Irrigation Crop Diversification Corporation

ICDC

Research and Demonstration

Program Report

2013

ICDC – Delivering "value for money R&D" to Saskatchewan Irrigators

www.irrigationsaskatchewan.com

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Irrigation Crop Diversification Corporation

VISION

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

OBJECTIVES AND PURPOSES OF ICDC

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

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

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

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

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Irrigation Crop Diversification Corporation

BOARD OF DIRECTORS

Director	Position	Irrigation District	Development Area Represented	Term Expiry (# of terms)
Kevin Plummer	Chairman	Moon Lake	NDA	2013 1-year appointment
David Bagshaw	Director	Luck Lake	LDDA	2013 (1)
Jay Anderson	Alt. Vice Chair	SSRID	LDDA	2014 (1)
Greg Oldhaver	Director	Miry Creek	SWDA	2014 (1)
Russell Swihart	Director	Vidora	SWDA	2013 (1)
Ryan Miner	Director	Riverhurst	SEDA	2015 (1) 3-year appointment
Colin Ahrens	Director	Individual Irrigators	Non-District	2015 (2)
Larry Lee	Director	Macrorie	SIPA representative	Appointed
Rob Oldhaver	Vice Chair	Miry Creek	SIPA representative	Appointed
John Linsley	Director	N/A	SA representative	Appointed
Doug Billett	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.

Irrigation Crop Diversification Corporation

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ICDC Research and Demonstration Program Report 2013

ISSN: 1926-7789

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FIELD CROPS

Flax Fungicide Demonstration*

Project Lead

- Rory Cranston, PAg, Regional Crop Specialist, Saskatchewan Agriculture

Co-operators

- Randy Bergstrom, Luck Lake Irrigation District, Birsay, SK
- Ryan Miner, Riverhurst Irrigation District, Riverhurst, SK

Project Objective

The purpose of this project was to demonstrate the efficacy of a fungicide application to control disease and promote plant health in high yielding flax under high-management irrigation conditions.

Project Plan

Two fungicides, Headline and Proline, were demonstrated at two sites in the Lake Diefenbaker Development Area. Each co-operator was provided with enough fungicide to treat 40 acres of flax with Proline and 40 acres with Headline. A check strip was left in each field for comparison. The crop was monitored for disease development throughout the season. Yield and thousand kernel weight (TKW) were used to determine the efficacy of the treatments.

Luck Lake Demonstration Site

The site is located at NE 18-24-7 W3M in the Luck Lake Irrigation District and was under a 137-acre low-pressure pivot. The soil texture is clay, and the field was cropped to wheat the previous year.

Crop management

Bethune flax was seeded on May 14. See Table 1 for agronomic management of the site.

Irrigation

Soil moisture was monitored throughout the year using the feel method and gravimetric analysis. Rainfall and irrigation were recorded with the use of rain gauges and a WeatherBug station in the area. Timely spring rains and irrigation in July and August kept the soil moisture above 50% of field capacity throughout the growing season.

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* Project 2013-07

Table 1. Agronomic Management of the Luck Lake Demonstration Site

Nutrients (0-12")	N	P	K
Soil residual	30 lb./acre	50 lb./acre	800 lb./acre
Applied	123 lb./acre	P_2O_5 at 35 lb./acre	5 lb./acre
Variety	Bethune		
Seeding	May 14, 2013, 34 lb./acre		
Herbicide	Glyphosate 0.5 L/acre May 8		
	MCPA 0.4 L/acre and Authority 100 ml/acre May 17		
	MCPA Ester 0.28 L/acre June 23		
Fungicide	Headline 120 ml/acre July 19		
	Proline 128 ml/acre July 19		
Available Moisture from May 1 to Sept. 1			
Irrigation	137 mm (5.5 inches)		
Rainfall	199 mm (8 inches)		
Harvest	October 9		

Riverhurst Demonstration Site

The site is located at NW 31-22-7 W3M in the Riverhurst Irrigation District and was under a 133-acre low-pressure pivot with a corner arm. The soil texture is sandy clay loam and the field was cropped to canola the previous year.

Crop Management

Sorrel flax was seeded on June 6. See Table 2 for agronomic management of the site.

Table 2. Agronomic Management of the Riverhurst Demonstration Site

Nutrients (0-12")	N	P	K
Soil residual	30 lb./acre	50 lb./acre	800 lb./acre
Applied	100 lb./acre	P_2O_5 at 40 lb./acre	N/A
Variety	Bethune		
Seeding	June 6, 2013, 34 lb./acre		
Herbicide	Glyphosate 0.5 L/acre and Authority 100 ml/acre, preseed		
	Buctril M 0.4 L/acre and Equinox 54 ml/acre, in crop		
Fungicide	Headline 120 ml/acre July 25		
	Proline 128 ml/acre July 25		
Available Moisture from May 1 to Sept. 1			
Irrigation	75 mm (3 inches)		
Rainfall	199 mm (8 inches)		
Harvest	October 7		

Irrigation

Soil moisture was monitored throughout the year using the feel method and gravimetric analysis. Rainfall and irrigation were recorded using rain gauges and a WeatherBug station in the area. The pivot was installed on the field this year. There were some problems with construction and as a result the field could not be irrigated until late July. This caused the soil moisture to drop below 50% of field capacity for most of July. Once irrigation began, soil moisture was raised above 50% of field capacity.

Fungicide Evaluation

The fungicide treatments were applied at the Luck Lake site on July 19 and the Riverhurst site on July 25. Throughout most of the growing season, there were no visual differences between the treated and untreated areas. During harvest at the Riverhurst site, it was noted that the Headline treated area had less lodging than the untreated area and the area treated with Proline. See Figures 1–3.

Figure 1. Lodging in the untreated area at Riverhurst.

Figure 2. Lodging in the area treated with Proline at Riverhurst.

Figure 3. Lodging in the area treated with Headline at Riverhurst.

Harvest

Harvest yield measurements were taken on October 7 at Riverhurst and October 9 at Luck Lake, see Tables 3 and 4 for full results. A sample was taken from each treatment and measured for yield and TKW. Treated areas had a similar yield and TKW at the Luck Lake site. The yield and TKW were higher in the treated areas than the untreated area. At the Riverhurst site the treated areas did not have a significantly greater yield or TKW compared to the untreated area.

Table 3. Harvest Results from the Luck Lake Demonstration Site

	Yield	Yield as % check	TKW
Untreated	44.5 bu./acre	100	9.2g
Proline	48.9 bu./acre	110	10.1g
Headline	49.5 bu./acre	111	9.9g

Table 4. Harvest Results from the Riverhurst Demonstration Site

	Yield	Yield as % check	TKW
Untreated	31.2 bu./acre	100	8.4g
Proline	32.1 bu./acre	103	8.6g
Headline	32.2 bu./acre	103	8.7g

Final Discussion

This project was built based on a similar ICDC demonstration carried out in 2012, where flax treated with Headline had a yield increase of 10 bu./acre and a TKW increase of 0.9 g. This year a yield gain was observed only at the Luck Lake site, where the area treated with Headline had the highest yield (49.5 bu./acre), followed closely by Proline, and the untreated area. TKW was greater in the areas treated with a fungicide. The area treated with Proline had the highest TKW (10.1 g), followed by the area treated with Headline and the untreated area.

The Riverhurst site had several factors that negatively impacted the crop. When flax is planted after a canola crop, a 10% reduction in yield can occur due to a reduced mycorrhizal population in the soil. The irrigation pivot was only installed this year, and it was not operational in June and early July. As a result the crop experienced drought stress. However, this area did demonstrate a difference in lodging. The Headline treated area had very little lodging. The area treated with Proline experienced some lodging. The untreated area had the greatest incidence of lodging.

Acknowledgements

The project lead would like to thank the following contributors:

- BASF – for donating the fungicide Headline.
- Bayer CropScience – for donating the fungicide Proline.

Canola Fungicide Demonstration*

Project Lead

- Rory Cranston, PAg, Regional Crop Specialist, Saskatchewan Agriculture

Co-operators

- Mark Gravelle, Riverhurst Irrigation District, Riverhurst, SK
- Murray Purcell, Moon Lake Irrigation District, Moon Lake, SK

Industry Co-operators

- Bayer CropScience
- Syngenta
- DuPont

Project Objective

The purpose of this project was to demonstrate and compare the efficacy of a single application of fungicide to the efficacy of two applications to control *Sclerotinia sclerotiorum* in high-yielding canola under high-management irrigation conditions.

Project Plan

This project compared a single fungicide application treatment to control *Sclerotinia sclerotiorum* to a treatment that had two fungicide applications in high-yielding irrigated canola. The plan was to treat 49 acres of canola once with a fungicide of the grower's choice at a high rate during the 20% to 50% flower stage. The other planned treatment was to apply a fungicide of the grower's choice at the 20% flower stage and again 7 to 10 days later.

At the Riverhurst site the following fungicide treatments were applied to a canola field: Proline was applied on July 6, Vertisan on July 6, Proline on July 6 and again on July 16, and Proline applied on July 6 and Vertisan applied on July 16. The custom applicator did not leave a check strip.

At the Moon Lake site, Proline was applied to the field on July 8, the fungicide Astound was then applied to a 40 acre area that had previously been treated with Proline. A 10 acre check strip was left untreated and used for comparison.

The crops were monitored for disease development throughout the season. Yield, thousand kernel weight (TKW), disease incidence, and severity were used to determine the efficacy of the treatments.

* Project 2013-03

Riverhurst Demonstration Site

The Riverhurst site is located at NW 24-22-7 W3M in the Riverhurst Irrigation district under a 91-acre low-pressure pivot. The soil texture was fine sandy clay loam, and the field was cropped to dry beans the previous year.

Crop management

L130 canola was seeded on May 7. Establishment was poor and spotty, but the crop filled in by mid-June. Weed control was effective with an application of Liberty and Centurion. See Table 1 for agronomic management of the site.

Table 1. Agronomic Management of Riverhurst Demonstration Site

Nutrients (0-12")	**N**	**P**	**K**
Soil residual	30 lb./acre	35 lb./acre	800 lb./acre
Applied	150 lb./acre	P_2O_5 at 50 lb./acre	15 lb./acre
Variety	L150		
Seeding	May 7, 2013,		
Herbicide	Liberty and Centurion 1.6 L/acre, June 8		
Fungicide	First applications July 2		
	Second applications July 12		
Available Moisture from May 1 to September 1			
Irrigation	150 mm (6 inches)		
Rainfall	199 mm (8 inches)		
Swathing	August 14		
Harvest	August 29		

Irrigation

Soil moisture was monitored throughout the year; soil samples were subjected to the feel method and gravimetric analysis. Rainfall and irrigation were recorded with the use of rain gauges and WeatherBug stations. Timely spring rains and irrigation in July and August maintained soil moisture at above 50% of field capacity.

Moon Lake Demonstration Site

This demonstration was located at NE 10-35-6 W3M in the Moon Lake Irrigation district under a 130-acre high-pressure pivot. The soil texture was fine sandy loam and the field was cropped to wheat the previous year.

Crop management

InVigor 5440 canola was seeded on May 25. See Table 2 for agronomic management of the site.

Table 2. Agronomic Management of Moon Lake Demonstration Site

Nutrients (0-12")	**N**	**P**	**K**
Soil residual	30 lb./acre	35 lb./acre	800 lb./acre
Applied	78 lb./acre	P_2O_5 at 42.5 lb./acre	7.5 lb./acre
Variety	InVigor 5440		
Seeding	May 20, 2013, 5.4lb./acre		
Herbicide	Edge 6.9 kg/acre, May 5		
	Glyphosate 1.5 L/acre, May 15		
	Liberty and Centurion 1.6 L/acre, June 8		
	Liberty and Centurion 1.6 L/acre, June 13		
Fungicide	Proline 126 ml/acre July 5		
	Astound 320 ml/acre July19		
Available Moisture from May 1 to September 1			
Irrigation	0 mm (0 inches)		
Rainfall	199 mm (8 inches)		
Swathing	Sept 10		
Harvest	Sept 23		

Irrigation

Soil moisture was monitored throughout the year; soil samples were subjected to the feel method and gravimetric analysis. Rainfall and irrigation were recorded with the use of rain gauges. The pivot broke down during seeding and could not be repaired during the season. As a result, the soil moisture at this site fell below 50% of field capacity during July.

Disease Incidence and Severity

Disease incidence and severity was observed on August 19, see Tables 3 and 4 for results. Disease severity is ranked on a scale of 0–5, with 0 being no disease and 5 being high. Disease severity was determined by the following the protocol.

One hundred plants were collected at random from each of the treated and checked areas. Each plant was then rated for the presence of *Sclerotinia sclerotiorum* stem rot:

- 0 = No symptoms
- 1 = Infection of pods only
- 2 = Lesions situated on main stem or branches, with potential to affect up to ¼ of seed formation and filling on plant
- 3 = Lesions situated on main stem or branches, with potential to affect up to ½ of seed formation and filling on plant
- 4 = Lesions situated on main stem or branches, with potential to affect up to ¾ of seed formation and filling on plant
- 5 = Main stem lesion with potential to affect seed formation and filling of entire plant

Kutcher, H.R and T.M. Wolf. 2006. Low-drift fungicide application technology for *Scleortinia* stem rot control in canola. *Crop Protection* 25:7, 640-646.

The severity rating was calculated using the following equation:

$$\frac{\text{Sum of the rating of all infected plants}}{\text{The number of infected plants}} = \text{Disease severity}$$

Table 3. Disease Severity at the Riverhurst Demonstration Site

Treatment	Disease Incidence	Disease Severity
Proline	36%	1.97
Vertisan	32%	2.09
1st app Proline & 2nd app Proline	24%	1.95
1st app Proline & 2nd app Vertisan	20%	2.05

Table 4. Disease Severity at the Moon Lake Demonstration Site

Treatment	Disease Incidence	Disease Severity
Untreated	28%	2.14
Proline	22%	2.10
1st app Proline & 2nd app Astound	18%	1.95

In all cases where a second fungicide was applied, disease incidence was lower. At the Riverhurst site the treatment of two fungicides with different modes of action had the lowest incidence. Disease severity was very low through all treatments.

At the Moon Lake demonstration site, the treatment with two fungicide applications had the lowest disease incidence and severity, followed by the single application treatment and the untreated.

Harvest

The Riverhurst site was harvested on August 29 and the Moon Lake site was harvested on September 23. A sample was taken from each treatment and measured for yield and TKW. See Tables 5 and 6 for harvest results.

Table 5. Harvest Results from the Riverhurst Demonstration Site

Treatment	Yield	Yield as % Proline	TKW
Proline	67.3 bu./acre	100	6.9 g
Vertisan	73.1 bu./acre	109	7.1 g
1st app Proline & 2nd app Proline	67.1 bu./acre	100	6.9 g
1st app Proline & 2nd app Vertisan	77.9 bu./acre	116	7.4 g

Table 6. Harvest Results from the Moon Lake Demonstration Site

Treatment	Yield	Yield as % check	TKW
Untreated	51.1 bu./acre	100	7.3 g
Proline	54.8 bu./acre	106	7.1 g
1st app Proline & 2nd app Astound	62.6 bu./acre	123	7.2 g

At the Riverhurst site the area treated with Proline and followed by Vertisan had the highest yield and TKW. The area treated with one application of Vertisan had the second highest yield and TKW. The areas treated with a single and double application of Proline had similar yields and TKWs.

At the Moon Lake site, the area treated with two fungicides had the highest yield, followed by the single application treatment and the untreated area. The TKWs were similar between treated and untreated areas.

Final Discussion

Canola yield losses due to *Sclerotinia sclerotiorum* vary from year to year, as the disease is greatly influenced by weather. However, *Sclerotinia sclerotiorum* is a perennial problem in irrigated canola because watering events create a moist environment that is favorable to disease infection. Fungicide application can reduce disease infection and protect against yield loss.

This project built based on a similar ICDC demonstration carried out in 2011, where one application of fungicide increased yield by 5 bu./acre, and two applications of fungicide increased yield by 15 bu./acre.

At Riverhurst the treatment that used two different fungicides to control *Sclerotinia sclerotiorum* had the highest yield. The area treated with a single application of fungicide with group 7 mode of action yielded the second highest yield, followed by the areas treated with one and two applications of a fungicide with a group 3 mode of action.

Fungal pathogen populations naturally contain strains that are insensitive or resistant to certain fungicide modes of action. Overuse of a mode of action can lead to increased populations of the insensitive strain. This can cause a gradual loss of disease control with that group of fungicides. The group 3 mode of action is the most commonly used mode in North America. This project demonstrates that alternating modes of action with a fungicide rotation can provide an improved level of disease control.

The disease incidence and severity did not correlate with the yield results at this site. Both treatments that had two application of fungicide had lower disease incidence than those with just one.

At the Moon Lake site, the area treated with two fungicides had the highest yield and lowest disease incidence and severity. The area treated with one fungicide had a higher yield and lower disease incidence and severity when compared to the untreated area.

Acknowledgements

The project lead would like to thank the following contributors:

- Bayer CropScience – For donating the fungicide Proline.
- DuPont – For donating the fungicide Vertisan.
- Syngenta – For donating the fungicide Astound.

Fungicide Application at Herbicide Timing Demonstration*

Project Lead

- Rory Cranston, PAg, Regional Crop Specialist, Saskatchewan Agriculture

Co-operators

- Ryan Miner, Riverhurst Irrigation District, Riverhurst, SK

Project Objective

The purpose of this project was to demonstrate the efficacy of applying fungicide at herbicide timing to control diseases in high yielding wheat under high-management irrigation conditions.

Project Plan

This project demonstrated three different fungicides applied at herbicide timing to control early disease infection of irrigated wheat. The three fungicides demonstrated were Quilt, Tilt, and TwinLine. The co-operating producer was provided with sufficient chemical for application of a 40-acre treatment of each fungicide. On June 12, each chemical was applied to a field of irrigated soft white wheat; a check strip was left for comparison. The crop was monitored for disease development throughout the season. Yield and thousand kernel weight (TKW) were measured at the end of the season and used to determine the efficacy of the treatments.

Demonstration Site

The site is located at NW 36-22-7 W3M in the Riverhurst Irrigation District and was under a 134-acre low pressure pivot. This field was first irrigated in 2011. The soil texture is a sandy clay loam, and the field was planted to canola the previous year.

Crop Management

AC Andrew soft white spring wheat was seeded on May 2. Establishment was very good. See Table 1 for agronomic management of the site.

Irrigation

Soil moisture was monitored throughout the year using Watermark™ sensors, the feel method, and gravimetric analysis. Watermark™ sensors were installed at 12- and 24-inch depths. Rainfall and irrigation were recorded using rain gauges and a WeatherBug station in the area. Timely rains in the spring, as well as irrigation in late June, July, and August, kept the soil moisture level above 60% of

* Project 2013-04

field capacity. Irrigation was discontinued in early August to prevent lodging and to allow the crop to mature. As a result, soil moisture dropped to below 50% of field capacity by the end of August.

Table 1. Agronomic Management of the Riverhurst Demonstration Site

Nutrients (0-12")	**N**	**P**	**K**
Soil residual	30 lb./acre	20 lb./acre	>800 lb./acre
Applied	125 lb./acre	P_2O_5 at 30 lb./acre	N/A
Variety	AC Andrew		
Seeding	May 2, 120 lb./acre		
Herbicide	Heat 10.4 g/acre and Glyphosate 1 L/acre Preseed		
	Barricade 12 g/acre and Traxos 0.5 L/acre in crop		
Fungicide	Quilt, 200 ml/acre, June 12		
	Tilt, 100 ml/acre, June 12		
	TwinLine, 150 ml/acre, June 12		
	Prosaro, 324 ml/acre, July 15		
Available Moisture from May 1 to September 1			
Irrigation	120 mm (4.8 inches)		
Rainfall	199 mm (8 inches)		
Harvest	September 13		

Fungicide Evaluation

The fungicide treatments were applied on June 12. Throughout the growing season there was no notable difference in leaf disease incidence amongst the treated and untreated areas. However, the area treated with Tilt was more chlorotic than the other areas.

Figure 4. Height differences of plants, from left to right: untreated, Tilt, Quilt, TwinLine.

Plants randomly sampled from each treatment on August 15 demonstrated a height difference between the treatments. The untreated plants were tallest, plants from the areas treated with Tilt and Quilt were about one to two inches shorter, and the plants from the area treated with TwinLine were about two to three inches shorter. See Figure 1.

Harvest

The crop was harvested on September 13. A sample was taken from each treatment and measured for yield and TKW. See Table 2 for full harvest results. The area treated with TwinLine had the highest average yield and thousand kernel weight, followed by the area treated with Quilt, the untreated area, and the area treated with Tilt.

Table 2. Harvest Results for the Riverhurst Site

Treatment	Yield	Yield as % Untreated	TKW
Untreated	105.0 bu./acre	100	41.9g
Tilt	99.5 bu./acre	95	41.8g
Quilt	106.6 bu./acre	102	42.8g
TwinLine	110.0 bu./acre	105	43.5g

Final Discussion

The goal of applying a fungicide at herbicide timing is to prevent early infection from cereal leaf disease. Once a leaf disease infects a plant, there is no practice or chemicals to cure it. All available fungicides for controlling cereal leaf disease will only prevent an infection.

Cereal leaf diseases thrive in warm, moist conditions. In this demonstration the environmental conditions at herbicide spraying time and most of June and July were cool and dry, conditions that are not favorable to disease development. Under these conditions there was no notable difference in cereal leaf disease incidence between the treated and untreated areas.

Height differences were observed in the plant samples taken near the end of the growing season. The plants from the area treated with TwinLine were the shortest, followed by the plants taken from the Quilt and Tilt treatment areas. Plants taken from the untreated area were the tallest. A taller cereal plant stand can be prone to lodging. This project demonstrated that an application of these chemicals can potentially reduce the height of the plant stand. A follow-up project should be initiated to verify the observations in this demonstration.

The area treated with TwinLine had the highest average yield and TKW, followed by the area treated with Quilt, the untreated area, and the area treated with Tilt. Yields of all treatments were within 5 per cent of the untreated area. The cool, dry weather did not provide an environment favorable to disease development and as a result, the untreated check yield was similar to the treated areas.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- BASF – For donating the fungicide TwinLine.
- Syngenta – For donating the fungicides Quilt and Tilt.

