Irrigation Crop Diversification Corporation

ICDC

Research and Demonstration

Program Report

2014

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Irrigation Crop Diversification Corporation

Research and Demonstration Program Report 2014

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ICDC Research and Demonstration Program Report 2014

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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 (current term)
Jay Anderson	Chairman	SSRID	LDDA	2014 (1st)
Ryan Miner	Vice Chairman	Riverhurst	SEDA	2015 (1st)
Greg Oldhaver	Alt. Vice Chairman	Miry Creek	SWDA	2014 (1nd)
David Bagshaw	Director	Luck Lake	LDDA	2016 (2nd)
Vacant	Director		NDA	2015
Vacant	Director		SWDA	2016
Colin Ahrens	Director	Individual Irrigators	Non-District	2015 (2nd)
Joel Vanderschaaf	Director	SSRID	SIPA representative	Appointed
Rob Oldhaver	Vice Chair	Miry Creek	SIPA representative	Appointed
Kelly Farden	Director	N/A	SA representative	Appointed
Doug Pchajek	Director	N/A	SA representative	Appointed

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

Northern (NDA),

South Western (SWDA),

South Eastern (SEDA), and

Lake Diefenbaker (LDDA).

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

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

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

TABLE OF CONTENTS

FIELD CROPS

Demonstration of Using Single and Multiple Modes of Action for a Double Fungicide Application System in Irrigated Canola*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Craig Langer, Grower, Riverhurst, SK, Riverhurst Irrigation District
- Mark Oram, Grower, Central Butte, SK, Grainland Irrigation District

Project Objective

This project aimed to demonstrate that using different modes of action and creating a fungicide rotation can provide an improved level of disease control, increased yield, and extend the effective life of current fungicides.

Project Plan

Two producers who had planned to apply a fungicide participated. They applied two different fungicides at the 30% bloom stage. Three different treatments were undertaken, including Proline at the rate of 40 acres per jug, Astound at 40 acres per jug, and Astound at 26 acres per jug. Proline and Astound at the 40 acre rate were applied again 10 to 14 days after the first application. Each treatment area was approximately 20 acres in size, resulting in a field that consisted of seven different treatment areas with either a single or double fungicide application, areas with single or double mode of action fungicide, and areas with the same or different fungicides applied. Disease incidence, disease severity, and yield were considered in the evaluation of the success of each treatment.

Riverhurst Demonstration Site

The demonstration site, SE27-22-7-W3, is a 130 acre center pivot plot located in the Riverhurst Irrigation District. The soil texture is loam, and the field was seeded to durum in 2013.

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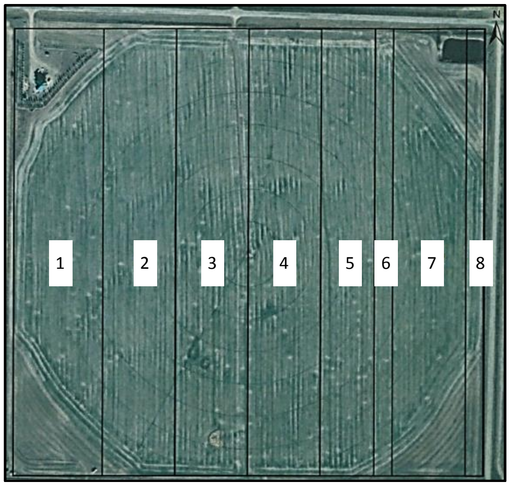
* Project 2014-06

Crop Management

Liberty L150 canola was seeded on May 15, 2014. The first fungicide application of Astound and Proline took place on July 7, 2014. The second fungicide application of Astound and Proline was on July 16, 2014. The canola was swathed on August 26, 2014 and harvested September 17, 2014.



Area	Product	Application #	Rate
1	Proline	1	40 ac rate
2	Proline	1	40 ac rate
	Astound	2	40 ac rate
3	Proline	1	40 ac rate
	Proline	2	40 ac rate
4	Astound	1	40 ac rate
	Proline	2	40 ac rate
5	Astound	1	40 ac rate
	Astound	2	40 ac rate
6	Astound	1	40 ac rate
7	Astound	1	26 ac rate

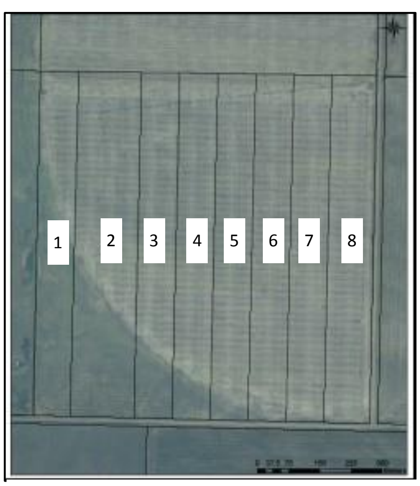
Figure 1. Aerial view of SE27-22-07-W3M with overlaid plot areas.

Grainland Demonstration Site

The demonstration site, SE5-23-7-W3, is a 307-acre center pivot plot located in the Grainland Irrigation District. The field was seeded to durum in 2013.

Crop Management

Liberty 5440 canola was seeded on May 15, 2014. The first fungicide application of Astound and Proline took place on July 4, 2014. The second fungicide application of Astound and Proline took place on July 14, 2014. The canola was swathed August 25, 2014 and harvested September 8, 2014.



Area	Product	Application #	Rate
1	Astound	1	40 ac rate
2	Astound	1	26 ac rate
3	Astound	1	40 ac rate
	Astound	2	40 ac rate
4	Astound	1	40 ac rate
	Proline	2	40 ac rate
5	Proline	1	40 ac rate
	Proline	2	40 ac rate
6	Proline	1	40 ac rate
7	Proline	1	40 ac rate
	Astound	2	40 ac rate
8	Proline	1	40 ac rate

Figure 2. Aerial view of SE5-23-7-W3 with overlaid plot areas.

Disease Incidence and Severity

Disease incidence and severity was observed on August 19 at Grainland and August 20 at Riverhurst, 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 level of disease. Disease severity was determined using the following 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 *Sclerotinia* stem rot control in canola. *Crop Protection* 25:7, 640-646.

The severity rating was calculated using the following equation:

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

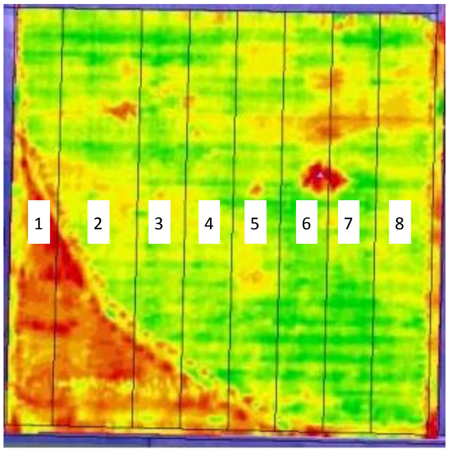
Results

Table 1. Riverhurst SE27-22-7-W3

Treatment	Rep	Distance (M)	Cut Width (ft)	Weight (lb)	Yield (bu/acre)	AVG (Bus/acre)	Incidence	Severity
Astound 1st app	1	400	33	2276 ŧ	45.79 ŧ	45.20 ŧ	74% ŧ	1.9
Astound 1st app	2	400	33	2220 ŧ	44.60 ŧ			
Astound High Rate	1	400	33	2288	46.00	47.27	64%	1.7
Astound High Rate	2	400	33	2412	48.53			
Proline 1st app	1	400	33	2640 ᵗ	53.00 ᵗ	52.70 ᵗ	50%	2.1 ŧ
Proline 1st app	2	400	33	2604 ᵗ	52.40 ᵗ			
Proline 1st app Astound 2nd app	1	400	33	2488	49.50	49.94	44%	1.7
Proline 1st app Astound 2nd app	2	400	33	2504	50.38			
Astound 1st app Proline 2nd app	1	400	33	2584	52.00	50.89	26%ᵗ	1.3ᵗ
Astound 1st app Proline 2nd app	2	400	33	2474	49.77			
Astound 1st & 2nd app	1	400	33	2420	48.70	48.39	52%	1.5
Astound 1st & 2nd app	2	400	33	2390	48.08			
Proline 1st & 2nd app	1	400	33	2455	49.40	50.00	34%	1.7
Proline 1st & 2nd app	2	400	33	2518	50.60			

ᵗ Best ŧ Worst

Table 2. Grainland SE5-23-7-W3



Treatment	Area (acres)	Yield (Bu/acre)	Incidence	Severity
Astound 1st App (1)	5.38	55.64	24%	2.3
Astound High Rate (2)	12.72 ŧ	55.18 ŧ	14%	2.7
Proline 1st App (6 &8)	15.00	56.51	27% ŧ	2.2
Proline 1st App Astound 2nd App (7)	17.54 [t]	59.64 [t]	15%	1.5
Astound 1st App Proline 2nd App (4)	14.50	56.12	16%	1.5
Astound 1st & 2nd App (3)	12.91	56.82	12% [t]	2.7 ŧ
Proline 1st & 2nd App (5)	16.12	55.53	12% [t]	1.3 [t]
Total	**94.17**	**56.49**	**17%**	**2.0**

[t] Best ŧ Worst

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 is similar to an ICDC demonstration carried out in 2013 in which a double fungicide application with two different modes of action increased yield by 10 bu./acre compared to a single application at the Riverhurst site. A second site at Moon Lake showed a single application of fungicide increased yield by 4 bu./acre and a double fungicide application with two different modes of action increased yield by another 8 bu./acre.

In 2014, the Riverhurst site found a single application of Proline to produce the highest yield, although it had 50% incidence of disease and the highest severity at 2.1. A single application of Astound produced the lowest yield, which correlated with the fact that the treatment area had the highest incidence of disease. The double fungicide application with different modes of action did result in the lowest incidence and severity on the site, but did not achieve the top yield.

The Grainland site found a first application of Proline followed by Astound to produce the highest yield, yet the disease survey found that the treatment area that received a double application of Proline to have the lowest incidence and severity of disease. The high rate of Astound produced the smallest yield, with a single application of Proline experiencing the highest incidence of disease.

It has been shown through demonstration in three separate years that application of fungicide for *Sclerotinia sclerotiorum* in irrigated canola is worth the investment. In 2014, a double fungicide application did not show comparable results to those in 2013 or 2011. This is likely due to the change in conditions from year to year and the fact that damage from *Sclerotinia sclerotiorum* cannot be predicted prior to infection. Drastic differences were found between the two sites, with Riverhurst experiencing a much higher incidence of disease and slight differences in yield between the treatments. In Grainland, severity was fairly high but incidence was low and the yield differences were very minimal between treatments. At the Grainland site, it is unlikely that disease was the factor that impacted the variability in yield. More likely, the yield difference was due to soil and topography variability. In 2014, a second application of fungicide was not found to be economical.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Western Sales – Field Smart – for yield map analysis
- Bayer Crop Science – for fungicide products
- Syngenta – for fungicide products

Demonstration of Plant Growth Regulator Application on Irrigated Wheat Production*

Project Lead

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

Co-operator

- Canada-Saskatchewan Irrigation Diversification Centre (CSIDC)

Project Objective

The objective of this project was to demonstrate the effect of applying a plant growth regulator (PGR) on irrigated wheat production. This project was undertaken to demonstrate the optimal stage for PGR application, fertility levels, and irrigation amounts in an intensive verses normal irrigation program. This project demonstrated the research results from a project that was conducted at the Indian Head Agriculture Research Foundation (IHARF) in 2013.

Demonstration Plan

This project was established at the Canada Saskatchewan Irrigation Diversification Centre (CSIDC) in Outlook. This project demonstrated the effects that a PGR has on an irrigated wheat crop. It demonstrated two different application timings: growth stage 21 and growth stage 32. It demonstrated three different fertility levels based on soil test recommendations. The fertility levels were: recommended fertility and 125% and 150% of recommended fertility. Two different irrigation levels were demonstrated, normal and increased. The increased irrigation treatment attempted to lodge the crop with extra watering.

Demonstration Site

The demonstration was conducted on Field 1 under a variable-rate center pivot at CSIDC.

Project Methods

Detailed agronomics are displayed in Table 1. Extensive monitoring occurred through the growing season to regulate irrigation between the regular and intensive irrigation treatments. Monitoring plant stage was also important for staging PGR. Following PGR application, the field was monitored and differences between treated and untreated areas were noted.

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* Project 2014-07

Table 1. Agronomic Management

Nutrients	**N**	**P**		
Recommended:	107	32		
125%:	134	32		
150%:	160	32		
Seeding				
Date:	May 26, 2014			
Variety:	Utmost			
Herbicide				
Date:	June 11, 2014 & June 26, 2014			
Product:	Bison/Buctril M			
Plant Growth Regulator				
Growth Stage:	21		Date:	July 1, 2014
Growth Stage:	32		Date:	July 8, 2014
Product:	Manipulator			
Fungicide				
Date:	July 14, 2014			
Product:	Headline			
Harvest				
Date:	September 22, 2014			
Precipitation:	**mm**	**inches**		
Rainfall:	242.0	9.7		
Regular Irrigation:	87.5	3.5		
Intensive Irrigation:	137.5	5.5		

Results

Results are recorded in Table 2. Plant height reduction was noted but did not show any pattern within treatments. Some lodging was also noted, however there did not appear to be any particular pattern between treatments for this either.

Table 2. Project Results

Treatment	Yield (bu/ac)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)
Irrigation Regime				
Irrigation	86	15.3	76.4	34.4
Intensive Irrigation	84.5	15.3	75.9	33.8
LSD (0.05)	NS	NS	S	NS
CV	4.3	0.8	0.2	2.1
Plant Growth Regulator				
Control	86	15.4	76.5	34.9
Growth Stage 21	84	15.2	75.9	33.6
Growth Stage 32	85.5	15.4	76.0	33.9
LSD (0.05)	NS	NS	0.2	0.5

Treatment	Yield (bu/ac)	Protein (%)	Test weight (kg/hl)	Seed weight (mg)
N Application				
1.00X	85	15.3	76.2	34.0
1.25X	85.5	15.3	76.2	34.1
1.50X	85	15.3	76.1	34.2
LSD (0.05)	NS	NS	NS	NS
Irrigation x Plant Growth Regulator x N Application				
LSD (0.05)	NS	NS	NS	NS

Final Discussion

Lodging is a major issue in cereal production under irrigation. When a crop lodges, it becomes much more difficult to harvest and there is potential for yield loss. A PGR has potential to shorten a crop, which reduces the chances that the crop will lodge.

This demonstration follows a field-scale ICDC project conducted in 2013 on irrigated wheat. In 2014, this demonstration was a more extensive plot format and incorporated increased nitrogen rates, increased irrigation intensity, and two different PGR application timings.

All treatments in this demonstration showed no statistical difference in yield, protein, or TKW. Both plant height reduction and lodging were noted, but no particular pattern between treatments was observed.

ICDC will continue to investigate and perform demonstration projects with plant growth regulators in 2015.

Acknowledgements

The project lead would like to acknowledge the following contributors:

- Engage Agro – for demonstration product PGR Manipulator

Field Demonstration of Plant Growth Regulator Application on Irrigated Wheat Production*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Dale Ewen, Grower, Riverhurst, SK, Riverhurst Irrigation District

Project Objective

The objective of this project was to demonstrate the effect of applying a plant growth regulator on durum under irrigation. This project built upon a field-scale demonstration that ICDC had conducted in 2013.

Project Plan

This project was established on a co-operator's field near Riverhurst, SK. The co-operating producer carried out normal operations across the field, with the addition of a small treated area that was used to compare the height, lodging, and yield to that of the untreated area.

Demonstration Site

The demonstration site, NW12-23-7W3, has a 200-acre corner-arm center pivot and is located in the Riverhurst Irrigation District. The soil texture is loam, and the field was seeded to canola in 2013.

Project Methods

Detailed agronomics are displayed in Table 1. Monitoring plant stage was important for staging the PGR, which occurred at growth stage 31 (Figures 1 and 2). Extensive moisture level monitoring took place weekly through the growing season and moisture requirements were predicted using the Alberta Irrigation Management Model (AIMM). The AIMM graph for the field is shown in Figure 3. Following PGR application, the field was monitored weekly to observe differences between treated and untreated areas.

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* Project 2014-04

Figure 1. PGR application timing – growth stage 31.

Figure 2. PGR application timing – growth stage 31.

Table 1. Agronomic Management

Seeding	
Date:	May 23,2014
Variety:	Brigade
Rate:	120 lb./ac
Herbicide	
Date:	June 23,2014
Product:	Octane & Traxios
Plant Growth Regulator	
Date:	June 27,2014
Product:	Manipulator
Fusarium Headblight Fungicide	
Date:	July 21,2014
Product:	Prosaro
Harvest	
Date:	September 29, 2014
Available Moisture (inches)	
Rainfall:	8.2
Irrigation:	1.1

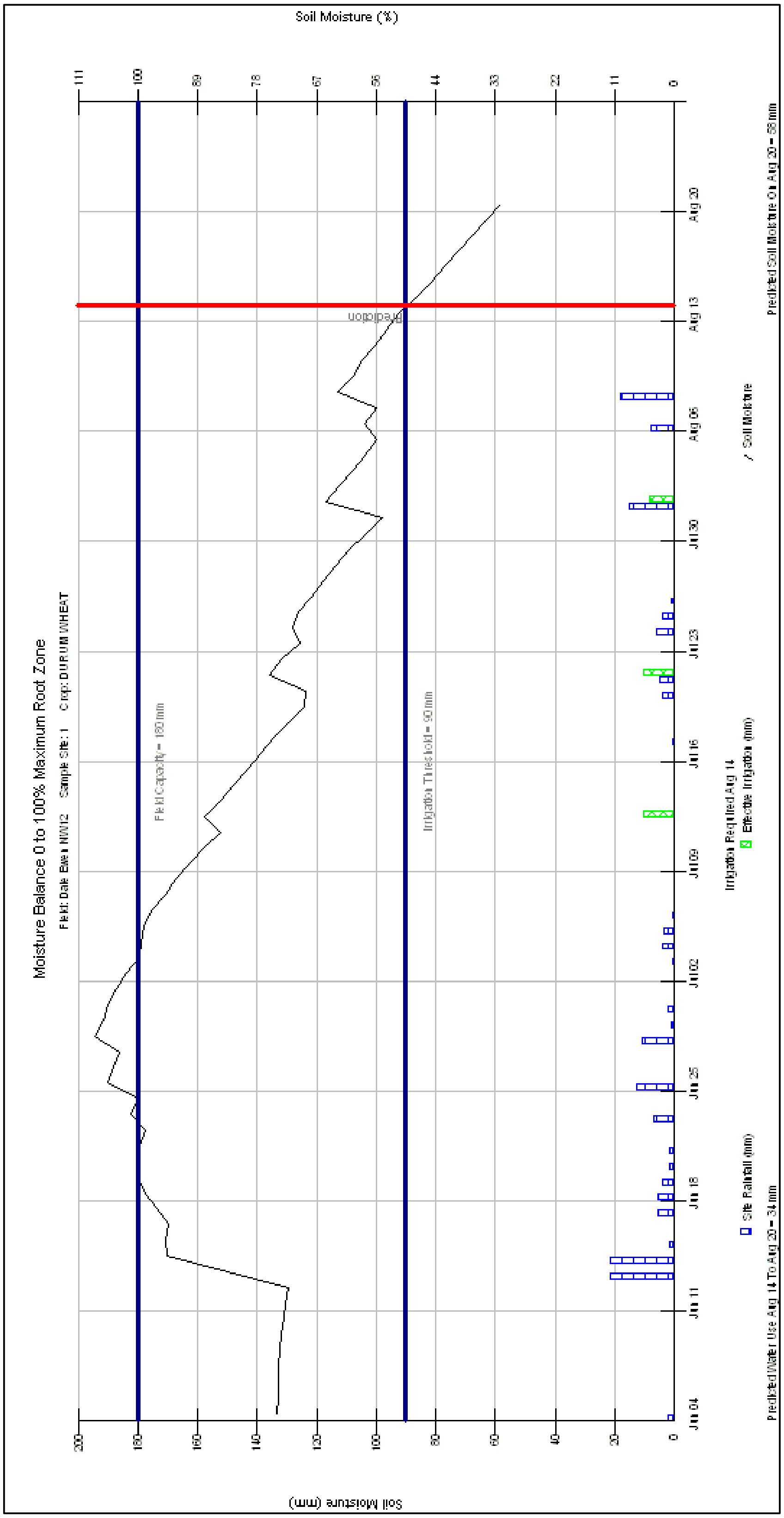

Figure 3. AIMM graph for NE 11-22-7-W3.

