT	2015-12	92
Fertigation Application Timing on Irrigated Durum	ICDC (in house)	2015-43	96
Demonstration of Potential Irrigated Crops	ADOPT	2015-14	100
Reclamation of Sodium-Affected Soil	ICDC (in house)	2014-09	106

Project Title	Funding Agency	ICDC Project	Page
Copper Fertility on Low Soil Test Production Fields under Irrigation	ADOPT	2015-48	109
Understanding Soil Variability in Availability of Nutrients for Irrigated Soils	ADOPT	2015-12	112
Saline Tolerant Forage Demonstration	ICDC (in house)	2013-01	117
Demonstration of Perennial Forage Crops	ICDC (in house)	2012-01	120
Copper and Zinc Fertilization of Alfalfa	ADOPT	2015-17	122
Corn Variety Demonstration for Silage and Grazing	ADOPT	2014-03	127
Demonstration of Cantaloupe and Watermelon Production in Saskatchewan	ADOPT	2015-15	131
Treatments to Improve Plant Health and Productivity in Mature Saskatoon, Haskap, and Sour Cherry Orchards Located in High pH Soil	ADOPT	2014-25	135
Demonstration of Ethnic Vegetable Production in Saskatchewan	ADOPT	2015-13	142

See Abbreviations page for definitions of abbreviations and acronyms used in this table.

Thank you to all the funding agencies for their support.

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.

ICDC Research and Demonstration Program Report 2015
Irrigation Crop Diversification Corporation (ICDC), Saskatchewan
Box 609, Outlook, SK S0L 2N0 Phone: 306-867-5500
www.irrigationsaskatchewan.com

ISSN: 1926-7789 December 2015