Demonstration of Plant Growth Regulator Application in Irrigated Cereal Production*

Project Lead

- Rory Cranston, PAg, Regional Crop Specialist, Saskatchewan Agriculture

Co-operators

- Craig Millar, Luck Lake Irrigation District, Birsay, SK

Project Objective

The purpose of this project was to demonstrate to irrigators the effects of a plant growth regulator on irrigated cereals.

Project Plan

This project demonstrated the use of a plant growth regulator in an irrigated cereal crop to reduce the height of the crop and to prevent lodging. On June 24, a 14-acre area of irrigated hard red spring wheat was treated with a plant growth regulator called Manipulator. The rest of the field was untreated and used for comparison. The field was monitored for height and lodging differences throughout the growing season. Yield, thousand kernel weight (TKW), and grade were used to determine the efficacy of the treatments.

Demonstration Site

The site is located at SW 27-24-8 W3M in the Luck Lake Irrigation District and was under a 114-acre high pressure pivot. This field has been irrigated since 2009. The soil texture is clay, and the field was planted to canola the previous year.

Crop Management

Unity VB hard red spring wheat was seeded on May 27. Establishment was very good. See Table 1 for agronomic management of the site.

Irrigation

Soil moisture was monitored throughout the year using the feel method and gravimetric analysis. Rainfall and irrigation were recorded using rain gauges and a WeatherBug station in the area. The heavy soil was saturated at the beginning of the season. Timely spring rains and irrigation in July and August kept the soil moisture level above 50 per cent of field capacity. Irrigation was discontinued in early August to prevent lodging.

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* Project 2013-05

Table 1. Agronomic Management of the Luck Lake Demonstration Site

Nutrients (0–12”)	**N**	**P**	**K**
Soil residual	30 lb./acre	20 lb./acre	>800 lb./acre
Applied	100 lb./acre	50 lb./acre of P_2O_5	N/A
Variety	Unity VB		
Seeding	May 27, 2013, 120 lb./acre		
Herbicide	Glyphosate 0.8 L/acre preseed		
	Dyvel 0.51 L/acre and NextStep NG 376 ml/acre June 24		
Fungicide	Proline 168 ml/acre July 19		
Plant Growth Regulator	Manipulator 0.7 L/acre June 24		
Available Moisture from May 1 to September 1			
Irrigation	80 mm (3.1 inches)		
Rainfall	199 mm (8 inches)		
Harvest	October 9		

Plant Growth Regulator Evaluation

The plant growth regulator was applied on June 24. Throughout the season samples taken from the treated area were noticeably shorter than samples taken from the untreated area, see Figures 1 and 2. At the end of the season, plant height was measured in both areas. The height of the crop in the untreated area was 110.2 cm. The height of the crop in the treated area was 97.2 cm. The area treated with a plant growth regulator had a reduced height of 13 cm, or 12%. The co-operating producer also noted that the untreated area looked like it was going to lodge during the growing season, while the treated area did not. Irrigation was discontinued in early August to prevent lodging in the untreated area. If lodging had not been an issue, the co-operator would have irrigated for a longer period and would have potentially achieved a higher yield.

Harvest

The crop was harvested on September 13. A sample was taken from the treated and untreated areas and measured for yield, protein, and TKW. Full harvest results can be seen in Table 2. The area treated with a plant growth regulator had a higher yield and TKW than the untreated area.

Table 2. Harvest Results from the Luck Lake Demonstration Site

Treatment	Yield	Yield as % of Untreated	TKW	Protein
Untreated	62.5 bu./acre	100	35.5 g	13.5%
Treated with a PGR	72.0 bu./acre	115	37.3g	13.5%

Figure 1. Plant samples taken on July 19. Left: Treated with PGR. Right: Untreated.

Figure 2. Plant samples taken on August 14. Left: Treated with PGR. Right: Untreated.

Final Discussion

Lodging is a major issue that irrigators must consider and deal with when irrigating wheat. If a crop lodges, it becomes much harder to harvest and there is potential for yield loss. A plant growth regulator has the potential to shorten the crop and as a result reduces the chance that the crop will lodge. If the crop is less prone to lodging, irrigators may increase inputs and potentially increase yield.

In this demonstration, an application of a plant growth regulator to an irrigated wheat crop shortened the height by 13 cm, or 12%. The treated area also had a higher yield and TKW.

ICDC will continue to investigate and demonstrate plant growth regulator use in irrigated production conditions.

Acknowledgements

The project lead would like to acknowledge the following contributor:

- Engage Agro – for donating the plant growth regulator, Manipulator.

Seed Placed Potash on Durum*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-Investigators

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Gary Ewen, Riverhurst Irrigation District, Riverhurst, SK

Project Objective

The objective of this study was to demonstrate the yield and standability benefits of seed-placed potash on irrigated durum production.

Demonstration Plan

Application of potash fertilizer was planned to occur at the time of seeding at a rate of 10 lb./acre on approximately 100 acres of the 130 acre centre pivot. Samples for tissue tests were planned to be taken at early boot to determine plant uptake. Harvest yield and standability was to be documented.

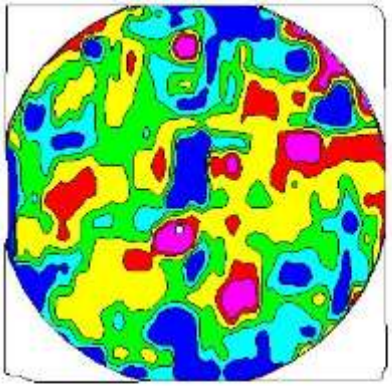
Demonstration Site

The demonstration site, NE 22-22-7-W3, is a 130-acre field with a centre pivot located in the Riverhurst Irrigation District. The field was seeded to dry beans in 2012.

Project Methods and Observations

The durum variety, Brigade, was seeded May 11 at 120 lb./acre. Variable rate nitrogen and phosphorus recommendations were provided by Farmers Edge (Figure 1). Nitrogen fertilizer was applied as 46-0-0 at rates ranging from 100 to 146 lb./acre. Phosphate fertilizer was applied as 11-52-0 at rates ranging from 25 to 40 lb./acre. Potash fertilizer was applied as 0-0-62 at a rate of 10 lb./acre. Plant tissue samples were taken at the early boot stage on July 16 and submitted for analysis to indicate the relative nutrient status on both the seed-placed potash and check plot areas (Table 1). Yield was reported through a yield map and standability reported from the producer (Figure 2).

* Staff Project



Zone	Yield Target	Acres	N	P	K
1	95	4	100	25	10
2	100	12	145	35	10
3	100	38	146	35	10
4	100	34	145	35	10
5	100	25	139	40	10
6	105	18	139	35	10

Figure 1. Farmers Edge variable rate application zone map.

Table 1. Plant Tissue Analysis of Treated, Untreated, and Threshold

Sample	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ppm	Fe ppm	Mn ppm	Zn ppm	B ppm
Durum Treated	3.54	0.30	3.81	0.33	0.27	0.22	8.5	110	47	20	6
Durum Untreated	3.73	0.27	3.57	0.38	0.38	0.25	7.6	109	47	23	9
Threshold	2.0	0.25	2.0	0.15	0.2	0.15	4.5	40	20	15	5

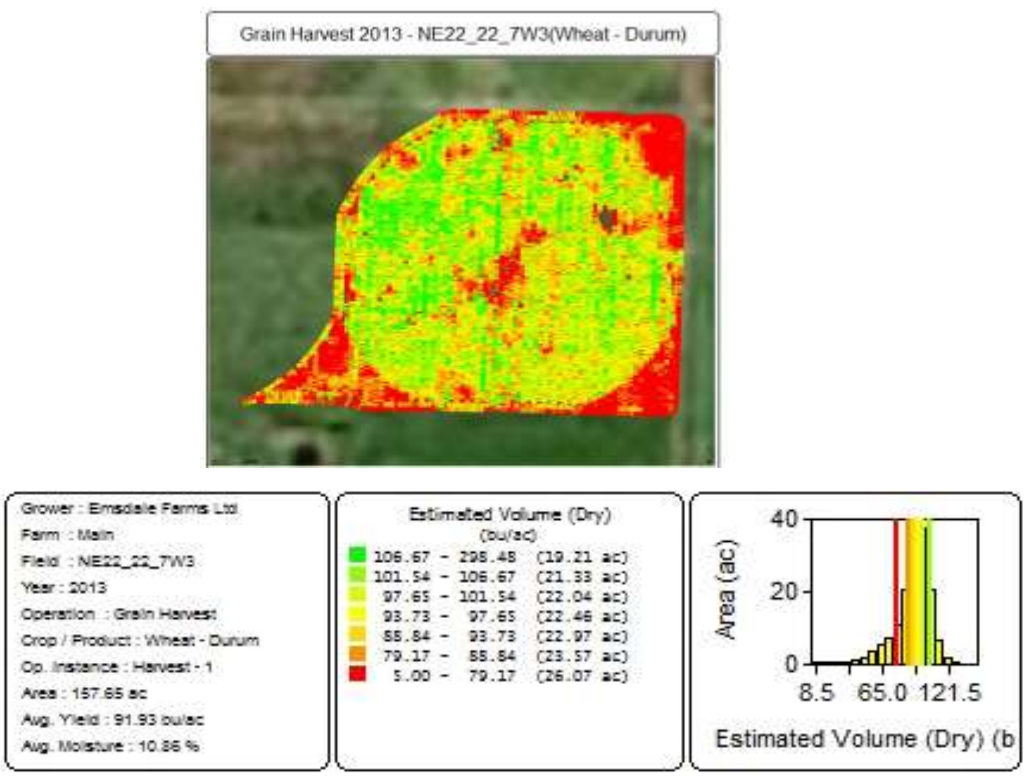


Figure 2. Farmers Edge yield map.

Final Discussion

The tissue sample analysis in Table 1 shows that seed placed potash increased plant tissue potassium levels. Based on the yield map, the seed placed potash treatment did not have any effect on durum yield. Producer observations indicated there was no difference in standability. Based on this demonstration there appears to be no benefit to seed placed potash.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Farmers Edge – for yield map and variable rate application zone map.

Relationship between GPS collected Grain Yield and EM38 Salinity Mapping*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Gary Ewen, Riverhurst Irrigation District, Riverhurst SK

Project Objective

The objective of this study was to correlate combine yield maps with EM38 salinity maps.

Project Background

Modern farm equipment is equipped with many electronic devices, such as combine yield monitors. The yield monitor system coupled with data management software can be used by farmers to conduct their own field-scale trials. One such option is the EM38, which is used to measure soil salinity. In this demonstration we attempted to evaluate the impact of salinity on yield by comparing yield monitor and EM38 maps.

Demonstration Plan

The project plan was to use an irrigated parcel of land that had been previously mapped with the EM38. The cooperating producer had the ability to collect yield data. The field was monitored for production issues, such as weeds and disease. It was also monitored for moisture using the Alberta Irrigation Management Model (AIMM). The yield map was correlated with the EM map to determine the extent of productivity differences. A second objective was to compare the current yield map to past yield maps to discover similarities and differences.

Demonstration Site

The demonstration was on a 130-acre centre pivot irrigation field at Riverhurst, (NE11-22-7-W3). Soil texture at this location is silt loam. The cooperator seeded canola into flax stubble. EM work was done in 2009 by the soils unit of the Crops and Irrigation Branch, Saskatchewan Agriculture.

Project Methods and Observations

The demonstration was seeded May 11, to Liberty Link L130 canola. The field was sprayed June 5 with Liberty mixed with 12 gal./acre of water. When the Canola reached 30% bloom (June 29), it was sprayed with Proline to protect against *Sclerotinia sclerotiorum*. The insecticide, Matador, was

* Project 2013-14

also tank mixed at fungicide timing to control cabbage seedpod weevil, as its presence was expected to be well above threshold. The field received approximately 1.8 in. of rainfall and 7.5 in. irrigation during the growing season. The field was swathed on August 15 and harvested on September 2. Yield maps were obtained for the 2013 crop (Figure 1). The maps were studied visually to identify areas of lower yield. Once the problem areas were determined, they were correlated to the EM38 map (Figure 2) obtained from the soils unit at the Crops and Irrigation Branch.

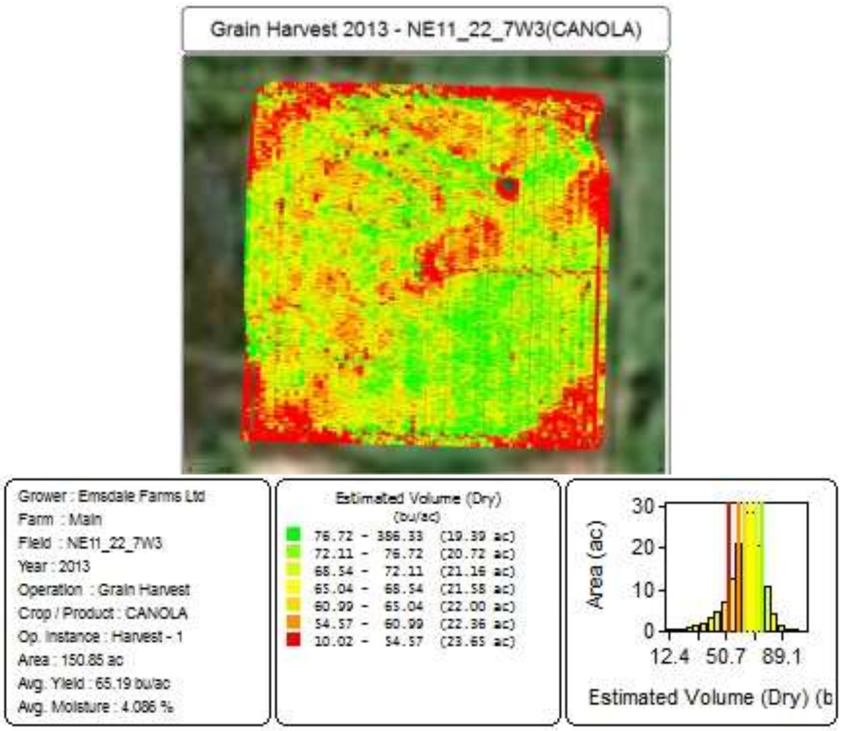
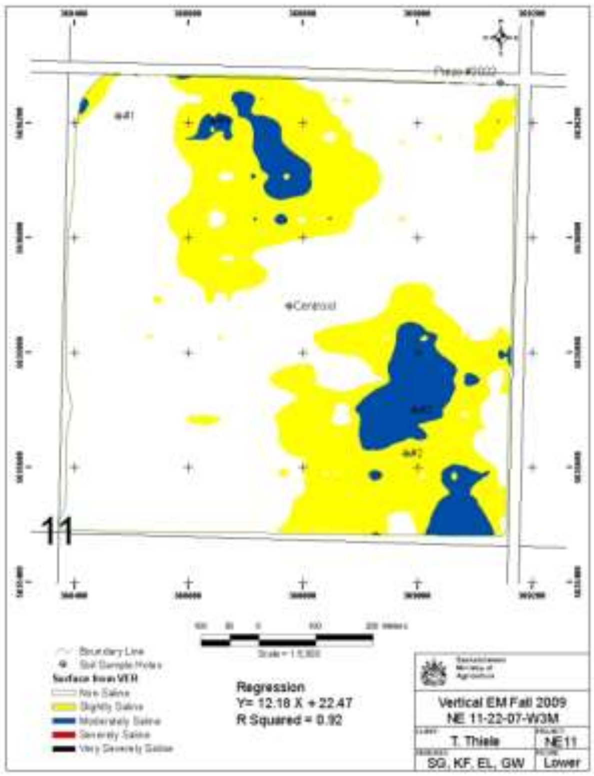


Figure 1. 2013 durum yield map.

Final Discussion

Visually, there is some correlation between the yield maps for 2013 and the EM38 vertical map. Any interpretation must consider the crop, soil texture, and weather conditions of this season. Unfortunately, there was a poor correlation found between the yield maps and the moderate salinity readings from the EM38 maps (Figure 3). This could be due to several factors, including crop tolerance, moisture, and other climatic factors.

This demonstration will be continued in 2014 to further our understanding of the relationship between the maps. Also, it is hoped that new data software will be used to compare the historic yield maps, which will then be correlated with the EM38 map. This will hopefully provide a better understanding of the impact of salinity in the problem areas, and whether it is economically feasible to attempt improvements. It can also prove to be a very useful tool for on-farm research and demonstration.



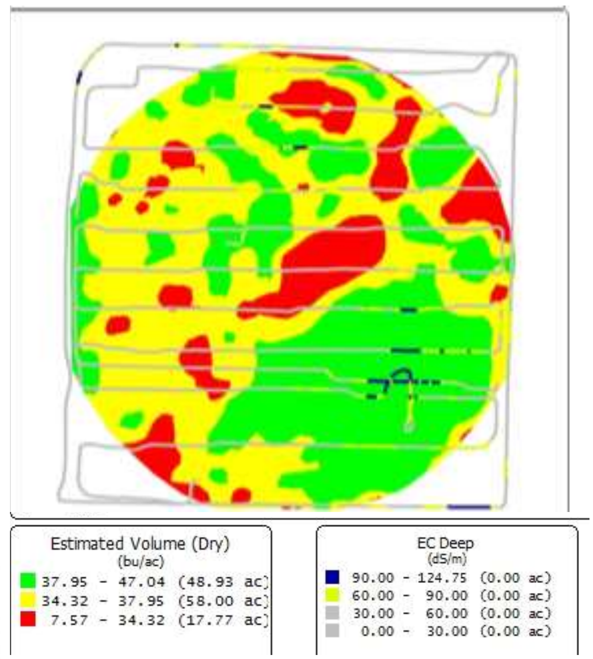


Figure 2. EM38 vertical salinity map.

Figure 3. EM38 vs. Yield correlation map.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Farmers Edge – for yield map analysis and map correlation.
- Government of Saskatchewan Geomatics Services department – for data analysis and correlation.

Crop Varieties for Irrigation – ICDC 2013

Principal Investigators

- Garry Hnatowich, PAg, Research Agronomist, ICDC (Project Lead)
- Harvey Joel, Research Technician, ICDC
- Don David, CSIDC

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 the *Crop Varieties for Irrigation* guide.

Research Plan

The CSIDC locale (on-station and Knapik fields) was used as the test location in 2013 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), oilseeds (canola, flax), pulses (pea, dry bean, faba bean, soybean), and both perennial forage grasses (timothy, meadow bromegrass, hybrid bromegrass, orchardgrass, tall fescue) and perennial forages/legumes (alfalfa, cicer milkvetch, red clover, sainfoin). 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 3).

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 2013.

Results

The 2013 variety trials were established within recommended seeding date guidelines for the selected crops (Table 4). Climatic conditions in the 2013 growing season (May–September) with respect to precipitation and accumulated heat units and Cumulative Corn Heat Units are shown in Tables 1 through 3. Total seasonal precipitation was only 75% of historic recordings; seasonal cumulative growing degree days ended higher than historical.

Table 1. 2013 Growing Season Precipitation vs Long-Term Average

Month	mm (inches)		% of Long-Term
	2013	1981-2010	
May	13.8 (0.6)	45.0 (1.8)	31
June	68.2 (2.7)	63.0 (2.5)	108
July	29.2 (1.1)	55.0 (2.2)	53
August	33.0 (1.3)	42.0 (1.7)	92
September	37.4 (1.5)	36.0 (1.4)	104
Total	181.6 (7.3)	241.0 (9.6)	75

Table 2. 2013 Cumulative Growing Degree Days (Base 0° C) vs Long-Term Average

Month	Year		% of Long-Term
	2013	1981-2010	
May	248	226	110
June	724	710	102
July	1267	1291	98
August	1850	1844	100
September	2317	2058	113

Table 3. 2013 Cumulative Corn Heat Units vs Long-Term Average

Month	Year		% of Long-Term
	2013	1981-2010	
May	275	211	130
June	821	742	111
July	1453	1409	103
August	2108	2024	104
September	2598	2338	111

Early Season Trial Establishment

In general, early season establishment was ideal, with adequate seed bed moisture and soils that were warming quickly. Plant establishment of all crops was generally excellent, particularly cereals and canola. Flax and field pea regional variety trial seedling establishment and growth in certain areas of the trials were adversely influenced by salinity.

Midseason to Harvest

In general for all crops, vegetative growth development was excellent. Heavy vegetative growth in cereals and canola resulted in above typical lodging for some varieties. Very high yield potentials were confirmed and established through the month of July. July was very dry and normal in temperature, moisture when required was provided by irrigation. However, the weather was not conducive to foliar disease. Cereals did indicate some foliar leaf disease, but flag leaves were protected by fungicide applications. Oilseed crops were relatively disease free. Further, no insect pests appeared in any magnitude to be of concern.

Late season anthracnose did appear in dry bean trials at both CSIDC and the off-Station site and likely did influence seed yield.

Harvest was excellent, slowed only by the amount of grain being combined.

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 2014 Crop Production Show. It will be mailed to all irrigators early in 2014.