Results

Harvest took place September 29, 2014. The yield map from the demonstration site is depicted in Figure 6. Visual identification of the treatment in the field could be seen a week after application and until after the crop was harvested. Lodging of the untreated area started in late July and the treated area remained standing until August 24, 2014. Final lodging rates were 90% in the untreated area and 70% in the treated area. Average yield of the untreated area was 68.8 bu./acre and the treated area averaged 78.6 bu./acre.

Figure 4. Plant samples taken July 22 (25 DAT).
Top: Untreated. **Bottom:** Treated with PGR.
Note the 10-15 cm height difference.

Figure 5. Treatment line August 2, 2014.
Left: Untreated. **Right:** Treated with PGR.

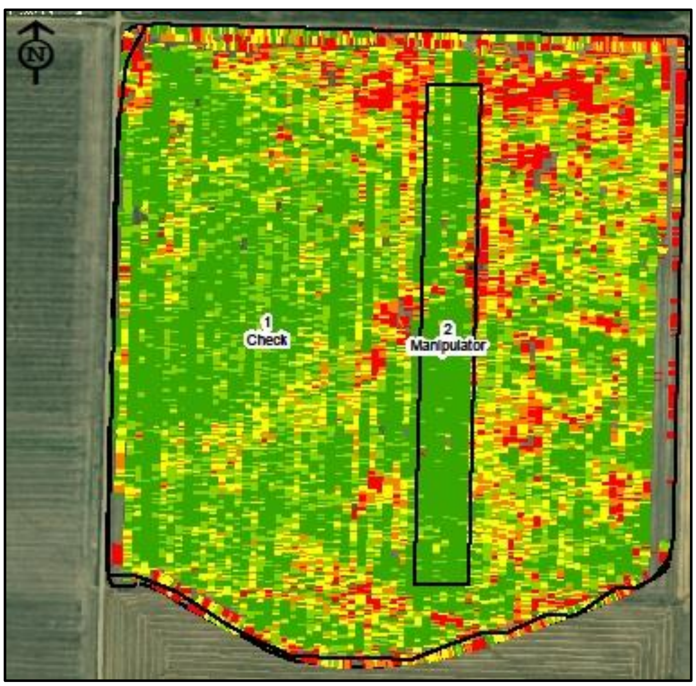

Figure 6. Farmers Edge yield map.

Final Discussion

Lodging is a major issue in cereal production under irrigation. When the crop lodges, it becomes much harder to harvest and there is potential for yield loss. A plant growth regulator has the potential of shortening the stem of the crop and, as a result, reduces the chances that the crop will lodge.

This demonstration is a follow up to a similar ICDC project conducted in 2013 on irrigated wheat. In 2014, irrigated durum was chosen, which traditionally grows taller and has higher yields.

In this demonstration, the application of plant growth regulator shortened the height by 12.6 cm or 11.2%. Lodging was avoided for approximately an extra month through heading and in the end the plant growth regulator reduced lodging by 20%. The treatment also increased yield by 9.8 bu./acre. The substantial yield increase is believed to be the result of the crop being able to stand through the head-filling stages when the untreated area was already lying down.

The plant growth regulator used, which goes by the trade name Manipulator®, was not registered at the time of application and this project followed PMRA regulations. Manipulator was officially registered in September, 2014 and will be available for application in 2015. ICDC will continue to investigate and demonstrate plant growth regulators in 2015.

Acknowledgements

The project lead would like to thank the following contributors:

- Engage Agro – for demo product PGR Manipulator
- Farmers Edge – for analyzing yield data

Vertical Tillage under Irrigation*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Craig Langer, Grower, Riverhurst, SK, Riverhurst Irrigation District
- David Bagshaw, Grower, Birsay, SK, Luck Lake Irrigation District

Project Objective

The purpose of this project was to demonstrate vertical tillage for trash management, increased straw mineralization from partial straw burial, and faster soil warming in the spring to allow for earlier seeding, which may contribute to increased yield.

Demonstration Plan

Vertical tillage occurred on two sites with heavy cereal stubble. A plot of approximately 40 acres was split into two treatment areas: half was tilled with both shanks and disks and half was tilled with only disks. The remainder of the field was treated per normal practice and used as a check. The following spring, normal practice seeding occurred. Throughout the growing season, soil moisture was monitored for irrigation scheduling, and weekly visits were made to observe any visual differences between treatments.

Riverhurst Demonstration Site

The demonstration site, NE27-22-7-W3, is a 100-acre center pivot field located in the Riverhurst Irrigation District. The soil texture is loam, and the field was seeded to durum in 2013.

Project

Vertical tillage occurred on October 25, 2014. Three treatments were carried out (Figures 1 and 2): vertical tillage disk and shank, vertical tillage disk only, and no vertical tillage (check).

* Project 2014-12

Figure 1. Check (left); shank and disk (right).

Figure 2. Check (left); disk only (right).

Crop Management

In the fall of 2013, 102 lb. of nitrogen per acre, along with 61 lb. of phosphate per acre, was applied with a floater prior to vertical tillage. Liberty L150 canola was seeded on May 16, 2014 with 40 lb./acre of seed-placed-nitrogen. In-crop herbicide application was carried out using Liberty and Centurion on June 9, 2014. The fungicide, Proline, was applied on July 8, 2014. The canola was swathed on August 26, 2014 and was harvested on September 17, 2014.

Irrigation

Soil moisture was monitored throughout the year. Soil texture was considered and a soil gravimetric was conducted to determine the exact soil moisture. The collected data was analyzed using the Alberta Irrigation Management Model (AIMM) and tracked throughout the growing season.

Luck Lake Demonstration Site

The demonstration site, NE25-24-8-W3, has a 300-acre center pivot and is located in the Luck Lake Irrigation District. The soil texture is clay to clay loam, and the field was seeded to spring wheat in 2013.

Project

Vertical tillage occurred on October 29, 2013. There were three treatments (Figures 3 and 4): vertical tillage disk and shank, vertical tillage disk only, and no vertical tillage (check).

Figure 3. Disk and shank (left); check (right).

Figure 4. Disk Only (left); disk and shank (right).

Crop Management

Vertical tillage occurred on October 29, 2013. On May 10, 2014, 50 lb./acre of nitrogen along with 20lb./acre of phosphate was banded. Pioneer Hibred 45H29 canola along with 25 lb./acre of nitrogen, 15 lb./acre of phosphate, and 15 lb./acre of sulfur was seeded on May 23, 2014. In-crop herbicide application of Round-Up was carried out. An additional 36 lb./acre of liquid nitrogen was fertigated in two separate applications: July 4, 2014 and July 20, 2014. Fungicide application of Vertisan was applied July 17, 2014. The canola was swathed September 10, 2014 and harvested on October 9, 2014.

Irrigation

Soil moisture was monitored throughout the year. Soil texture was considered and a soil gravimetric was conducted to determine the exact soil moisture. The collected data was analyzed using AIMM and tracked throughout the growing season.

Results

Final results of this project are summarized in Tables 1 and 2.

Table 1. Results at the Riverhurst Site – NE27-22-7-W3

Treatment	Rep	Distance (M)	Cut Width (ft)	Weight (lb.)	Yield (Bu/ac)	AVG (Bus/ac)
Disk and Shank	1	461.52	33	2938	51.09	53.33
Disk and Shank	2	674.9	33	4668	55.57	
Disk	1	338.07	33	2200	52.38	53.41
Disk	2	629.92	33	4259	54.43	
Check	1	604.21	33	3946	52.6	52.6

Table 2. Results at the Luck Lake Site – NE25-24-8-W3

Treatment	Rep	Distance (M)	Cut Width (ft)	Weight (lb.)	Yield (Bu/ac)	AVG (Bus/ac)
Disk and Shank	1	200	20	838	55.66	54.5
Disk and Shank	2	200	20	803	53.33	
Disk	1	200	20	716	47.32	50.50
Disk	2	200	20	806	53.54	
Check	1	200	20	600	39.85	40.78*
Check	2	200	20	628	41.71	

*area not equally represented

Final Report

Irrigators have recently expressed interest in vertical tillage. This project was initiated to demonstrate possible advantages of this operation. Both the Luck Lake and Riverhurst sites had good soil conditions in the fall to allow initiation of the project. Seeding earlier on lightly tilled ground was not possible due to the late spring and delay of earlier-seeded crops. The Riverhurst site had the straw baled and the Luck Lake site had a banding operation. This also made evaluation of the straw management and mineralization difficult. As a result, the project had to look specifically at potential yield responses related to vertical tillage.

At the Riverhurst site, there was no detectable yield response. Slight differences that did occur in yield are likely attributable to variability throughout the field. The Luck Lake site did have fairly distinct yield responses between the treatments. However, the check area conditions were not comparable to the treated areas, and this may account for the differences in harvest. Specifically, the check area had effects from salinity and the swath was noticeably smaller. In conclusion, there does not seem to be a significant yield advantage that can be directly attributed to the use of a vertical tillage implement.

Acknowledgements

The project lead would like to acknowledge the following contributor:

- Salford Machine – for demonstration of the 24' RTS vertical tillage implement

Figure 5. 24' RTS vertical tillage implement.

Winter Wheat for Gravity-Irrigated Fields*

Project Lead

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Co-operators

- Andre Perrault, Grower, Ponteix, SK, Ponteix Irrigation District
- Randy Wig, Grower, Eastend, SK, Eastend Irrigation District
- Russ Swihart, Grower, Consul, SK, Vidora Irrigation District
- Harvey Bauer, Grower, Maple Creek, SK, Maple Creek Irrigation district

Project Objective

This project demonstrates practices needed for successful winter wheat production in irrigated southwest Saskatchewan, specifically, an adequate seeding rate, a shallow seeding depth, and sufficient nitrogen (N) fertilization to support the yield potential of the winter wheat.

Project Background

Annual cereal production is needed in perennial forage rotations as a break crop. A cereal is traditionally grown as greenfeed for two to three years on land taken out of alfalfa or hay production. This practice provides opportunity for the soil to mineralize depleted soil nutrients, for control of dandelions and other perennial weeds, and for the improvement of soil tilth through the breakdown of soil clods so the forage can be resown at a shallow depth with adequate soil contact. Barley, oats, and triticale are commonly grown for two or three years before reseeding the land back to perennial forage.

The demonstration will show that shallow seed placement and adequate nitrogen fertility allow the winter wheat to yield well. An application of 100 lb. N per acre as ESN was applied during seeding to reduce labour requirments and to simplify fertilization practices. The supply of specialized fertilizer blends is limited in the Southwest. The suggested project design was intended to improve adoption by local farmers.

Demonstration Plan

An August seeding date gives winter wheat seedlings opportunity to grow to the late 3-leaf to early 4-leaf stage prior to freeze-up. Achieving this growth stage will improve the ability of seedlings to

* 2013-15—This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

tolerate the early growing-season gravity irrigation that occurs in mid-May. This growth stage was difficult to attain at all three sites due to the busyness of the season.

The demonstration had two seeding depths, 1 cm and 2–3 cm, and two seeding rates, 2 and 3 bu./acre. With a germination rate of 96%, emergence rate of 90%, and TKW of 37 grams, these two target seeding rates would support emergence of 30 and 45 plants per sq. ft. respectively. The winter wheat should be sufficiently developed and big enough to tolerate an early spring flood. It will also be adaptable to a second flood if conditions allow.

Demonstration Site

Three sites were established throughout the southwest. Ponteix (durum stubble), Eastend (chemfallow), and Vidora (chemfallow) were selected as demonstration sites in the fall of 2013. The Ponteix site had excellent stubble protection as the previous crop was harvested with a stripper header. The Eastend site had fair stubble protection, while the Consul site had very little stubble left after a summer of chemfallow.

Table 1. Soil Analysis of Sites Selected for Winter Wheat Demonstration

Site	pH^2	EC^2 (dS/m)	OM^2 (%)	Pounds per Acre								
				N^1	P^2	K^2	S^1	Cu^2	Fe^2	Mn^2	Zn^2	B^2
Ponteix	7.9	0.5	3.3	25	10	572	63	2.1	46	12.7	2.0	4.8
Eastend	8.1	1.3	3.5	50	38	432	86+	2.8	35	5.6	1.6	3.5
Consul	7.7	0.5	3.5	62	12	600+	43	1.3	25	9.9	1.7	3.3

[1] 0–12" sampling depth; [2] 0–6" sampling depth

Soil analysis was undertaken (Tabel 1). The soils at all of the sites are clay textured. Soil structure at the Ponteix site has been influenced to some degree by the sodic nature of the irrigation water out of Gouvenour Reservoir.

Project Methods and Observations

None of the sites had any visible weed pressures prior to seeding so it was decided not to perform pre-seed glyphosate burn-offs. All three sites were seeded later than initially hoped. The goal of an August seeding date is not easily achieved. The border dykes at Ponteix were sown September 10, 2013 with a Flexicoil 5000 airdrill. The Eastend site was sown September 12, 2013 with a Flexicoil airseeder. At Consul, the winter wheat was sown September 28, 2013 with a John Deere airdrill. All three seeding implements were low disturbance and maintained the stubble attached to the soil.

One concern for the sites was volunteer spring wheat growth, which could act as a vector for wheat streak mosaic disease when the wheat curl mite is present. The risk for this threat was low because of the isolation of the irrigation projects and the predominance of forage in the area. Even so, eliminating this risk is important for the prevention of yield loss from this disease.

Plant emergence counts were collected on October 22, 2013. With the fall precipitation in the southwest in 2013, excellent plant stands were observed. Seedling counts for the Ponteix and

Eastend sites averaged 24 and 29 seedlings/ft^2 and 27 and 34 seedlings/ft^2 for the 2 bu. and 3 bu. seeding rates respectively. Using the seeding rate calculator, 103 lb. of seed per acre was required to achieve 25 plants/ft^2. Although moisture conditions were good, the data suggest seedling mortality was higher than the 10% assumed for the calculation. When the seedling counts were conducted, the plants had grown to the 3-leaf stage at Ponteix, the 3-leaf stage at Eastend and the 1-leaf stage at Consul. The winter of 2013 was not kind to fall-seeded cereals. Snow cover was thin at all three sites with periods of melt intermittent during the harsh cold winter. Temperatures were very cold for extended periods. Winter injury to the seedlings was harsh, but two of the three sites survived with a sufficient plant stand to produce a viable crop.

Plant tissue samples were collected at the flag leaf stage at Ponteix and Eastend. The analysis did not indicate any nutrient deficiencies (Table 2). Both fields had been routinely sown to annual crops for several years prior to planting the winter wheat in the fall of 2013. Continuous annual cropping builds phosphate reserves in the soil because of annual fertilization with phosphorus.

One surprise was the low level of boron (B) in the winter wheat plant tissue at Eastend. The level of organic matter and the clay texture of the soil at this site are not usually associated with low B supply for winter wheat. Unusually high annual rainfall during the chemfallow may have reduced the soil levels of B at the site. The high N level in the plant tissue relative to the indicated threshold reflects the 100 lb. of N fertilizer application with the seed. The polymer coating on the ESN limits the release of the fertilizer N to the seed row, protecting the germination of the seed and improving the efficiency of N utilization by the winter wheat during the growing season.

Table 2. Plant Tissue Analysis of Winter Wheat Samples Collected at the Flag Leaf Stage (June, 2014)

Location	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Ponteix	4.0	0.27	2.59	0.27	0.33	0.22	9.0	83	56	54	14
Eastend	4.7	0.31	2.46	0.27	0.28	0.24	10.0	209	35	32	4
Threshold	2.0	0.25	1.50	0.15	0.20	0.15	4.5	20	15	15	5

Table 3. Grain Yield and Quality of Grain in 2014

Location	Grain yield (bu/ac)	Protein	Grade	Bushel Weight	Thousand Kernel Weight (g)
Ponteix[1] Winter wheat	21	11.7	3	61.5	33.1
Eastend Winter wheat	80	13.3	3	62.7	30.7
Eastend Spring wheat	70	15.6	3	63.0	38.8

[1] Site experienced two hail events during the 2014 growing season, which reduced yield potential.

The yields of winter wheat observed with this project for 2014 (Table 3) show that this crop has potential as an alternative in the gravity irrigated regions of the province. At Eastend, spring wheat was also grown as a comparison. The winter wheat yielded 10 bu./acre more than the spring wheat.

The protein content in the winter wheat was lower than that of the spring wheat and may reflect dilution of nitrogen on the basis of the higher yield.

Although the yield of winter wheat at Ponteix is not high, the crop did experience two hail storms during the growing season. Winter wheat is viable because of its yield potential, but also because it is less expensive to grow.

Table 4. Detailed Salinity Analysis of Soil Located in the Pasture Across from Plot 58 (Maple Creek)

	Maple Creek		
Parameter	**0-12"**	**12-24"**	**24-36"**
pH	8.4	8.3	8.5
Conductivity (dS/m)	5.2	14.4	8.5
% Saturation	108.0	88.0	136.0
Calcium (mg/L)	46.0	488.0	70.0
Magnesium (mg/L)	51.0	474.0	132.0
Potassium (mg/L)	< 10.0	< 30.0	< 20.0
Sodium (mg/L)	1100.0	3180.0	1870.0
Sulphate (mg/L)	1540.0	8540.0	3950.0
Chloride (mg/L)	659.0	695.0	397.0
SAR	26.5	24.6	30.5
TGR (sodic) (t/ha)	18.9	14.2	27.4

Final Discussion

Winter wheat is a viable option for southwest irrigators who have access to the equipment to plant and harvest the crop. The marketing of the crop can be a challenge if the grain must be sold into the commercial grain market, as there may be a limited number of local growers for buyers to work with.

Winter wheat as a feed grain has excellent quality and can readily be marketed to livestock feedlots.

Reclamation of Sodium-Affected Soil*

Project Lead

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Co-operators

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Project Objective

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

Demonstration Plan

Sodium, a monovalent cation, does not effectively neutralize the negative charge associated with clay minerals, leading to defloculation of soil structure. Calcium is able to displace sodium from the cation exchange sites. If the sodium can be flushed from the soil profile, calcium can restore adequate water infiltration to soil. Three different calcium products were broadcast on the surface of sodium-affected soils to evaluate their impact on soil properties and grain or forage yield: calcium chloride, calcium nitrate, and calcium sulphate. Each has different solubility and mobility in soil. The application rate selected for these sites was 200 lb. calcium per acre, which is substantially less than needed to fully reclaim these soils. The applications will be made repeatedly for several years in an effort to correct the structural problems.

Demonstration Sites

Two sites were selected for the demonstration. The Ponteix site was situated on Alluvium soils along the edge of Notekeu Creek. Plot 22 in Ponteix Irrigation District is clay textured and has been irrigated with high SAR water in the past.

The Miry Creek site was located on orthic Willows-Sceptre lacustrine soils with poor water infiltration. Plot 13 in Miry Creek Irrigation District is a field near the bay at the edge of the South

* Project 2014-09

Saskatchewan River. The soil is heavy textured and suffers from waterlogging in a low lying area. High sodium is present on the exchange complex in the area affected by waterlogging.

At each site, two replicates of the soil applications were made. Soil samples were collected from each of the two replicates and divided into three depths, 0-12”, 12-24”, and 24-36”. Detailed salinity analysis was conducted on each sample to determine the soil chemical properties at the location. These results are reported in Tables 1.1 and 1.2. The Ponteix site is sown to a variety of annual crops. The Miry Creek site is currently sown to alfalfa, but rotates to annual crops when the productivity of the alfalfa stand tapers off as the stand ages.

Table 1.1. Soil Properties Determined for the Sodium-Affected Soils at the Ponteix Site

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

Table 1.2. Soil Properties Determined for the Sodium-Affected Soils at the Miry Creek Site

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

Project Methods and Observations

The amendments were applied to the soils on May 20, 2014. The rate of application was 200 lb. of calcium per acre. The application rate was based on gypsum rates applied to cultivated potato fields to improve conditions for potato harvest. The approach attempts to correct water infiltration issues from a long-term perspective, as compared to rapid remediation taken in contaminated soils in oilfield operations. The rate applied to the site is less than 10% of the calculated theoretical gypsum requirement from the detailed salinity analysis.

Plant tissue samples were also collected from each of the treated areas in 2014. The analysis of these plants shows that the barley was not deficient in nutrients for this cropping season. The nitrogen content of the alfalfa was low for all tissue samples collected, pointing toward ineffective N fixation at this site. The potassium level in the alfalfa samples were all low, which may explain the suboptimal protein content of the forage. Potassium is important for promoting efficient fixation of nitrogen in legumes.

Table 2.1. Plant Tissue Analysis from Calcium-Amended Soils—Alfalfa at Miry Creek

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
$CaCl_2$-Rep 1	3.9	0.25	1.41	0.30	1.92	0.45	9	124	34	66	55
$CaCl_2$-Rep 2	4.1	0.22	1.47	0.31	1.79	0.57	9	154	32	44	66
$CaNO_3$- Rep 1	4.2	0.24	1.62	0.28	1.85	0.49	9	112	30	75	60
$CaNO_3$- Rep 2	3.7	0.23	2.03	0.23	1.38	0.43	9	129	26	42	41
$CaSO_4$- Rep 1	4.4	0.29	1.62	0.32	1.71	0.47	10	139	35	41	58
$CaSO_4$- Rep 2	3.7	0.22	1.84	0.27	1.30	0.45	8	151	25	29	48
Threshold	**4.5**	**0.25**	**2.00**	**0.30**	**0.50**	**0.25**	**8**	**50**	**20**	**20**	**30**

Table 2.2. Plant Tissue Analysis from Calcium-Amended Soils—Barley at Ponteix

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
$CaCl_2$-Rep 1	5.0	0.41	3.72	0.27	0.72	0.21	11.0	87	20	46	10
$CaCl_2$-Rep 2	4.9	0.35	3.81	0.29	0.69	0.23	11.0	75	23	94	11
$CaNO_3$- Rep 1	5.1	0.44	3.36	0.27	0.69	0.23	9.0	84	19	34	11
$CaNO_3$- Rep 2	4.7	0.37	3.71	0.28	0.53	0.20	9.0	70	21	33	10
$CaSO_4$- Rep 1	4.9	0.37	3.41	0.32	0.67	0.22	10.0	78	22	34	11
$CaSO_4$- Rep 2	5.3	0.36	3.86	0.30	0.61	0.22	10.0	76	20	44	10
Threshold	**2.0**	**0.26**	**2.00**	**0.15**	**0.20**	**0.15**	**4.5**	**40**	**20**	**15**	**5**

The first year of yield results for this reclamation demonstration are reported in Tables 2.1 and 2.2. Any response to the treatments for this project at this time would be premature. The calcium nitrate and calcium sulphate amendments also supply plant nutrients. This effect must be considered in the interpretation of the results before drawing conclusions about the benefits of the treatments on the soil structure at the sites. Another factor to consider is the impact on water infiltration.

Productivity measurements were collected at the Ponteix and Miry Creek locations. The Ponteix site was sown to barley and dry matter yields were harvested at this site for 2014. The Miry Creek site was in alfalfa production when the calcium products were applied to the soil surface. Two cuts of the forage were collected for 2014 (Table 3).

Table 3. Productivity of Irrigated Soils Treated with Calcium Amendment

Site	Ponteix	Miry Creek – Alfalfa Dry Matter Yield (t/ac)		
Treatment	**Barley Dry Matter Yield (t/ac)**	**First Cut**	**Second Cut**	**2014 Yield**
Control	3.46	0.71	2.68	3.39
Calcium Chloride	3.41	0.71	2.85	3.53
Calcium Nitrate	3.55	1.14	2.65	3.89
Calcium Sulphate	3.75	1.14	2.92	3.96

Final Discussion

The trends in the productivity of the treatments indicate growth benefits from calcium application in 2014. Further investigation will be required to determine whether the treatments have increased the productivity of the alfalfa or the barley. Evaluation is needed as to whether any effects observed are due to nutrient application or improvement in soil structure. This project will be continued for at least two more seasons, depending on the results observed in the coming two years.

Crop Varieties for Irrigation – ICDC 2014

Principal Investigators

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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 2014 for conducting variety evaluation trials under intensive irrigated conditions. The sites selected included a range of soil types. Crop and variety selection for the project was made in consultation with plant breeders from AAFC, universities, the private sector, and associated producer groups.

Trials were conducted for registered varieties of cereals (spring wheat, barley, oat, corn, winter wheat, fall hybrid rye), oilseeds (canola, flax), pulses (pea, dry bean, faba bean, soybean, chickpea), and 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 4). Between the CSIDC main station and the second Knapik location, in excess of 5,000 individual plots were established and maintained throughout the growing season.

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

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

ICDC staff also assisted in the establishment and maintenance of numerous CSIDC and CDC projects in 2014.

Results

The 2014 variety trials were established within recommended seeding date guidelines for the selected crops (Table 4). Climatic conditions in the 2014 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, seasonal cumulative growing degree days and corn heat units ended near historical values.

Table 1. 2014 Growing Season Precipitation vs Long-Term Average

	mm (inches)		
Month	**2014**	**1981–2010**	**% of Long-Term**
May	61.2 (2.4)	45.0 (1.8)	136
June	97.0 (3.9)	63.0 (2.5)	154
July	27.6 (1.1)	55.0 (2.2)	50
August	37.6 (1.5)	42.0 (1.7)	90
September	21.8 (0.9)	36.0 (1.4)	61
Total	245.2 (9.8)	241.0 (9.6)	102

Table 2. 2014 Cumulative Growing Degree Days (Base 0° C) vs Long-Term Average

	Year		
Month	**2014**	**1981–2010**	**% of Long-Term**
May	249	226	110
June	684	710	96
July	1245	1291	96
August	1813	1844	98
September	2196	2058	107

Table 3. 2014 Cumulative Corn Heat Units vs Long-Term Average

	Year		
Month	**2014**	**1981–2010**	**% of Long-Term**
May	262	211	124
June	741	742	100
July	1404	1409	100
August	2059	2024	102
September	2424	2338	104

Early Season Trial Establishment

Seeding operations began on May 16; cool wet conditions delayed planting prior to this date. 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 (at CSIDC). Field pea and canola variety trials at the Knapik location were adversely influenced by poor seedling establishment and growth and deemed unusable for meaningful analysis.

Midseason to Harvest

In general, for all crops, vegetative growth development was excellent. High yield potentials were confirmed and established through the month of July, particularly for cereals and oilseeds. Cereals did indicate some foliar leaf disease, but flag leaves were protected by fungicide applications, some Fusarium Head Blight was apparent in some wheat and durum varieties. Oilseed crops were relatively disease free. Late season Anthracnose and *Sclerotinia sclerotiorum* (white mold) did appear in dry bean trials at both CSIDC and the off-station site and did reduce seed yield.

No insect pests appeared in any magnitude to be of concern.

A frost event occurred in the early hours of September 12; the lowest temperature recorded was -1.8° C, mean temperature was -1.5° C, and the duration was 7 hours. This effectively stopped further growth and development of corn, soybean, and some late-season dry bean varieties.

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 2015 Crop Production Show. It will be mailed to irrigators early in 2015.

A list of projects conducted in 2014 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	21	ICDC	CSIDC - main CSIDC - off station
2. SVPG CWRS (Hex1) Wheat Regional	39	Dr. R. Depauw, AAFC M. Japp, SMA S. Piche, SVPG	CSIDC - main

Cereal Trials (continued)	Varieties/Entries Evaluated	Collaborators	Location
3. SVPG High Yield (Hex2) Wheat Regional	18	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 2-Row Barley Regional Trial	16	Dr. A. Beattie, CDC M. Japp, SMA S. Piche, SVPG	CSIDC - main
7. SVPG 6-Row Barley Regional Trial	6	Dr. A. Beattie, CDC M. Japp, SMA S. Piche, SVPG	CSIDC - main
8. SVPG Oat Regional	12	Dr. A. Beattie, CDC M. Japp, SMA S. Piche, SVPG	CSIDC - off station
9. SK Winter Wheat Regional Trial	17	Dr. R. Graf, AAFC	CSIDC - main
10. ICDC Hybrid Silage Corn Performance Trials	12 irrigated 12 dry land	S. Sommerfeld, SMA	CSIDC - main
11. Alberta Corn Committee Silage Corn Performance Trial	20	Dr. B. Bares, AAFC	CSIDC - main
12. Alberta Corn Committee Grain Corn Performance Trial	15	Dr. B. Bares, AAFC	CSIDC - main
Oilseed Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
13. ICDC Irrigated Canola Evaluation Trial	19	ICDC	CSIDC - main CSIDC - off station
14. Canola Coop (XNL1)	21	R. Gadoua, CCC	CSIDC - main
15. Canola Coop (XNL2)	21	R. Gadoua, CCC	CSIDC - main
16. Canola Coop (XNL3)	22	R. Gadoua, CCC	CSIDC - main
17. Canola Performance Trial	25	Dr. R. Gjuric, Halpotech	CSIDC - main
18. Ultimate Canola Challenge	14 input products	CCC	CSIDC - main
19. Flax Regional Trial	12	ICDC	CSIDC - main CSIDC - off station
20. Flax Mycohrihizia and P Fertility	8 treatments		
Pulse Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
21. Dry Bean Narrow Row Regional (Saskatchewan)	20	Dr. K. Bett, CDC & ICDC	CSIDC - main CSIDC - off station
22. Short Season Wide Row Irrigated Coop	30	Dr. P. Balasubramanian, AAFC	CSIDC - main
23. Irrigated Bean Variety Trial – Wide Row	17	Dr. P. Balasubramanian, AAFC	CSIDC - main CSIDC - off station
24. Irrigated Bean Variety Trial – Narrow Row	17	Dr. P. Balasubramanian, AAFC	CSIDC - main CSIDC - off station

Pulse Trials (continued)	Varieties/Entries Evaluated	Collaborators	Location
25. Irrigated Prairie Regional Variety Trial	30	Dr. T. Warkentin, CDC & ICDC	CSIDC - main CSIDC - off station
26. MCVET Irrigated Soybean Performance Trial	35	Manitoba Agriculture	CSIDC - main
27. MCVET Dry Land Soybean Performance Trial	35	Manitoba Agriculture	CSIDC - main
28. Northstar Genetics Irrigated Soybean Variety Trial	8	Northstar Genetics & ICDC	CSIDC - main
29. Northstar Genetics Dry Land Soybean Variety Trial	8	Northstar Genetics & ICDC	CSIDC - main
30. CDC Faba Bean and Dry Bean Advanced Line Trials	1653 plots	Drs. B. Vandenberg & K. Bett, CDC	CSIDC - main CSIDC - off station
31. Chickpea/Flax Intercropping	10 mono or intercrop strategies	ICDC, ADOPT	CSIDC - main
32. Soybean Inoculation Study	16 treatments	ICDC, ADF, WGRF	CSIDC - main
33. Soybean Date of Seeding with or without seed treatment	6 planting dates No/yes seed treat	ICDC, ADF, WGRF	CSIDC - main
34. Soybean Plant Population and Row Spacing Study	5 populations 10” vs 20” spacing	ICDC, ADF, WGRF	CSIDC - main
Perennial Forage Trials	**Varieties/Entries Evaluated**	**Collaborators**	**Location**
35. Timothy	3	Dr. B. Coulman, U of S T. Nelson, AAFC ICDC	CSIDC - main
36. Meadow Bromegrass	2		
37. Hybrid Bromegrass	2		
38. Orchardgrass	3		
39. Tall Fescue	3		
40. Alfalfa	9		
41. Cicer Milkvetch	4		
42. RedClover	2		
43. 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

Winter Wheat Variety Evaluation for Irrigation*

Project Leads

- Garry Hnatowich, PAg, Research Agronomist, ICDC (Project Lead)
- Harvey Joel, Research Technician, ICDC
- Don David, Research Technician, Canada-Saskatchewan Irrigation Diversification Centre

Co-operator

- Dr. Robert Graf, Agriculture and Agri-Food Canada

Project Objective

The objective was to identify the top-producing or best-adapted varieties of winter wheat for irrigation production. Winter wheat varieties were last evaluated for their irrigation production potential approximately 25 years ago. No variety at that time suited intensive irrigation management. Genetic improvements to the latest winter wheat varieties warrant a renewed assessment of their potential under irrigation management.

Project Background

Winter wheat is not a widely grown cereal under irrigation production. Recently, however, irrigation producers are seeking information on variety selection. ICDC/CSIDC evaluations of winter wheat varieties have not occurred for decades. Older varieties available at the time had insufficient disease resistance or winter hardiness to warrant producer interest. Annual crops produced at the time were also later-maturing and interested irrigation producers often did not have the ability to seed into stubble during the appropriate planting window for winter wheat. Earlier varieties of traditional crops as well as improved genetics within winter wheat suggest that the crop may well have production potential for irrigators. Presently, those irrigation producers seeking information on variety selection are required to search for information outside of Saskatchewan.

Demonstration Plan

Seed of sixteen registered winter wheat varieties was acquired from winter wheat breeder Dr. R. Graf, AAFC-Lethbridge. Varieties were direct seeded into canola stubble on September 2, 2014. Winter wheat varieties were established in a small plot replicated and randomized trial design, replicated 3 times. All varieties are being evaluated under both irrigated and dry land systems.

* Project 2014-15—This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

Demonstration Site

Canada-Saskatchewan Irrigation Diversification Centre, Outlook, Saskatchewan.

Project Methods and Observations

Both irrigated and dry land trials had excellent germination and fall season growth. It is anticipated that the winter wheat will proceed into dormancy with plants at the 5–6 leaf stage.

Final Discussion

Results of this trial will be available after the harvest in 2015.

Agronomic Investigations of Irrigated Soybean*

Project Lead

- Garry Hnatowich, PAg, Research Agronomist, ICDC (Project Lead)
- Harvey Joel, Research Technician, ICDC
- Don David, Research Technician, Canada-Saskatchewan Irrigation Diversification Centre

Co-operators

- Agriculture Development Fund (ADF)
- Western Grains Research Foundation (WGRF)

Project Objective

The specific objectives of the research are to:

- determine optimal seeding date ranges for soybean and their effect on grain yield and quality;
- assess the impact of soybean seed treatment and possible benefits, particularly under less than optimal soil temperature seeding conditions;
- determine optimal soybean seeding rates for both solid seeded (25 cm) and row cropped (50 cm) production; and
- examine the impact and determine the economic feasibility of combination inoculant applications.

Demonstration Plan

Each trial outlined below will be conducted annually for a three-year period. Seeding rate and date trials will be established in a randomized split-plot design. The inoculant study will be established in a randomized complete block design. All trials will be randomized four times. All trials will be conducted at CSIDC, Outlook under irrigated production, or at irrigated off-station locations if/as required for agronomic or operational purposes.

Project #1. Seeding Date/Seed Treatment Trial:

Main Treatments: Seeding dates, six dates beginning the first week of May (or closest as conditions allow) with weekly planting dates up to, and including, the second week of June.

Subtreatments: Untreated and treated seed.

* Project 2014-23—This project was supported by the Agriculture Development Fund and the Western Grains Research Foundation.

Project #2. Seeding Rate/Row Spacing Trial:

Main Treatments: Row spacings, subtreatments established at both 25 cm row spacing (10") and 50 cm row spacing (20").

Subtreatments: Seeding rates to establish target populations of 350,000 plants/ha (140,000 plants/acre), 400,000 plants/ha (160,000 plants/acre), 450,000 plants/ha (180,000 plants/acre), 500,000 plants/ha (200,000 plants/acre) and 550,000 plants/ha (220,000 plants/acre).