A list of projects conducted in 2013 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. 2013 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	
Cereal Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
1. Irrigated Wheat Regional	28 each location	ICDC	CSIDC - main CSIDC - off station
2. SVPG CWRS (Hex1) Wheat Regional	29	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG	CSIDC - main CSIDC - off station
3. SVPG High Yield (Hex2) Wheat Regional	20	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG	CSIDC - main
4. SVPG CWAD Wheat Regional	10	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG	CSIDC - main
5. Soft White Spring Wheat Coop	16	Dr. H. Randhawa, AAFC	CSIDC - main
6. SVPG Barley Regional (2-row & 6-row)	18 2-row 4 6-row	Dr. A. Beattie, CDC M. Japp, SMA S. Piche, SVPG	CSIDC - main

Cereal Trials *(continued)*	Varieties/Entries Evaluated	Collaborators	Location
7. ICDC Hybrid Silage Corn Performance Trials	12 irrigated 12 dry land	S. Sommerfeld, SMA	CSIDC - main
8. Soft White Wheat Seeding Rate Trial	5 seeding rates	ICDC	CSIDC - main
Oilseed Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
9. ICDC Irrigated Canola Evaluation Trial	22 each location	ICDC	CSIDC - main CSIDC - off station
10. Canola Coop (XNL1 & XNL2)	47	R. Gadoua, CCC	CSIDC - main
11. Canola Performance Trial	26	Dr. R. Gjuric, Halpotech	CSIDC - main
12. Canola Seeding Rate Trial	2 hybrids 7 seeding rates	ICDC	CSIDC - main
13. Flax Regional Trial	9 each location	ICDC	CSIDC - main CSIDC - off station
Pulse Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
14. Dry Bean Narrow Row Regional (Saskatchewan)	20 each location	Dr. K. Bett, CDC & ICDC	CSIDC - main CSIDC - off station
15. Irrigated Prairie Regional Variety Trial	26 each location	Dr. T. Warkentin, CDC & ICDC	CSIDC - main CSIDC - off station
16. Northstar Genetics Soybean Variety Trial	10	Northstar Genetics & ICDC	CSIDC - main
Perennial Forage Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
17. Timothy	3	Dr. B. Coulman, U of S T. Nelson, AAFC ICDC	CSIDC - main
18. Meadow Bromegrass	2		
19. Hybrid Bromegrass	2		
20. Orchardgrass	3		
21. Tall Fescue	3		
22. Alfalfa	9		
23. Cicer Milkvetch	4		
24. RedClover	2		
25. Sainfoin	4		

Abbreviations

AAFC = Agriculture and AgriFood Canada

ACC = Alberta Corn Committee

CCC = Canola Council of Canada

CDC = Crop Development Centre, U of S

CSIDC = Canada-Saskatchewan Irrigation Diversification Centre

ICDC = Irrigation Crop Diversification Corporation

SMA = Saskatchewan Ministry of Agriculture

SVPG = Saskatchewan Variety Performance Group

MAFRI = Manitoba Agriculture, Food and Rural Initiatives

U of S = University of Saskatchewan

Irrigated Canola Seeding Rate Trial 2013

Project Investigators

- Garry Hnatowich, PAg, Research Agronomist, ICDC (Project Lead)
- Harvey Joel, Research Technician, ICDC
- Don David, CSIDC

Project Objective

The objective was to determine the appropriate seeding rates for canola under irrigation production.

Project Plan

This study was initiated to evaluate the agronomic implications of seeding canola at rates both below and above present suggested seeding rates for irrigation production. Present guidelines for canola suggest a target population of 110 plants per square meter (plants/m^2). Two canola hybrids, 45H21 and 5440, where evaluated within the trial. The trial was seeded at rates of 50, 75, 100, 150, 200, and 300 plants/m^2.

Demonstration Site

This project was located at CSIDC to limit field and equipment variation and to allow for greater ease of management. CSIDC staff assisted ICDC staff in seeding of the trial, pesticide and irrigation applications, and collection of harvest data. Soils on the project site are classified as a very fine sandy loam to a loam.

Project Methods and Observations

Establishment and Crop Management

The seeding rate for each treatment was calculated using the formula:

Seeding rate (kg/ha) = Target plant density/m^2 x TKW (g) ÷ Seedling survival (in decimal form, ex. 0.90) ÷ 100

Where TKW = thousand kernel weight

Seeding rate (lb./acre) = Seeding rate (kg/ha) x 1.121

Pioneer Roundup Ready canola variety 45H21 and Bayer InVigor 5440 were chosen for the test. The TKW of 45H21 was 4.9 g; 5440 weighed 5.2 g. Seedling germination and survival was estimated to be 90%. The seeding rate of each treatment is shown in Table 1.

The trial was seeded on May 18 at a 1.3 cm seeding depth. Plot size was 1.5 m by 4.0 m with 25 cm row spacing. Seed was treated with Helix XTra. Soil testing indicated residual available levels of NO_3-N = 161 lb. $acre^{-1}$ (0-24”); P = 57 lb. $acre^{-1}$ (0-6”); K = 336 lb. $acre^{-1}$ (0-6”); and SO_4-S $\geq$ 192 lb.

acre^{-1} (0-24”). All plots received a sideband application of 55 kg N/ha (50 lbs. N/acre) and 20 kg P_2O_5/ha at seeding. Plots were maintained weed free with chemical herbicide applications and hand weeding. Proline fungicide was applied on July 8. Irrigation was provided throughout the growing season.

Table 1. Plant Density Treatments and Seeding Rates

Seeding Rate (plants/m^2)	45H21 Seeding Rate kg/ha (lb./acre)	5440 Seeding Rate kg/ha (lb./acre)
50	2.7 (3.0)	2.9 (3.2)
75	4.0 (4.5)	4.3 (4.9)
100	5.4 (6.1)	5.8 (6.5)
150	8.2 (9.2)	8.7 (9.7)
200	10.9 (12.2)	11.6 (13.0)
250	13.6 (15.3)	14.4 (16.2)
300	16.3 (18.3)	17.3 (19.4)

Harvest

Plots were swathed on August 28 and harvested September 6 by ICDC and CSIDC staff.

Table 2. Yield Data, 2013

Treatment	Yield (kg/ha)	Yield (bu./acre)	Oil (%)	Test Weight (gm/hl)	TKW (gm)	Height (cm)	Lodging (1-5)
Hybrid							
45H21	5475	97.7	45.7	68.5	5.8	124.0	2.1
5440	6724	119.9	45.6	69.3	6.0	134.0	1.1
LSD (0.05)	333	6.1	NS	0.2	NS	5.8	0.4
CV (%)	7.8	7.8	1.3	0.7	3.7	3.7	29.5
Seeding Rate (plants/m^2)							
50	5193	92.6	46.0	68.9	6.0	130.0	1.3
75	5886	105.0	46.2	69.0	5.8	129.0	1.4
100	6151	109.8	46.0	69.1	5.9	129.0	1.4
150	6326	112.9	46.0	68.7	5.8	131.0	1.6
200	6313	112.6	45.2	68.8	5.9	128.0	1.6
250	6533	116.6	45.3	68.7	5.9	129.0	1.8
300	6295	112.3	45.0	68.9	5.9	128.0	2.1
LSD (0.05)	485	8.6	NS	NS	NS	NS	0.5
Hybrid x Seeding Rate Interaction							
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS

NS = not significant

Note on Harvest Data Values and Statistical Analysis

Values listed for each variety are the means obtained from combining all seed rate observations. For example, the yield of 97.7 bu./acre for 45H21 is the overall average obtained by combining all yields at each seeding rate of 45H21. Likewise, the mean yield of 109.8 bu./acre for the 100 seeds/m^2 seeding rate is the average of both 45H21 and 5440 yields harvested at this seeding rate. Data for each variety at each seeding rate is not shown; however, the "Hybrid x Seeding Rate Interaction" is provided at the bottom of Table 2. All measured observations (yield, oil, etc.) are statistically not significant (NS). This means, for example in terms of yield, that both varieties responded in a similar manner to increased seeding rates. Least Significant Difference (LSD) denotes the numerical difference required between treatments to be statistically significant. If the difference between seeding rates exceeds 8.6 bu./acre, the seeding rates are significantly different from each other. The Coefficient of Variation (CV) is a numerical value describing the amount of variation between and within treatments; the higher the CV, the less confidence is associated with the reliability of the results to be reproduced in future identical experiments. Generally, CV values less than 15 are deemed acceptable; exceptions to this are measurements that are evaluated subjectively. For example, in rating an agronomic parameter such as lodging, values recorded for each treatment are based on the judgment of the researcher. As such, higher CV values are commonly associated with subjective measurements.

Discussion

Mean yields of hybrids and seeding rates are summarized in Table 2. Overall yields of hybrids at all seeding rates were very high. Mean yield of hybrid 5440 was significantly greater (23% higher yield) than that of 45H21. This wide gap in yield between the two hybrids differs significantly from the 13% yield advantage listed in *Crop Varieties for Irrigation*. Hybrid 5440 did seem to have more vigorous growth during early season seedling growth.

As the seeding rate increased, so did yield, up to the 100 plants/m^2 treatment; no statistical yield benefit was observed when seeding rates were above this treatment. Present recommendations suggest that producers target a plant density of 110 seeds/m^2. The effect of seeding rates on the yield of each hybrid was statistically not significant, meaning that both responded in a similar manner with respect to yield relative to increasing seeding rates. This relationship is illustrated in Figure 1. Though not statistically significant, the yield of 45H21 appears to maximize at about 200 seeds/m^2, while that of the higher yielding 5440 maximizes at the 250 seeds/m^2 rate. The vertical bar on the graph indicates the recommended seeding rate of 110 seeds/m^2. Yield results of this season's trial suggest the present recommendation is likely inadequate for achieving optimal canola yield.

No differences occurred between 45H21 and 5440 with respect to per cent oil and thousand kernel weight (TKW). The 5440 hybrid had significantly higher test weight and was significantly taller than 45H21. No significant differences occurred between hybrids with respect to days to flower and maturity (data not shown). Hybrid 45H21 had a significantly higher degree of lodging compared to 5440.

Seeding rate had an effect only on yield and lodging. As the seed rate increased beyond 100 seeds/m^2, lodging also increased.

Statistical analysis indicates that both hybrids responded similarly to seeding rates with respect to all agronomic parameters measured.

This trial has been conducted over three seasons and site years need to be combined. A decision of whether or not to repeat this experiment will be made prior to the 2014 field season.

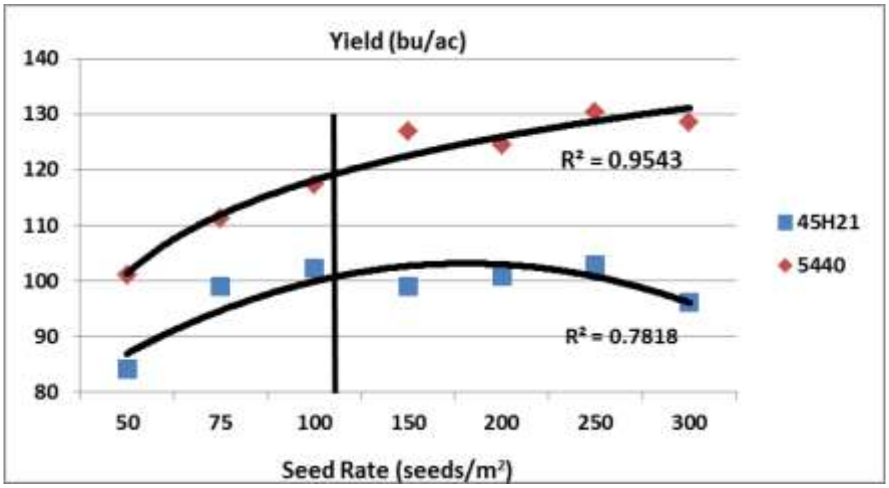


Figure 1. Effect of increasing seeding rates on seed yield of irrigated canola hybrids, 2013.

Irrigated Soft White Wheat Seeding Rate Trial 2013

Project Investigators

- Garry Hnatowich, PAg, Research Agronomist, ICDC (Project Lead)
- Harvey Joel, Research Technician, ICDC
- Don David, CSIDC

Project Objective

The objective was to determine the appropriate seeding rates of soft white wheat under irrigation production.

Project Plan

This study was initiated to evaluate the agronomic implications of seeding durum wheat at rates both below and above present suggested planting rates for irrigation production. Present guidelines for durum suggest a target population of 250 plants per square meter (plants/m^2). The trial was expanded in 2012 to include a soft white wheat variety in addition to the durum wheat. In 2013 the seeding rate investigation of durum was discontinued when it was concluded that present target populations were deemed optimal. Soft white wheat seeding rate was continued in 2013 with seeding rates of 100, 200, 300, 400, and 500 plants/m^2.

Demonstration Site

This project was located at CSIDC to limit field and equipment variation and to allow for greater ease of management. CSIDC staff assisted in the seeding of the trial, pesticide and irrigation applications, and collection of harvest data. Soils on the project site are classified as a very fine sandy loam to a loam.

Project Methods and Observations

Establishment and Crop Management

The seeding rate for each treatment was calculated using the formula:

Seeding rate (kg/ha) = Target plant density/m^2 x TKW (g) ÷ Seedling survival (in decimal form eg. 0.90) ÷ 100

Where TKW = thousand kernel weight

Seeding rate (lb./acre) = Seeding rate (kg/ha) x 1.121

Soft White Wheat variety cv. Sadash was chosen for the test; seed had a thousand kernel weight (TKW) of 34.2 g, seedling survival was estimated to be 90% for each. The seeding rate for each treatment is shown in Table 1.

The trial was seeded on May 16 at a 2.5 cm seeding depth. Plot size was 1.5 m by 4.0 m with 25 cm row spacing. The trial was unfertilized, as the site had been in a green manure field pea rotation for the previous two growing seasons. Soil testing indicated residual available levels of NO_3-N = 256 lb. acre^{-1} (0-24”); P = 57 lb. acre^{-1} (0-6”); K = 301 lb. acre^{-1} (0-6”); and SO_4-S = >192 lb. acre^{-1} (0-24”). Plots were maintained weed free with chemical herbicide applications and hand weeding. Fungicide applications of Headline and Proline were applied on June 26 and July 8, respectively. Irrigation was provided throughout the growing season.

Harvest

Plots were harvested on September 16 by ICDC and CSIDC staff. Yield and other agronomic-determined parameters are summarized in Table 2.

Table 1. Plant Density Treatments and Seeding Rates, 2013

Seeding Rate (plants/m^2)	Sadash Seeding Rate kg/ha (lb./acre)
100	38 (42.5)
200	76 (85.0)
300	114 (128)
400	152 (170)
500	190 (213)

Table 2. Harvest Data, 2013

Seeding Rate	Yield (kg/ha)	Yield (bu./acre)	Protein (%)	Test Weight (gm/hl)	TKW (gm)	Maturity (days)	Plant Height (cm)	Lodging (1-9)
100 seed/m^2	8103	120.5	12.0	80.8	45.8	107.0	91.0	1.0
200 seed/m^2	9439	140.3	11.9	80.8	45.0	106.0	94.0	1.0
300 seed/m^2	9639	143.3	12.0	80.9	43.9	105.0	95.0	1.0
400 seed/m^2	9801	145.7	12.1	80.3	43.5	106.0	97.0	1.3
500 seed/m^2	9978	148.3	12.1	80.6	42.9	104.0	95.0	2.5
LSD (0.05)	676	10.1	NS	NS	0.9	0.5	1.7	0.7
CV (%)	6.0	6.0	1.0	0.5	1.8	0.4	1.5	42.0

NS = Not Significant

Note on Harvest Data Values and Statistical Analysis

Least Significant Difference (LSD) denotes the numerical difference required between treatments to be statistically significant. In the Yield (bu./acre) column, if the difference between seeding rates exceeds 10.1 bu./acre, the seeding rates are significantly different from each other. The Coefficient of Variation (CV) is a numerical value describing the amount of variation between and within treatments; the higher the CV, the less confidence is associated with the reliability of the results to be reproduced in future identical experiments. In general, CV values less than 15 are deemed acceptable; exceptions to this are measurements that are evaluated subjectively. For example, in rating an agronomic parameter such as lodging, values recorded for each treatment are based on the judgment of the researcher. As such, higher CV values are commonly associated with subjective measurements.

Discussion

The mean yield statistically increased with the first incremental seed rate (i.e., as the seeding rate increased from 100 to 200 seeds/m^2). There was no statistical difference between the 200 and 500 seed/m^2 seeding rate, although numerical yields continued to rise to the 500 seeds/m^2 rate. This is illustrated in Figure 1. Present recommendations suggest that producers target a plant density of 250 plants/m^2, as illustrated by the vertical line positioned at 250 seeds/m^2 in Figure 1. With the seed size of the planted Sadash in 2013, this would correspond to a seeding rate of 95 kg/ha or 107 lb./acre.

Increased seeding rates had no impact on protein content, which was considered unusual due to the inverse relationship between yield and protein. As yield increases, protein decreases. This lack of influence on protein suggests that the very high residual soil nitrogen was sufficient to obtain a high yield and maintain protein levels. Seeding rate also had no influence on test weight. TKW and maturity decreased as seeding rates increased, while plant height increased. Seeding rate resulted in increased lodging only at the two highest seeding rates, as illustrated in Figure 2. Even at the highest seeding rate, the degree of lodging would not result in harvest management difficulty.

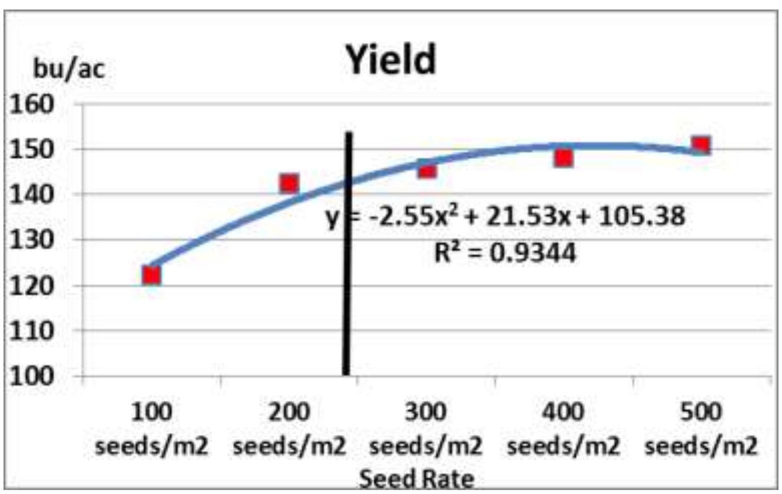


Figure 1. Effect of seeding rates on yield of irrigated Sadash Soft White Wheat, 2013.

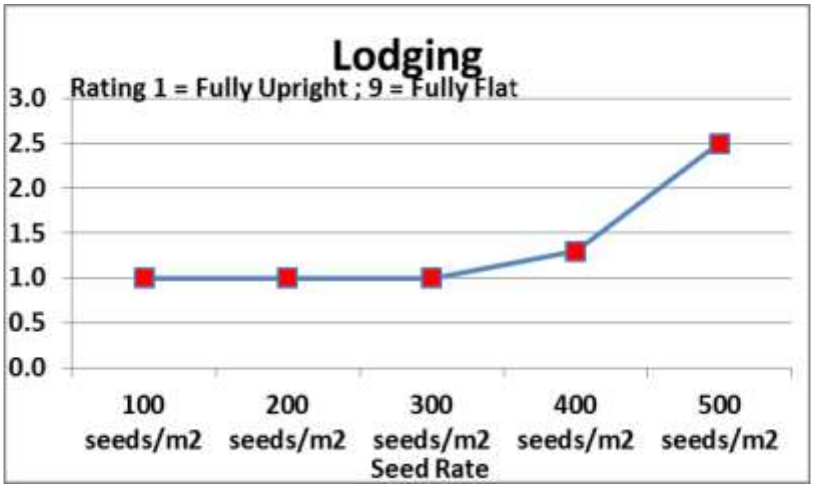


Figure 2. Effect of seeding rates on lodging of irrigated Sadash Soft White Wheat, 2013.

Future Evaluation

Studies on seeding rates of soft white wheat were conducted in 2011, 2012, and 2013. A review and assessment of these trials will be evaluated in order to determine whether additional trials should be contemplated. Once assessment is complete, an economic analysis should be conducted on the results, if seeding rates above the recommended rate of 250 seeds/m^2 appear beneficial. Economic and risk analysis need to be assessed in consideration of seeding rate. For example, do yield gains obtained by increasing seeding rates warrant the increased delay in refilling seed tanks during planting? Does the risk of possible difficulties in harvesting a wheat crop lodged to a greater degree because of higher seeding rates warrant those seeding rates?

Dryland and Irrigated Lentil Comparison*

Project Lead

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

Co-operator

- CSIDC

Project Objective

The object of this project was to determine the response of red lentil to irrigation.

Demonstration Plan

Two plots of lentil were sown. One was irrigated during the flowering stage to reduce flower drop and pod abortion due to moisture stress. The plants were irrigated to maintain at least 50% of field capacity within the rooting zone.

Demonstration Site

The demonstration was conducted on Field 10 at CSIDC. The soil is sandy loam texture.

Project Methods and Observations

CDC Maxim lentil was sown in two plots on May 27. Weed control consisted of Odyssey and Equinox applied on June 12. The irrigated plot received supplemental water when the moisture status dropped below 50% of field capacity. Irrigation applications consisted of 0.3 in. in June, 1.5 in. in July, and 1.0 in. in August for the irrigated plot, compared to no irrigation for the dryland site. Lance fungicide was applied on July 9. The sites were desiccated on August 29 with Reglone and harvested on September 13.

Table 1. 2012 Growing Season Precipitation at CSIDC

Month	2013 (Irrigation)	1931-2011 Average	% of Long Term
May	14	45	31
June	68 (8)	61	115
July	29 (38)	57	51
August	33 (25)	44	75
Total	144 (71)	207	70

* Project 2012-19

Table 2. Growing Degree Days (Base 0° C) at CSIDC

Month	2013 Monthly	2013 Cumulative	1931-2011 Average	1931-2011 Cumulative Average	% of Monthly GDD
May	248	248	227	227	109
June	476	666	484	711	98
July	543	1286	594	1305	91
August	583	1850	556	1861	105

Table 3. Conventional Soil Analysis of Field 10 (SW15-29-8-W3) at CSIDC in Fall 2012 (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	7.8	
Soil Conductivity (1:2 soil:water) mmhos/cm	0.2	
Organic Matter (%)	2.5	**Rating**
Nitrate-N (0-12") (lb./acre)	31.0	H
Phosphate-P (0-6") (lb./acre)	60.0+	H
Potassium-K (0-6") (lb./acre)	228.0	L
Sulphate-S (0-12")	59.0	H

Fertilizer recommendations for 43 bu were 10 P_20_5/acre and 15 K_20/acre. The actual fertilizer applied was 25 lb. P_20_5/acre and 0 K_20/acre. The micronutrients were not determined for this soil test. No micronutrients were applied for the demonstration.

Table 4 summarizes the lentil seed yield harvested from the demonstration. The data shows a 13% yield response to irrigation of red lentil. The dry fall was an important factor in the successful harvest of this crop.

Table 4. Yield and Grain Quality for 2013 Irrigated Lentil Project

Treatment	Yield (lb./acre)	Thousand Kernel Weight (g/1000 seeds)
Irrigated	2006	27.4
Dryland	1768	27.2

Final Discussion

The response of red lentil to the application of just under 3 in. of irrigation showed a modest increase in yield of 13% (240 lb./acre) in 2013. The demonstration showed that fungicides were effective in maintaining red lentil seed yield under irrigation, with the assistance of a dry fall.