Project #3 Inoculation Trial:

Treatments:

1. 8 lb./ac granular Novozymes inoculant + liquid Novozymes inoculant + seed treatment
2. 8 lb./ac granular BASF inoculant + liquid BASF inoculant + seed treatment
3. 12 lb./ac granular Novozymes inoculant + liquid Novozymes inoculant + seed treatment
4. 12 lb./ac granular BASF inoculant + liquid BASF inoculant + seed treatment
5. 8 lb./ac granular Novozymes inoculant + liquid Novozymes inoculant
6. 8 lb./ac granular BASF inoculant + liquid BASF inoculant
7. 12 lb./ac granular Novozymes inoculant + liquid Novozymes inoculant
8. 12 lb./ac granular BASF inoculant + liquid BASF inoculant
9. 8 lb./ac granular Novozymes inoculant
10. 8 lb./ac granular BASF inoculant
11. 12 lb./ac granular Novozymes inoculant
12. 12 lb./ac granular BASF inoculant
13. liquid Novozymes inoculant
14. liquid BASF inoculant
15. seed treatment
16. control

Data Collection: Includes grain yield, seed protein/oil content, TKW, seed test weight, seed moisture, established plant populations, dates of flowering and maturity, pod clearance, plant height, plant lodging ratings, disease and insect incidence, irrigation frequency and time, soil analysis, any additional observed agronomic parameters of merit.

Demonstration Site

Canada-Saskatchewan Irrigation Diversification Centre, Outlook, Saskatchewan.

Project Methods and Observations

No trial summaries are available at the time of printing.

Final Discussion

There will be annual reports and in 2017 a final project summary of all three trials will be reported.

Chickpea Flax Intercropping*

Project Leads

- Garry Hnatowich, PAg, Research Agronomist, ICDC (Project Lead)
- Harvey Joel, Research Technician, ICDC
- Don David, Research Technician, Canada-Saskatchewan Irrigation Diversification Centre

Co-operators

- Agri-ARM locations at Redvers, Indian Head, Scott and Swift Current

Project Objective

The objective of this study is to demonstrate whether an intercrop can be used to increase the area suitable to produce chickpeas. This demonstration will compare desi and kabuli chickpea and flax as a monocrop to chickpea and flax as an intercrop.

Project Background

Chickpeas have been a high profit grain crop on a per acre basis in Saskatchewan since their introduction. However, the lack of consistent terminal stress and disease pressure limited the expansion of this crop into irrigation production.

Intercrops, while interesting in theory, have proven to be difficult to scale up to a commercial level due to many factors. Issues around separating grain, timing of harvest, and weed control restrain many potential crop pairings. There must be a compelling agronomic reason to add the extra complication of an additional crop to get farmer and industry adoption of this new practice. The chickpea flax combination may just be an intercrop that will work on a commercial scale in Saskatchewan. Seeding, weed control, harvest timing, and separation are all very manageable. Given the agronomic problems with chickpeas in Saskatchewan, an intercrop may be a way to alter the area of adaptation or production systems for chickpea in the province and possibly into irrigation production.

Due to the fact that this production practice may be highly influenced by both geographical location and local weather patterns, it was proposed that this project be carried out for two years at sites located at Redvers, Swift Current, Indian Head, Scott, and Outlook. Extensive regional testing is more likely to fully test the practicability of this new technique. If the intercrop is proven successful

* Project 2014-16—This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

at multiple locations for more than one year, the chance of it being adopted as a common practice is greater.

Demonstration Plan

This demonstration was seeded with a no-till plot drill in mid-May. One desi chickpea and one Kabuli chickpea were intercropped with flax. The chickpea was intercropped at three seeding rates: 30, 40, and 50 plants/m^2. In addition to those 6 treatments, each chickpea cultivar was grown as a monocrop and there were two flax monocrop treatments, one at the low fertility level used for all the chickpea treatments and one at a higher fertility level with 60 kg/ha applied. The intercropped flax was seeded at 40 lb./acre, while the monocrop flax was seeded at 60 lb./acre. The chickpeas were seeded through the fertilizer shanks below and to the side of the flax. All treatments were replicated four times.

Demonstration Site

Canada-Saskatchewan Irrigation Diversification Centre, Outlook, Saskatchewan.

Project Methods and Observations

No trial summaries are available at the time of printing.

Final Discussion

There will be annual reports and a final project summary of all location trials will be reported in 2015-16.

Performance of Super U Fertilizer on Irrigated Spring Wheat*

Project Leads

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture
- Dr. Rigas Karamanos, Koch Fertilizer, Calgary, AB

Co-operator

- Murray Kasper, Grower, Broderick, SK, SSRID

Project Objective

The project objective is to compare the relative performance of wheat fertilized with broadcast urea versus Super U.

Demonstration Site

The field selected for the Super U demonstration is located north of Broderick on NW34-29-7-W3. The area is mapped as a Bradwell fine sandy loam soil. An initial soil sample was collected from the field and analysis is reported in Table 1.

Table 1. Soil Analysis of Site Selected for Super U Fertilizer Demonstration

Depth		EC[2]	OM[2]	N[1]	P[2]	K[2]	S[1]	Cu[2]	Fe[2]	Mn[2]	Zn[2]	B[2]
(in)	pH[2]	dS/m	%	---------------------------- lb/ac ----------------------------								
0-6	7.0	0.2	1.9	4	34	600+	11	0.8	51	12.1	1.5	1.7
6-12	8.1	0.2		5			21					

[1] 0-6, 6-12" sampling depths; [2] 0-6" depth

Project Methods and Observations

The field was sprayed with glyphosate tank-mixed with 2,4-D and fertilized with N using a test strip of Super U applied with a spin spreader at the rate of 120 lb./acre on May 26. Regular urea was broadcast with the same spin spreader just prior to the seeding operation. A light shower (0.2–0.3 in.) fell in the evening of June 3 on the spread fertilizer. The grower did not start seeding the Unity variety blend until June 5 and 6. In-crop weed control consisted of Thumper and Horizon applied according to label recommendations. Harvest was completed on October 11.

* Project 2014-16

Table 2. Plant Tissue Analysis of Spring Wheat Samples Collected from the Super U Fertilizer Demonstration at the Early Flag Leaf Stage (July, 2014)

Treatment	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Regular 46-0-0	3.8	0.33	3.9	0.28	0.22	0.15	6	105	40	42	6
Super U	3.9	0.24	3.3	0.23	0.25	0.17	6	119	42	41	4
Threshold	2.0	0.25	2.0	0.15	0.20	0.15	4.5	40	20	15	5

Table 3. Yield and Quality of Spring Wheat Harvested from the Super U Fertilizer Demonstration at Broderick (October, 2014)

Treatment	Yield (bu/ac)	Protein (%)	Bushel Weight (lb)	Thousand Kernel Weight (g)	% Fusarium
Regular 46-0-0	44.2	14.6	61.4	33.8	0.2
Super U	44.3	14.6	61.8	34.7	0.4

The Super U fertilizer did not provide any economic advantage for wheat yield or grain quality on this site. The quarter has a wide variety of soil textures across the landscape, making it an excellent candidate for determining any benefits from the new technology of Super U. The potential for leaching losses of N from excessive irrigation and heavy rain shower activity on the sandier portions of the field are significant.

Final Discussion

The application of Super U to a portion of this field did not demonstrate superior performance compared to regular urea. Broadcast application of the fertilizer without precipitation occurring for several days will increase the likelihood of seeing a benefit in yield and/or quality of the grain. This grower used his seeding operation to incorporate the urea, which minimizes the potential for N losses by volatilization. Fields with varying soil texture are better candidates for taking advantage of this technology.

Copper Fertility on Sandy Soil under Irrigation*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Peter Hiebert, Grower, Riverhurst, SK, Riverhurst Irrigation District

Project Objective

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

Demonstration Plan

A site within the Lake Diefenbaker Irrigation District that had shown visual symptoms of copper deficiency was selected for the demonstration. Soil samples from each area were compared to a control treatment to determine the yield response to copper.

Treatment list:

1) control
2) 3.5 lb. Cu broadcast as granular copper fertilizer on the soil surface
3) 5 lb. Cu broadcast as granular copper fertilizer on the soil surface

Demonstration Site

Two sites were selected for application of copper fertilizer based on soil analysis, notably, low levels of available copper in the soil test. Both the NE35 and SW30 sites were sandy loam Chaplin soils developed on gravelly glacio-fluvial deposits. The soil analyses for the sites are shown in Table 1. The NE35 site has never grown field bean or potato, but SW30 has grown beans once in recent history and was sprayed once with fungicide.

Table 1: Soil Analyses of Sites Selected for Copper Fertilizer Demonstration

Riverhurst Site	pH	EC dS/m	OM %	N	P	K	S	Cu	Fe	Mn	Zn	B
				ppm				ppm				
NE35-23-7-W3												
0–6”	7.9	0.3	1.4	5	8.5	140	7	0.3	5.2	1.1	1.4	0.2
6–12”	8.6	0.3		3			7	0.2				
SW30-23-6-W3												
0–6”	7.2	0.3	2.7	6	9.3	190	13	1.0	20	5.9	2.3	0.4
6–12”	7.4	0.3		8			8	0.5				

* Project 2014-11—This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

	meq/100g		% Saturation							
Extractable Cations NE35	CEC	20.3	Ca	89	Mg	8.3	K	1.8	Na	0.5
Extractable Cations SW30	CEC	14.6	Ca	72	Mg	23	K	3.4	Na	1.5

Project Methods and Observations

Both sites were sprayed with preseed 0.75 L/acre glyphosate tank mixed with 0.33 L/acre 2,4-D prior to seeding Verona durum on May 17-18, 2014. Fertilizer was applied at seeding: nitrogen at 70 lb./acre as 28-0-0 and P205 at 52 lb./acre as 11-52-0. The NE35 site did not receive any irrigation during the 2014 season because the pivot was broken. The SE30 site was fertilized with broadcast urea (46-0-0) at 200 lb./acre and this nutrient was watered in with irrigation on June 12. Prosaro was applied to the fields for fusarium control.

Plant tissue samples were collected from each of the treatments at flag leaf, and the nutrient levels are reported in Table 2. The plant tissue results are considered adequate for all wheat treatments at both demonstration sites. The levels of copper in the plant tissue did not vary much with the copper applications and seem very high for a site that is potentially deficient. According to other research, this observation is common. The plant tissue analysis for both demonstrations did not reflect the rates of copper application.

The grower was concerned that potassium might be low on these gravelly soils. The potassium level in the plant tissue, however, indicates little risk of potassium deficiency for these fields. The soil test recommendations agree with the plant tissue analysis.

Copper application generally decreases the level of zinc in the plant tissue. If copper is applied to soils that are marginally adequate in zinc, a deficiency of zinc can be induced. This is why indiscriminate applications of micronutrients can potentially be harmful to soil fertility.

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

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
NE35-23-7-W3											
No Copper	4.2	0.39	3.0	0.20	0.45	0.16	11.0	86	45	73	7
3.5 lb Copper	4.2	0.38	3.7	0.23	0.35	0.15	11.0	89	49	68	7
5 lb Copper	4.4	0.37	3.5	0.25	0.37	0.16	13.0	89	53	59	8
SW30-23-6-W3											
No Copper	4.5	0.35	2.9	0.30	0.47	0.17	10.0	108	44	61	7
3.5 lb Copper	4.4	0.40	2.8	0.28	0.51	0.20	11.0	110	45	56	8
5 lb Copper	4.7	0.38	3.0	0.28	0.42	0.17	10.0	118	41	55	6
Threshold	**2.1**	**0.25**	**2.0**	**0.15**	**0.20**	**0.15**	**4.5**	**40**	**20**	**15**	**5**

Grain yield was determined on September 26, 2014 at the copper demonstrations and are reported in Table 3. The soil analysis suggested a response to copper will be observed for the NE35 site, but not for the SW30 site. The observed yields agree with this prediction. The relationships for grain quality are not perfect, but the observed trends are consistent with expectations for the impact of copper fertilizer on wheat quality. As you increase the rate of copper fertilizer, protein should decline, bushel weight should increase, and the level of ergot should decrease. Copper is needed for deposition of carbohydrate in the wheat kernel. The impact that copper fertilization had on protein content and bushel weight in this demonstration is consistent with this effect. Ergot infection should also decrease as the rate of copper fertilizer increases, if the ergot infection was caused by a copper deficiency.

Table 3. Grain Yield and Quality of Durum Sampled from Copper Demonstrations

Treatment (Fertilizer/ac)	Grain Yield (bu/ac)	Grade	Protein (%)	Bushel Weight (lb/bu)	Ergot (%)	Fusarium (%)
NE35-23-7-W3						
No Copper	31.6	5	19.0	57.8	0.037	3.6
3.5 lb Copper	36.6	5	17.0	60.2	0.020	3.3
5 lb Copper	39.9	5	17.1	61.4	0.003	2.3
SW30-23-6-W3						
No Copper	65.9	5	19.0	59.6	0.038	2.7
3.5 lb Copper	63.0	5	18.5	57.1	0.000	3.9
5 lb Copper	60.4	5	14.4	62.2	0.046	3.9

Copper fungicides are commonly used to control bacterial blight in dry beans and late blight in potatoes. These two crops are commonly grown on lighter-textured soils in the irrigated region. Rates of Cu application can be as much as 0.5 lb./acre for each application. Up to six applications to beans and ten applications to potatoes are registered for the control of disease in these crops. Rates of copper fertilizer application for deficient sites range between 3.5 and 5 lb./acre of Cu. These rates are adequate to correct copper deficiency for up to twenty years. Fungicide use on beans and potatoes can easily supply adequate copper to correct any potential deficiency on soils that require supplemental copper.

Final Discussion

This demonstration showed the potential for yield response of wheat to copper fertilization. The lack of response to copper fertilizer in many irrigated rotations may largely be due to the use of copper fungicides for control of disease.

FORAGE CROP PROJECTS IN 2014

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 of 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. 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. Fertilizer treatments were to be applied in fall 2013. Data collection was planned to begin in 2014 and along with dry matter yield and forage quality analysis. Significant winterkill of alfalfa plants was observed across the plot area during spring stand assessments in May 2014. Following this observation, the project was abandoned and no further field work or data collection was performed.

* Project 2012-02

Demonstration of Perennial Forage Crops*

Project Lead

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

Industry Co-operators

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

Project Objective

The objective of this 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 differences in establishment, growth habit, maturity, and yield of 50 different perennial forage varieties, including 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, (Tables 1 and 2). 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.

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* 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 P205, 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. In the establishment year, 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 carried out in the legume plots. In 2014, the area recorded 238 mm (9.4 inches) of rainfall from May 1 to September 22.

A biomass harvest of the grass and legumes plots took place on July 3, 2014. Dry matter yields are reported in Tables 3 and 4. No harvest weights were recorded for the clover plots due to winterkill. No harvest weights were recorded for four grass plots due to poor establishment.

Table 3. Legume Dry Matter (DM) Harvest Weights – July 3, 2014

Crop	Variety	Yield t DM/acre
Alfalfa	AC Grazeland	3.0
Alfalfa	AC Dalton	4.1
Alfalfa	Stealth	2.0
Alfalfa	Equinox	2.4
Alfalfa	Spreador 4	2.5
Alfalfa	4010 BR	2.8
Alfalfa	PS 3006	4.0
Alfalfa	HB 2410	4.0
Alfalfa	Halo	3.5
Alfalfa	Rugged	3.7
Alfalfa	AC Yellowhead	5.5
Cicer milkvetch	Oxley II	2.5
Cicer milkvetch	AC Veldt	1.3
Birdsfoot Trefoil	Leo	1.4
Sainfoin	Common	1.5
Clover	Altaswede Single Cut Red Clover	--
Clover	Belle Double Cut Red Clover	--
Clover	Wildcat Double Cut Red Clover	--
Clover	Alsike Clover	--
Clover	White Dutch Clover	--

Table 4. Grass Plot Harvest Weights – July 3, 2014

Crop	Variety	Yield t DM/acre
Smooth bromegrass	Carlton	3.18
Smooth bromegrass	AC Rocket	3.21
Meadow bromegrass	AC Armada	2.96
Meadow bromegrass	AC Admiral	2.71
Meadow bromegrass	MBA	1.95
Hybrid bromegrass	AC Knowles	2.89
Hybrid bromegrass	AC Success	2.54
Hybrid bromegrass	Bigfoot	0.90
Russian wildrye	Swift	0.32
Dahurian wildrye	Common	2.71
Altai wildrye	Common	--
Green needlegrass	Common	0.80
Tall fescue	Courteney	0.29
Sheep fescue	Common	0.56
Creeping red fescue	Boreal	1.23
Tall wheatgrass	Common	--
Crested wheatgrass	Fairway	4.96
Crested wheatgrass	Kirk	7.61
Crested wheatgrass	AC Goliath	3.17
Intermediate wheatgrass	Chief	7.56
Pubescent wheatgrass	Greenleaf	4.96

Crop	Variety	Yield t DM/acre
Slender wheatgrass	Common	2.72
Northern wheatgrass	Common	1.19
Western wheatgrass	Common	0.79
Western wheatgrass	Common	1.06
Timothy	AC Pratt	2.64
Creeping foxtail	Garrison	0.31
Meadow foxtail	Common	0.41
Orchardgrass	AC Kootenay	2.49
Orchardgrass	AC Killarney	1.95
Kentucky bluegrass	Troy	--
Reed canarygrass	Venture	--

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 yield data presented in Tables 3 and 4 represent only a single small plot in a single year, and should be considered with caution. More information on the relative yield of these forage cultivars is available in the factsheet Relative Cultivar Yields for Perennial Species found on the Saskatchewan Ministry of Agriculture website.

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 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

Industry Co-operators

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

Project Objective

The objective of 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 project site was identified at CSIDC, with specific project location dependent on soil salinity ratings. Soil samples and EM38 maps were used to determine a suitable plot area. Plots were aligned on a salinity gradient ranging from slight to severely saline. No randomization or replication of forage varieties occurred. Yield data collection began in 2014.