Nitrogen Rate for Irrigated Oats on Terminated Alfalfa*

Project Leads

- Garry Hnatowich, PAg, Research Agronomist, ICDC
- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Barry Vestre, Farm Manager, CSIDC

Project Objective

The objective of this study was to determine adequate N fertilization practices for irrigated oats.

Project Background

When alfalfa is taken out of production on dryland, the major release of nitrogen from crop residue is delayed until the second year. Soil moisture needs recharging before micro-organisms can begin their decomposition work. Irrigation removes variability in the timing of this soil process by supplying the moisture needed by the microbes to transform the nitrogen in the decomposing roots to nutrients that are available to the growing crop in the year of breaking. This demonstration was initiated to better understand the effect of nitrogen dynamics on oat production on alfalfa breaking under irrigation.

Demonstration Plan

The project was established at two sites in 2013 – a first-year breaking, where the alfalfa was terminated with a 2 L/acre application of glyphosate, as well as a second year breaking, where the oats was sown on canola stubble. Two varieties of oats – Triactor, a milling oat variety, and CDC Haymaker, a forage variety – were sown with a zero till drill. At the time of seeding, both varieties were fertilized with N at 0, 25, 50, 75, 100, and 125 lb./acre. The experimental design was a split plot design with varieties as main plots and fertilizer N rates as subplots, randomized and replicated 4 times. Grain yield will indicate the best suited N rate for irrigated oat for this crop rotation. Grain protein content will evaluate the nitrogen impact on grain quality.

Demonstration Site

The demonstration was conducted at the Canada-Saskatchewan Irrigation Diversification Centre on Field 3, for the first year of breaking, and on Field 12, for the second year of breaking. The texture at the site is sandy loam on the surface. A 0–6” soil sample from Field 3 collected October 30, 2012

* Project 2013-08

contained 23 lb./acre NO_3-N; >60 lb./acre P; 345 lb./acre K; and 40 lb./acre SO_4-S. A 0–24" soil sample from Field 12 collected October 31, 2012 contained 30 lb./acre $N0_3$-N and > 192 lb./acre SO_4-S. The 0–6" P and K test levels were 39 lb./acre and 258 lb./ace respectively. Organic matter in the surface sample tested 2.0%.

Project Methods and Observations

The demonstrations were seeded on May 22. The forage yield was determined on August 20 and the grain yield was harvested on September 19. The field received 5.7 in. of rainfall from May to August, 2013.

The difference in yield levels between Field 3 and Field 12 was startling. Field 3 is nonsaline, whereas Field 12 on the salinity map prepared by the Agronomy Unit is moderately saline. The above average rainfall in 2012 contributed to lower salinity levels in the soil for the 2013 year.

Triactor yielded very well on the nonsaline site, with nearly 250 bu./acre of grain and 10 ton/acre of forage. CDC Haymaker yielded slightly less, but this is likely due in part to its slower development relative to Triactor. The harvest of both varieties occurred on the same day due to logistical constraints. Grain and forage yield showed no response to the nitrogen applications on the new alfalfa breaking.

Table 1. Oat N-Fertility Response on 1st Year of Alfalfa Breaking in 2013

Variety	YIELD (kg/ha)	YIELD (bu./acre)	Protein (%)	Test Weight (kg/hl)	TKW (gm)	Height (cm)	Forage Yield (t/acre)
Triactor	9429 a	247.5 a	12.0 b	52.3 a	37.8 b	127.0 b	9.8 a
CDC Haymaker	7028 b	184.4 b	13.4 a	50.8 b	43.3 a	138.0 a	8.8 b
LSD (0.05)	298	7.8	0.5	0.9	2.1	2.1	0.4
N Applied (kg/ha)							
0	8524	223.7	12.5	51.86	40.9	134.0 a	9.1
25	8328	218.6	12.5	51.70	40.4	130.0 b	9.4
50	8006	210.1	12.7	51.51	40.6	134.0 a	9.6
75	8492	222.9	12.8	51.83	40.7	133.0 ab	9.2
100	8235	216.1	12.8	51.14	40.4	135.0 a	9.1
125	7785	204.3	13.0	51.29	40.4	130.0 b	9.4
LSD (0.05)	NS	NS	NS	NS	NS	3.0	NS
Variety x N Applied Interaction							
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS
CV (%)	8.0	8.0	3.6	1.4	2.1	2.2	7.8

[1] Means followed by the same letter are not significantly different at P = 0.05

In contrast, the second year breaking showed yield response in grain and forage up to 25 lb. N/acre. Again, further applications of N did not increase grain or forage yield. Increases in protein content were significant for the second year breaking demonstration.

Table 2. Oat N-Fertility Response on 2nd Year of Alfalfa Breaking in 2013

Variety	YIELD (kg/ha)	YIELD (bu./acre)	Protein (%)	Test Weight (kg/hl)	TKW (gm)	Height (cm)	Forage Yield (t/acre)
Triactor	7137	187	11.7 a	49.7 a	37.7 b	100 b	5.8 a
Haymaker	6275	165	12.0 a	47.9 b	42.3 a	126 a	6.7 a
LSD (0.05)	NS	NS	NS	1.2	2.0	7.9	NS
N Applied (kg/ha)							
0	5961 b	156 b	10.6 d	48.9	40.0	108	5.7 b
25	6890 a	181 a	11.0 d	49.0	40.1	114	6.3 ab
50	6896 a	181 a	11.7 bc	48.5	39.6	115	6.5 ab
75	6875 a	180 a	12.2 ab	48.9	39.5	117	6.9 a
100	6969 a	183 a	12.8 a	48.9	40.4	114	6.0 b
125	6643 a	174 a	12.7 a	48.5	40.4	111	6.2 ab
LSD (0.05)	663	17.4	0.6	NS	NS	NS	0.8
Variety x N Applied Interaction							
LSD (0.05)	NS	NS	NS	NS	NS	NS	ND
CV (%)	9.7	9.7	4.7	1.8	2.7	6.2	ND

[1] Means followed by the same letter are not significantly different at P = 0.05

Final Discussion

Grain yield responses to added nitrogen with oats did not occur on first year breaking alfalfa and were limited to 25 lb. N/acre on second year breaking alfalfa. Forage yields increased with the application of 50 lb. N/acre on first year breaking and 75 lb. N/acre on second year breaking. Nitrate levels were not determined on the forage samples, but based on the protein content in the grain, elevated levels are likely. Samples have been saved from the first year of breaking for future analysis. Growers regularly report elevated levels of nitrate in green feed sown on alfalfa breaking. Growing oats on alfalfa breaking is not likely maximizing economic return on alfalfa stubble.

This work supports the research conclusions determined by Les Henry and others in the early 1980s. Irrigation of alfalfa breaking eliminates the need for supplemental nitrogen on first year breaking.

Foliar Application of Copper for Ergot Control Assessment*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Randy Dahl, South Saskatchewan River Irrigation District, Outlook, SK
- Ryan Grunerud, South Saskatchewan River Irrigation District, Outlook, SK
- David Bagshaw, Luck Lake Irrigation District, Birsay, SK
- Peter Hiebert, Riverhurst Irrigation District, Riverhurst, SK

Project Objective

The objective of this project was to evaluate the copper status of coarser-textured irrigated wheat fields within the Lake Diefenbaker Development Area (LDDA).

Project Background

The irrigation community has experienced variable levels of ergot in wheat fields during recent years. Low copper fertility has contributed to ergot in other regions over the past three decades. Soil testing for copper status is not conclusive because of the wide marginal range of the soil test. A large region of LDDA contains soils with marginal copper soil test levels. This demonstration tested whether foliar copper application at flagleaf will increase grain yield and reduce ergot infection in harvested wheat samples.

Demonstration Plan

The producers applied foliar copper to spring wheat fields at flagleaf stage. This nutrient application was tank mixed with fungicide to save an application pass. Previous experience with this tank mix had caused excessive damage to the flagleaf. To minimize this risk, the rate for the copper foliar treatment was reduced from 1.0 L/acre to 0.5 L/acre. This change in the rate reduced the actual copper applied to 0.065 lb. Cu/acre. This foliar applied rate was one-third the rate used for foliar applications in 1983 field trials. The yield of control and foliar copper treated areas of the wheat fields were determined using the weigh wagon and measuring wheel. Samples of grain were collected from the control and copper treated areas of the wheat field. Ergot infection, grade, protein, and thousand kernel weight (TKW) for the grain samples were reported and the level of copper in the grain was analyzed.

* Project 2013-10

Demonstration Sites

The demonstrations were conducted on five sandy sites located within the LDDA. The sites are listed in Table 1, along with copper soil test levels for a 0–6" depth, ranging between 0.5 to 1.1 lb. Cu/acre.

Table 1. LDDA Sites Selected for Foliar Copper Applied at Flagleaf Stage

Site #	Cooperator	Legal Location	Soil Association	DTPA Ext Cu (lb. Cu/acre)
1	Randy Dahl	NW10-31-7-W3	Asquith sandy loam/fine sandy loam	0.8
2	Ryan Grunerud	SE35-28-8-W3	Dune Sand / loamy sand	0.5
3	David Bagshaw	NE25-24-8-W3	Haverhill loam	1.1
4	Peter Hiebert	NW13-23-7-W3	Birsay loam/fine sandy loam/ Fox Valley loam	1.0
5	Peter Hiebert	SW27-24-5-W3	Birsay loam/fine sandy loam/Dune Sand/ loamy sand	0.6

Project Methods and Observations

The level of DTPA extractable copper was determined on a composite 0–6" soil sample collected from each field. Copper soil test levels varied from 0.5 lb. Cu/acre for a Dune Sand, to 1.1 lb. Cu/acre for a Haverhill loam. Cooperators applied 0.5 L/acre liquid chelated copper fertilizer to wheat at the flagleaf stage. The foliar fertilizer was tank mixed with fungicide to save a pass with the sprayer. At site 5, the copper fertilizer was applied at two timings: 0.5 L/acre Cu chelate tank mixed with herbicide at the four leaf stage, and 0.5 L/acre Cu chelate tank mixed with fungicide at flagleaf stage. At site 3, the Cu chelate was applied separately from the fungicide at three rates: a control, 0.5 L Cu chelate/acre, and 1.0 L Cu chelate/acre. Separating the fungicide and fertilizer still inflicted significant burn to 25% of the flagleaf. At site 2, the fungicide was applied separately as well. Decis insecticide to control grasshoppers was applied with the fungicide about two days following the foliar fertilizer application. Damage to the flagleaf was similar to that found at the Haverhill loam site. The grain yield at each site was compared to a check strip where no copper had been applied. Site 1 was a dryland site in 2013 because power was not supplied to the pivot until the irrigation season had passed.

Table 2. Soil Analysis of Site 1 – Asquith Sandy Loam Site (NW10-31-7-W3) (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	6.7	
Soil Conductivity (1:2 soil:water) mmhos/cm	0.2	
Organic Matter (%)	2.1	**Rating**
Nitrate-N (0-12") (lb./acre)	13.0	L
Phosphate-P (0-6") (lb./acre)	11.0	L
Potassium-K (0-6") (lb./acre)	361.0	M
Sulphate-S (0-12")	10.0	L
Cu (0–6")	0.8	L
Fe (0–6")	60.0	M
Mn (0–6")	33.0	M
Zn (0–6")	1.6	L
B (0–6")	1.3	M

Fertilizer recommendations for 73 bu HRS wheat were 130 lb. N/acre, 35 lb. $P_2 0_5$/acre, 10 lb. $K_2 0$/acre, 15 lb. S/acre, and 3.5 lb. Cu/acre.

Table 3. Soil Analysis of Site 2 – Dune Sand (SE35-28-8-W3) (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	8.0	
Soil Conductivity (1:2 soil:water) mmhos/cm	0.5	
Organic Matter (%)	1.7	**Rating**
Nitrate–N (0–12") (lb./acre)	44.0	M
Phosphate-P (0–6") (lb./acre)	19.0	M
Potassium-K (0–6") (lb./acre)	351.0	L
Sulphate-S (0–12")	49.0	H
Cu (0–6")	0.5	L
Fe (0–6")	24.0	M
Mn (0–6")	9.0	M
Zn (0–6")	2.1	M
B (0–6")	1.7	M

Fertilizer recommendations for 65 bu HRS wheat were 90 lb. N/acre, 35 lb. $P_2 0_5$/acre, 10 lb. $K_2 0$/acre, and 3.5 lb. Cu/acre.

Table 4. Soil Analysis of Site 3 – Haverhill Loam (NE25-24-8-W3) (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	7.3	
Soil Conductivity (1:2 soil:water) mmhos/cm	1.1	
Organic Matter (%)	2.6	**Rating**
Nitrate-N (0-12") (lb./acre)	45.0	M
Phosphate-P (0-6") (lb./acre)	19.0	L
Potassium-K (0-6") (lb./acre)	600.0+	VH
Sulphate-S (0-12")	96.0+	VH
Cu (0-6")	1.1	L
Fe (0-6")	59.0	L
Mn (0-6")	26.0	M
Zn (0-6")	1.6	L
B (0-6")	2.0	H

Fertilizer recommendations for 65 bu HRS wheat were 65 lb. N/acre, 35 lb. $P_2 0_5$/acre, and 3.5 lb. Cu/acre.

Table 5. Soil Analysis of Site 4 - Birsay Fox Valley Sandy Loam (NW13-23-7-W3) (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	7.0	
Soil Conductivity (1:2 soil:water) mmhos/cm	0.2	
Organic Matter (%)	3.0	**Rating**
Nitrate-N (0–12”) (lb./acre)	62.0	L
Phosphate-P (0–6”) (lb./acre)	15.0	L
Potassium-K (0–6”) (lb./acre)	540.0+	L
Sulphate-S (0–12”)	40.0	VH
Cu (0–6”)	1.0	L
Fe (0–6”)	37.0	H
Mn (0–6”)	24.0	M
Zn (0–6”)	1.5	L
B (0–6”)	2.0	H

Fertilizer recommendations for 65 bu HRS wheat were 65 lb. N/acre, 35 lb. P_20_5/acre, and 3.5 lb. Cu/acre.

Table 6. Soil analysis of Site 5 – Birsay Sandy Loam/Dune Sand Loamy Sand (SW27-24-5-W3) (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	8.1	
Soil Conductivity mmhos/cm (1:2 soil:water)	0.2	
Organic Matter (%)	2.5	**Rating**
Nitrate-N (0–12”) (lb./acre)	35.0	L
Phosphate-P (0–6”) (lb./acre)	10.0	L
Potassium-K (0–6”) (lb./acre)	271.0	L
Sulphate-S (0–12”)	35.0	M
Cu (0–6”) lb./acre	0.6	L
Fe (0–6”) lb./acre	18.0	H
Mn (0–6”) lb./acre	8.0	H
Zn (0–6”) lb./acre	4.6	M
B (0–6”) lb./acre	2.0	M

Fertilizer recommendations for 65 bu HRS wheat were 100 lb. N/acre, 45 lb. P_20_5/acre, 15 lb. K_20/acre, and 3.5 lb. Cu/acre.

The plant tissue analysis of whole plant samples collected at flagleaf stage from the control portion of the fields is summarized in Table 7. Two of the sites had marginal levels of plant tissue copper, the Dune Sand site (# 2) and the Birsay Dune Sand site (#5).

Table 7. Plant Analysis of Wheat Grown on Soils Selected for Copper Application

Demo Site	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
NW10-31-7-W3	2.86	0.25	2.5	0.19	0.21	0.17	5.8	84	41	24	4.8
SE35-28-8-W3	3.33	0.24	3.2	0.29	0.27	0.15	4.5	74	35	22	4.5
NE25-24-8-W3	3.26	0.32	3.2	0.31	0.23	0.18	6.0	95	43	19	8.1
NW13-23-7-W3	3.56	0.30	3.0	0.33	0.36	0.24	5.3	93	52	21	7.2
SW27-24-5-W3	3.26	0.24	2.4	0.30	0.33	0.21	4.8	90	44	18	5.3
Threshold	**2.10**	**0.20**	**2.0**	**0.15**	**0.20**	**0.15**	**4.5**	**40**	**20**	**15**	**4.0**

The grain yield and quality of the demonstrations are reported in Tables 7 to 10.

Yield responses to foliar copper were observed at two sites – Site #1 (Table 8) and Site #2 (Table 9). Yield responses were not large, at only 4–6 bu./acre. Note that the yield response to copper did not occur on the eroded site (Site #2). At this location, visual symptoms of potassium deficiency occurred at the 3–4 leaf stage. A response to copper foliar treatment will not occur if another major nutrient is not adequate.

Table 8. Grain Yield and Quality of Wheat Grown on Asquith Soil (Site #1)

Demo Site and Treatment	Grain Yield bu./acre	Grade	Ergot (%)	Protein (%)	Bushel Weight (g/0.5 L)	Thousand Kernel Weight (g)
NW10-31-7-W3 0.5 L Cu foliar/acre	33.0	2 Red	None	13.8	394	30.3
NW10-31-7-W3 Control	27.0	2 Red	None	13.3	384	29.7

Table 9. Grain Yield and Quality of Wheat Grown on Dune Sand Soil (Site #2)

Demo Site and Treatment	Grain Yield (bu./acre)	Grade	Ergot (%)	Protein (%)	Bushel Weight (g/0.5 L)	Thousand Kernel Weight (g)
SE35-28-8-W3 0.5 L Cu foliar/acre undisturbed	75.9	1 Red poor	None	15.0	414	38.2
SE35-28-8-W3 Control Undisturbed	71.7	3 Red	0.034	15.2	410	37.1
SE35-28-8-W3 0.5 L Cu foliar/acre Eroded	32.6	3 Red	0.024	13.6	401	33.9
SE35-28-8-W3 Control Eroded	31.0	1 Red	None	14.0	405	32.7

Table 10. Grain Yield and Quality of Wheat Grown on Haverhill Soil (Site #3)

Demo Site and Treatment	Grain Yield (bu./acre)	Grade	Ergot (%)	Protein (%)	Bushel Weight (g/0.5 L)	Thousand Kernel Weight (g)
NE25-24-8-W3 1.0 L/acre Cu foliar at flagleaf	76.3	3 Red	None	14.0	407	46.1
NE25-24-8-W3 0.5 L/acre Cu foliar at flagleaf	80.7	3 Red	None	14.0	415	47.0
NE25-24-8-W3 Control	78.6	3 Red	None	14.0	407	47.2

A yield response was also likely for Site #5 (Table 11), but no control was included in the treatments at this site. The grower previously had difficulty with copper deficiency and ergot and was not willing to leave a control strip in this field. The maximum allowable ergot in #1 wheat is 0.01%, for #2 it is 0.02%, and for #3 it is 0.04%.

Table 11. Grain Yield and Quality of Wheat Grown on Birsay Fox Valley and Birsay Haverhill Soil (Sites #4 and #5)

Demo Site and Treatment	Grain Yield bu./acre	Grade	Ergot (%)	Protein (%)	Bushel Weight (g/0.5 L)	Thousand Kernel Weight (g)
NW13-23-7-W3 0.5 L/acre Cu foliar with fungicide at flagleaf	84.3	2 Red	None	14.4	375	37.1
NW13-23-7-W3 Control	85.8	2 Red	None	14.2	380	37.1
SW27-24-5-W3 0.5 L/acre Cu foliar with fungicide	63.4	Canada Feed (ergot)	0.1	13.8	391	40.2
SW27-24-5-W3 0.5 L/acre Cu foliar with herbicide	71.5	2 CPSR	None	14.2	399	41.1

King and Alston (1975) suggest wheat grain with more than 2.5 ppm copper is not deficient. This observation was tested with wheat from responsive locations within LDDA. None of the yield responsive sites had levels of grain copper as low as the Australian researchers observed. This critical level derived from Australian work with Australian wheat varieties grown in Australia appears lower than is likely to occur in Canada. Perhaps the level of copper in the seed wheat used for the demonstrations supplies enough copper to hide the yield response. Another complicating factor is the use of copper compounds as a fungicide in the dry bean growing areas under irrigation. Up to 1 lb. of Cu is applied to the foliage of dry beans to control anthracnose, downy mildew, and bacterial blight. This level of copper applied to dry beans may be adequate to mask the yield response to copper fertilizer when the rotation returns to wheat.

Table 12. Grain Analysis of Wheat Grown on Soils Selected for Copper Application

Demo Site	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
NW10-31-7-W3 Control	2.41	0.29	0.31	0.15	0.02	0.13	3.9	30	39	35	< 3
NW10-31-7-W3 0.5 L Copper	2.67	0.36	0.34	0.16	0.02	0.15	4.3	34	46	41	< 3
SE35-28-8-W3 Control	2.78	0.35	0.33	0.15	0.02	0.14	3.8	39	39	34	< 3
SE35-28-8-W3 0.5 L Copper	2.76	0.33	0.31	0.15	0.02	0.14	3.8	35	37	33	< 3
NE25-24-8-W3 Control	2.32	0.25	0.34	0.12	0.03	0.13	3.6	42	42	30	< 3
NE25-24-8-W3 0.5 L Copper	2.59	0.29	0.32	0.15	0.03	0.11	3.2	34	40	25	< 3
NE25-24-8-W3 1.0 L Copper	2.56	0.34	0.37	0.15	0.03	0.14	3.7	36	43	28	< 3
NW13-23-7-W3 Control	2.65	0.28	0.28	0.15	0.04	0.14	3.9	36	39	32	< 3
NW13-23-7-W3 0.5 L Copper	2.77	0.26	0.27	0.15	0.04	0.13	3.3	33	38	27	< 3
SW27-24-5-W3 Herbicide Timing	2.83	0.29	0.33	0.15	0.03	0.11	3.9	30	37	29	<3
SW27-24-5-W3 Fungicide Timing	2.51	0.38	0.38	0.16	0.03	0.15	4.6	28	33	26	<3
Threshold	**2.0**	**0.25**	**-**	**0.12**	**-**	**-**	**2.5**	**10**	**11**	**5**	**1**

Final Discussion

The accepted critical level for available copper for wheat is 0.8 lb. Cu/acre on a 0–6” sample. Many soils in the LDDA test this low in copper, but appear not to respond to copper application as a foliar treatment. For 2014, a demonstration will be conducted for soil-applied copper to eliminate the possibility that the amount of copper applied to the flagleaf in 2013 was not adequate to correct the deficiency. The Australian critical level of 2.5 ug/g of copper in wheat grain may be too low for Canadian wheat varieties grown on Canadian soils.

Liquid and Granular Phosphate Demonstration*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Glen Erlandson, South Saskatchewan River Irrigation District, Outlook, SK

Project Objective

The object was to compare granular and liquid sources of phosphate fertilizer for wheat production.

Demonstration Plan

The standard recommendation for use of liquid ortho-phosphate fertilizer is to apply 8 lb. P_20_5/acre (13 L/acre) of 6-22-2 with the seed plus 20 lb. P_20_5/acre as mono-ammonium phosphate or an equivalent phosphate source. The demonstration tested rates of no ortho phosphate liquid, 8 lb. P_20_5/acre (13 L/acre ortho phosphate liquid), and 14 lb. P_20_5@ 22 L/acre ortho phosphate liquid both with and without 20 lb. P_20_5 granular/acre. Each strip was about 0.80 acres with no replication.

Demonstration Site

The demonstration was sown on canola stubble on SW20-30-7-W3, a Bradwell fine sandy loam. The site was soil sampled on April 3 for conventional soil analysis. The results are reported in Table 1.

Table 1. Conventional Soil Analysis of SW20-30-7-W3 in Spring 2013 (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	7.2	
Soil Conductivity (1:2 soil:water) mmhos/cm	1.1	
Organic Matter (%)	2.8	**Rating**
Nitrate-N (0-12") (lb./acre)	21.0	L
Phosphate-P (0-6") (lb./acre)	12.0	L
Potassium-K (0-6") (lb./acre)	600.0+	VH
Sulphate-S (0-12")	96.0+	VH
Cu (0-6") lb./ac	1.0	L
Fe (0-6") lb./ac	40.0	H
Mn (0-6") lb./ac	21.0	H
Zn (0-6") lb./ac	1.8	L
B (0-6") lb./ac	2.0	H

Fertilizer recommendations for 65 bu HRS wheat were 115 N/acre, 33 P205/acre and 3.5 lb. Cu/acre.

* Project 2013-13

Project Methods and Observations

The wheat field was sown on June 3 with a John Deere 1610 airseeder equipped with Technotill openers mounted on 10" centres. AC Barrie HRS wheat with 99% germination was used. A liquid blend of nitrogen and sulphur was sidebanded at seeding at a rate of 80 lb. N/acre and 5 lb. S. The phosphate source was mono-ammonium phosphate seed-placed fertilized with liquid 6-22-2 at 13 L/acre. Weeds were controlled with clodinafop and 2,4-D amine. Whole plant tissue samples were collected at early flagleaf; analysis is reported in Table 3. The analyses indicate all nutrients were at optimum level in all of the wheat treatments. The soil analysis had suggested that the soil copper was marginal, but the plant tissue analysis at flagleaf confirmed that available copper was adequate for the crop. Phosphorus levels in the plant tissue increased with phosphate fertilization by a small percentage.

Table 3. Nutrient Status of Wheat Grown on Soils Treated with Fertilizer Treatments

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
No granular, No liquid	3.11	0.26	4.2	0.35	0.22	0.17	6.4	95	49	28	4.9
No granular, 8 lb. $P_2 0_5$ liquid	3.42	0.28	4.3	0.45	0.30	0.16	6.2	102	45	23	5.5
No granular, 14 lb. $P_2 0_5$ liquid	3.03	0.27	3.9	0.36	0.23	0.17	7.2	102	51	29	5.9
20 $P_2 0_5$ granular, No liquid	3.08	0.27	4.2	0.34	0.22	0.16	8.9	101	45	32	6.1
20 $P_2 0_5$ granular, 8 lb. $P_2 0_5$ liquid	3.53	0.27	4.2	0.41	0.27	0.17	7.6	119	41	26	6.4
20 $P_2 0_5$ granular, 14 lb. $P_2 0_5$ liquid	3.49	0.28	4.1	0.40	0.21	0.18	7.0	95	51	25	6.3
Threshold	2.10	0.20	2.0	0.15	0.20	0.15	4.5	**40**	**20**	**15**	**4**

The grain yields for each individual treatment are reported in Table 4. The yields are summarized by phosphate source in Table 5.

Table 4. Wheat Yield of Phosphate Treatments at Erlandson Site

Treatment	Wheat Yield (bu./acre)
No granular, No liquid	43.6
No granular, 8 lb. $P_2 0_5$ liquid	53.1
No granular, 14 lb. $P_2 0_5$ liquid	57.5
20 $P_2 0_5$ granular, No liquid	58.3
20 $P_2 0_5$ granular, 8 lb. $P_2 0_5$ liquid	57.4
20 $P_2 0_5$ granular, 14 lb. $P_2 0_5$ liquid	53.1

Table 5. Demonstration Treatment Summary

Granular		Liquid		
0 lb. P_20_5 /acre	20 lb. P_20_5 /acre (40 lb. 11-52-0)	0 lb. P_20_5 / ac liquid	8 lb. P_20_5 /acre (13 L 6-22-2 /acre)	14 lb. P_20_5/acre (22 L 6-22-2/acre)
(43.6+53.1+57.5)/3 51.4 bu./acre	(58.3+57.4+53.1)/3 56.2 bu./acre	(43.6+58.3)/2 50.9 bu./acre	(53.1+57.4)/2 55.2 bu./acre	(57.5+53.1)/2 55.3 bu./acre

Final Discussion

The demonstration showed a strong yield response of wheat to phosphate treatments of up to 20 lb. P_20_5/acre at this site. Hard red spring wheat yields increased 4–5 bu./acre from the application of phosphate fertilizer. The response was similar for both granular and liquid sources. This observation contrasts sharply to the lack of response for both sources observed in 2012 in the same field sown to canola.

The lower soil temperature associated with early seeding reduces the diffusion of phosphate from the soil to the root surface and slows the growth rate of roots to unexplored soil. The crops were seeded in June in both years. An excellent response was observed with wheat in 2013 for both granular and liquid sources of phosphate. Both sources were adequate for providing the phosphate needs of the growing crop.

N-Zn Application to 40% Bloom Canola Demonstration*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-Investigators

- Dr. Rigas Karamanos, PAg. Agronomist, Viterra

Co-operator

- Kelly Farden, South Saskatchewan River Irrigation District, Outlook, SK

Project Objective

The objective was to demonstrate the topdressing of liquid fertilizer to canola at the 40% bloom stage.

Demonstration Plan

The liquid fertilizer was tank mixed with fungicide and applied to canola at the 40% bloom stage.

Demonstration Site

The demonstration site was a half section converted from dryland farming to irrigated production for the 2013 growing season. The soil is classified as Elstow sandy loam. The field was a mixture of wheat stubble and conventional fallow prior to seeding. The soil sample was collected from the stubble portion.

Table 1. Conventional Soil Analysis of Wheat Stubble on NH8-28-7-W3 Sampled May 22, 2013 (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	8.5	
Soil Conductivity (1:2 soil:water) (mmhos/cm)	0.2	
Organic Matter (%)	1.5	**Rating**
Nitrate-N (0-12”) (lb./acre)	18.0	L
Phosphate-P (0-6”) (lb./acre)	5.0	L
Potassium-K (0-6”) (lb./acre)	408.0	M
Sulphate-S (0-12”) (lb./acre)	8.0	L
Cu (0-6”) (lb./acre)	0.5	L
Fe (0-6”) (lb./acre)	8.0	L
Mn (0-6”) (lb./acre)	3.6	M
Zn (0-6”) (lb./acre)	0.6	L
B (0-6”) (lb./acre)	1.0	L

* Project 2013-15

Fertilizer recommendations for 54 bu canola from ALS Laboratories were 140 lb. N/acre, 45 lb. P_20_5/acre, 25 lb. S/acre, 3.5 lb. Cu/acre, 4 lb. Zn/acre and 1.0 lb. B/acre.

Project Methods and Observations

The field was banded with fertilizer prior to seeding with 120 lb. N/acre, 25 P_20_5/acre, and 12 lb. S/acre. Invigor L130 canola was sown May 28 with a JD1890 disk drill equipped with on-row packing. Another 25 P_20_5/acre and 12 lb. S/acre were seed placed during planting. Weeds were controlled with Liberty herbicide tank mixed with the low rate of Select. Plant tissue was sampled at late bud stage (July 9) to indicate the relative nutrient status. This analysis is reported in Table 2. The analyses indicated all nutrients were at optimum levels in the canola plants at the time of sampling. A foliar nitrogen zinc fertilizer, Canola Thrust (15-0-0 5% Zn 0.1% Fe), was tank mixed with the fungicide Vertisan and applied aerially to the canola at 40% bloom on July 14. Yield was determined by weigh wagon, calculating the area harvested for the sample with a measuring wheel.

Table 2. Nutrient Status of Canola Prior Flowering: Sampled July 9, 2013

Sample	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Canola NH8-28-7-W3	3.89	0.31	4.27	1.27	2.85	0.48	5.4	72	54	22	33
Threshold	**3.00**	**0.25**	**2.0**	**0.40**	**0.50**	**0.20**	**4.5**	**40**	**20**	**15**	**30**

Table 3. Yield of Canola from NH8-28-7-W3

Treatment	Area (acre)	Yield (bu./acre)	Average (bu./acre)
ZnN	0.48	57.67	57.87
ZnN	0.48	58.08	
Control	0.48	58.08	56.55
Control	0.48	55.01	

Table 4. Soil Test Results for a 0–6", 6–12" Sample Collected from the portion of NH8-28-7-W3 used for yield estimation. The soil sample was collected from the area where the seed harvest was measured following the harvest on September 20, 2013. (ALS Laboratory, Saskatoon)

pH (1:2 soil:water)	8.4	
Soil Conductivity (1:2 soil:water) mmhos/cm	0.1	
Organic Matter (%)	1.1	**Rating**
Nitrate-N (0-12") (lb./acre)	8.0	L
Phosphate-P (0-6") (lb./acre)	3.0	L
Potassium-K (0-6") (lb./acre)	411.0	M
Sulphate-S (0-12")	12.0	L
Cu (0-6") (lb./acre)	0.7	L
Fe (0-6") (lb./acre)	14.0	L
Mn (0-6") (lb./acre)	4.0	M
Zn (0-6") (lb./acre)	1.0	L
B (0-6") (lb./acre)	1.2	L

The measured yield from the treated strip was over 1 bu./acre higher than the untreated portion of the field. This difference would not be significant from a statistical perspective. The soil test collected from the treated area indicates the soil zinc supply is higher where the fertilizer product was applied, compared to the soil test collected in spring. These soil tests and the observed yield response indicate some of the frustrations encountered when working with micronutrients. The landscape varies considerably in micronutrient supply, especially in response to topography and exposure to erosion. Higher elevations and eroded sites will trend higher in soil pH, which reduces the availability of zinc in soils. Wind-eroded areas are also prone to lower organic matter, which decreases N-supplying power.

Final Discussion

Past work with application of an NZn product to canola at 40% bloom has increased grain yield in 60% of the demonstrations. The project field has been cultivated with a fallow wheat rotation since breaking and has experienced wind erosion during dry seasons. This cropping system is prone to nutrient deficiency of zinc. The soil test initially sampled from the field showed a strong probability of yield response to a zinc fertilizer, but the soil sample collected from the harvested portion of the field indicates near-adequate zinc. A plant tissue sample collected during the 2013 growing season indicated that zinc was adequate in the canola crop.

Seed yield at harvest did not show a strong response to the application of the nitrogen zinc foliar fertilizer. Potentially responsive soils are areas affected by soil erosion. A generalized response to application of zinc is unlikely to be observed. Significant benefit from zinc with canola is likely if the application is made to the eroded portions of the field.

References

Karamanos, R.E., Flore, N.A., and Harapiak, J.T. (2012). *Impact foliar fertilization of canola with a nitrogen-zinc product*. Joint meeting of CSA-CSHS-CCA-AIC, Saskatoon, July 16-19, 2012.

Adaptation of Tillage Radish to Sodium-Affected Soils*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Andre Perrault, Ponteix Irrigation District, Ponteix, SK

Project Objective

The objective was to evaluate the potential for tillage radish to assist in reclamation of sodium-affected soils in Southwest Saskatchewan Irrigation Districts.

Demonstration Plan

Growers are interested in growing mixtures of cover crops on eroded low organic matter soils in an attempt to improve soil fertility and crop growth. Tillage radish is one of the species that is commonly included in the mix because of its rooting habit of penetrating into dense soil layers.

Demonstration Site

The demonstration was conducted on Plot 22 of SW33-9-12-W3 in the Ponteix Irrigation District. The field was chemfallow in 2012 and was seeded in early July, 2013. The soil has a clay texture and is mapped as Alluvium Association.

Project Methods and Observations

Winter wheat was sown together with 2 lb./acre of tillage radish on July 2, 2013. The winter wheat and tillage radish established well with the timely rains during mid-summer. The radish and winter wheat grew well on better soil, but both were severely restricted where sodium was present in the soil profile. On August 12, the soil at three sites within plot 22 was sampled – one with good growth, one with poor growth, and a third on the neighboring border dyke where growth was good.

The soil conductivity was surprisingly low, even where wheat and tillage radish growth was severely reduced. The soil analysis confirmed that the major limitation to crop growth on this field was the presence of sodium in the soil. The Sodium Adsorption Ratio describes the relative abundance of divalent and monovalent cations competing for the surface of the soil colloids. When monovalent cations (Na+) are present in a high concentration, the soil loses its structure because the clay particles become dispersed and are no longer held together. Water percolation through the soil cannot occur, as the channels for water flow become disrupted.

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* Project 2012-17

Table 1. Soil Analysis of Differential Growth Areas of Plot 22 at Ponteix Irrigation District

	Good Wheat Growth in Field			Wheat Growth on Top of Border Dyke			Poor Wheat Growth in Field		
Parameter	**0-6”**	**6-12”**	**12-18”**	**0-6”**	**6-12”**	**12-18”**	**0-6”**	**6-12”**	**12-18”**
pH	6.8	7.5	8.3	6.9	7.1	7.8	7.5	8.4	8.6
Conductivity	**1.2**	**0.8**	**1.1**	**1.2**	**0.8**	**0.8**	**1.4**	**1.6**	**2.5**
% Saturation	**76.0**	**81.0**	**116.0**	**69.0**	**70.0**	**99.0**	**77.0**	**130.0**	**115.0**
Calcium	37.0	12.0	14.0	46.0	16.0	9.0	24.0	10.0	17.0
Magnesium	24.0	7.0	9.0	32.0	8.0	6.0	14.0	9.0	15.0
Potassium	31.0	4.0	3.0	36.0	8.0	5.0	8.0	4.0	3.0
Sodium	193.0	170.0	308.0	213.0	183.0	197.0	304.0	354.0	530.0
Sulphate	76.0	111.0	374.0	93.0	69.0	93.0	195.0	401.0	999.0
Chloride	63.0	11.0	8.0	55.0	32.0	11.0	34.0	26.0	7.0
SAR	**6.1**	**9.7**	**15.9**	**5.9**	**9.3**	**12.6**	**12.2**	**19.5**	**22.8**

The SAR ratio is an important parameter for predicting the risk for loss of water via percolation in a soil. A low ratio (less than 5) indicates limited risk of loss of soil structure. A high ratio (greater than 13) indicates that the soil will have difficulty conducting water. Between these two extremes, the soil texture and the quality of soil water play greater roles in determining whether soil structure will be maintained or lost as soil water moves through the soil.

The demonstration was not successful in reducing the harmful effect of sodium on the growth of the tillage radish and winter wheat. The tillage radish was not able to grow productively in the Plot 22 soils that contain the levels of sodium found at Ponteix.

Final Discussion

The demonstration showed that tillage radish is not adapted to high sodium soils. The reduction in growth of the radish in response to sodium indicates that tillage radish is a poor candidate to assist in reclamation of these soils. Its development was sharply curtailed in the high sodium soil at the Ponteix Irrigation District.

FORAGE CROP PROJECTS IN 2013

Phosphorus, Potassium and Sulphur Fertilization of a New Alfalfa Stand*

Project Lead

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

Co-investigators

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Garry Hnatowich, PAg, Research Agronomist, ICDC

Project Objective

The objective was to demonstrate forage responses to phosphorus, potassium, and sulphur fertilizer applications, alone and in combination, on a new alfalfa stand.

Project Background

Previous research work performed on forage under irrigation by Les Henry, showed a response to phosphorus fertilization at levels of up to 200 lb./acre applied phosphate. This response was seen on land that was previously deficient in phosphorus due to land grading from gravity irrigation development. Higher phosphate levels were found in the tissue samples of tested plots, but yields were not increased. Applications of potassium and sulphur did not show a plant tissue or yield response. Providing consideration for previous research results, the project lead believed that there was merit in revisiting the effects of phosphorus, potassium, and sulphur applications on irrigated alfalfa. The response of alfalfa to nutrients applied alone or in combination in a banded application under irrigation in Saskatchewan is not well documented. This project was designed as an opportunity to provide information to producers through extension events and publications.

Project Plan

A randomized, replicated design of field-scale plots with eight fertilizer treatments was to be implemented and managed for three production years. Under the initial project plan, the intent was to establish the alfalfa field site in 2012. Due to wet field conditions and localized flooding, successful establishment of the plot area did not occur. In the spring of 2013, a new alfalfa seeding was planted using a variety suited for an intensive, three-cut management system. Application of

* Project 2012-02

fertilizer treatments was planned for fall 2013. Data collection will begin in 2014 and will include dry matter yield and forage quality analysis.

The fertilizer treatments to be applied (Table 1) may be amended to reflect soil test recommendations in future years. An additional fertilizer treatment of phosphorus, potassium, sulphur, and zinc was added to the project plan in September 2013, following plant tissue analysis of the alfalfa field that indicated a zinc deficiency was present (Table 2).

Table 1. Fertilizer Treatments

Control	0-0-0-0
P only	0-75-0-0
K only	0-0-75-0
S only	0-0-0-15
P and K	0-75-75-0
P and S	0-75-0-15
K and S	0-0-75-15
P, K and S	0-75-75-15
P, K, S and Zn	0-75-75-15-4

Table 2. Plant Tissue Analysis of Alfalfa Indicating a Zinc Deficiency

Treatment	N %	P %	K %	S %	Ca %	Mg %	Cu ppm	Fe ppm	Mn ppm	Zn ppm	B ppm
Healthy plants	4.15	0.303	2.41	0.388	1.62	0.316	4.9	128.0	43.3	15.8	54.5
Abnormal plants	2.75	0.234	1.76	0.251	1.28	0.228	3.3	96.3	32.8	11.1	36.5
Sufficient	3.50	0.250	2.00	0.250	1.00	0.300	3.0	25.0	25.0	20.0	30.0
Marginal	3.00	0.200	1.50	0.200	0.50	0.200	2.5	20.0	20.0	15.0	20.0

Demonstration Site

The project area is located at an off-station site of CSIDC and is irrigated with a Valley pivot system. The soil texture of the plot area is classified as a loam at the 0-91 cm (0-36 inches) depth and clay loam at the 91–121 cm (36–48 in.) depth.

Project Methods and Observations

Alfalfa variety Dupont Pioneer 54Q32 was planted on June 10, 2013 at 12 lb./acre, using a John Deere 750 drill. No fertilizer was applied at the time of establishment. Weed control included a pre-seed burnoff application of 1 L/acre glyphosate. No in-crop herbicides were applied. An establishment year harvest was taken in late July. No forage samples were submitted for forage quality analysis in the establishment year.

A soil analysis of the project area was taken prior to fertilizer application (Table 3). Fertilizer treatments were applied on October 10 as a banded application using a small plot seeder with disc openers on 8 in. row spacing (Figure 1). Fertilizer was applied to the half inch depth to minimize alfalfa crown damage (Figure 2). Each fertilizer treatment was replicated three times.

Plant stand assessments will occur in spring 2014 to determine the level of winter injury and the impact of the fertilizer application on stand survival. Data collection will also begin in 2014 and will include both yield and forage quality analysis information. One forage sample per fertilizer treatment per year will be submitted for quality analysis.

Table 3. Soil Analysis of Alfalfa Plot Area Prior to Fertilizer Application

Nutrient	NO_3-N	P	K	S	Cu	Mn	Zn	B	Fe
Depth (inches)	**lb./ac**								
0 – 6	7	39	434	10	0.5	5.9	1.4	1.4	21
6 – 12	3		13						

Figure 1. Disc opener in-field.

Figure 2. Visual representation of depth of fertilizer placement.

Acknowledgements

The project lead would like to acknowledge Garry Hnatowich, ICDC Research Agronomist, and Gary Kruger, PAg, for their agronomic guidance and support on this project. The lead would also like to acknowledge CSIDC staff, Barry Vestre and Darryl Jacobson, who assisted with the field and irrigation operations of this project.

Demonstration of Perennial Forage Crops*

Project Lead

- Sarah Sommerfeld, PAg, Regional Forage Specialist, Saskatchewan Agriculture
- Julia Warwaruk, ICDC Summer Student

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 ongoing 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 also to demonstrate any differences in establishment, growth habit, maturity, and yield of 50 different perennial forage varieties, including both grasses and legumes.

Project Background

Perennial forage crops are a vital component of the livestock industry in Saskatchewan, providing forage and feed through either 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 therefore beneficial for side-by-side comparisons of perennial forages to occur at the local level.

Project Plan

The project was designed as a small plot demonstration, with no replication or randomization, to allow for inclusion of several legume and grass species (Tables 1 and 2) and to minimize cost and land requirements. The project plan included seeding plots following a pre-seed burn-off application of glyphosate. In-crop herbicide applications to control broadleaf or grassy weeds would be performed, if necessary, following label guidelines. Data collection in the establishment year was to include visual assessment of establishment success, evaluation of plant populations, and plot mechanical harvest in early August.

Demonstration Site

CSIDC is providing the land and facilities to accommodate this multi-year project. The site has a fine sandy loam soil texture in the 0-30 cm (0-12 inch) profile. All plots are irrigated.