* Project 2013-01

Demonstration Site

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

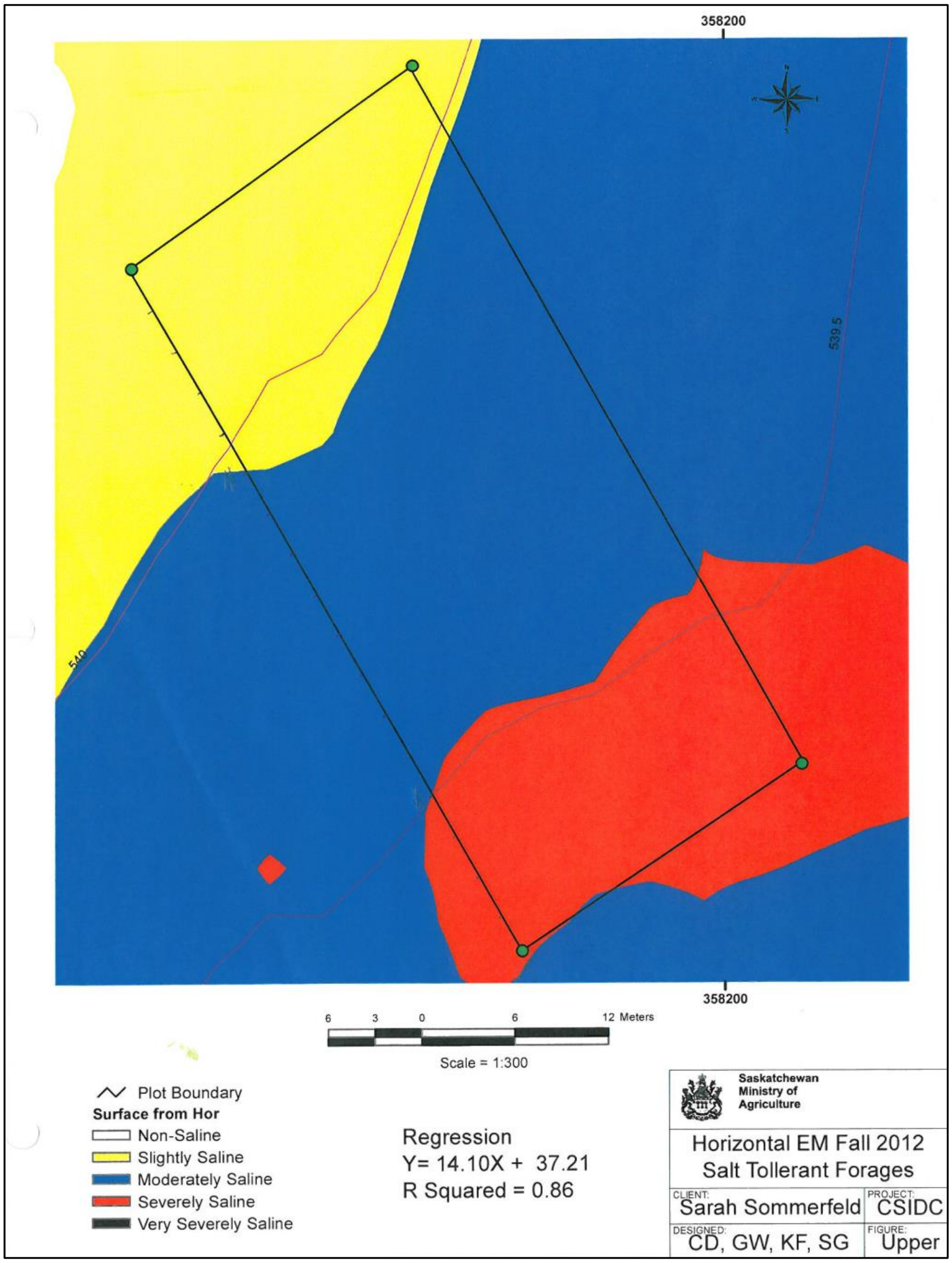

Figure 1. Horizontal EM38 map.

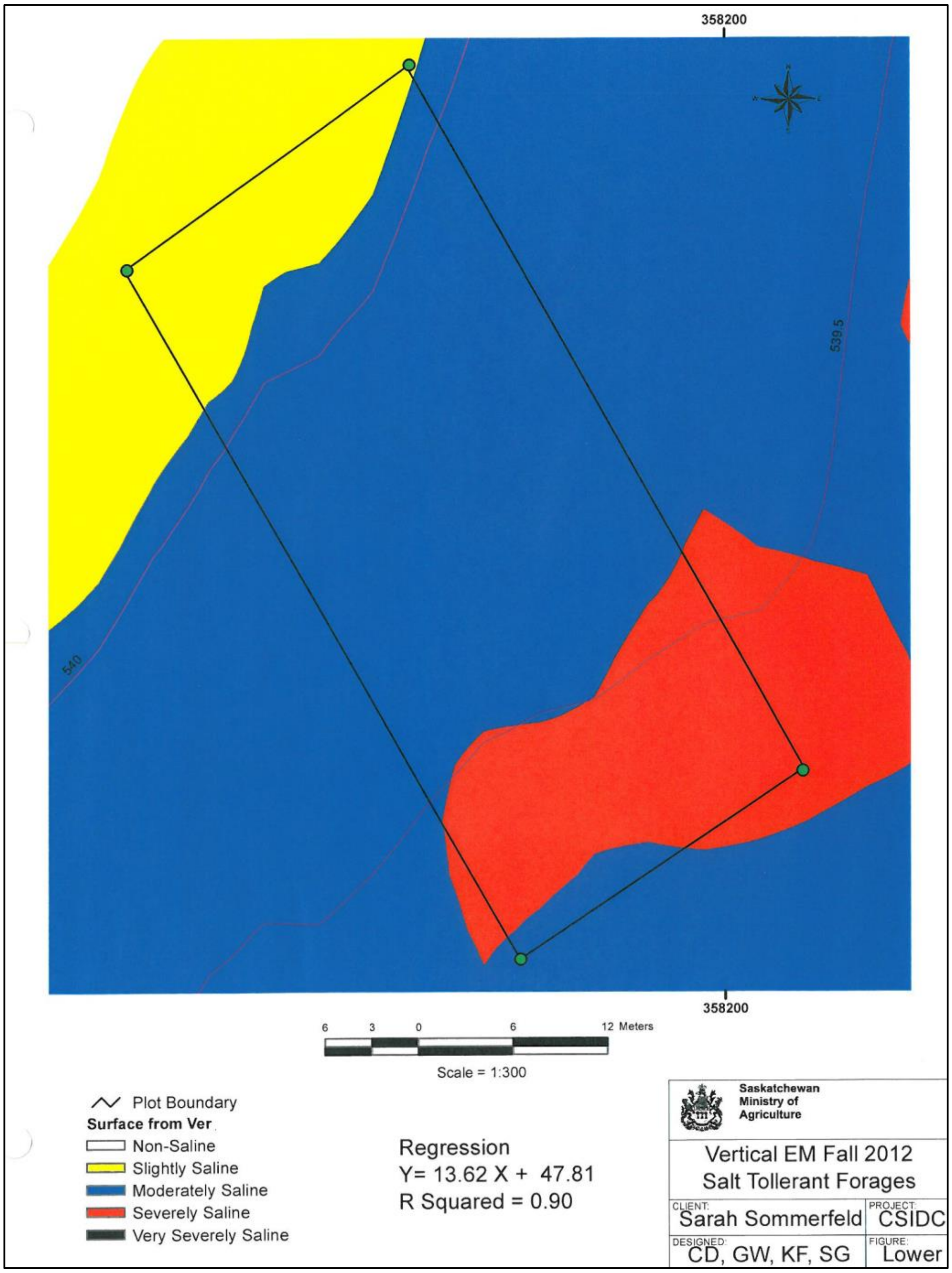

Figure 2. Vertical EM38 map.

Project Methods and Observations

All plots were direct seeded on June 18, 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. 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.

In the spring of 2014, a soil sample was collected from the non-saline areas of the grass and alfalfa plots. Nutrient analysis details are provided in Tables 2 and 3. Grass plots received 50 lb./acre N, as 46-0-0, on May 20. No fertilizer was applied to alfalfa plots. No herbicide applications for weed control were required. The plot area received 297 mm (11.6 inches) of rainfall from April 1 to September 22.

First cut forage harvest occurred on July 2. Forage yields were collected from the slight, moderate, and severely saline areas of each forage variety. Dry matter forage yields are summarized in Tables 4 and 5.

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

Table 2. Soil nutrient Analysis Results for the Non-Saline Grass Area – May 8, 2014.

Depth (inches)	NO_3-N lb./acre	P lb./acre	K lb./acre	SO_4-S lb./acre
0 – 6	9	31	258	>48
6 – 12	7			>48

Table 3. Soil Nutrient Analysis Results for the Non-Saline Alfalfa Area – May 8, 2014

Depth (inches)	NO_3-N lb./acre	P lb./acre	K lb./acre	SO_4-S lb./acre
0 – 6	3	35	294	>48
6 – 12	2			>43

Table 4. Dry Forage Yield of Grass Species – July 2, 2014.

Grasses - Severely Saline Area	Yield (MT DM/acre)	Grasses - Moderately Saline Area	Yield (MT DM/acre)	Grasses – Slightly Saline Area	Yield (MT DM/acre)
Creeping foxtail	0.6	Creeping foxtail	0.7	Creeping foxtail	2.8
Smooth brome	1.0	Smooth brome	3.2	Smooth brome	3.6
Slender wheatgrass	1.0	Slender wheatgrass	4.7	Slender wheatgrass	2.6
Tall wheatgrass	0.7	Tall wheatgrass	1.9	Tall wheatgrass	1.8
Green wheatgrass	1.4	Green wheatgrass	3.2	Green wheatgrass	2.5

Table 5. Dry Matter Forage Yield of Alfalfa Varieties – July 2, 2014

Alfalfa – Severely Saline Area	Yield (MT DM/acre)	Alfalfa – Moderately Saline Area	Yield (MT DM/acre)	Alfalfa – Slightly Saline Area	Yield (MT DM/acre)
Halo	0.6	Halo	0.7	Halo	2.9
Barricade	0.7	Barricade	1.1	Barricade	2.7
Rugged	0.6	Rugged	0.8	Rugged	3.1
Assalt	0.6	Assalt	0.8	Assalt	2.5
55V50	0.6	55V50	0.7	55V50	2.6
54Q32	0.6	54Q32	1.4	54Q32	2.5

Discussion

Figure 3. Alfalfa plots under moderate to severe saline conditions – July 2, 2014.

The objective of this project was to demonstrate the performance of commonly used and new forage varieties with different salinity tolerances under varying soil salinity levels. The forage yields in the severely saline area of both grasses and alfalfa are of the greatest interest. The forage yield data (Tables 3 and 4) shows that the severely saline areas yielded less than the moderate and slightly saline areas, which was expected. In the severely saline area, the grasses had a higher level of production compared to the alfalfa varieties, which was also expected. Perennial grasses generally have a higher salt tolerance compared to forage legumes. This increased salt tolerance allows a plant to be more productive in those saline areas.

A second point of interest are the yields of the green wheatgrass variety, AC Saltlander, under saline conditions (Table 3). Green wheatgrass (*Elymus hoffmannii*) provided the highest yield in the severely saline area. Green wheatgrass is a cross between bluebunch wheatgrass and quackgrass. It was selected for its salinity tolerance, vigour, palatability, and winter hardiness. The salinity tolerance of green wheatgrass is similar to tall wheatgrass. However, green wheatgrass has a creeping root system and can quickly spread out over an area, whereas tall wheatgrass is a bunch grass. The creeping root system, along with a high level of salt tolerance, allows the green wheatgrass to establish and be productive in saline areas over other perennial grass and legume varieties.

Based on observations of the alfalfa varieties, no single variety showed greater forage yield over another. Alfalfa is a moderately salt-tolerant plant 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 established plants. 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 visual symptoms to any great extent. The forage yields of these alfalfa varieties in the moderate and slightly saline areas increased as the degree of salinity decreased (Table 4).

Acknowledgements

The project lead would like to acknowledge Garry Hnatowich, ICDC Research Agronomist, and Harvey Joel, ICDC Research Technician, for their agronomic support on this project. The lead would also like to acknowledge CSIDC staff who assisted with the irrigation operations for this project.

Corn Weed Control Demonstration*

Project Lead

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

Co-investigator

- Garry Hnatowich, PAg, Research Agronomist, ICDC

Industry Co-operator

- Glenda Clezy, DuPont Pioneer

Project Objective

The objective of this project was to demonstrate the best management practices for weed control in corn.

Project Background

Corn is a poor competitor against early season weed pressure. When weed pressure is very high, corn yield potential is significantly reduced. Implementing early season weed control strategies is necessary to ensure success when growing a high input, high yield potential crop, such as silage or grain corn.

Project Plan

The project was designed as a single plot per-treatment demonstration with no replication. A single corn variety provided by Dupont Pioneer was planted. Each plot consisted of two corn rows. A seeding rate of 32,000 seeds/acre was targeted. Corn seed received from the industry partner was treated. Eight weed control treatments were applied. Data collection included plant population 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 = 14 lb./acre to 6 in.
- P = 45 lb./acre to 6 in.
- K = 286 lb./acre to 6 in.
- SO_4-S = 333 lb./acre to 6 in.

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* Project 2014-02— This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

Project Methods and Observation

The trial was seeded on June 2 into good seedbed conditions. All plots received a broadcast and incorporated application of 80 lb./acre N, as 46-0-0, prior to seeding. Fertilizer application at time of seeding included 50 lb./acre N as 46-0-0, and 50 lb./acre P_2O_5 as 12-51-0, in a side band application. One corn hybrid, Dupont Pioneer hybrid P7332R, was selected and provided by industry for use in this demonstration.

Eight herbicide treatments are outlined in Table 1. The in-crop herbicide selected for use was 2,4-DB, applied at the recommended rate. Application timing for in-crop herbicide was at the six-leaf stage. In-crop herbicide timing outside the recommended crop stage occurred at the eight-leaf stage. In-season plant damage was observed for most applications as the applicator could not be elevated high enough and physical damage occurred to plants. Refer to the Ministry of Agriculture publication *Guide to Crop Protection* for further information on crop staging and rates.

Cumulative Corn Heat Units (CHU) from May 15 to September 12 was 2167. Cumulative precipitation from May 12 to September 12 was 234 mm (9.2 inches). On September 12, a killing frost of -1.8^{o} C for a 7-hour duration was experienced. All plots were harvested on September 23.

Table 1. Herbicide Treatments and Corn Weed Control Demonstration Yield Data

Treatment	Description	Moisture (%)	Dry Yield (kg/ha)	Dry Yield (t/ac)
A	½ L glyphosate/acre applied in-crop	64.14	4341	1.94
B	1 L glyphosate/acre applied in-crop	66.26	4563	2.03
C	One in-crop herbicide application	65.64	3430	1.53
D	Weedy check	63.82	3252	1.45
E	One in-crop herbicide application beyond recommended crop stage timing	62.05	3410	1.52
F	Pre-emergent burn-off application plus one in-crop herbicide application at recommended timing	62.47	4212	1.88
G	No burn-off application plus one in-crop	64.91	3662	1.63
H	Two in-crop herbicide applications at recommended rate at recommended crop stage timing	67.06	4027	1.80
I	Burn-off only with no in-crop herbicide application	63.08	4142	1.85

Results and Discussion

Harvest data is presented in Table 1. The highest yielding treatment was treatment B, the 1 L/acre glyphosate application applied in-crop. The lowest yielding treatment was treatment D, the weedy check. Overall, there is very little difference between the eight treatments and statistical analysis of the data cannot be completed as it is a single plot demonstration with no replication. The yield results do demonstrate the importance of early season weed control in corn production, but further exploration into which herbicide application options and timing provide the best weed control is needed.

Corn Variety Demonstration for Silage and Grazing*

Project Lead

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Co-investigators

- Garry Hnatowich, PAg, Research Agronomist, ICDC

Industry Co-operators

- Glenda Clezy, DuPont Pioneer
- Andrew Chilsom, Monsanto
- Neil Mcleod, Northstar Seeds Ltd.
- Chad Keisig, Pickseed

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 database 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 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. Seed for each individual plot was packaged according to individual seed weights and adjusted for estimated per cent germination. All seed received from suppliers was treated. Data collection included plant population, corn heat units (CHU) accumulated, days to 10% anthesis, days to 50% silk, and dry matter (DM) yield.

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* Project 2013-03— This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

Demonstration Site

The trial was established at CSIDC on loam-textured soil. Soil analysis prior to trial establishment indicated the following nutrient levels:

- NO3-N = 14 lb./acre to 6 in.
- P = 45 lb./acre to 6 in.
- K = 286 lb./acre to 6 in.
- SO4-S = 333 lb./acre to 6 in.

Project Methods and Observations

The trial was seeded on May 30 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.

Thirteen corn hybrids were planted in each production system. Hybrid selection was made by seed companies with the criteria being that each variety selected was recommended for the 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.

Cumulative CHU from May 15 to September 12 was 2167. Cumulative precipitation from May 12 to September 12 was 234 mm (9.2 inches). On September 12, a killing frost of -1.8°C for a 7 hour duration was experienced. All plots were harvested on September 23.

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

Brand	Variety	Corn Heat Unit (CHU) Rating
DuPont Pioneer	P7632HR RR	2200
DuPont Pioneer	P7410HR RR	2100
DuPont Pioneer	39V05 RR	2250
DuPont Pioneer	P8210HR RR	2500
Dekalb	DKC 33-78 RR RIB	2500
Dekalb	DKC 30-07 RR RIB	2325
Hyland	HL Baxxos RR	2300
Hyland	HL R219 RR	2375
Hyland	HL SR22 RR	2400
Hyland	HL 3085 RR	2400
Pickseed	PS 2348VT2P RIB	2275
Pickseed	PS 2501 RR	2300
Pickseed	PS 2304 RR	2225

Results and Discussion

The average established plant population of irrigated plots was 32,847 plants/acre. Average established plant population of dry land plots was 27,622 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	32847	7.3	74.2	79	82
Dry Land	27622	5.7	73.3	80	82
LSD (0.05)	4048	0.6	NS	NS	NS
CV (%)	3.2	3.1	1.1	1.4	91.0
Hybrid					
PS 2304 RR	37056	7.7	73.0	76	81
PS 2501 RR	31545	7.4	72.0	80	80
Baxxos RR	31095	7.3	71.7	75	79
HLR219	29915	6.8	72.8	81	81
DKC 30-07RIB RR	32445	6.8	75.0	81	84
39V05	30421	6.6	73.2	77	82
3085	29408	6.3	75.1	81	83
HL 5R22SF	27440	6.2	75.9	87	88
P8210HR	27609	6.2	73.9	79	81
DKC33-78RIB	31208	6.1	75.6	81	84
PS 2348VT2P RIB	27272	6.1	73.4	79	83
P7632HR	30983	5.9	73.5	77	81
P7410HR	26653	4.9	74.2	76	81
LSD (0.05)	3466	0.76	1.2	0.7	0.9
Production System vs. Hybrids					
LSD (0.05)	NS	S	NS	NS	NS

S = Significant; NS = Not Significant

The irrigation treatment produced greater DM silage yields compared to the dry land treatment (Figure 2) by an average of 1.6 t/acre or 21.5%. Based on the 2014 yield data (Table 2 and Figure 2), the variety that performed the best under irrigated conditions for silage production was PS 2304 RR. Under dry land conditions, the variety that performed the best for silage production was PS 2501 RR. Baxxos RR was used as the hybrid check variety.

Statistical analysis indicated a significant yield difference between irrigation and dry land yields (Figure 2). All hybrids were significantly higher yielding under irrigation.