* Project 2012-01

Table 1. Grass Species

Grass Species	Variety	Company
Meadow Brome	AC Armada	Secan
Meadow Brome	AC Admiral	Secan
Meadow Brome	MBA	Pickseed
Hybrid Brome	AC Knowles	Northstar
Hybrid Brome	AC Success	Pickseed
Hybrid Brome	Bigfoot	Brett-Young
Smooth Brome	Carlton	Northstar
Smooth Brome	AC Rocket	Viterra
Creeping Red Fescue	Boreal	Brett-Young
Sheep fescue	common	Northstar
Tall fescue	Courtenay	Northstar
Crested Wheatgrass	Fairway	Brett-Young
Crested Wheatgrass	Kirk	Pickseed
Crested Wheatgrass	AC Goliath	Brett-Young
Intermediate Wheatgrass	Chief	Pickseed
Pubescent Wheatgrass	Greenleaf	Northstar
Slender Wheatgrass	common	Northstar
Tall Wheatgrass	common	Ag Vision Seeds
Northern Wheatgrass	common	Northstar
Western Wheatgrass	common	Northstar
Russian Wildrye	Swift	Pickseed
Altai Wildrye	common	Viterra
Dahurian wildrye	common	Northstar
Timothy	AC Pratt	Secan
Meadow Foxtail	common	Northstar
Creeping Foxtail	Garrison	Northstar
Reed Canarygrass	Venture	Northstar
Green Needle Grass	common	Northstar
Kentucky Bluegrass	Troy	Brett-Young
Orchardgrass	AC Kootenay	Secan
Orchardgrass	AC Killarney	Secan
TOTAL: 30 grasses		

Table 2. Legume Species

Legumes	Variety	Company
Alfalfa (Tap)	AC Grazeland Br	Northstar
Alfalfa (Tap)	AC Dalton	Secan
Alfalfa (Tap)	Stealth	Northstar
Alfalfa (Tap)	Equinox	Viterra
Alfalfa (Hybrid)	HB 2410	Brett-Young
Alfalfa (Creeping)	Spreader 4	Viterra
Alfalfa (Branched Root)	4010 BR	Brett-Young
Alfalfa (Multifoliate)	PS3006	Pickseed
Alfalfa (Saline Tolerant)	Rugged	Northstar
Alfalfa (Saline Tolerant)	Halo	Viterra
Aflalfa (Yellow-flowered)	AC Yellowhead	Secan
Cicer Milk Vetch	Oxley II	Northstar
Cicer Milk Vetch	AC Veldt	Northstar/Viterra
Birds Foot Trefoil	Leo	Brett-Young
Sainfoin	common	Northstar
Single Cut Red Clover	Altaswede	Pickseed
Double Cut Red Clover	Belle	Pickseed
Double Cut Red Clover	Wildcat	Brett-Young
Alsike Clover	common	Northstar
White Dutch clover	common	Northstar
20 Total legumes		

Project Methods and Observations

All plots were direct seeded on June 10, 2013 into wheat stubble using an eight-row small plot seeder with eight inch row spacing. Fifteen pounds P_20_5, as 11-52-0, was side-banded at the time of seeding. Establishment of both the legume and grass plots was challenged by weed competition. Grass plots were sprayed with 2, 4-D (700 g/ai) at 0.32 L/acre, and alfalfa plots were sprayed with Odyssey at 17.3 g ai/acre. A small amount of hand weeding was done in the legume plots. The area recorded 193 mm (7.6 inches) rainfall from April 3 to October 9. The plot site received an additional 76 mm (3.0 inches) of irrigation from time of planting until end of August.

A biomass harvest of the grass plots for weed control purposes was performed on August 29. No harvest weights were recorded. Harvest of legume plots occurred on October 4 (Table 3). Visual assessment of establishment and plant population counts were not collected in 2013 due to weed competition. Plots will be visually assessed in spring 2014 for establishment and overwintering success.

Table 3. Legume Dry Matter (DM) Harvest Weights Establishment Year at October 4, 2013

Crop	Variety	**Yield** t DM/acre
Alfalfa	AC Grazeland	2.1
Alfalfa	AC Dalton	1.8
Alfalfa	Stealth	2.0
Alfalfa	Equinox	2.0
Alfalfa	Spreador 4	2.3
Alfalfa	4010 BR	2.1
Alfalfa	PS 3006	2.0
Alfalfa	HB 2410	2.1
Alfalfa	Halo	2.0
Alfalfa	Rugged	1.6
Alfalfa	AC Yellowhead	2.0
Cicer milkvetch	Oxley II	1.3
Cicer milkvetch	AC Veldt	2.2
Birdsfoot Trefoil	Leo	1.8
Sainfoin	Common	2.6
Clover	Altaswede Single Cut Red Clover	1.1
Clover	Belle Double Cut Red Clover	2.9
Clover	Wildcat Double Cut Red Clover	2.1
Clover	Alsike Clover	1.3
Clover	White Dutch Clover	0.6

Discussion

Perennial forage establishment can be a challenge, even under the best seeding and growing conditions, and this demonstration project was no exception. After much effort to manage the weeds, reduce plant competition, and maintain moist seedbed conditions, 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 long-term average yield of irrigated alfalfa in the establishment year was 2.5 t/acre (*ICDC Irrigation Economics and Agronomics, 2013*). Alfalfa yields recorded in Table 3 are comparable to the documented long term average. Long term establishment yield data for the other legume crops under irrigation in Saskatchewan is not well documented. Under dry land production systems, cicer milkvetch and sainfoin typically yield 20–25% less than alfalfa. The yield data above indicates that the yields of alternative legumes in Table 3 are comparable to the alfalfa yield data, indicating that performance across all varieties is respectable. Further yield data collection will assist in determining the long-term performance of these legume species and provide better insight into their potential and utility under irrigation.

Acknowledgements

The project lead would like to acknowledge Garry Hnatowich, ICDC Research Agronomist, and Harvey Joel, ICDC Research Technician, for their agronomic guidance and support on this project. The lead would also like to acknowledge CSIDC staff members Barry Vestre, Don David, and Darryl Jacobson, who assisted with the field and irrigation operations for this project.

Saline Tolerant Forage Demonstration*

Project Lead

- Sarah Sommerfeld, PAg, Regional Forage Specialist, Saskatchewan Agriculture
- Julia Warwaruk, ICDC summer student

Industry Co-operators

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

Project Objective

The objective of the 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 under 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.

Project Plan

The potential project site was identified at CSIDC, with specific project location dependent on soil salinity ratings and land base availability. 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. Plot size was to be determined by plot area availability.

Establishment of the project area was planned for May 2013. All plots were to receive phosphate fertilizer at the time of seeding. Planned data collection in the establishment year would include seedling counts, seedling identification, and assessment of weed percentage and percentage of

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* Project 2013-01

forage in the stand. An establishment year harvest would be taken, if feasible. Yield data collection will begin in 2014.

Demonstration Site

CSIDC is providing the land and facilities to accommodate this multi-year project. The 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.

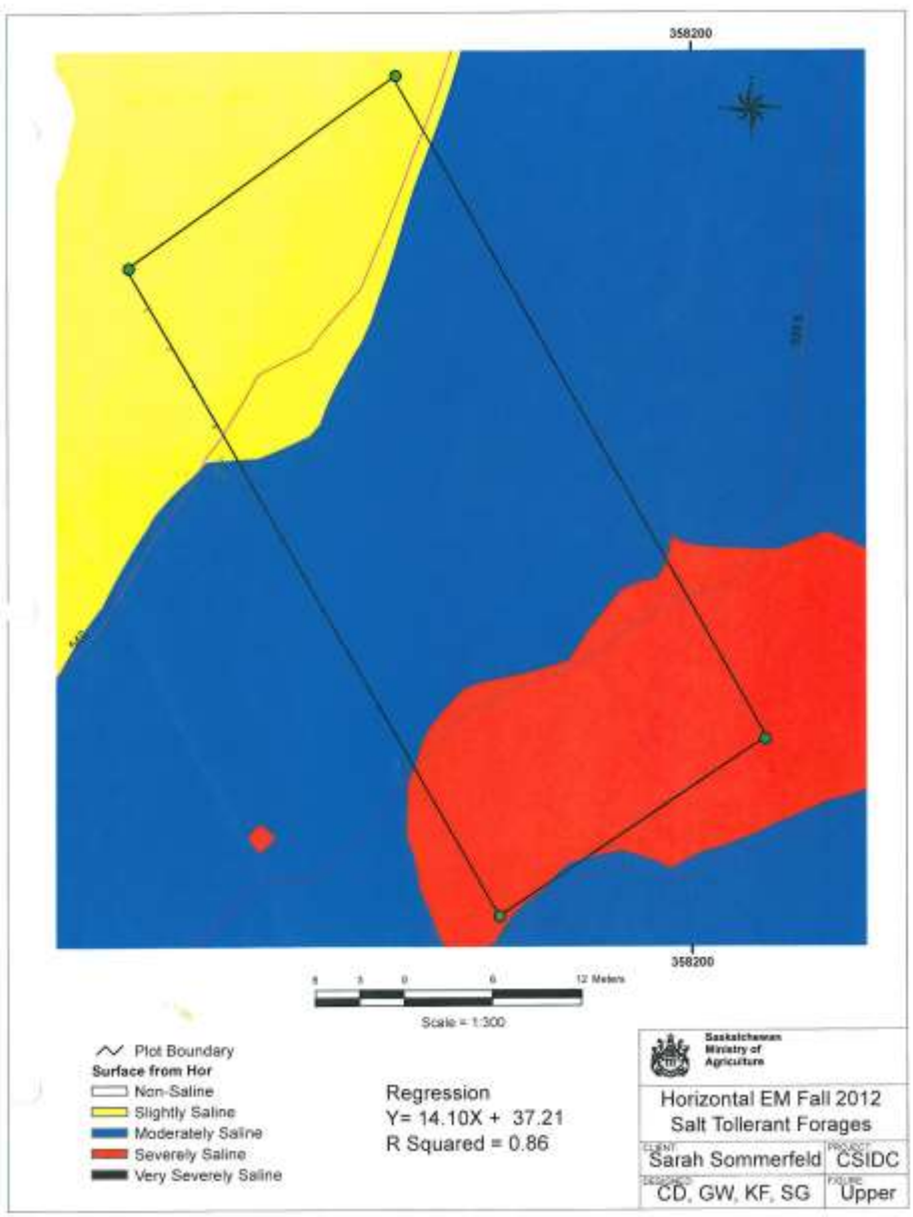

Figure 1. Horizontal EM38 map.

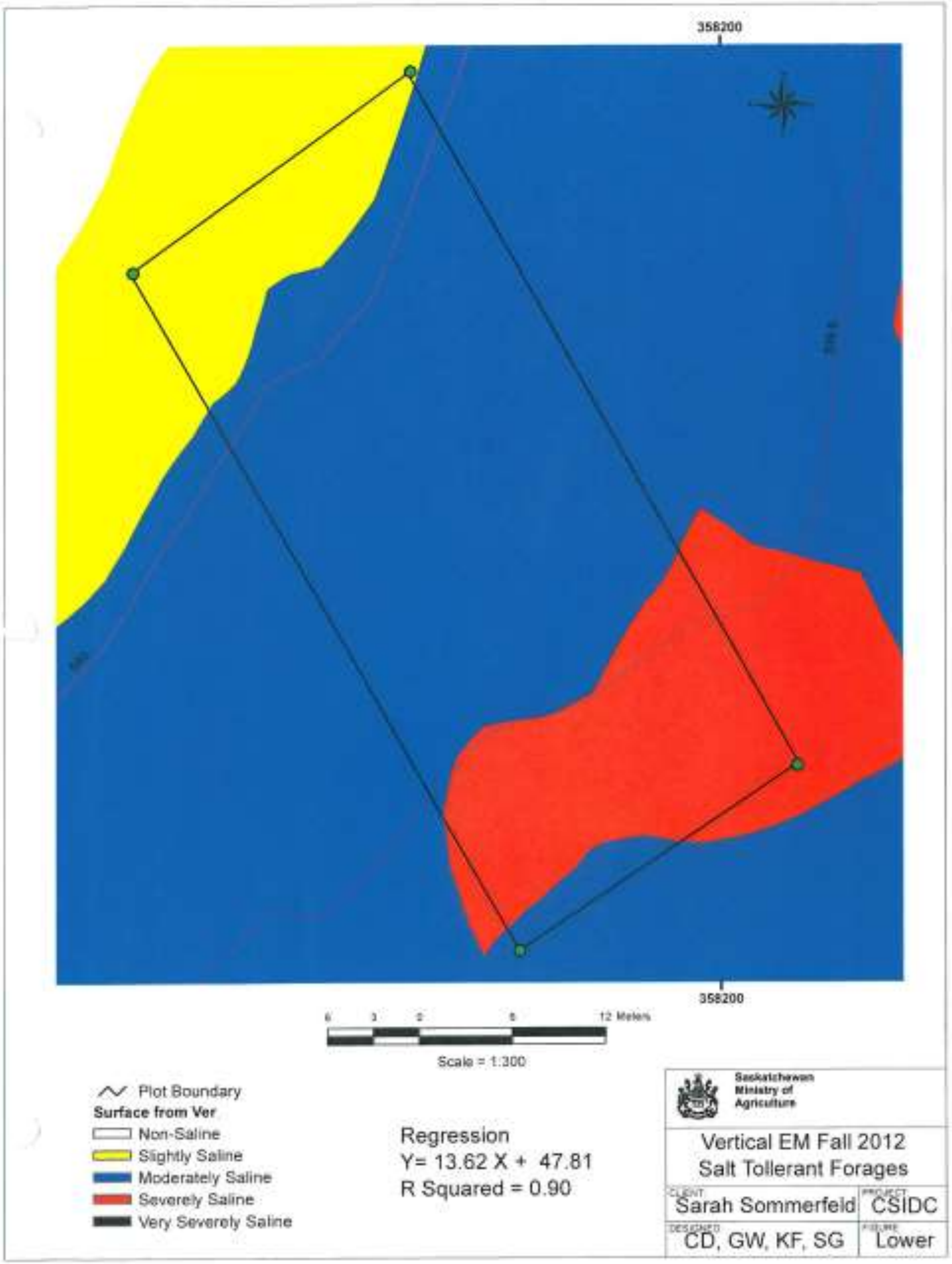

Figure 2. Vertical EM38 map.

Project Methods and Observations

All plots were direct seeded on June 18 into wheat stubble using an eight-row small plot seeder with eight inch row spacing. Fifteen pounds P_20_5, as 11-52-0, was side-banded at the time of seeding. Table 1 lists the forages planted and their respective seeding rates. Carlton smooth bromegrass and Dupont Pioneer 54Q32 alfalfa serve as the check varieties for each of the respective species.

A group-2 resistant wild oats problem exists on the field site, resulting in significant plant competition and detriment to forage establishment in the slight and moderate saline areas. The severely saline area was not negatively affected by the wild oat infestation and showed reasonable forage emergence (Figures 3 and 4). A biomass harvest of all plots for weed control occurred on August 29. No harvest weights were recorded. The plot area received 193 mm (7.6 inches) of rainfall from April 3 to October 9. An additional 140 mm (5.5 inches) of irrigation was applied from July through September.

Table 1. Forage Varieties and Seeding Rates

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

Figure 3. Alfalfa plots under moderate to severe saline conditions – August 8, 2013.

Figure 4. Grass plots under moderate to severe saline conditions – August 8 2013.

Discussion

Based on observations of the severely saline area, the Garrison creeping foxtail had the poorest forage emergence. AC Saltlander green wheatgrass and Carlton smooth bromegrass showed the best emergence and greatest amount of ground cover. Slender wheatgrass and tall wheatgrass did reasonably well.

Tall wheatgrass is a forage species that has excellent tolerance to saline and/or flooding conditions. Tall wheatgrass is slow to establish, but does have good competitive ability once established. Feed quality and palatability can be poor at later plant maturity stages. Slender wheatgrass establishes easily, begins growing in early spring, and has very good tolerance to saline conditions. Its greatest limitation is that it is a short-lived grass species. Both tall wheatgrass and slender wheatgrass are bunch-type grasses, and as such, are not aggressively spreading grass species.

Green wheatgrass, smooth bromegrass, and creeping foxtail have creeping root systems, also known as rhizomes. Under good growing conditions, rhizome production increases and allows these grasses to be very competitive with other plant species. Often, under saline conditions, rhizome production decreases and the plant's competitive ability declines. Green wheatgrass maintains its competitive ability, thus allowing the plant to compete well against foxtail barley and other weeds often found in saline sites. Similar to other wheatgrasses, green wheatgrass begins growth early in the spring, but feed quality and palatability remain higher at later plant maturity compared to other wheatgrasses. Creeping foxtail is moderately tolerant to saline conditions and requires good moisture conditions for establishment. Once established, creeping foxtail is very aggressive and competitive, which is often both its greatest benefit and greatest limitation.

Based on observations of the alfalfa varieties, no single variety showed improved emergence success over another. Alfalfa is moderately salt tolerant once established, but alfalfa seedlings are very sensitive to salts. High salt levels can reduce germination of seeds and impair nutrient and water uptake by the plant roots. All varieties did exhibit symptoms of growing under saline conditions, such as yellowing of leaves, stunting, unthrifty, as shown in Figure 3. Plants within the moderately and slightly saline areas did not exhibit these symptoms to any great extent. Also, the moderate and slightly saline areas of alfalfa plots were not as negatively affected by the group-2 wild oat competition as were the adjacent grass plots.

Plots will be visually assessed in spring 2014 for establishment and overwintering success. Data collection in 2014 will also include harvest yield.

Acknowledgements

The project lead would like to acknowledge Garry Hnatowich, ICDC Research Agronomist, and Harvey Joel, ICDC Research Technician, for their agronomic guidance and support on this project. The lead would also like to acknowledge CSIDC staff members Barry Vestre, Don David, and Darryl Jacobson, who assisted with the field and irrigation operations for this project.

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Corn Variety Demonstration for Silage and Grazing*

Project Lead

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Co-investigators

- Garry Hnatowich, PAg, Research Agronomist, ICDC
- Harvey Joel, Research Technician, ICDC
- Donald David, CSIDC

Industry Co-operators

- Glenda Clezy, DuPont Pioneer
- Andrew Chilsom, Monsanto
- Neil Mcleod, Northstar Seeds Ltd.
- Kent Clark, Rack Petroleum

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 among 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 located at CSIDC and 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/acre for irrigated plots and 28,000 seeds/acre for dry land plots was targeted. Both irrigated and dry land plots were established in very close proximity to each other. Seed for each individual plot was packaged according to individual seed weights and adjusted for estimated per cent germination. All seed

* Project 2013-02

received from suppliers was treated. Weed control included a pre-plant burnoff application of 1 L/acre glyphosate. In-crop herbicide applications were performed as required according to label guidelines. 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. Soil analysis prior to trial establishment indicated the following nutrient levels;

- NO_3-N = 70 lb./acre to 24 in.
- P $\geq$60 lb./acre to 6 in.
- K = 228 lb./acre to 6 in.
- SO_4-S $\geq$155 lb./acre to 24 in.

Project Methods and Observations

The trial was seeded on May 21 into good seedbed conditions. Irrigated and dry land plots received a broadcast and incorporated application of 80 lb./acre N, as 46-0-0, prior to seeding. Both irrigated and dry land received 50 lb./acre N as 46-0-0, and 50 lb./acre P_2O_5 as 12-51-0, in a side band application at seeding. Irrigated plots received a post emergent broadcast application of 50 lb./acre N as 46-0-0 that was immediately incorporated by an irrigation application.

Twelve corn hybrids were planted in each production system. Hybrid selection was made by seed companies in consultation with local retail suppliers, with the criteria being that each variety selected was recommended for the Lake Diefenbaker irrigation area (Table 1). Weed control included a pre-plant application of Eradicane and glyphosate. In-crop weed control included applications of glyphosate at recommended rates and periodic hand weeding.

Dry land plots were harvested on September 19 and irrigated plots were harvested on September 24. Seasonal crop water use was 338 mm (13.1 inches) from May 21 to September 24. Cumulative Corn Heat Units (CHU) from May 15 to September 24 was 2550. Cumulative precipitation from April 3 to October 9 was 193 mm (7.6 inches). Irrigated plots received an additional 224 mm (8.8 inches) through periodic irrigation.

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

Variety	Company	Corn Heat Unit (CHU) Rating
P7443R RR	DuPont Pioneer	2100
39m26 RR	DuPont Pioneer	2100
39V05 RR	DuPont Pioneer	2350
P8210 RR	DuPont Pioneer	2475
DKC 33-78 RR	Dekalb	2500
DKC 30-07 RR	Dekalb	2325
Baxxos RR	Hyland	2300
HL R219 RR	Hyland	2375
HL SR22 RR	Hyland	2400
HL 3085 RR	Hyland	2400
Silex Bt RR	Pickseed	2200
2501 RR	Pickseed	2300

Results and Discussion

Plant population establishment of irrigation plots was targeted at 32,000 plants/acre and 28,000 plants/acre for dry land plots. Seeding rates were adjusted, assuming a germination rate of 90% for planted seed. The average established plant population of irrigated plots was 32,070 plants/acre. Average established plant population of dry land plots was 27,253 plants/acre (Table 2). Established plant populations of each corn hybrid within the two production systems are illustrated in Figure 1.

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

Treatment	Plant Population (plants/acre)	Dry Yield (t/acre)	Whole Plant Moisture (%)	Days to Tassel	Days to Silk
Production System					
Irrigation	32070	11.1	62.9	72	75
Dry Land	27253	8.5	58.2	72	74
LSD (0.05)	2546	0.4	3.8	NS	NS
CV (%)	12.8	11.1	4.9	1.0	1.0
Hybrid					
P7443R RR	30702	9.8	53.8	69	73
39m26 RR	28115	8.5	54.7	65	70
39V05 RR	30983	9.3	55.4	70	75
P8210 RR	27609	10.0	59.4	74	75
DKC 33-78 RR	30758	9.5	64.6	74	77
DKC 30-07 RR	30926	10.0	64.1	74	78
Baxxos RR	27609	9.1	59.3	68	72
HL R219 RR	27609	10.1	62.3	74	75
HL SR22 RR	30252	10.6	65.5	78	79
HL 3085 RR	33682	9.8	60.5	73	76
SilEX BtRR	26653	9.7	64.3	73	75
2501 RR	31039	10.8	62.7	74	75
LSD (0.05)	3801	1.1	2.9	0.7	0.8
Production System vs. Hybrids					
LSD (0.05)	NS	NS	NS	S	NS

S = Significant   NS = Not Significant

The irrigation treatment produced greater dry matter (DM) silage yields compared to the dry land treatment (Figure 2) by an average of 2.6 t/acre or 30.5%. Based on the 2013 yield data (Table 2 and Figure 2), the variety that performed the best under irrigated conditions for silage production was 2501 RR. Under dry land conditions, the variety that performed the best for silage production was HL SR22 RR. Baxxos RR was used as the hybrid check variety to which all other hybrids were compared.