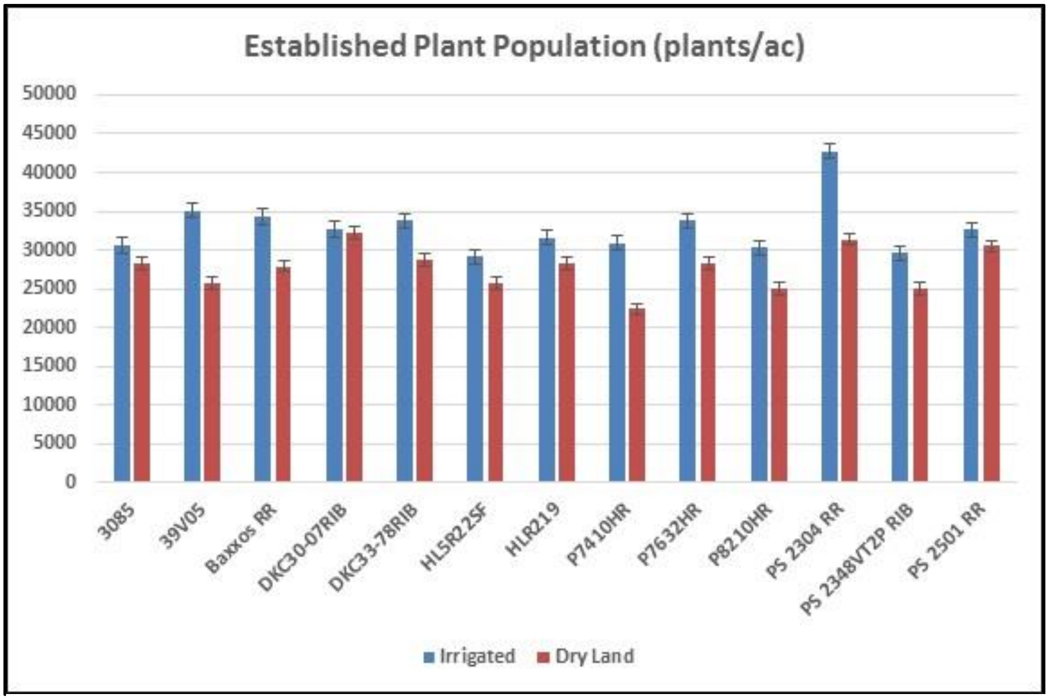


Figure 1. Established plant population by hybrid; irrigated vs dry land.

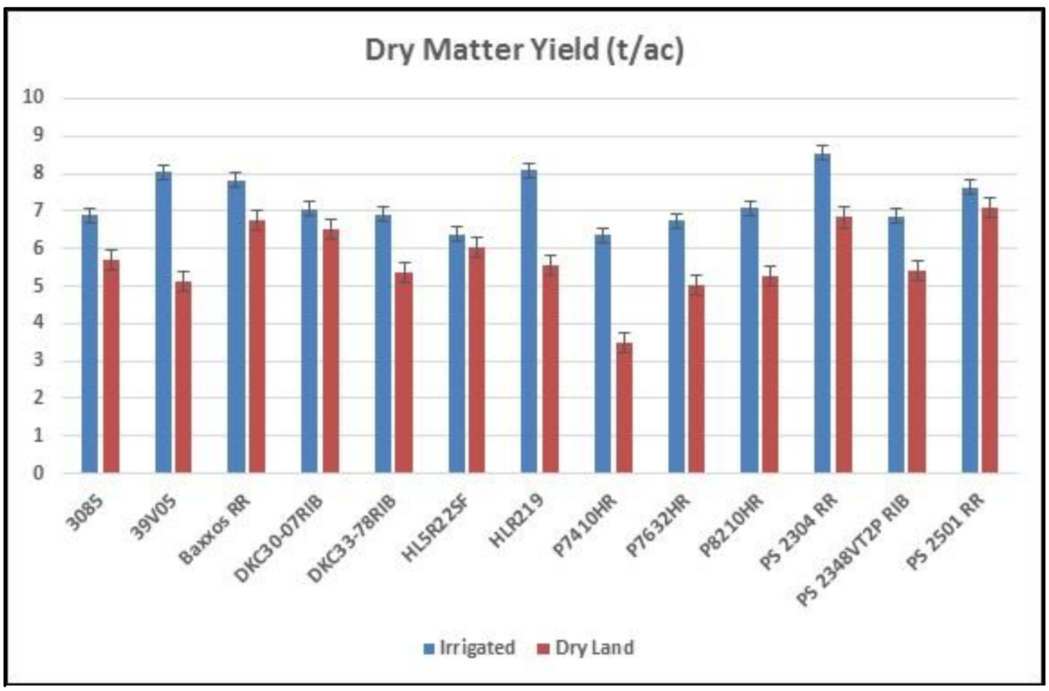


Figure 2. Dry matter yield of hybrids; irrigated vs dry land.

Whole plant moisture content did not differ between irrigation and dry land treatments (Figure 3). Target harvest moisture was 65 per cent. Actual average harvest moisture was 74.2 percent for irrigated treatment and 73.3 per cent for the dry land treatment. If field dry down had continued, yield losses would have accumulated due to leaf loss following the frost event. No difference between the two production systems was observed with respect to days to corn tasselling or silking. In general, early-tasselling hybrids were also the lowest yielding and had the lowest plant moisture content at harvest.

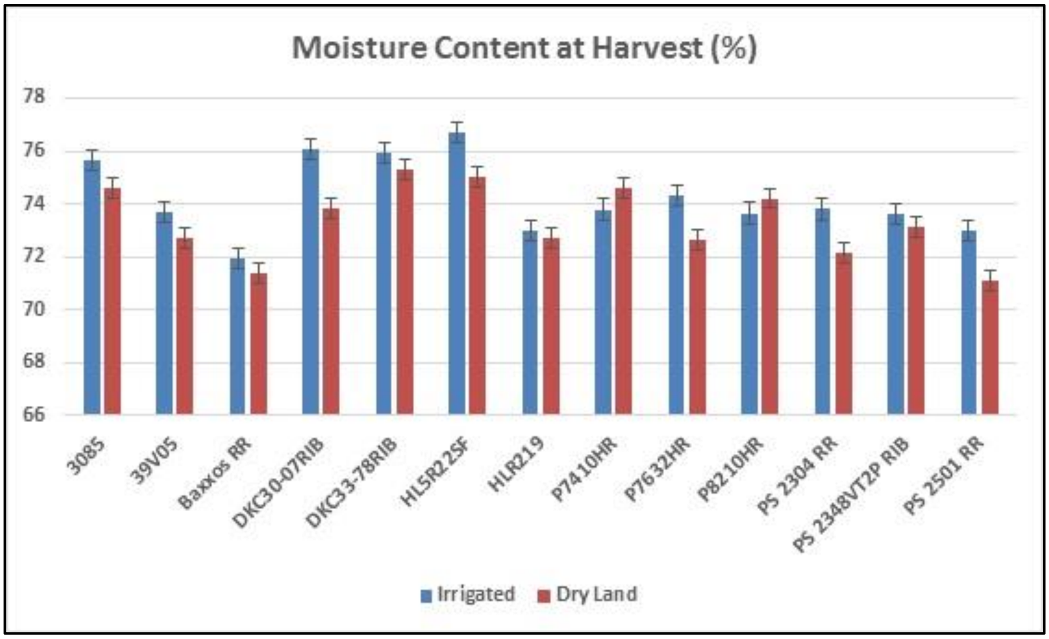


Figure 3. Whole plant moisture content.

Forage Yield and Quality of New Annual Forage Varieties*

Project Lead

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

Project Objective

The objective of this project was to demonstrate the yield and forage quality of new annual forage varieties in side-by-side comparison to other annual forage varieties commonly grown for livestock feed under irrigated conditions. This project will add to the yield and forage quality information collected from previous similar ADOPT demonstrations.

Project Background

Oats and barley are commonly grown across the province for livestock feed as greenfeed or swath grazing. Previous ADOPT projects conducted in 2012 and 2013 demonstrated triticale varieties for swath grazing and greenfeed in comparison to oats and barley. Release of a new annual forage oat variety, CDC Haymaker, and annual forage barley variety, CDC Maverick, may be alternate variety options for producers. Recent side-by-side comparisons of these new forage varieties to commonly used barley and oat varieties demonstrated that triticale varieties are beneficial to producers. The project results will help producers determine whether using a new annual forage oat or barley variety provides a yield or forage quality advantage over more traditional choices.

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. A soil sample was collected and submitted for nutrient analysis in October 2013 (Table 1).

* Project 2014-01—This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

Table 1. Soil Nutrient Analysis from ALS Labs, October 2013

Depth	N lb./acre	P lb./acre	K lb./acre	S lb./acre
0 – 15 cm	6	29	34	11
0 – 3- cm	42			104

Project Methods and Observations

A pre-seeding burnoff application of glyphosate at 1 L/acre was applied on May 28. Seeding date was June 2. All plots were direct seeded into soybean stubble using a 10-row small-plot seeder with eight inch row spacing. Annual forage varieties and seeding rates of each variety are provided in Table 2. Fifty pounds N, as 46-0-0, and 20 pounds $P_2 0_5$, as 11-52-0, were side banded at the time of seeding. In-crop broadleaf weed control application of Buctril M at the 0.4 L/acre rate was applied in June. Minimal hand weeding was done. The plot area recorded 237 mm of rainfall from May 15 to September 12.

Table 2. Annual Forage Varieties and Seeding Rates

Species	Crop Variety	Germination (%)	TKW (g)	Seeding Rate (kg/ha)	Seeding Rate (lb/acre)
Oat	CDC Haymaker	92	41.18	141.60	126.0
Oat	CDC Baler	99	39.50	126.20	112.3
Barley	CDC Cowboy	99	56.33	150.00	133.5
Barley	CDC Maverick	87	51.09	154.80	137.8
Triticale	Tyndall	95	38.11	126.90	113.0
Triticale	Bunker	81	43.15	168.50	150.0
Foxtail millet	Golden German millet	93	--	22.46	20.0

The optimum crop stage to harvest greenfeed balances yield, quality, and palatability simultaneously. Current recommended crop stages for harvest are listed in Table 3. The days from seeding to greenfeed harvest for each variety are listed in Table 3. The overall trend for increasing days of crop development in the order of barley, oats, triticale, and golden German millet was as expected. Average greenfeed yields and forage quality are reported in Tables 4 and 5.

Table 3. Days from Seeding to Greenfeed Harvest

Species	Optimum Harvest Stage	Variety	Seeding Date	Harvest Date	Days from Seeding to Harvest
Oat	Milk dough	CDC Haymaker	June 2	August 12	71
Oat	Milk dough	CDC Baler	June 2	August 12	71
Barley	Soft dough	CDC Cowboy	June 2	August 8	67
Barley	Soft dough	CDC Maverick	June 2	August 8	67
Triticale	Soft to firm dough	Tyndall	June 2	August 28	87
Triticale	Soft to firm dough	Bunker	June 2	August 28	87
Foxtail millet	Two weeks after heading	Golden German millet	June 2	September 12	102

Table 4. Average Greenfeed Yield, Dry Matter (DM) Basis

Species	Variety	Yield (kg/ha DM)	Yield (lb./acre DM)
Oat	CDC Haymaker	7919 a	7071 a
Oat	CDC Baler	7905 a	7058 a
Barley	CDC Cowboy	7342 a	6555 a
Barley	CDC Maverick	7421 a	6626 a
Triticale	Tyndall	7477 a	6675 a
Triticale	Bunker	8013 a	7154 a
Foxtail millet	Golden German millet	6922 a	6181 a

Table 5. Forage Quality Analysis, DM Basis

Species	Variety	Crude Protein (CP) (%)	Total Digestible Nutrients (TDN) (%)	Acid Detergent Fiber (ADF) (%)	Neutral Detergent Fiber (NDF) (%)
Oat	CDC Haymaker	9.41	54.52	41.29	67.17
Oat	CDC Baler	9.39	52.93	42.78	69.57
Barley	CDC Cowboy	9.92	64.06	32.36	56.42
Barley	CDC Maverick	9.81	64.06	33.46	55.75
Triticale	Tyndall	11.05	64.77	31.70	49.85
Triticale	Bunker	11.32	64.02	32.40	51.45
Foxtail millet	Goldern German millet	12.66	60.64	35.56	62.31

Discussion

In this demonstration, there was no significant difference in greenfeed yield between any of the forage varieties. Based on the demonstration project results, using a new annual forage oat or barley variety does not provide a yield benefit. In reference to forage quality, as the stage of gestation progresses, beef cow nutrient requirements increase. All forage varieties would meet the protein requirements during mid and late gestation. Triticale and foxtail millet would also meet the protein requirements during lactation. Energy requirements up to and during late pregnancy could be met by all varieties, with the exception of oats. No varieties would meet cow energy requirements during lactation.

Previous research from AAFC Lacombe has shown triticale to have a significant yield advantage over oats and barley. Although triticale is later maturing and has more opportunity to accumulate dry matter yield, the yield produced was not statistically different than that of the other varieties grown. Millet is a warm season crop option for greenfeed, but yields tend to be more variable compared to the cool season cereals, depending on growing season temperatures. Producers should select annual forage varieties that meet the production goals of the farm. Producers must also pay attention to kernel development and cut the crop at the optimum crop stage to ensure optimum forage quality and yield. Submitting forage samples for feed analysis will provide producers with the information needed to ensure that cow nutrient requirements are being met during the winter feeding period.

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 who assisted with the field and irrigation operations for this project.

Nitrate Analysis of Greenfeed Oats on Irrigated Alfalfa Breaking*

Project Lead

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operators

- Garry Hnatowich, Research Agronomist, ICDC
- Harvey Joel, Research Technician, ICDC
- Don David, Research Technician, Canada-Saskatchewan Irrigation Diversification Centre

Project Objective

This project demonstated the impact of salinity on the accumulation of nitrate in greenfeed samples produced on alfalfa breaking. This project was developed in response to reports from growers about high nitrate levels in greenfeed grown on alfalfa breaking.

Demonstration Plan

Greenfeed oats was grown at CSIDC on a nonsaline first-year alfalfa breaking site on Field #3 and a moderately saline second year alfalfa breaking site on Field #12 in 2013. A salinity map of the CSIDC Research Farm showing these two areas can be seen in the *2011 Research and Demonstration Report* in the Irrigated Salt Tolerant Alfalfa Variety report. Feed samples from oat forage sites were collected at the late milk stage of the oats from both sites. Grain and forage yields were reported in the 2013 ICDC Research and Demonstration Report. There was no budget to analyze the forage samples for nitrate in the original project. The 0N samples from two reps for both varieties of oats, Triactor and CDC Haymaker, were analyzed for nitrate.

Demonstration Site

Field #3 is a nonsaline site with the greenfeed oats grown on first year breaking. Field #12 is a moderately saline site on canola stubble with the greenfeed oats grown on second year breaking.

Project Methods and Observations

The two demonstrations were conducted on Fields #3 and #12 during the 2013 growing season. Greenfeed oats was grown on nonsaline alfalfa breaking (Field #3) and in moderately saline soil; second year breaking was grown in canola stubble. Interest in this project developed because the yields on Field #12 were about two-thirds those of Field #3. Analysis of nitrates in two replicates of

* Project 2014-10

the greenfeed samples collected from the two demonstrations were determined by Central Testing Laboratories. The data is summarized in Table 1.

Table 1. Summary of Nitrate Analysis of Greenfeed Oat Samples

Oat Variety	Year after Breaking	Salinity Rating	Grain Yield (bu/ac)	Forage Yield (t/ac)	Total Nitrate (%)
CDC Haymaker	First	Nonsaline	197	9.22	0.25
Triactor	First	Nonsaline	266	9.36	0.26
	First	Average	231	9.29	0.25
CDC Haymaker	Second	Moderate	145	5.92	1.10
Triactor	Second	Moderate	176	5.44	1.41
	Second	Average	161	5.68	1.25

The average nitrate content of the greenfeed oat samples was considerably higher for oats grown on saline soils compared to nonsaline soils. The reduction in yield imposed on the oats by the salinity in the field was sufficient to prevent the oats from using the nitrogen mineralized by the soil on alfalfa breaking for growth and yield. This led to an increased risk of elevated nitrates in the forage similar to the effect of hail, drought, spray drift, or frost. The level of nitrates in the greenfeed samples grown on saline ground increased to levels that require special feeding management practices.

Final Discussion

Salinity should be added to the stresses that can elevate nitrate levels in annual cereal greenfeed. On nonsaline soils, annual cereal growth on irrigated soils can respond to the N release from the soil with growth and use the extra N released from alfalfa breaking ground. When salinity restricts the yield of the annual cereal greenfeed, the release of N from the soil remains high because of the moist soil conditions on irrigated ground. In contrast, salinity prevents the annual cereal from using the N released by the soil for yield, which leads to elevated nitrates in the greenfeed.

P, K, S, and Zn Fertilization of an Annual Forage Crop

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-Investigators

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Project Objective

The objective of this study was to demonstrate yield benefits of various combinations of fertilizers, including zinc, on annual forage production.

Project Background

This site was previously part of the P, K, and S fertilization of a new alfalfa stand project, but due to severe winter kill of the alfalfa, those plots were abandoned. It was decided that the plots would be salvaged and converted into a project that considered triticale and barley as annual forages. The same principals of the former alfalfa project were used. Those principals were to determine whether there was a response to banded nutrients on forage under irrigation in Saskatchewan.

Project Plan

Triticale and Barley was to be seeded on June 12. Tissue samples were collected for each crop and analyzed for nutrient levels. Each treatment was divided into two parts, one for a biomass harvest and the other for a seed harvest. The data collected was for dry matter yield, forage quality analysis, as well as seed yield. The plots included 2 treatments that were divided into two sections, one for barley and the other for triticale. Each crop had nine different treatments (Table 1) and was replicated twice.

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

Demonstration Site

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

Project Methods and Observations

Barley and triticale were planted June 12, 2014 after burning off the alfalfa stand with glyphosate at a rate of 2 L/acre. Both triticale and barley were seeded at a rate of 110 lb./acre using a plot seeder. Fertility treatments were applied on October 10, 2013 as a banded application using a small plot seeder with disc openers on 8 inch row spacing. Fertilizer was applied to the half inch depth. The barley biomass harvest occurred on August 19, 2014 and the triticale on August 27, 2014 for the triticale. The biomass samples were then dried and the weights were recorded. Seed was harvested for both barley and triticale on October 14, 2014 and samples were dried at CSIDC.

Based on observations during the growing season, the barley outperformed the triticale in seed emergence and plant vigor. Since no in-crop herbicide was applied, the plots were infested with wild oats and stink weed, which resulted in yield loss and high dockage.

The biomass dry weights were processed to determine the yield in tons/acre (Table 2). The seed samples were cleaned at CSIDC, weighed, and then converted into yield information. The plant tissue results for the barley showed no response to the fertilizer treatments (Table 3).

Table 2. Average Biomass Yields for Barley and Triticale

Treatment	Barley Yield (t/acre)	Triticale Yield (t/acre)
Control	4.14	2.47
P only	4.18	2.12
K only	4.04	2.00
S only	4.24	2.51
P and K	4.23	1.93
P and S	4.39	2.32
K and S	4.28	2.33
P, K and S	4.48	2.11
P, K, S and Zn	4.49	3.00

Table 3. Plant Tissue Analysis of Barley Samples Collected at the Early Boot Stage of Development

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	4.8	0.44	3.72	0.34	0.54	0.20	9.3	65	39	28	6
P, K, S and Zn	4.1	0.40	3.71	0.31	0.49	0.19	9.6	55	34	27	5
Threshold	2.3	0.25	2.00	0.15	0.20	0.15	4.5	40	20	20	5

Final Discussion

Based on the biomass results, the treatments that received P, K, S, and Zn out yielded the others. This suggests that there may have been a response to zinc, which would confirm alfalfa tissue tests from 2013 that showed a zinc deficiency. Seed biomass yields were taken, but the samples were not cleaned in time to record them in this report. The results of the tissue tests provide contradicting information, suggesting that there was no response from the fertilizer treatments. The average yields for both of the annual forages fall short of the 2013 irrigated green feed average of 5 t/acre. This was due to poor soil fertility, lack of in-crop spraying, and inadequate seeding rate, especially for the triticale.

Acknowledgments

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 for providing staff to assist with the field and irrigation operations of this project.

P, K, S, and Zn Fertilization of a New Alfalfa Stand

Project Lead

- Joel Peru, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-Investigator

- Gary Kruger, PAg, Irrigation Agrologist, Saskatchewan Agriculture

Project Objective

The objective of this study was to demonstrate yield benefits using various combinations of fertilizers, including zinc, on alfalfa forage production.

Project Background

This is the second year of a three-year project started in 2013. Due to severe winter kill, two thirds of this project was abandoned and seeded to annual forage. The remaining third will continue to be harvested and observed until the project is complete. Previous research by Les Henry showed a response to phosphorus fertilizations on land that was previously deficient in phosphorus due to land grading for gravity irrigation. Phosphorus levels were higher in the plant tissue, although the crop yield did not increase. Alfalfa's response to banded nutrients under irrigation is not well documented. Therefore, this project will provide information on the suitability of this practice.

Project Plan

It was planned that the established alfalfa stand would be cut twice and data collected to determine dry matter yield. Tissue tests were planned to determine whether the fertilizer treatments had any impact on nutrient accumulation. The salvaged treatments were separated into three replications to be analyzed separately.

Project Site

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

Project Methods and Observations

Due to extensive winter kill, only 7 treatments were salvageable. Tissue samples were taken from the alfalfa stands on June 17 and sent to the lab for analysis (Table 1). The first cut was taken on June 28 with a small-plot forage harvester. The second and final cut was taken on August 13 and the results for both cuts were processed and recorded (Table 2). The plots appeared uniform throughout the growing season with the exception of some light green plants that may have suggested zinc deficiency. The soil test results showed a low level of copper (Table 3), which explains why the tissue tests showed a below-threshold concentration.

Table 1. Plant Tissue Analysis of Alfalfa Samples Collected at the Early Bud Stage

Treatment (Fertilizer/acre)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Control	4.9	0.40	1.92	0.33	2.45	0.37	3.7	130	68	72	46
P only	5.0	0.33	1.54	0.30	2.46	0.38	3.5	121	67	30	40
K only	5.0	0.33	1.72	0.33	2.22	0.33	3.4	114	58	25	37
S only	5.0	0.33	1.77	0.32	2.34	0.35	3.7	120	67	21	41
P and K	5.0	0.36	1.77	0.32	2.53	0.43	4.8	138	83	21	44
P, K and S	5.0	0.37	1.79	0.34	2.25	0.35	3.5	127	67	22	44
P, K, S and Zn	5.1	0.37	1.80	0.32	2.18	0.31	3.9	120	68	31	42
Threshold	4.5	0.25	2.00	0.30	0.50	0.25	8	50	20	20	30

Table 2. Dry Biomass Yields for Both Cuts of Alfalfa

Treatment	First Cut average (t/acre)	Second Cut average (t/acre)
Control	1.90	1.75
P only	1.54	2.10
K only	1.38	1.96
S only	1.73	2.12
P and K	1.73	2.11
P, K, and S	2.11	2.10
P, K, S, and Zn	2.22	2.12

Table 3. Soil Test Results for Alfalfa Plots

	NO_3-N	P	K	SO_4-S	Cu	Mn	Zn	B	Fe
0-6 inch (PPM)	7	21	155	2	.3	3.2	0.5	0.7	10

Final Discussion

The tissue results in Table 1 show that there was minimal response, if any, to the fertilizer treatments. They also show that the plants were deficient in copper, which suggests copper fertilization on this piece of land may be of benefit. Alfalfa dry matter yield did increase with the addition of fertilizers compared to the control. The yield results hovered around the average irrigated alfalfa yield at Outlook in 2014, which was 3.5 t/acre total. Since the treatments that included P, K, and S performed better than the rest, there is a case to fertilize alfalfa when the stand is new. Hard winter conditions and the low levels of copper may have affected this stand's metabolism, which may have caused a lower response from the treatments. This project will be terminated due to the poor quality of the stand and will not continue into its third year.

Acknowledgments

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 for providing staff to assist with the field and irrigation operations of this project.

IRRIGATION SCHEDULING PROJECTS 2014

Maximum Economic Yield Under Irrigation*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Gary Ewen, Grower, Riverhurst, SK, Riverhurst Irrigation District

Project Objective

The objective of this project was to demonstrate the use of variable rate fertilization (VRF), plant growth regulator (PGR), fungicide, and extensive water management, with the goal of comparing different combinations of each application to determine the approaches that are most economical when resulting yield is considered.

Demonstration Plan

An 80-acre pivot area was divided into 7 strips and different treatments were applied to each strip. See Figure 1 for treatment details. Variable-rate mapping was carried out by Farmers Edge. The pivot was managed to ensure the crop water use was maximized. Tissue samples were taken at the early boot stage. The field was monitored for disease throughout the growing season. Each treatment was harvested and yield determined. Economics was considered to determine the best rate of return.

Demonstration Site

The demonstration site, NE21-22-7W3, is an 80-acre parcel with a center pivot located in the Riverhurst Irrigation District. The soil texture is sandy loam, and the field was seeded to canola in 2013.

Project Methods

The durum variety, Brigade, was seeded on May 20. Variable rate nitrogen recommendations were provided by Farmers Edge (Figure 12). Nitrogen fertilizer (applied as 46-0-0) was applied at rates ranging from 100 to 127 lb./acre. Phosphate fertilizer applied as (11-52-0) was applied at a the rate of 50 lb./acre. Extensive monitoring occurred weekly throughout the growing season and water use

* Project 2014-13— This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

needs were predicted using Alberta Irrigation Management Model (AIMM) to ensure soil moisture was kept above 50%. Refer to the AIMM graph that summarizes all irrigation and rain events (Figure 1). Monitoring at all plant stages was also important for staging different treatment applications. Detailed agronomics are displayed in Table 1.

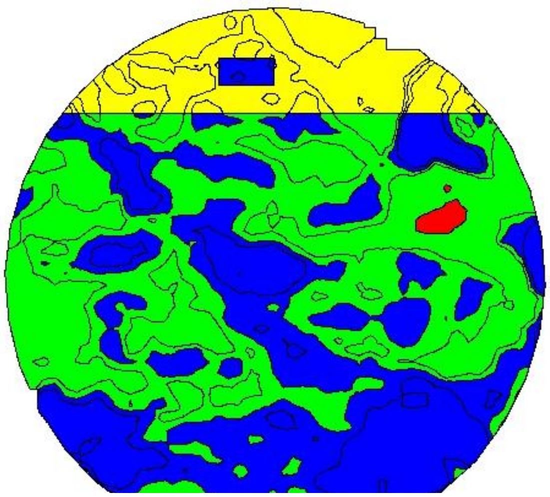


Figure 1. AIMM graph summarizing moisture needs.

Table 1: Agronomic Management

Seeding	
Date:	May 20,2014
Variety:	Brigade
Rate:	120 lb./ac
Herbicide	
Date:	June 22,2014
Product:	Simplicity
Flag Leaf Fungicide	
Date:	July 8,2014
Product:	Twinline
Plant Growth Regulator	
Date:	July 11,2014
Product:	Ethrel
Fusarium Headblight Fungicide	
Date:	July 19,2014
Product:	Caramba
Harvest	
Date:	September 22, 2014
Available Moisture (inches)	
Rainfall:	8.5
Irrigation:	3.4

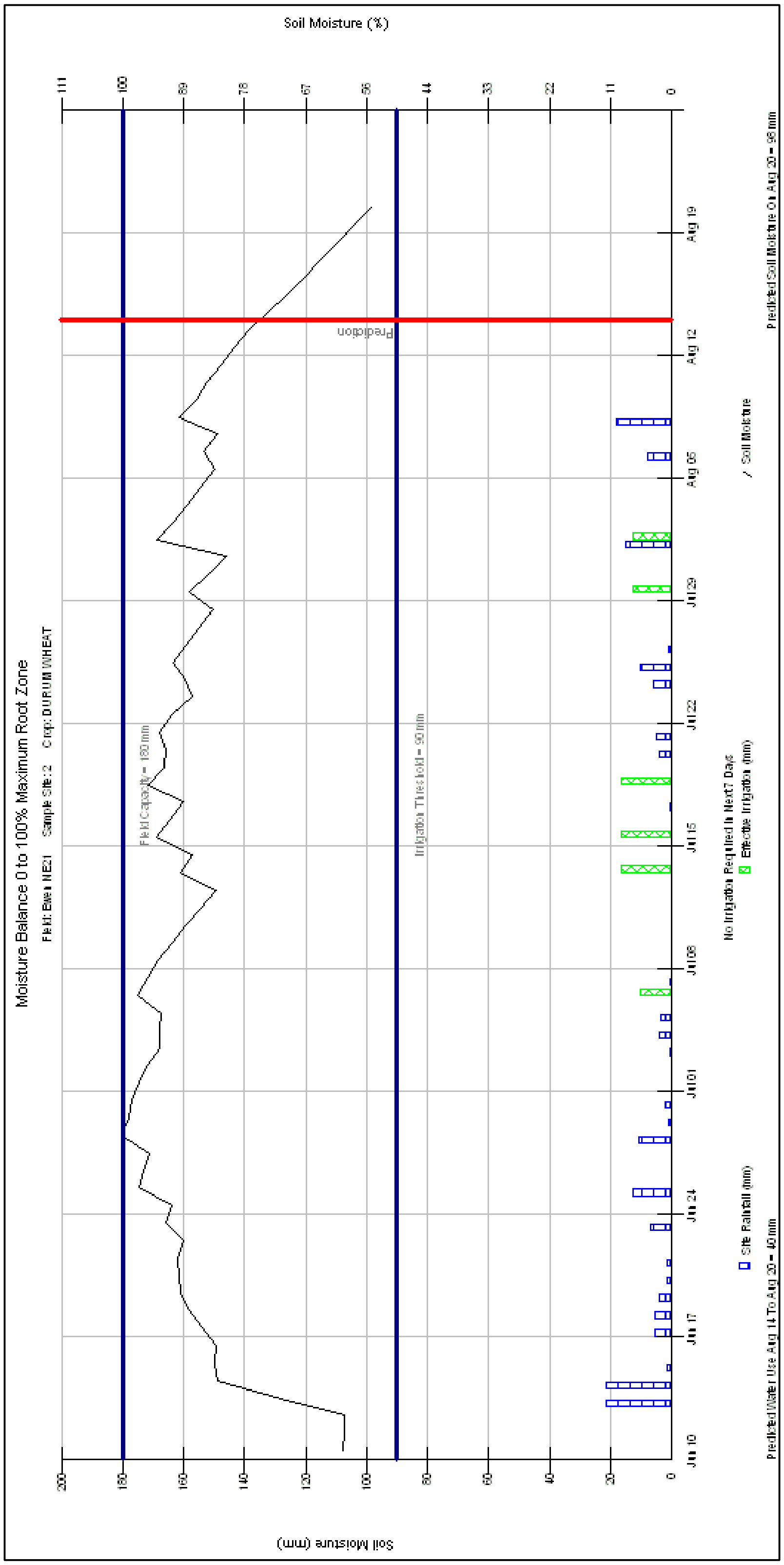


Figure 2. AIMM graph for NE21-22-7-W3.

Table 2: Plant Tissue Analysis of Flat Rate, Variable Rate, and 125% N Taken on July 8

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
Flat Rate	3.5	0.29	3.6	0.31	0.43	0.22	13.4	84.4	78.9	40.5	6.34
VR	3.5	0.32	3.8	0.31	0.41	0.20	12.3	120.0	100.0	36.3	6.37
125% N	4.0	0.30	3.8	0.33	0.43	0.25	11.9	78.4	88.6	27.8	7.14
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.50**	**0.25**	**8.0**	**50.0**	**20.0**	**20.0**	**5.00**

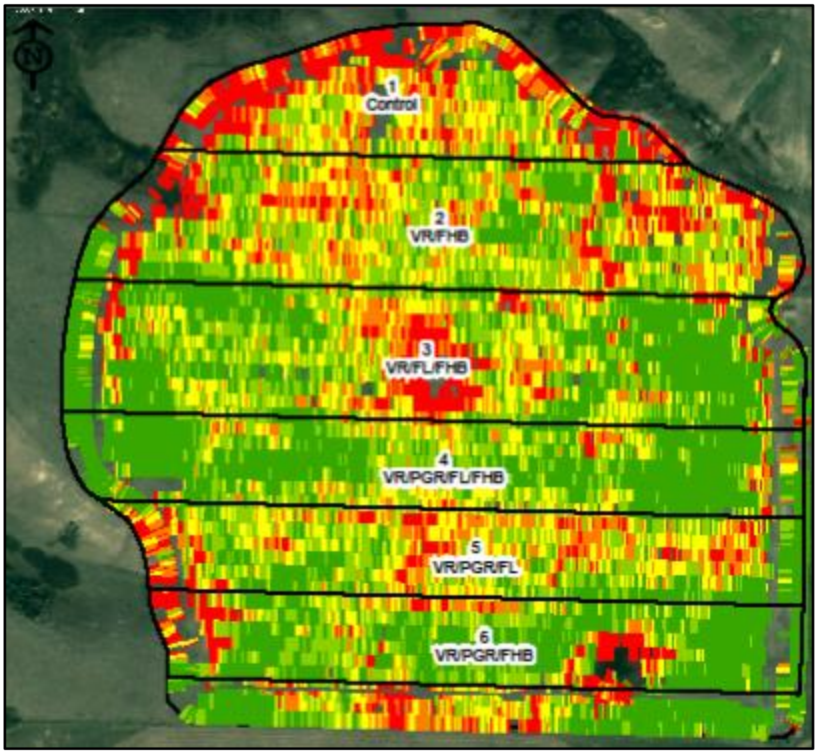


Figure 3: Farmers Edge yield map.

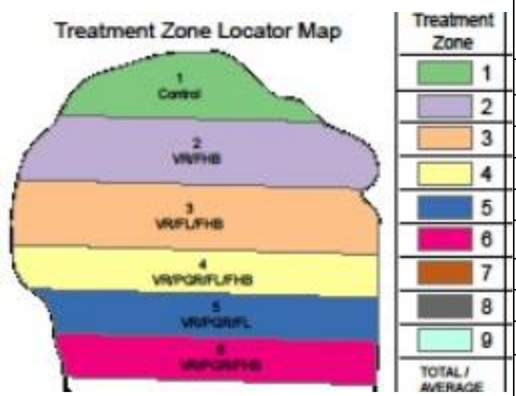
Harvest Results

The crop was harvested on September 22, 2014. Samples were taken from all treatments and measured for yield, protein, and fusarium-damaged kernels (FDK). Four samples were also submitted for mycotoxin testing for Deoxynivalenol (DON). Full harvest results are shown in Table 3. Detailed economics were also done to determine the most profitable combination of applications. The assumptions for the economics are based on: $5/bu. Durum, Variable Rate at $8/acre, Custom High Clearance Spray Application at $5/acre, Plant Growth Regulator at $7/acre, Flag leaf Fungicide at $8/acre, and Fusarium Head Blight Fungicide at $14/acre. The economic analysis is shown in Table 4.

Table 3. Harvest Results from NE21-22-7-W3

Treatment:	Yield (bu/ac)	Protein (%)	FDK (%)	DON (ppm)
VR/FHB	57.3	14.2	4.7	N/A
VR/PGR/FHB	58.1	14.4	6.1	2.1
VR/PGR/FL	52.9	15.2	7.6	2.6
VR/PGR/FL/FHB	60.6	13.8	4.6	1.6
VR/FL/FHB	55.8	14.0	4.7	N/A
Control	46.5	13.8	4.8	1.5

Table 4: Economic Analysis from NE21-22-7-W3



Treatment Name	Treatment Area (acres)	Treatment Cost ($/acre)	Yield (bu./acre)	Return ($/acre)
Control	8.0	$0.00	46.6	$233.00
VR/FHB	15.1	$27.00	51.4	$230.00
VR/FL/FHB	16.5	$40.00	55.8	$239.00
VR/PGR/FL/FHB	11.0	$52.00	60.6	$251.00
VR/PGR/FL	10.1	$33.00	53.0	$232.00
VR/PGR/FHB	9.7	$39.00	58.5	$253.50
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
	74.9			

Final Discussion

Durum production is a high risk crop that has the potential for high reward when grown under irrigation. Many different inputs are promoted as being capable of increasing and/or protecting yield. This demonstration was an attempt to distinguish what combination of inputs to a durum crop produces the highest return.

The most detrimental factors to yield loss in irrigated durum production are lodging, leaf disease, and Fusarium head blight. Utilizing a plant growth regulator and variable rate nitrogen are management tools to help reduce lodging, as are flag leaf fungicide to protect against leaf disease, and Fusarium head blight fungicide to protect against Fusarium head blight.

After economic analysis, treatment #6 with variable rate nitrogen, plant growth regulator, and Fusarium head blight fungicide created the highest return, while variable rate nitrogen and Fusarium head blight fungicide had the lowest return. The control produced the lowest yield, which was expected, but still demonstrated a decent return because no additional input or sprayer costs were incurred. The full treatment package of variable rate, plant growth regulator, flag leaf fungicide, and

Fusarium head blight fungicide produced the highest yield, but due to input and sprayer costs of $52/acre, returns were reduced.

The results seem to show that a plant growth regulator has a substantial effect on economic outcomes, although there was no reduction in height or lodging in this demonstration. The soil map shows that the south half of the field, both the east and west sides, is the more favorable area for better yield. It is likely that the soil and topography characteristics of that area is more conducive to producing higher yields.

As a whole, yield differences were significant between the treatments, but the average yield of 55 bu./acre for the demonstration is disappointing. The large loss of productivity is believed to be the high incidence of Fusarium, despite the fact that products were applied to reduce infection. The Fusarium fungicides currently work best for suppression only, and in high pressure situations yield loss will occur.

ICDC will continue to work with variable rate applications, plant growth regulator, and fungicides in 2015.

Acknowledgements

The project lead would like to thank the following contributors:

- Farmers Edge – for providing the yield and variable rate application zone maps
- BASF – for supplying fungicide products
- Gardiner Dam Terminal – for grading harvest samples

Fertigation Application Timing*

Project Lead

- Jeff Ewen, AAg, Irrigation Agrologist, Saskatchewan Agriculture

Co-operator

- Gary Ewen, Riverhurst Irrigation District, Riverhurst, SK

Project Objective

The purpose of this project was to demonstrate the proper timing for applying liquid nitrogen through injection into irrigation water and to determine the best application timing that will optimize yield and protein.