Under irrigation, hybrid 2501 RR DM yield was 20% higher than Baxxos RR. Under dry land, the DM yield of hybrid HL SR22 RR was 31 per cent greater than Baxxos RR. Statistical analysis indicated a significant yield difference between irrigation and dry land yields (Figure 2). All hybrids were significantly higher yielding under irrigation.

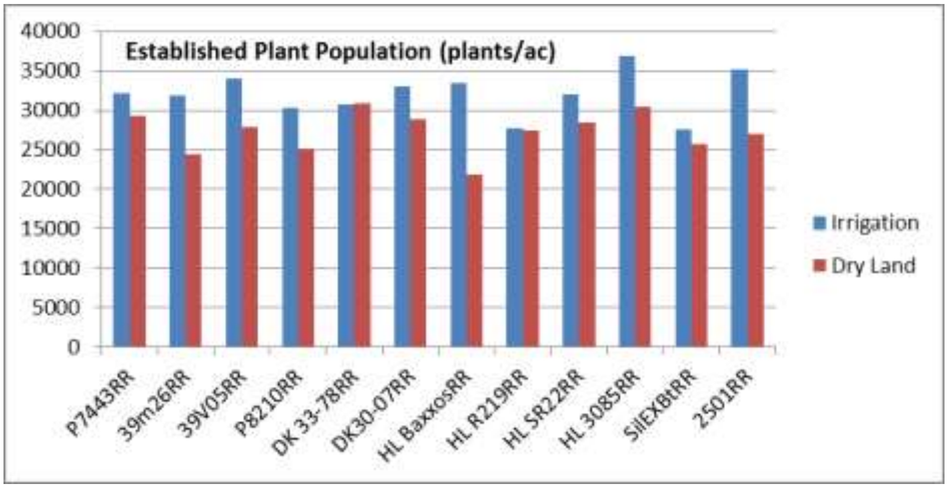

Figure 1. Established plant population by hybrid; irrigated vs dry land.

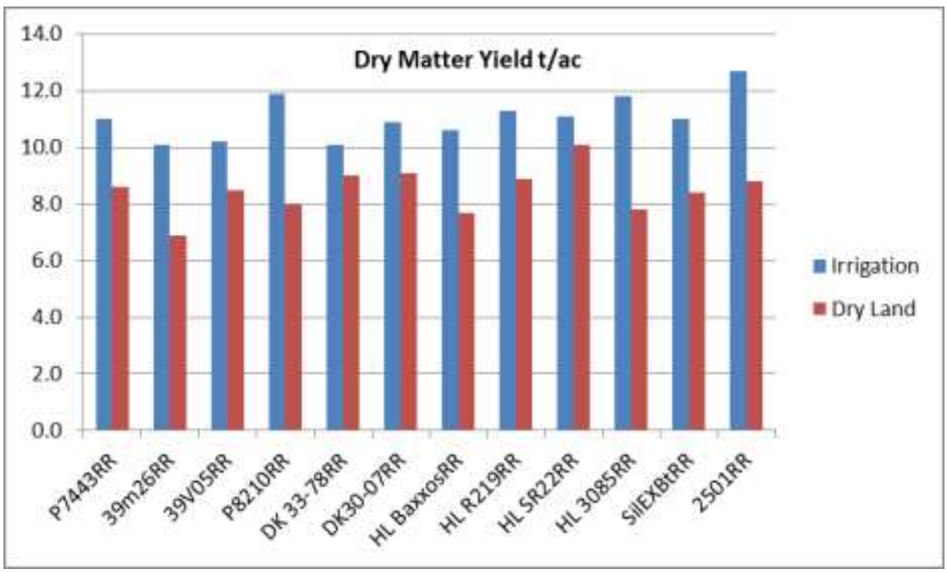

Figure 2. Dry matter yield of hybrids; irrigated vs dry land.

Whole plant moisture content did differ between irrigation and dry land treatments (Figure 3). Target harvest moisture content was 60%. No difference between the two production systems was observed with respect to days to corn tasselling or silking. Differences between hybrids with days to tassel did occur. In general, early tasselling hybrids were also the lowest yielding and had the lowest plant moisture content at harvest.

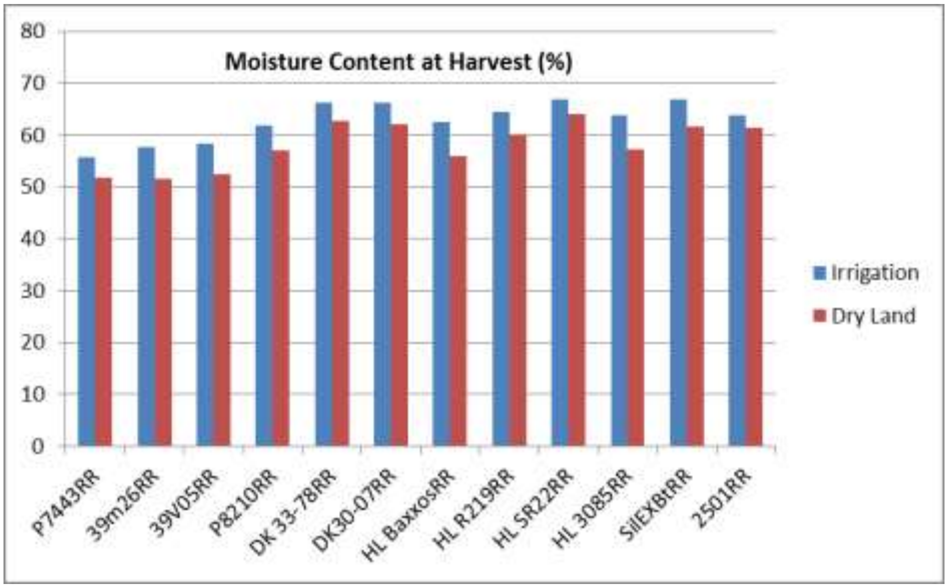

Figure 3. Whole plant moisture content.

Future Evaluation

The results of this study, augmented by results from the Alberta Corn Committee Irrigated Grain and Silage Corn study conducted at CSIDC, are being used to develop a data base on corn hybrid production. Silage corn hybrid performance was included in *Crop Varieties for Irrigation* for the first time in the January 2013 edition.

Irrigated Salt Tolerant Varieties Demonstration*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-Investigators

- Dr. Harold Steppuhn, PAg. Salinity Hydrologsit, Semiarid Prairie Agricultural Research Centre (SPARC), Agriculture and Agri-Food Canada, Swift Current, SK
- Garth Weiterman, PAg, Manager, Agronomy Services, Saskatchewan Agriculture

Co-operator

- Barry Vestre, Field Operations Supervisor, Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)

Industry Support

- Don Miller, Producer's Choice Seeds, Nampa, Idaho, USA
- Jonathan M. Reich, Cal/West Seeds, Woodland, California, USA

Project Objective

The objective of this project was to demonstrate the performance of several alfalfa lines that offer improved salt tolerance.

Project Background

Alfalfa is grown on many acres in Saskatchewan because of its ability to tolerate salinity and to produce excellent quality forage, where other crops struggle to survive. Preliminary testing at the Semiarid Prairie Agricultural Research Centre (SPARC) by Dr. Harold Steppuhn identified three varieties with superior salt tolerance – Bridgeview, Halo, and CW064027. These varieties, along with AC Blue J as the control, were grown in the field demonstration at CSIDC.

AC Blue J is a proven alfalfa variety widely grown under irrigation. Bridgeview was developed at Agriculture and Agri-Food Canada, Lethbridge, from salt-tolerant selections of Apica, AC Blue J, Barrier, Beaver, Heinrichs, Rangelander, and Roamer alfalfa. This line was initially known as L4039 SC Salt until it received registration in 2011. Halo was developed by Calwest Seeds based in Woodland, California, and is currently marketed by Viterra Seed. As a research line, it was known as CW34024. CW064027 is another research line from the Calwest Seeds program that has not received registration for production in Canada.

* Project 2012-14

Demonstration Plan

The salt-tolerant alfalfa demonstration consists of narrow plantings of each variety on soils with a range of salinity ratings. The design allows comparison of the performance of alfalfa varieties over a wide range of salinity readings in the field.

Demonstration Site

The site is located on Field 12 at CSIDC and was irrigated with a Valley pivot system. Prior to planting the alfalfa, the field had grown triticale green feed for two years. The north side of the field is heavier textured, lower lying, and more prone to waterlogging.

In October 2010, the site was mapped by the Irrigation Environmental Unit to record changes in soil salinity over time. The survey was used to prepare a salinity contour map of the plot area. This survey was repeated again in the fall of 2012.

Project Methods and Observations

The alfalfa varieties were seeded June 29, 2010, with a six-row disk research drill at 25 cm row spacing. The four varieties were sown in long narrow strips 1.5 m wide by 600 m long across the field. The strips were sown in two blocks, with the restriction that each variety was adjacent to each of the other varieties between the two blocks. The seeding rate was 9 kg seed/ha. The seeds were planted at a depth of 1.5 cm.

Yield data was collected in 2011 and 2012 using two methods. Please refer to the 2011 and 2012 *ICDC Research and Demonstration Reports* for details from these years. In 2013, the yield was determined with the forage harvester.

The spring of 2013 was delayed until mid-May. The forage harvest from the salt tolerant forage demonstration was limited to two cuts because drainage reclamation work was conducted in August adjacent to the field. Irrigation to the site was severely restricted in the latter part of the growing season, which reduced growth after the second cut to virtually nil. The data collected in 2013 is summarized in Table 3.

Table 3: Harvester Yield Measurements in 2013 for Variety Demonstration in Field 12 at CSIDC (3rd year of production)

Variety	Winter Injury Assessment[1] (Shoots/m^2)		1st cut Yield June 27 (t/acre)	2ndcutYield August 9 (t/acre)	2013Yield 2 cuts (t/acre)
	2012	2013			
Halo	428	384	2.24	1.50	3.74
CW064027	280	329	2.35	1.65	4.00
Bridgeview	475	317	1.95	1.18	3.13
AC Bluejay	461	460	2.26	1.58	3.84

[1] Shoots per m^2 in early June

Final Discussion

Plant shoot counts in spring 2013 point toward decline of the stand. Shoot counts less than 400 per square meter are considered inadequate for alfalfa production, according to industry standards. Yield levels observed in 2013, however, were still very good for only two cuts. The demonstration was continued to observe the persistence of alfalfa varieties with quicker regrowth. The Halo and CW64027 varieties persisted even with reduced dormancy. Irrigation is an important agronomic practice to promote the persistence of less dormant alfalfa varieties in our environment.

Phosphate and Potassium Fertilization of Irrigated Alfalfa*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Greg Oldhaver, Miry Creed Irrigation District, Cabri, SK

Project Objective

To evaluate the nutrient requirements of a new seed seeding of alfalfa to provide improved yield, stand longevity, and competition with weeds (dandelion).

Demonstration Plan

The demonstration field was divided into six strips to test the following fertilizer treatments: phosphorus alone, potassium alone, phosphorus, potassium and zinc together, phosphorus and potassium together, and control treatments.

Demonstration Site

The demonstration was located on Plot 13 of SE19-21-18-W3 of the Miry Creek Irrigation District. The soil is clay texture. The field had been sown to annual cereals for several years to improve the soil tilth and prepare a seedbed for planting alfalfa.

Project Methods and Observations

A 0-6" soil sample was collected from the plot area in fall, 2010 prior to fertilization. The soil was analyzed at Midwest Laboratories, Calgary.

Table 1. Soil Analysis of Plot 13, Miry Creek Irrigation District

pH (1:1 soil:water)	8.5		Soluble salts (1:1 soil:water)	0.6 mmhos/cm		
Organic Matter (%)	2.2		Excess lime	M		
CEC (meq/100g)	32.8					
Nitrate-N (0-6")(ppm)	17	L				
Sulphate S (ppm)	12	L		Micro Analysis		
Available P (ppm)	12	M	Base Saturation %	Zn	1.0 ppm	L
Extractable K (ppm)	322	H	2.5	Mn	2.0 ppm	VL
Extractable Mg (ppm)	1061	VH	27.0	Fe	15.0 ppm	M
Extractable Ca (ppm)	4476	H	68.1	Cu	2.3 ppm	VH
Extractable Na (ppm)	183	H	2.4	B	1.9 ppm	VH

* Project 2013-11

Fertilizer recommendations based on a target yield of 3 ton alfalfa/acre from this analysis:

40 lb. P_20_5, 9 lb. S, 1.8 lb. Zn, 2.3 lb. Mn and 20 lb. elemental S/acre.

The fertilizer treatments were banded November 6, 2010. The field was divided into six strips that included phosphorus alone, potassium alone, phosphorus and potassium together, phosphorus, potassium and zinc together, and two controls, one each on the east and west sides of Plot 13. The site at Miry Creek was seeded to Stealth alfalfa on June 12, 2011, with a cover crop of Morgan oats sown at 35 lb./acre. The Stealth alfalfa was sown by splitting the seed in half and double seeding the field at 45^o to the direction the cover crop was sown. The alfalfa had excellent emergence and establishment in 2011.

Alfalfa tissue samples were collected in mid-June, 2012 to evaluate the nutrient status of the alfalfa stand and the effectiveness of the banded fertility treatments. Phosphorus was applied to the field at about double the recommended rate suggested by the November 2010 soil analysis. The top 15 cm of 25 alfalfa plants were collected from each of the six fertility treatments in the field and the nutrient levels are reported in Table 2. Note that phosphorus fertilization reduces Zn uptake in alfalfa. Zinc levels in the P alone and PK treatments were lowered to marginal levels in the alfalfa tissue. The higher level of Zn in the PKZn treatments may have contributed to the darker green color of the alfalfa noted in this treatment.

Table 2. Plant Tissue Analysis of Alfalfa Samples Collected from the fertilizer treatments at the early bud stage of development (June, 2012)

Treatment (Fertilizer/acre)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
None	4.2	0.32	2.20	0.35	1.93	0.37	10	140	38	26	42
100 lb. P_2O_5	4.3	0.35	2.20	0.37	2.31	0.48	9	85	34	21	42
120 lb. K_2O	3.5	0.32	2.33	0.33	2.14	0.43	8	81	29	24	38
100 lb. P_2O_5 + 120 lb. K_2O	4.3	0.37	2.37	0.37	2.32	0.44	9	85	32	20	43
100 lb. P_2O_5 + 120 lb. K_2O + 4 lb. Zn	4.4	0.38	2.25	0.38	2.49	0.47	8	84	34	28	42
None	5.1	0.33	2.34	0.35	2.37	0.43	9	79	32	24	43
Threshold	**4.5**	**0.25**	**2.00**	**0.30**	**0.50**	**0.25**	**8**	**50**	**20**	**20**	**30**

Yields responded to the fertilizer applications at Miry Creek for the first cut. There was a 0.52 ton/ acre increase in hay yield when P, K, and Zn were banded prior to seeding. PKZn fertilizer treatments increased alfalfa hay yield by 0.5 ton/acre compared to no fertilizer.

Differences in yield were minor for the second cut. Over the growing season, the banded PKZn fertilizer treatments increased alfalfa hay yield by 0.5 ton/acre compared to no fertilizer.

One concern from the analysis is the nitrogen content of the alfalfa. The seed had been inoculated and protected from desiccation with a coating, but it needed to be stored for an extra year before sowing. The grower had re-inoculated the seed with a slurry treatment prior to seeding with his airdrill. There were occasions during the growing season as well as times of the day that the K treatments and the Zn treatment appeared darker green than the other portions of the field. This observation was by no means consistent.

Table 3. Alfalfa Yields in 2012 at Miry Creek Irrigation District, Field 13

Treatment	Rate of Nutrient (lb./acre)	Shoot Counts (shoots/m^2)	1st Cut Alfalfa Yield (ton/acre)	2nd Cut Alfalfa Yield (ton/acre)	2012 Total Alfalfa Yield (ton/acre)
Control West	None	559	2.28	1.33	3.61
Phosphorus	100 P_2O_5	535	2.54	1.14	3.68
Potassium	120 K_2O	531	2.50	1.06	3.56
Phosphorus & Potassium	100 P_2O_5 + 120 K_2O	500	2.68	1.19	3.87
Phosphorus, Potassium, & Zn	100 P_2O_5 + 120 K_2O + 4 Zn	571	2.95	1.09	4.08
Control East	None	480	2.43	--	--

Table 4. Alfalfa Yields in 2013 at Miry Creek Irrigation District, Field 13

Treatment	Rate of Nutrient (lb./acre)	Shoot Counts (shoots/m^2)	1st Cut Alfalfa Yield (ton/acre)	2nd Cut Alfalfa Yield (ton/acre)	2013 Total Alfalfa Yield (ton/acre)
Control West	None	445	--	--	--
Phosphorus	100 P_2O_5	448	1.99	1.56	3.55
Potassium	120 K_2O	485	1.83	1.24	3.07
Phosphorus & Potassium	100 P_2O_5 + 120 K_2O	474	1.89	1.42	3.31
Phosphorus, Potassium, & Zn	100 P_2O_5 + 120 K_2O + 4 Zn	458	1.95	1.39	3.34
Control East	None	419	1.57	1.32	2.89

Table 5. Alfalfa Yields in 2012 and 2013 at Miry Creek Irrigation District, Field 13

Treatment	Rate of Nutrient (lb./acre)	2012 Total Alfalfa Yield (ton/acre)	2013 Total Alfalfa Yield (ton/acre)	2012-13 Total Cumulative Alfalfa Yield (ton/acre)
Control West[1]	None	3.61	--	6.5
Phosphorus	100 P_2O_5	3.68	3.55	7.23
Potassium	120 K_2O	3.56	3.07	6.63
Phosphorus & Potassium	100 P_2O_5 + 120 K_2O	3.87	3.31	7.18
Phosphorus, Potassium, & Zn	100 P_2O_5 + 120 K_2O + 4 Zn	4.08	3.34	7.42
Control East[1]	None	--	2.89	6.5

[1] Cumulative two-year yield is the sum of west control for 2012 and east control for 2013

Table 6. First Cut Alfalfa Hay Quality at Miry Creek in 2013 (dry matter basis)

Fertilizer Treatment	Control	$P_2O_5$100	K_2O 120	$P_2O_5$100 K_2O 120	$P_2O_5$100 K_2O 120Zn4
Moisture (%)	6.68	8.69	7.57	7.38	7.49
Dry Matter (%)	93.32	91.31	92.43	92.62	92.51
Crude Protein (%)	16.85	14.62	16.16	14.70	16.46
Calcium (%)	1.69	1.50	1.44	1.40	1.43
Phosphorus (%)	0.20	0.18	0.16	0.17	0.18
Magnesium (%)	0.38	0.35	0.29	0.30	0.31
Potassium (%)	1.76	1.70	1.48	1.86	1.52
Copper (mg/kg)	12.65	9.29	9.56	8.79	8.17
Sodium (%)	0.09	0.08	0.05	0.05	0.07
Zinc (mg/kg)	38.36	19.33	22.10	18.88	18.02
Manganese (mg/kg)	49.46	25.33	26.32	21.89	23.58
Iron (mg/kg)	117.6	93.7	100.4	65.83	82.81
Acid detergent fiber (%)	37.57	41.73	39.49	40.33	39.77
Neutral detergent fiber (%)	56.10	59.95	57.92	56.10	56.51
Non fiber carbohydrate (%)	15.04	14.53	15.12	18.40	16.23
Total digestible nutrients (%)	59.40	57.32	58.44	58.01	58.30
Metabolizable energy (Mcal/kg)	2.14	2.07	2.11	2.09	2.10
Digestible energy (Mcal/kg)	2.61	2.52	2.57	2.55	2.57
Relative feed value	99.00	88.00	93.00	95.00	95.00

Soil cation analysis indicated that the soil from the south end of Plot 13 experienced impeded water infiltration due to elevated levels of sodium on the cation exchange of the soil. Application of calcium nitrate will be investigated as a method to improve the water infiltration at this site.

Table 7. Saturated Paste of Soil Samples Collected from area of Plot 13 with restricted water infiltration.

Miry Creek Plot 13	pH	Electical Cond. (mS/cm)	Saturated %	Ca mg/L	Mg mg/L	K mg/L	Na mg/L	SO_4 mg/L	Cl mg/L	SAR
14" Depth	8.59	1.18	114	18	12	2.5	225	213	114	10
18" Depth	8.55	3.13	92	37	42	<5	561	1100	310	37

Final Discussion

Soil testing is an important factor for guiding fertilization of irrigated alfalfa. General guidelines are inadequate for indicating fertility requirements for optimum irrigated alfalfa production because fields differ in their ability to supply the nutrient requirements of crops. Flood irrigated fields are land leveled to control the flow of water over the landscape. This disturbance introduces variability in the depth of topsoil and introduces subsoil to the surface of the soil, which is similar to erosion of soils. Soil testing is an essential management practice to guide investment in fertilizer on these fields.

Alfalfa is a perennial crop. Although its productivity declines over time, its performance should be evaluated over 2-3 years of production instead of a single cut. With this background, the flood project irrigators should consider both the yield performance and the quality of the production from their fields. Several conclusions can be made from this demonstration.

1) The greatest responses to fertilizer were observed with the application of phosphorus.
2) There was an initial yield response to balanced fertilizer application (PKZn), but the response was not carried through for all years and forage cuts.
3) Phosphate fertilization decreased mineral content of the forage, but adequate levels were maintained to meet nutritional requirements for cattle.
4) Phosphate fertilization decreased the level of zinc in the forage to low or marginal levels for soil with low soil test levels.
5) Balanced fertility in accordance with soil testing guidelines produced feed with higher relative feed value.

Foliar Manganese (Mn) Application to Alfalfa Under Gravity Irrigation on Sandy Loam Soil*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Bill Coventry, Chesterfield Irrigation District, Mantario, SK

Project Objective

The objective of this project was to determine the potential yield response of irrigated alfalfa to Manganese (Mn) on sandy loam soil in the Chesterfield Irrigation District.