Project Plan

The project field had a 130-acre center pivot equipped with a 1,600 gallon liquid fertilizer tank, injection pump, and injection valve. The pivot area was seeded to durum and a variable rate map was produced by Farmers Edge. The map was used to split the area into 33-acre quarters for the demonstration. After seeding, intensive irrigation management took place. Fertigation was applied at the specified timing for each 33-acre parcel. Tissue tests were carried out at the flag leaf stage to determine plant nitrogen levels. Yield was calculated for each plot and combined with a yield map obtained from the producer.

Demonstration Site

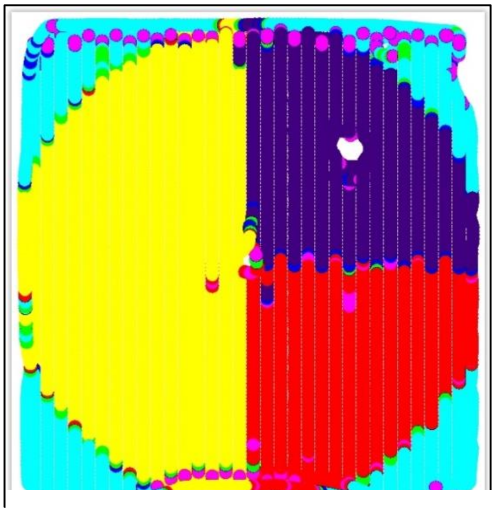
The demonstration site, NE11-22-7W3, has a 130-acre center pivot and the parcel is located in the Riverhurst Irrigation District. The soil texture is loam, and the field was seeded to canola in 2013.

Project Methods

Soil tests were taken in the spring from each application area to determine residual nutrients and to calculate the application rates required to achieve the grower's targeted yield. The durum variety, Brigade, was seeded on May 2. Figure 1 shows the variable rate nitrogen application zone map provided by Farmers Edge. Detailed agronomics are shown in Table 1. Extensive monitoring occurred weekly through the growing season and moisture needs were predicted using the Alberta Irrigation Management Model (AIMM) to ensure that soil moisture was kept above 50%. The AIMM graph is shown in Figure 2. Monitoring plant stage was also an important factor for staging

* Project 2014-14—This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bilateral agreement.

fertigation events. Table 2 shows the different events. Plant tissue samples were taken during the flag leaf stage, and the results from those tests are shown in Table 3. Harvest yield and protein were analyzed to determine the success of each treatment. Soil samples were taken in the fall to determine the residual nitrogen level differences between the treatments.



Zone	Nitrogen (lb./acre)
	115
	100
	55
	35

Figure 1: Farmers Edge variable rate application zone map.

Table 1: Agronomic Management

Nutrients (lb./ac)	N	P	K	S
Soil Test (0-12")				
NE Quadrant:	27	9	340	22
NW Quadrant:	24	9	460	48
SE Quadrant:	26	8	560	46
SW Quadrant:	24	16	440	36
Applied:	35-115	40	0	0
Seeding				
Date:	May 21, 2014			
Variety:	Brigade			
Rate:	120 lb./ac			
Herbicide				
Date:	June 22, 2014			
Product:	Simplicity			
Fungicide				
Date:	July 27, 2014			
Product:	Prosaro			
Harvest				
Date:	September 27, 2014			
Available Moisture (inches)				
Rainfall:	9.8			
Irrigation:	2.3			

Table 2: Fertigation Events

Quadrant	Pivot Angle	Timing	Date	N (lb./acre)	H_2O
SE	90°–180°	4–6 Leaf	June 24	45	0.3
SW	180°–270°	Early Flag	July 2	60	0.3
NE	90°–180°	Early Boot	July 13	35	0.5
NW	270°–0°	Early Boot	July 14	60	0.5

Table 3: Plant Ttissue Analysis of Durum Samples Collected from the Fertigation Treatments at the Flag Leaf Stage of Development (July 8, 2014)

Treatment (Fertilizer/ac)	N (%)	P (%)	K (%)	S (%)	Ca (%)	Mg (%)	Cu ug/g	Fe ug/g	Mn ug/g	Zn ug/g	B ug/g
NW 65 lb./N	2.0	0.32	4.0	0.26	0.34	0.19	10.20	75.6	66.1	39.5	6.54
NE 110 lb./N	3.7	0.32	3.2	0.29	0.52	0.22	10.20	88.9	84.7	40.6	7.28
SE 90 lb./N	3.2	0.34	4.3	0.27	0.36	0.16	8.57	78.9	62.1	36.8	6.90
SW 125 lb./N	3.8	0.33	3.5	0.28	0.39	0.18	8.64	92.8	75.0	32.0	5.88
Threshold	**4.5**	**0.25**	**2.0**	**0.30**	**0.50**	**0.25**	**8.00**	**50.0**	**20.0**	**20.0**	**5.00**

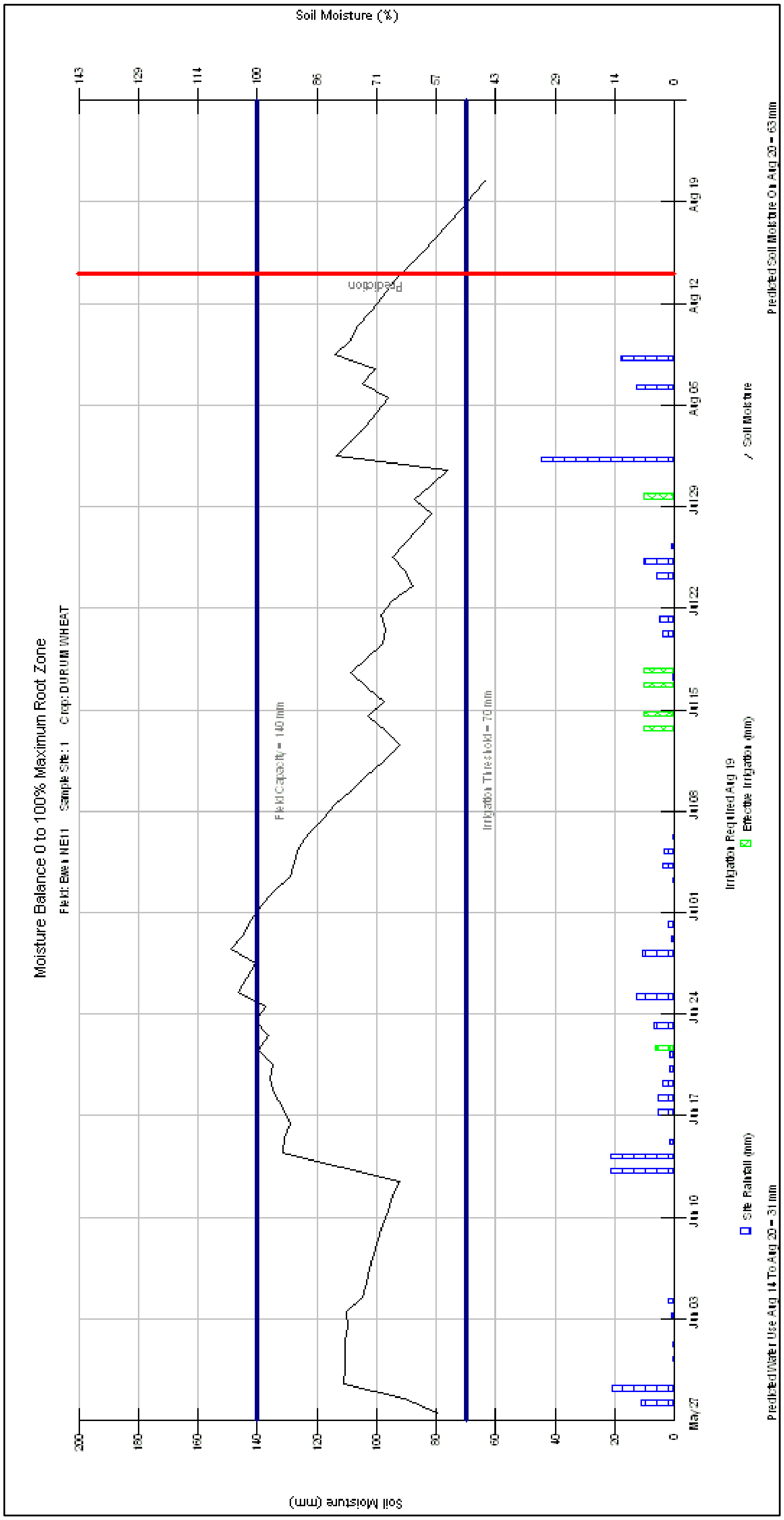


Figure 2. AIMM graph for NE 11-22-7-W3.

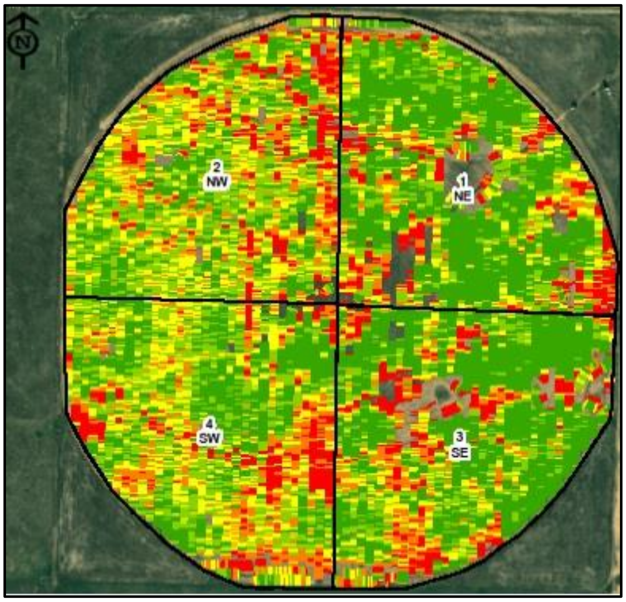


Figure 3: Farmers Edge yield map.

Final Discussion

Over the years, fertigation has been integrated with irrigation to top-up the supply of nitrogen to a crop throughout the growing season. There is a question as to the proper timing of a fertigation application to achieve a desired yield rate and the proper timing to achieve a desired protein level. It is known that yield is determined at flag-leaf timing and that more than 75% of nitrogen uptake occurs prior to the 6-leaf stage.

The results of this demonstration show that nitrogen placed at the time of seeding still produces a higher yield than applying throughout the growing season. A small protein increase was achieved by applying nitrogen at either the 4-6 leaf stage or at early boot. It was a tough year to be applying fertigation given the high amount of rain fall that was received.

ICDC will continue to investigate fertigation in the future.

Acknowledgements

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- Farmers Edge – for yield map and application zone map
- Gardiner Dam Terminal – for grading harvest samples

TECHNOLOGY TRANSFER 2014

Ministry of Agriculture/ICDC Agrologist Extension Events

Field Days

CSIDC Irrigation Field Day and Tradeshow—July 10, 2014

- Field Tour Leaders – Gary Kruger and Kelly Farden, Ministry of Agriculture
- Crop Water Use Calculator Update – Kelly Farden, Ministry of Agriculture

Riverhurst Demonstration Field Tour—August 7, 2014

- Field Organizer and Tour Leader – Jeff Ewen, Ministry of Agriculture
- ADOPT *Copper Fertilizer Demonstration* – Gary Kruger and Joel Peru, Ministry of Agriculture

Forage Field Day—August 26, 2014

- Event Organizer and Tour Leader – Sarah Sommerfeld, Ministry of Agriculture
- Corn Varieties and Agronomy – Garry Hnatowich, ICDC
- N Fertility Following Alfalfa Termination on Oat Production Field Stop – Gary Kruger, Ministry of Agriculture
- New annual forage varieties and ergot in cereal crops – Sarah Sommerfeld & Sean Thompson, Ministry of Agriculture
- Feed testing your forage supply – Travis Peardon, Ministry of Agriculture

Diagnostic School—July

- N Ramp Fertilization Demonstration, Scott and Melfort – Gary Kruger, Ministry of Agriculture
- Managing Saline Soils, Scott – Kelly Farden and Gary Kruger, Ministry of Agriculture

Booth Display

- Crop Production Week, Saskatoon, January, 2014
- CSIDC Irrigation Field Day and Tradeshow, Outlook, July 10, 2014
- ICDC/SIPA Annual Conference, Moose Jaw, December 9-10, 2014

Publications

- *Crop Varieties for Irrigation*, January 2014
- *Irrigation Economics and Agronomics*, January 2014
- *Research and Demonstration Program Report 2014*, December 2014
- *The Irrigator*, March 2014

Presentations

Gary Kruger

- Grainland Irrigation District Annual Meeting, Central Butte, February 13 – ICDC report
- Chesterfield Annual Meeting, Leader, February 18 – Research Report Summary
- Ponteix Irrigation District Annual Meeting, Ponteix, February 28 – ICDC report
- Irrigation Development Programming, Rosetown, March 14 – FRWIP and Growing Forward II
- Irrigation Agronomy Workshop, Outlook, March 18 – Canola Fertility
- Irrigation Agronomy Workshop, Riverhurst, March 20 – Canola Fertility
- Herbert Irrigation District Meeting, March 25 – ICDC report
- Macrorie Irrigation District Meeting, March 28 – ICDC report
- Watrous Regional Services Meeting, April 2 – Canola Fertility
- Miry Creek Irrigation District Meeting, April 9 – ICDC report
- Crop Diagnostic School, Scott, July 22-23 – N Ramp Calibration and Role of Plant Tissue Analysis in Understanding the Response to N
- Crop Diagnostic School, Melfort, July 29-30 – N Ramp Calibration and Role of Plant Tissue Analysis in Understanding the Response to N
- Riverhurst Irrigation Tour, August 7 – ADOPT Copper Fertility Demo
- Eastend Winter Wheat Tailgate Tour, August 11 – Winter Wheat Demonstration Tour
- 2014 SIPA/ICDC Convention, Moose Jaw, December 9-10 – 2014 Research Report

Jeff Ewen

- Irrigation Agronomy Workshop, Outlook, March 18 – Irrigation Agronomics and Economics Website Calculator
- Irrigation Agronomy Workshop, Riverhurst, March 20 – Irrigation Agronomics and Economics Website Calculator
- Outlook Grade 11 Soil Lab, CSIDC, June 16 – Soil Genesis
- CSIDC Field Day, July 10 – Plant Growth Regulator on Wheat
- Riverhurst Irrigation Tour, August 7 – Maximum Economic Yield Under Irrigation, Double Fungicide on Irrigated Canola, Vertical Tillage, Plant Growth Regulator, and Fertigation Demonstrations
- Think AG Presentation, October 21
- 2014 SIPA/ICDC Convention, December 9-10, Moose Jaw – 2014 Research Report

Joel Peru

- Outlook Grade 11 Soil Lab, CSIDC, June 16 – Soil drainage and Soil Zones
- Irrigation Tour, Riverhurst, August 7 – ADOPT Copper Fertility Demo
- 2014 SIPA/ICDC Convention, Moose Jaw Dec 9-10 – 2014 Research Report
- CKRM Radio Interview, July 23, 2014 – Local Crop Report
- CKRM Radio Interview, September 8, 2014 – Local Harvest Update,

Sarah Sommerfeld

- Irrigation Agronomy Update, March 18 & 20, 2014 – Optimum Irrigation Management
- CKSW Radio Interview, May 1, 2014 – What to Consider When Seeding Forages?
- CJWW Radio Spot, May 2, 2014 – Assessing Winterkill in Forage Stands
- CJWW and CKSW Radio Spot, June 13, 2014 – Scouting for Weeds in Forage Stands
- Saskatchewan Forage Council Reclamation Workshop, July 17 & 19, 2014 – Minimizing Agronomic Issues in Forage Establishment
- CSIDC Field Day, July 10, 2014 – Corn Production in Saskatchewan and ICDC Corn Demonstration Projects
- CJWW Radio Spot, August 1, 2014 – Cutting Management in Legumes
- U of S Chinese Student Delegation, August 6, 2014 – Agriculture in Saskatchewan
- CJWW radio spot, September 5, 2014 – Dormant Seeding Forages
- CJWW radio spot, October 17, 2014 – Fall Fertilizing Forage Stands
- Local Careers in Agriculture Day, October 21, 2014 – ThinkAG Careers in Agriculture
- CTV FARMGATE, November 8, 2014 – Ministry of Agriculture and Webinars

Kelly Farden

- Real Agriculture, July 25, 2014 – Managing Saline Soils the Perennial Way
- Chinese Delegation, August 25, 2014 – Irrigation & Agriculture Extension in Saskatchewan

Agriview Articles 2014

Gary Kruger

- June 2014 – CSIDC Irrigation Field Day 2014
- September 2014 – Does Winter Wheat Fit into Gravity Irrigated Rotations in the Southwest?

Jeff Ewen

- May 2014 – Using Fertigation to Apply Crop Nutrients
- August 2014 – Maximizing the Use of Your Yield Monitor

Joel Peru

- November 2014 – 2014 SIPA/ICDC Annual Conference

Farmgate 2014

Jeff Ewen

- Maximizing the Use of Your Yield Monitor

Other Articles 2014

Kelly Farden

- *Crop Production News*, June 26, 2014 – Crop Water Use

Gary Kruger

- *The Irrigator* – Can Winter Wheat Fit Into the Flood Irrigated Crop Rotation in the Southwest?
- *The Irrigator* – Update on Copper Fertility for Irrigated Soils
- *Top Crop Manager*, September 2014 – Balancing Zinc Nutrition Needs under Irrigation
- *Top Crop Manager*, October 2014 – Consider Oats for Irrigated Alfalfa Breaking
- *Winter Wheat Newsletter*, Fall 2014 – Winter Wheat for Gravity Irrigated Fields in Southwest Saskatchewan

Jeff Ewen

- *The Irrigator* – Fertigation: Adapting Fertilizer Application to Irrigation
- *The Irrigator* – Cabbage Seedpod Weevil… Are you in the Dark?
- *The Irrigator* – Economics and Agronomics Calculator 2014

Sarah Sommerfeld

- June 13, 2014 – Scouting for Weeds in Forage Stands,
- September 5, 2014 – Feed Testing your Forages
- November 28, 2014 – Weeds of Concern

Surveys 2014

- Diamond Back Moth Survey, May/June 2014 – Diana Dunlop
- Bertha Army Worm Survey, June/July 2014 – Diana Dunlop
- Canola Disease Survey, August 2014 – Diana Dunlop, Jeff Ewen & Joel Peru
- Lake Diefenbaker Development Area Cropping Survey, August 2014 – Jeff Ewen & Joel Peru
- Fusarium Head Blight Survey, August 2014 – Jeff Ewen, Diana Dunlop & Joel Peru

www.irrigationsaskatchewan.com
Report 2014

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 2014 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 2014
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