Project Background

A tissue sample collected from the first cut of an older stand of alfalfa at the Chesterfield Irrigation District indicated Mn deficiency for both the alfalfa and bromegrass components of the hay crop in 2012. The plants were dwarfed and relatively limp with leaves that had interveinal chlorosis.

Figure 1. Yellowing, dwarfing, and stunting symptoms observed on alfalfa plants at Chesterfield Irrigation District during June of 2012. The symptoms were suspected to be indicative of a deficiency of manganese on the basis of the visual symptoms and plant tissue analysis. These symptoms became less prominent as the growing season continued and were diminished toward fall.

* Project 2013-09

Demonstration Plan

Tissue sampling in spring 2013 pointed toward a manganese deficiency occurring again. Three fields in Chesterfield District were selected for application of foliar manganese fertilizer to confirm manganese deficiency. Goals for the project were correction of the deficiency symptoms and determination of the potential yield response. Soil samples were collected from Fields 4, 10, and 15 in spring 2013 to establish a baseline soil test level for the project.

Demonstration Site

Three irrigated alfalfa fields at the Chesterfield Irrigation District were selected for application of foliar manganese. These fields are located along the northern bank floodplain of the South Saskatchewan River west of Leader. The soil texture is sandy loam. Unfortunately, floodwater arose from the South Saskatchewan River on June 15 and remained on the project fields for 2 days and up to 2 months. The alfalfa stands were severely damaged by the prolonged flooding and the manganese project could not be completed.

Project Methods and Observations

The soil sample and plant tissue samples were collected in 2011. Soil results are reported in Table 1.

Table 1. Soil Analysis of Plot 11A, Chesterfield Irrigation District in Spring 2011

pH (1:1 soil:water)	8.1		Soluble salts (1:1 soil:water)	0.3 mmhos/cm		
Organic Matter (%)	3.3		Excess lime	L		
CEC (meq/100g)	19.0					
Nitrate-N (0-6”)(ppm)	6.0	L				
Sulphate S (ppm)	10.0	L		Micro Analysis		
Bicarbonate P (ppm)	8.0	L	Base Saturation %	Zn	1.7 ppm	M
1 N NH4OAc K (ppm)	92.0	L	1.2	Mn	3.0 ppm	VL
1 N NH4OAc Mg (ppm)	478.0	VH	21.0	Fe	36.0 ppm	VH
1 N NH4OAc Ca (ppm)	2940.0	H	77.2	Cu	1.1 ppm	M
1 N NH4OAc Na (ppm)	26.0	L	0.6	B	0.6 ppm	L

Fertilizer recommendations with a target yield of 4 ton alfalfa/acre from this analysis:

75 P_20_5, 180 K_20, 14 S, 0.7 lb. Zn, 2.8 lb. Mn and 1.2 lb. B

Plant tissue samples were collected from the swaths in summer 2011 to help interpret the yield measurements. The nutrient results are reported in Table 2. Sulphur in the sample was below adequacy for both grass and alfalfa components. This observation was unexpected because the field was flood irrigated with water that supplies 4–5 lb. S/acre-in. of applied irrigation water. The application of sulphur from the water should have been adequate for production of alfalfa. Irrigation had been reduced in spring 2011 because of frequent adequate rainfall. For crops with high S requirements, such as alfalfa and canola, the S supplied by irrigation should be replaced when frequent rainfall leaches available sulphate that would normally be applied through irrigation water.

A plant tissue sample was collected in spring, 2013 from Field #4 to confirm a suspected low manganese level in the alfalfa prior to applying foliar manganese fertilizer. As shown in Table 3, a deficiency of manganese was beginning to develop in the alfalfa at the time of sampling.

Table 2. Plant Tissue Analysis of Hay in Swath in 2011

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Check	2.73	0.15	2.00	0.13	0.53	0.14	8.3	144	17	22	13
75 K_20 Band	3.00	0.14	2.09	0.14	0.48	0.11	7.0	68	18	24	12
75 P_20_5 Band	2.30	0.18	1.63	0.09	0.38	0.11	6.7	112	31	16	11
75 P_20_5 + 75 K_20 Band	2.25	0.19	2.10	0.10	0.40	0.13	6.6	72	23	15	9

Table 3. Plant Tissue Analysis of Alfalfa Growing in Field #4 Prior to Flooding in 2013

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Field #4	4.5	0.38	2.9	0.31	1.51	0.33	14.9	204	22	45	27
Threshold	4.5	0.25	2.0	0.25	0.50	0.3	8	45	25	20	30

Plant part sampled: top 0-6” of new growth on May 21, 2013

Once flooding over the banks of the South Saskatchewan River occurred in 2013, the project evaluating manganese fertility for alfalfa could not be completed. From experience in 2005, the growers indicated production was reduced for several years after the floodwaters subsided. The growers believed that this effect was beyond the impact of waterlogging on the alfalfa. The three fields sampled in the spring were sampled following the flood to determine the effect of the flooding on the soil nutrient status of the alfalfa fields. According to the soil data, the main effects of the flood event were: 1) an increase in available sulphate, and 2) a decrease in available potassium. The drop in available potassium could explain the observations expressed by the growers. The effect on available potassium would likely not be noticeable if the potassium supply was adequate to start with. The soil of this district is deficient to marginal in potassium. The hay producers should be including potassium along with phosphate in their fertilizer blends.

Table 4. Soil Analysis of Chesterfield Irrigation Fields before and after River Flooding

Site	Critical Value	Field #4		Field #10		Field #15	
Sample Timing	**(lb./acre)**	**Pre-flood**	**Post-flood**	**Pre-flood**	**Post-flood**	**Pre-flood**	**Post-flood**
N (0-12”) lb./acre	0.0	8.0	9.0	20.0	18.0	14.0	8.0
P (0-6”) lb./acre	30.0	29.0	26.0	12.0	20.0	9.0	12.0
K (0-6”) lb./acre	210.0	320.0	254.0	243.0	209.0	328.0	203.0
S (0-12”) lb./acre	21.0	30.0	67.0+	25.0	49.0	33.0	85.0+
Cu (0-6”) lb./acre	1.0	3.4	2.4	2.7	2.3	3.8	3.6
Fe (0-6”) lb./acre	9.0	82.0	73.0	61.0	64.0	83.0	122.0
Mn* (0-6”) lb./acre	2.0	10.7	10.9	7.9	9.9	10.5	16.4
Zn (0-6”) lb./acre	1.0	4.0	3.0	2.6	2.4	3.5	2.9
B (0-6”) lb./acre	1.2	1.7	1.8	1.4	1.4	1.5	1.0
Sampling date:	-	May 16	August 13	May 16	August 13	May 16	August 13

*Critical value determined from literature. It is has not been locally determined because deficiency has not been identified on mineral soils in Saskatchewan.

Conclusion

The alfalfa fields of Chesterfield Irrigation District have low available phosphate and potassium in addition to a low supply of manganese. Sulphur also is not adequate in the fields if rainfall is sufficient to reduce application of irrigation water. Soil sampling before and after the river flood event of 2013 indicates that potassium fertility is reduced once flood waters recede. The river flooding of 2013 will prevent testing of manganese foliar applications to alfalfa at Chesterfield until at least 2015.

IRRIGATION SCHEDULING PROJECTS 2013

Irrigation Water Management 2013

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Glen Erlandson, South Saskatchewan River Irrigation District, Outlook, SK
- Gary Ewen, Riverhurst Irrigation District, Riverhurst, SK
- David Bagshaw, Luck Lake Irrigation District, Birsay, SK
- Peter Hiebert, Riverhurst Irrigation District, Riverhurst, SK
- Randy Dahl, South Saskatchewan River Irrigation District, Outlook, SK.
- Ryan Grunerud, South Saskatchewan River Irrigation District, Outlook, SK

Project Objective

The objective was to familiarize producers with the Alberta Irrigation Management Model (AIMM) and eliminate the differences between current on-farm irrigation water management practices and optimal irrigation levels predicted through AIMM. A single site was also used to compare AIMM outcomes to those of a John Deere Field Connect moisture probe.

Project Plan

This project builds on similar projects carried out in 2010, 2011, and 2012 and was conducted on producer fields in the Riverhurst Irrigation District (RID), Luck Lake Irrigation District (LLID) and South Saskatchewan River Irrigation District (SSRID). This project was conducted using the copper demonstration fields (see page 40), as well as one separate site in which a Field Connect moisture probe was used. A weather station had previously been installed in each district in 2010 to collect appropriate weather data required for AIMM. Weather data was downloaded weekly into the model.

Fields were monitored weekly. Each field was equipped with dryland and irrigation rain gauges and two Watermark™ sensors, one located at a depth of 30 cm and another at 60 cm. Soil moisture content was determined gravimetrically following seeding. The actual irrigation management and crop water use data was compared to a modeled optimum irrigation management scenario for the fields determined through AIMM.

A single site in RID was set up with much more extensive monitoring. At this site a John Deere Field Connect moisture probe was installed to measure moisture at depths of 10, 20, 30, and 50 cm. This information was directly uploaded several times per day to the Field Connect webpage. A total of seven Watermark™ sensors were placed at 15, 45, and 70 cm, as well as 10, 20, 30, and 50 cm to mimic the measurements of the Field Connect probe. Two FullStop™ devices were installed, one at 15 cm and another at 30 cm. Dryland and irrigated rain gauges were placed, and an ET gauge was installed. The Field Connect probe consists of multiple sensors on a single probe and sends readings to a control box mounted directly onto the probe. The unit is powered via a solar panel and information is sent through satellite to a database and uploaded onto an internet account. The probe can also be equipped with many other features, similar to a weather station. A Watermark™ sensor is an electrical resistance sensing device that is used to measure soil water tension. As the tension changes with water content, the resistance changes as well. A FullStop is a wetting front detector with an indicator that becomes exposed when the wetting front is hit with water. Once the indicator is reset, if the indicator does not become re-exposed, the wetting front has passed; if it is re-exposed, the wetting front is still present. An ET gauge is a device that measures evapotranspiration using a filter over a cylinder of water that resists evaporation, similar to a crop canopy.

Demonstration Sites

Crops monitored under the copper demonstration were hard spring wheat and soft white wheat. Soil textures of these fields range from loamy sand to clay loam. Seeding occurred from May 6 to June 3, 2013.

The Field Connect site, SW 22-22-7-W3 in the RID, was seeded to durum wheat on May 17, 2013. Soil texture is silty loam.

Project Methods and Observations

Spring soil moisture levels were determined by gravimetric analysis for all field sites. Samples were collected as close to seeding as possible. Fields were monitored on a weekly basis following seeding to check soil moisture levels, irrigation application amounts, rainfall, and crop development.

Actual crop water use, or the amount of evapotranspiration, was calculated from the date of spring soil sampling to August 23. Effective irrigation, runoff, and deep percolation were calculated in AIMM. Graphs were generated by the AIMM model, depicting moisture use based on producer irrigation management practices.

At the Field Connect site, weekly measurements were taken from all instruments and compared to weekly gravimetric measurements, Field Connect readings, and the AIMM model results.

Final Discussion

The copper demonstration sites showed that optimum crop water use was not achieved. In most cases, this was a result of producers believing they had watered enough. Other factors included pump site problems prior to flood waters entering Lake Diefenbaker, electrical problems, and lodging concerns.

According to the Field Connect probe, AIMM, gravimetrics, and watermark sensors, optimum crop water use was also not achieved at the Field Connect site. The producer followed the Field Connect probe to make watering decisions. After an untimely rainfall on July 15, the crop went down significantly. Over the next 10 days, irrigation was stopped to determine whether the crop would stand up. During this time, fungicide was applied. A light application of irrigation at 0.3 of an inch was applied to test standability. After the crop handled the light irrigation, three more applications of 0.6 inches were applied in an effort to match crop water use. The crop did end up lodging significantly and crop water use brought available moisture to below 50% field capacity, largely due to the period July 15 to 25 when there was no irrigation.

The Field Connect probe gave exact correlation to the rain and irrigation events that took place (Figure 1), but the ability to input gravimetrics into AIMM allows adjustment of output values according to measured soil moisture (Figure 2). As for the Field Connect probe, the readings are strictly computerized and cannot be corrected. Budget lines between the two programs are set differently and this also accounted for differences between the graphs. Both systems produced useful data and further demonstration is needed in order to establish a true comparison.

Figure 1. Field Connect probe graph for SW 22-22-7-W3.

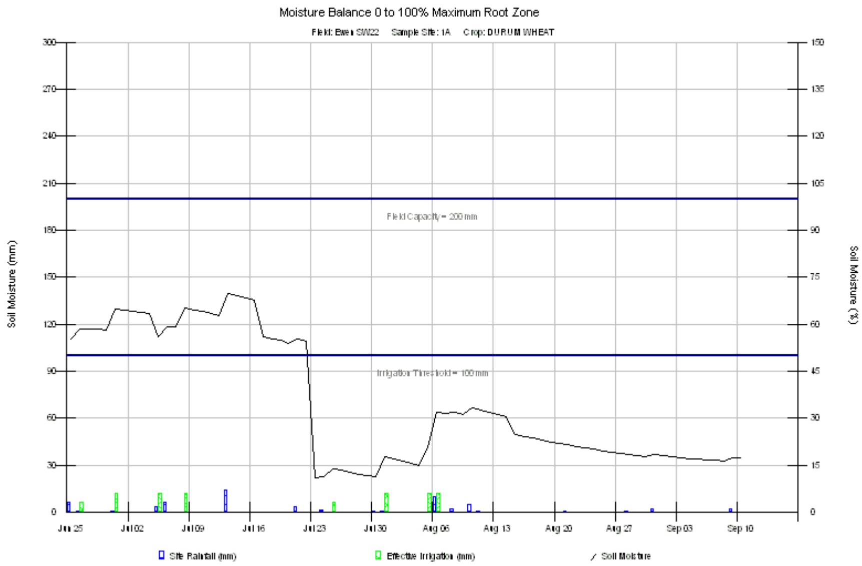

Figure 2. AIMM graph for SW 22-22-7-W3.

If ICDC is able to use the Field Connect probe for demonstration in the future, the AIMM and Field Connect project will be carried out at the same time using a gravimetric to calibrate both systems to keep them on par at the beginning and compare readings throughout the year. Further details of each program will also need to be explored to correlate the interpretation that each program is attempting to make.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Western Sales – Rob Warkentin – for the use of the John Deere Field Connect probe and website.
- Gary Ewen – for the use of the site and willingness to water according to probe readings.

TECHNOLOGY TRANSFER 2013

Ministry of Agriculture/ICDC Agrologist Extension Events

Field Days

CSIDC Irrigation Field Day and Tradeshow—July 11, 2013

- Water scheduling for irrigation, coordinated discussion by Gary Kruger, Ministry of Agriculture
- Field tour leaders were Garth Weiterman and Kelly Farden, Ministry of Agriculture

Forage Field Day—August 28, 2013

- Event organizer and tour leader, Sarah Sommerfeld, Ministry of Agriculture
- Corn variety demonstration field stop, Garry Hnatowich, ICDC
- N fertility following alfalfa termination on oat production field stop, Gary Kruger, Ministry of Agriculture
- Salt tolerant forage demonstration field stop, Sarah Sommerfeld and Kelly Farden, Ministry of Agriculture
- Demonstration of triticale for annual forages field stop, Sarah Sommerfeld and Nadia Mori, Ministry of Agriculture
- Demonstration of perennial forages field stop, Sarah Sommerfeld, Ministry of Agriculture and Leanne Thompson, Saskatchewan Forage Council

Diagnostic School

- Nodulation Assessment Section, organized and presented by Rory Cranston, Ministry of Agriculture, assisted by Garry Hnatowich, ICDC

Booth Display

- Crop Production Week, Saskatoon, January, 2013
- CSIDC Irrigation Field Day and Tradeshow, Outlook, July 11, 2013
- ICDC/SIPA Annual Conference, Moose Jaw, December 3–4, 2013

Publications

- *Crop Varieties for Irrigation*, 2013
- *Irrigation Economics and Agronomics*, January 2013
- *The Irrigator*, March 2013

Presentations

Gary Kruger

- ICDC Project Overview at AgriArm Day at Crop Production Show, January 11, 2013
- Forage Fertility – webinar presentation to Forage Specialists January 15, 2013
- ICDC Report to Chesterfield Irrigation District, February 5, 2013
- ICDC Report to Ponteix Irrigation District, March 18, 2013
- ICDC Report to Riverhurst Irrigation District, March 19, 2013
- ICDC Report to Macrorie Irrigation District, March 20, 2013
- ICDC Report to Luck Lake Irrigation District, March 27, 2013
- ICDC Report to South Saskatchewan River Irrigation District, April 2, 2013
- ICDC Report to Rush Lake Irrigation District, April 3, 2013
- Is Your Irrigated Field Looking for Zinc? Irrigation Agronomy Workshop, April 9, 2013
- ICDC Report to Miry Creek Irrigation District, April 9, 2013
- Irrigated Crop Rotations: A Risk Management Strategy, Presentation to Crop and Irrigation Branch, Outlook, April 18, 2013
- ICDC Report to North Waldeck Irrigation District, April 22, 2013

Rory Cranston

- Irrigation Research Update, Agronomy Research Update, December 13 2012
- ICDC Report to Riverhurst Irrigation District, March 19, 2013
- ICDC Report to Macrorie Irrigation District, March 20, 2013
- ICDC Report to Luck Lake Irrigation District, March 27, 2013
- ICDC Report to South Saskatchewan River Irrigation District, April 2, 2013
- Disease Management on Irrigation , April 9, 2013
- Agriculture and Irrigation Tour for Biology 20 class, June 11, 2013
- IPM principals, Perennial Weed Workshop, June 27, 2013
- Irrigation Research Update, Farmagate, July 5, 2013
- Irrigation Water Management and Disease Management, CSIDC Field Day July 11, 2013
- How to Stage a Crop for Fungicide Application, July 18, 2013
- Bertha Army Worm Infestation, MX 100 radio interview, July 19, 2013
- Irrigated Crop Progress, CKRM radio interview, August 28, 2013

Sarah Sommerfeld

- Forage Variety Recommendations, Irrigation Agronomy Workshop, April 9, 2013
- Forage Fertilization, Crop Production Services Agronomy meeting, April 16, 2013
- Agriculture and Irrigation Tour for Biology 20 class, June 11, 2013
- Forage Harvest Management, CJWW radio spot, June 21, 2013
- Foxtail Weeds and How to Manage Them, Perennial Weed Workshop, June 27, 2013
- Importance of Feed Testing, CJWW radio spot, August 2, 2013

- Feed Quality of Crop Residues, CJWW radio spot, September 13, 2013
- Advocate for Agriculture, CJWW radio spot, October 25, 2013

Agriview Articles 2013

Garth Weiterman

- 2013 SIPA/ICDC Annual Conference – November 2013
- 2013 Irrigation Research and Demonstration Highlights – December 2013/January 2014

Gary Kruger

- Managing Nitrogen for Oats – December 2012/January 2013
- Annual Cereal Demonstration – March 2013
- Irrigation Crop Diversification Field Program – June 2013
- Nutrient Assessment: Another Technique for Predicting Crop Performance – October 2013

Rory Cranston

- Identifying the Proper Stage to Control FHB – June 2013
- Understanding Crop Water Use to Improve Your Irrigation Water Management – July/August 2013
- Best Time to Control Winter Annuals Is After Harvest – September 2013
- 2013 Irrigation Research and Demonstration Highlights – December 2013/January 2014

Jeff Ewen

- 2013 SIPA/ICDC Annual Conference – December 2013

Sarah Sommerfeld

- Evaluation of Commercial Pasture Blends – February 2013
- The Cutting Edge in Forage Management – February 2013
- Forage Harvest Management – June 2013

Other Articles 2013

Garth Weiterman

- Weed Control in Irrigated Bean Crops, *Crop Production Newsletter* July 10, 2013
- Fungicides and Irrigation Scheduling, *Crop Production Newsletter* July 22, 2013

Gary Kruger

- Is Your Irrigated Field Looking for Zinc? *The Irrigator*, March 2013
- Irrigated Crop Rotations: A Risk Management Strategy, *The Irrigator,* March 2013

Rory Cranston

- Get a Leg up on Blackleg, *The Outlook* and *West Central Crossroads* newspaper article, January 2013
- Fungicide Application, *Regional Crops News*, January 2013
- Managing Herbicide Resistance, *West Region Newsletter*, February 2013
- What's Up with New Fertilizer Products, *West Region Newsletter*, February 2013 Fungicide Application in Cereals, *The Irrigator*, March 2013
- Concerns about 2013 Seed Quality, *The Outlook* and *West Central Crossroads* newspaper article, March 2013
- Flea Beatles, *The Outlook* and *West Central Crossroads* newspaper article, June 2013
- Post-Harvest Weed Management, *The Outlook* and *West Central Crossroads* newspaper article, August 2013
- Clubroot, Back in the Spotlight ,*The Outlook* and *West Central Crossroads* newspaper article, November 2013

Sarah Sommerfeld

- Cicer Milkvetch: A Non-bloat Forage Legume, *The Outlook* and *West Central Crossroads* newspaper article, December 2012
- Pasture Blends for Irrigation, *The Irrigator*, March 2013
- Corn Varieties for Silage and Grazing, *The Irrigator*, March 2013
- Alfalfa Weevil, *The Outlook* and *West Central Crossroads* newspaper article, June 2013
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- Diamond Back Moth Survey, May/June 2013 – Rory Cranston
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- Pea Root Rot Survey, June 2013 – Rory Cranston
- Field Pea Weevil, June 2013 – Gary Kruger
- Field Pea Weevil, June 2013 – Gary Kruger
- Canola Disease Survey, August 2013 – Rory Cranston
- Lake Diefenbaker Development Area Cropping Survey, August 6–8 – Jeff Ewen and Gary Kruger
- Fusarium Head Blight Survey, August 12 – 14 - Jeff Ewen

www.irrigationsaskatchewan.com Report 2013

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. All 2013 activities and publications have been uploaded to the site.

ABBREVIATIONS

AAFC	Agriculture and Agri-Food Canada
ac	acre or acres
ACC	Alberta Corn Committee
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

ICDC Research and Demonstration Program Report 2013
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ISSN: 1926-7789 November 2013